Day 1 (May 19, Friday) 第一天 (5月19日，星期五)

Venue /地點：NSYSU Building of International Research /國立中山大學國際研究大樓

12:00 - 13:30	**Registration 註冊報到**		
13:30 - 13:40	**Opening remarks 大會開幕致詞** **Chair: Shiang-Yu Wang** Welcome remark by Senior Vice President Prof. Shiow-Fon Tsay (NSYSU) 來賓致詞：國立中山大學 蔡秀芬副校長 (Kwang-Chung Hall/光中廳)		
13:40 - 15:10	**Scientific oral session S1 科學論文宣讀 S1** **Chair: Vivien Chen** **Star Formation**		
S1.1 **13:40 -13:55**	Extremely dense "nucleus" embedded in the prestellar core G208.68-19.92-N2	Naomi Hirano	ASIAA
S1.2 **13:55 -14:10**	Cloud scale CO freeze-out in the giant molecular filament G214.5-1.8	Seamus Clarke	ASIAA
S1.3 **14:10 -14:25**	The drag instability in C-shocks: simulation confirmation and 2D linear analysis	Pin-Gao Gu	ASIAA
S1.4 **14:25 -14:40**	Infall streams in the high-mass protostellar core G336.01-0.82	Fernando Olguin	NTHU
S1.5 **14:40 -14:55**	Multi-scale magnetic field and fragmentation of IRDC SDC18.624-0.070	Han-Tsung Lee	ASIAA/NTU
14:55 - 15:40	**Coffee break and poster session P1 茶敘及壁報欣賞**		
15:40 - 18:10	**Scientific oral session S2 科學論文宣讀 S2** **Chair: Cheng-Yu Kuo** **Extragalactic Astronomy**		
S2.1 **15:40 - 15:55**	Repeating rates of 36 fast radio bursts selected by machine learning	Tetsuya Hashimoto	NCHU
S2.2 **15:55 - 16:10**	A repeating Fast Radio Source in a globular cluster	Hsiu-Hsien Lin	ASIAA
S2.3 **16:10 - 16:25**	A new method to constrain the Hubble constant with scattering in host galaxies of fast radio bursts	Tsung-Ching Yang	NCHU
S2.4 **16:25 - 16:40**	SCUBA-2 Ultra Deep Imaging EAO Survey (STUDIES): Confusion-limited 450 μm Galaxy Number Counts and Machine Learning Identifications	Zhen-Kai Gao	ASIAA/NCU
S2.5 **16:40 - 16:55**	Exploring the faintest end of mid-infrared luminosity functions up to z~5 with the JWST CEERS survey	Chih Teng Ling	NTHU
S2.6 **16:55 - 17:10**	Coronal Properties of Low-Accreting AGNs	Arghajit Jana	NTHU
S2.7 **17:10 - 17:25**	The Mass Assembly of High-Redshift Central Black Holes and the Emergence of Jetted AGN	Olmo Piana	NTNU
S2.8 **17:25 - 17:40**	A comparison of numerical methods for computing the reionization of intergalacitc hydrogen and helium by a central radiating source	Ka Hou Leong	Univ. of Edinburgh
S2.9 **17:40 - 17:55**	Mock Catalogues for DESI MilkyWay Survey	Namitha Kizhuprakkat Ramachandran	NTHU
S2.10 **17:55 - 18:10**	The Metallicity of DESI Dwarf Galaxies	Yu Voon Ng	NTU
18:10 - 20:30	**Welcome reception 歡迎茶會** (Gymnasium corridor /體育館走廊)		

Day 2 (May 20, Saturday)			**第二天 (5月20日，星期六)**
	Venue /地點：NSYSU Building of International Research /國立中山大學國際研究大樓		
08:30 - 09:30	**Plenary talk (I) 大會講演(I)** **Chair: Shiang-Yu Wang** *" Our astrochemical origins "* Director Paola Caselli, (Max-Planck-Institut für extraterrestrische Physik)		
09:30 - 10:00	**Coffee break, group photo and poster session P2** **茶敘、與會來賓團體照及壁報欣賞 P2**		
10:00 - 12:00	**Scientific oral session S3** **科學論文宣讀 S3**	**Scientific oral session S4** **科學論文宣讀 S4**	
10:00 - 12:00	**Scientific oral session S3 科學論文宣讀 S3** **Chair: Wei-Ling Tseng** **Solar System/Stars** (Kwang-Chung Hall/光中廳)		
S3.1 **10:00 - 10:15**	Structures and Time Variability of the Lunar Sodium Exosphere and Tail	Ian-Lin Lai	NCU
S3.2 **10:15 - 10:30**	Outer Space Exploration 2nd Lunar Lander Payload Mission: Formosa Lunar Ultraviolet Telescope Experiment (FLUTE)	Yi-Chi Chang	NTHU
S3.3 **10:30 - 10:45**	Characterizing the Pre-stage Orbital Properties of Dynamically Young Short Period Comets	Yu-Chi Cheng	NTNU
S3.4 **10:45 - 11:00**	The Super Earth-Cold Jupiter Relations	Sridhar Gajendran	NTHU
S3.5 **11:00 - 11:15**	High-order discontinuous Galerkin scheme for the coagulation/fragmentation equation	Maxime Lombart	NTNU
S3.6 **11:15 - 11:30**	Monitoring H-alpha emission from a wide-orbit brown dwarf companion	Ya-Lin Wu	NTNU
S3.7 **11:30 - 11:45**	A T-Dwarf Candidate from JWST Early Release NIRCam data	Poya Wang	NTHU
S3.8 **11:45 - 12:00**	Impact of stellar rotation in binary system on core-collapse supernova progenitors and multimessenger signals	Hao-Sheng Wang	NTHU
10:00 - 12:00	**Scientific oral session S4 科學論文宣讀 S4** **Chair: Yi Chou** **High Energy Astronomy/Cosmology** (IR1002/一樓階梯教室)		
S4.1 **10:00 - 10:15**	Search for Gravitational Wave Emissions from Core-Collapse Supernovae	Kuo-Chuan Pan	NTHU
S4.2 **10:15 - 10:30**	Rapid Generation of Kilonova Light Curves Using Conditional Variational Autoencoder	Surojit Saha	NTHU
S4.3 **10:30 - 10:45**	On the X-ray Quiescent State of Magnetars: the Relations between Non-thermal and Thermal Spectral Properties	Che-Yen Chu	NTHU
S4.4 **10:45 - 11:00**	Study of the Accretion Flow Dynamics of EXO 1846-031 during its 2019 Outburst	Dipak Debnath	NTHU
S4.5 **11:00 - 11:15**	Odd radio circles as cosmic-ray dominated AGN jets	Yen-Hsing Lin	NTHU
S4.6 **11:15 - 11:30**	Exploring the Observability of Surviving Companions of Stripped-Envelope Supernovae: A Case Study of Type Ic SN 2020oi	Hsin-Pei Chen	NTHU
S4.7 **11:30 - 11:45**	MHD simulations of accretion and mass outflows around spinning supermassive black holes	Md Ramiz Aktar	NTHU
S4.8 **11:45 - 12:00**	Identification of Cosmic Voids as Massive Cluster Counterparts	Junsup Shim	ASIAA

Day 2 (May 20, Saturday)	**第二天 (5月20日，星期六)**
	Venue /地點：NSYSU Building of International Research /國立中山大學國際研究大樓

12:00 - 13:15	**Lunch break　午餐** (IR1002/一樓階梯教室) **National Observatory Discussion (IR1001/一樓階梯教室)**

13:15 - 15:00	**Scientific oral session S5　科學論文宣讀 S5　Chair: Hauyu Liu** **Star Formation** (Kwang-Chung Hall/光中廳)		
S5.1 **13:15 -13:30**	Long-Term Monitoring Observations of Jet Ejections and Mass Accretion for Active Pre-Main Sequence Stars	Hiro Takami	ASIAA
S5.2 **13:30 -13:45**	Searching for the connection between stellar activities and protoplanetary disks	Yuka Terada	ASIAA/NTU
S5.3 **13:45 -14:00**	Quantification of Sub-parsec Scale Dense Core Arrangements with Fragmentation Number	Wei-An Chen	ASIAA/NTU
S5.4 **14:00 -14:15**	Episodic Accretion in Protostars - An ALMA Survey of Molecular jets in Orion Molecular Cloud	Somnath Dutta	ASIAA
S5.5 **14:15 -14:30**	Identifying YSO Candidates from an Infrared All Sky Survey : Distribution of YSOs in the Nearby Galactic Region	Ying-Chi Hu	NTHU
S5.6 **14:30 -14:45**	Subaru-HDS Observations of the Optical Forbidden Line Wind from DG Tau	Yu-Ru Chou	NTHU
S5.7 **14:45 -15:00**	Dust spectral profiles of a large sample of Class II disks are barely distinguishable at 200-400 GHz	Chia-Ying Chung	ASIAA/NTU
15:00 - 15:30	**Coffee break and poster session P3　茶敘及壁報欣賞**		
15:30 - 18:00	**Scientific oral session S6　科學論文宣讀 S6　Chair: Chrong-Yuan Hwang** **Extragalactic Astronomy** (Kwang-Chung Hall/光中廳)		
S6.1 **15:30 - 15:45**	Investigating the dichotomy among early-type galaxies	Rogerio Monteiro-Oliveira	ASIAA
S6.2 **15:45 - 16:00**	Elucidating the role of interactions in galaxy evolution	Adarsh Ranjan	ASIAA
S6.3 **16:00 - 16:15**	Universality in the random walk structure function of luminous quasi-stellar objects	Ji-Jia Tang	NTU
S6.4 **16:15 - 16:30**	AGN Jet-Driven Spiral-Like Gas Features in Galaxy Clusters	Majidul Rahaman	NTHU
S6.5 **16:30 - 16:45**	Clash of Titans: the impact of dense environment on massive dusty star-forming galaxies	Yu-Jan Wang	ASIAA
S6.6 **16:45 - 17:00**	Are Odd Radio Circles virial shocks around massive galaxies?	Shotaro Yamasaki	NCHU
S6.7 **17:00 - 17:15**	Probing the impacts of radio-mode feedback on the properties of the CGM	Yu-Ling Chang	NTU
S6.8 **17:15 - 17:30**	Exploring the thermodynamic perturbations of the intracluster medium in cool cores of galaxy clusters	Shutaro Ueda	ASIAA
S6.9 **17:30 - 17:45**	A systematic search of distant super galaxy clusters in HSC-wide	Tsung-Chi Chen	ASIAA
S6.10 **17:45 - 18:00**	Decoding the magnetic Universe	Alvina Yee Lian On	NCTS
18:30 - 21:00	**Banquet　晚宴**		

Day 3 (May 21, Sunday)			第三天 (5月21日，星期日)
			Venue /地點：NSYSU Building of International Research /國立中山大學國際研究大樓
08:30 - 09:30	**Plenary talk (II)** 大會講演(II) **Chair: Yi-Nan Chin** *" Geophysical Imaging of Planetary Interiors: What makes habitable Earth Special Compared to Other Planets? "* Prof. Pei-Ying Patty Lin (National Taiwan Normal University) (Kwang-Chung Hall/光中廳)		
09:30 - 10:30	General Assembly, best-poster awards & presentations, **會員大會、頒發最佳壁報論文獎及得獎論文口頭報告**		
10:30 - 11:00	**Coffee break 茶敘**		
11:00 - 12:30	**Scientific oral session S7** **科學論文宣讀 S7**	**Education & Public Outreach session E1** **天文教育及業餘天文活動報告 E1**	
	Scientific oral session S7 科學論文宣讀 S7 **Chair: Chin-Fei Lee** **Star formation** (Kwang-Chung Hall/光中廳)		
S7.1 **11:00 - 11:15**	Multi-Scale Picture of Magnetic Field and Gravity in High-Mass Star-Forming Region W51	Patrick Koch	ASIAA
S7.2 **11:15 - 11:30**	JWST + ALMA views the earliest chemical inventory of planet-forming regions	Daniel Harsono	NTHU
S7.3 **11:30 - 11:45**	Magnetic fields of the starless core L1512	Sheng-Jun Lin	ASIAA
S7.4 **11:45 - 12:00**	Polarization in the GG Tau Ring -- Confronting Dust Self-scattering, Dust Mechanical and Magnetic Alignment, Spirals and Dust Grain Drift	Ya-Wen Tang	ASIAA
S7.5 **12:00 - 12:15**	JCMT BISTRO Survey: Two Types of Filaments in NGC 2264	Jia-Wei Wang	AISAA
S7.6 **12:15 - 12:30**	The JCMT BISTRO Survey: Unveiling the Magnetic Fields around Galactic Center	Meng-Zhe Yang	NTHU
	Education & Public Outreach session E1 天文教育及業餘天文活動報告 E1 **Chair: Mei-Yin Chou** (IR1002/一樓階梯教室)		
E1.1 **11:00 - 11:15**	Astronomy Education for all (AE4ALL) under Taiwan Top Science Student Project (TTSS)	Hao-Yuan Duan	NCU
E1.2 **11:15 - 11:30**	社區大學天文課程實作與重大天象事件結合—以『此生必見天象遺願清單』為例	Ching-Chuan Hung	台北市文山社區大學
E1.3 **11:30 - 11:45**	模組化天文主題課程的規畫與實踐	Chi-Feng Lin	TAM
E1.4 **11:45 - 12:00**	『臺語天文學』: 以台語進行天文教育之經驗分享	Anli Tsai	NCU
E1.5 **12:00 - 12:15**	我如何用 ChatGPT 協助我撰寫『天聞的資料科學』專欄文章	Yi-Hao Su	Astrohackers in Taiwan 社群
E1.6 **12:15 - 12:30**	Planetarium software localization in Chinese for effective teaching of astronomy	Tai-Shan Chen	NTNU
12:30 ~	**Lunch break/ Departure** **午餐/賦歸**		

Oral Presentation

Plenary I **Our astrochemical origins**
Director Paola Caselli (Max-Planck-Institut für extraterrestrische Physik）

Plenary II **Geophysical Imaging of Planetary Interiors: What makes habitable Earth Special Compared to Other Planets?**
Pei-Ying LIN (NTNU)

S1.1 **Extremely dense "nucleus" embedded in the prestellar core G208.68-19.92-N2**
Naomi Hirano (ASIAA), Sheng-Yuan Liu (ASIAA), Tie Liu (SHAO, China), Dipen Sahu (ASIAA, Physical Research Laboratory, India), Ken'ichi Tatematsu (NRO, Japan), and ALMASOP team

S1.2 **Cloud scale CO freeze-out in the giant molecular filament G214.5-1.8**
Seamus Clarke (ASIAA); Alvaro Sanchez-Monge (Cologne); Ya-Wen Tang (ASIAA); Gwenllian Williams (Leeds); Stefanie Walch (Cologne)

S1.3 **The drag instability in C-shocks: simulation confirmation and 2D linear analysis**
Pin-Gao Gu (ASIAA); Che-Yu Chen (LLNL, Univ. of Virginia); Emma Shen (Univ. of Cambridge); Chien-Chang Yen (Fujen Catholic Univ.); Min-Kai Lin (ASIAA, NCTS)

S1.4 **Infall streams in the high-mass protostellar core G336.01-0.82**
Fernando Olguin (NTHU)

S1.5 **Multi-scale magnetic field and fragmentation of IRDC SDC18.624-0.070**
Han-Tsung Lee (ASIAA & NTU), Ya-Wen Tang (ASIAA), Jia-Wei Wang (ASIAA), Patrick Koch (ASIAA), Seamus Clarke (ASIAA)

S2.1 **Repeating rates of 36 fast radio bursts selected by machine learning**
Hashimoto Tetsuya (NCHU); Yuri Uno (NCHU); Shinnosuke Hisano (Kumamoto Univ.); Sujin Eie (ASIAA); Arthur Chen (NTHU); Tomo Goto (NTHU); Bo Han Chen (SNU); Shotaro Yamasaki (NCHU); Seong Jin Kim (NTHU); Simon C.-C. Ho (ANU); Decmend F. J. Ling (NTU); Yi Hang Valerie Wong (CU Boulder); Tiger Y.-Y. Hsiao (JHU); Chih-Teng Ling (NTHU); Poya Wang (NTHU); Leo Y.-W. Lin (NTHU)

S2.2 **A repeating Fast Radio Source in a globular cluster**
F. Kirsten (Chalmers), B. Marcote (JIVE), K. Nimmo (ASTRON, University of Amsterdam), J. W. T. Hessels (University of Amsterdam, ASTRON), M. Bhardwaj (McGill University), S. P. Tendulkar (TIFR, NCRA), A. Keimpema (JIVE), J. Yang (Chalmers), M. P. Snelders (University of Amsterdam), P. Scholz (Dunlap), A. B. Pearlman (McGill University, Caltech), C. J. Law (Caltech), W. M. Peters (NRL), M. Giroletti (INAF), Z. Paragi (JIVE), C. Bassa (ASTRON), D. M. Hewitt (University of Amsterdam), U. Bach (MPIfR), V. Bezrukovs (ERI VIRAC), M. Burgay (INAF), S. T. Buttaccio (INAF), J. E. Conway (Chalmers), A. Corongiu (INAF), R. Feiler (NCU), O. Forssén (Chalmers), M. P. Gawroński (NCU), R. Karuppusamy (MPIfR), M. A. Kharinov (IAA RAS), M. Lindqvist (Chalmers), G. Maccaferri (INAF), A. Melnikov (IAA RAS), O. S. Ould-Boukattine (University of Amsterdam), A. Possenti (INAF, University of Cagliari), G. Surcis (INAF), N. Wang (XAO), J. Yuan (XAO), K. Aggarwal

(West Virginia University), R. Anna-Thomas (West Virginia University), G. C. Bower (ASIAA), R. Blaauw (ASTRON), S. Burke-Spolaor (West Virginia University, CIFAR), T. Cassanelli (Dunlap, University of Toronto), T. E. Clarke (NRL), E. Fonseca (McGill University, West Virginia University), B. M. Gaensler (Dunlap, University of Toronto), A. Gopinath (University of Amsterdam), V. M. Kaspi (McGill University), N. Kassim (NRL), T. J. W. Lazio (Caltech), C. Leung (MIT), D. Z. Li (Caltech), H. H. Lin (ASIAA/CITA), K. W. Masui (MIT), R. Mckinven (University of Toronto), D. Michilli (McGill University), A. Mikhailov (IAA RAS), C. Ng (University of Toronto), A. Orbidans (ERI VIRAC), U. L. Pen (ASIAA, CITA, Dunlap, Perimeter, CIFAR), E. Petroff (University of Amsterdam, McGill University), M. Rahman (Sidrat), S. M. Ransom (NRAO), K. Shin (MIT), K. M. Smith (Perimeter), I. H. Stairs (UBC), W. Vlemmings (Chalmers)

S2.3 **A new method to constrain the Hubble constant with scattering in host galaxies of fast radio bursts**

Tsung-Ching YANG (Department of Physics, National Chung Hsing University, Taichung, Taiwan); Tetsuya HASHIMOTO (Department of Physics, National Chung Hsing University, Taichung, Taiwan); Tomo Goto (Institute of Astronomy, National Tsing Hua University); Shotaro YAMASAKI (Department of Physics, National Chung Hsing University, Taichung, Taiwan); Chih-Teng Ling(Institute of Astronomy, National Tsing Hua University); Simon C.-C. Ho (Research School of Astronomy and Astrophysics, The Australian National University, Canberra, ACT 2611, Australia); Kai-Chun Huang (Department of Physics, National Chung Hsing University, Taichung, Taiwan)

S2.4 **SCUBA-2 Ultra Deep Imaging EAO Survey (STUDIES): Confusion-limited 450 µm Galaxy Number Counts and Machine Learning Identifications**

Zhen-Kai Gao (ASIAA/NCU), Chen-Fatt Lim (ASIAA/NTU), Ching-Min Lo (ASIAA), Wei-Hao Wang (ASIAA), Chian-Chou Chen (ASIAA), Chorng-Yuan Hwang (NCU), Yun-Hsin Hsu (ASIAA)

S2.5 **Exploring the faintest end of mid-infrared luminosity functions up to z~5 with the JWST CEERS survey**

Chih-Teng Ling (NTHU); Seong Jin Kim (NTHU); Tomotsugu Goto (NTHU); Cossas K.-W. Wu (NTHU); Tom C.-C. Chien (NTHU); Tetsuya Hashimoto (NCHU); Yu-Wei Lin (NTHU)

S2.6 **Coronal Properties of Low-Accreting AGNs**

Arghajit Jana (Institute of Astronomy, National Tsing Hua University),Hsiang-Kuang Chang (Institute of Astronomy, National Tsing Hua University), Arka Chatterjee (University of Manitoba), Prantik Nandi (Physical Research Laboratory), Neeraj Kumari (Physical Research Laboratory), Sachindra Naik (Physical Research Laboratory), Claudio Ricci (University of Diego Portales)

S2.7 **The Mass Assembly of High-Redshift Central Black Holes and the Emergence of Jetted AGN**

Olmo Piana (NTNU); Hung-Yi Pu (NTNU)

[S2.8](#) **A comparison of numerical methods for computing the reionization of intergalacitc hydrogen and helium by a central radiating source**
Ka-Hou Leong[1], Avery Meiksin[1], Althea Lai[1], K. H. To[2]1: SUPA, Institute for Astronomy, University of Edinburgh, Blackford Hill, Edinburgh EH9 3HJ, UK2: Department of Physics, University of Tokyo, 7 Chome-3-1 Hongo, Bunkyo City, Tokyo 113-8654, Japan

[S2.9](#) **Mock Catalogues for DESI MilkyWay Survey**
Namitha Kizhuprakkat Ramachandran (Institute of Astronomy, NTHU); Andrew Cooper (Institute of Astronomy, NTHU)

[S2.10](#) **The Metallicity of DESI Dwarf Galaxies**
Yu Voon Ng; Ting-Wen Lan

[S3.1](#) **Structures and Time Variability of the Lunar Sodium Exosphere and Tail**
Ian-Lin Lai (Graduate Institute of Astronomy, National Central University); Chen-Yen Hsu (Graduate Institute of Astronomy, National Central University); Yung-Ching Wang (Graduate Institute of Astronomy, National Central University); Wing-Huen Ip (Graduate Institute of Astronomy, National Central University)

[S3.2](#) **Outer Space Exploration 2nd Lunar Lander Payload Mission: Formosa Lunar Ultraviolet Telescope Experiment (FLUTE)**
Yi-Chi Chang (Institute of Astronomy, National Tsing Hua University, Hsinchu 30013, Taiwan); Aniket Hase (Power Mechanical Engineering, National Tsing Hua University, Hsinchu 30013, Taiwan); Cheng-Fang Ho (Taiwan Instrument Research Institute, National Applied Research Laboratories, Hsinchu 300, Taiwan); Ting-Ming Huang (Taiwan Instrument Research Institute, National Applied Research Laboratories, Hsinchu 300, Taiwan); A. K. H. Kong (Institute of Astronomy, National Tsing Hua University, Hsinchu 30013, Taiwan)

[S3.3](#) **Characterizing the Pre-stage Orbital Properties of Dynamically Young Short Period Comets**
Yu-Chi Cheng (NTNU-PHY), Kuo-Jui Wu (NTNU-PHY), and Ya-Lin Wu (NTNU-PHY)

[S3.4](#) **The Super Earth-Cold Jupiter Relations**
Sridhar Gajendran; Ing-Guey Jiang; Li-Chin Yeh

[S3.5](#) **High-order discontinuous Galerkin scheme for the coagulation/fragmentation equation**
Maxime Lombart (Department of Earth Sciences, National Taiwan Normal University), Mark Hutchison (Universitats-Sternwarte, Ludwig-Maximilians-Universitat Munchen), Yueh-Ning Lee (Department of Earth Sciences, National Taiwan Normal University)

[S3.6](#) **Monitoring H-alpha emission from a wide-orbit brown dwarf companion**
Ya-Lin Wu (NTNU); Yu-Chi Cheng (NTNU); Li-Ching Huang (NTNU); Brendan Bowler (UT Austin); Laird Close (U Arizona); Wei-Ling Tseng (NTNU); Ning Chen (NTNU); Da-Wei Chen (NTU)

[S3.7](#) **A T-Dwarf Candidate from JWST Early Release NIRCam data**
Poya Wang(NTHU); Tomotsugu Goto(NTHU); Simon C.-C. Ho(ANU); Yu-Wei Lin(NTHU); Tetsuya Hashimoto(NCHU); Cossas K.-W. Wu(NTHU); Chih-Teng Ling(NTHU); Seong Jin Kim(NTHU)

S5.2 **Searching for the connection between stellar activities and protoplanetary disks**

Yuka Terada(ASIAA;NTU), Hauyu Baobab Liu(NSYSU), David Mkrtichian(NARIT), Jinshi Sai(ASIAA), Mihoko Konishi(Oita Univ.), Ing-Guey Jiang(NTHU), Takayuki Muto(Kogakuin Univ.), Jun Hashimoto(Astrobiology Center; Subaru telescope; NAOJ), Motohide Tamura(Astrobiology Center; Univ. of Tokyo; NAOJ)

S5.3 **Quantification of Sub-parsec Scale Dense Core Arrangements with Fragmentation Number**

Wei-An Chen (Graduate Institute of Astrophysics, National Taiwan University; Institute of Astronomy and Astrophysics, Academia Sinica), Ya-Wen Tang (Institute of Astronomy and Astrophysics, Academia Sinica), Seamus Clarke (Institute of Astronomy and Astrophysics, Academia Sinica), Patrick Koch (Institute of Astronomy and Astrophysics, Academia Sinica), Jia-Wei Wang (Institute of Astronomy and Astrophysics, Academia Sinica), Kaho Morii (Department of Astronomy, Graduate School of Science, The University of Tokyo; National Astronomical Observatory of Japan, National Institutes of Natural Sciences), Patricio Sanhueza (National Astronomical Observatory of Japan, National Institutes of Natural Sciences; Department of Astronomical Science, SOKENDAI (The Graduate University for Advanced Studies))

S5.4 **Episodic Accretion in Protostars - An ALMA Survey of Molecular jets in Orion Molecular Cloud**

Somnath Dutta (ASIAA, Taiwan)Chin-Fei Lee (ASIAA, Taiwan)

S5.5 **Identifying YSO Candidates from an Infrared All Sky Survey : Distribution of YSOs in the Nearby Galactic Region**

Ying-Chi Hu(NTHU); Shih-Ping Lai(NTHU)

S5.6 **Subaru-HDS Observations of the Optical Forbidden Line Wind from DG Tau**

Yu-Ru Chou (National Tsing-Hua University); Hiro Takami (Institute of Astronomy and Astrophysics, Academia Sinica); Shih-Ping Lai (National Tsing-Hua University); Emma Whelan (Maynooth University); Noah Benjamin Otten (Maynooth University); Min Fang (Purple Mountain Observatory); Akito Tajitsu (National Astronomical Observatory of Japan); Masaaki Otsuka (Kyoto University); Hsien Shang (Institute of Astronomy and Astrophysics, Academia Sinica); Chun-Fan Liu (Institute of Astronomy and Astrophysics, Academia Sinica); Jennifer Lyanne Karr (Institute of Astronomy and Astrophysics, Academia Sinica)

S5.7 **Dust spectral profiles of a large sample of Class II disks are barely distinguishable at 200-400 GHz**

Chia-Ying Chung (Department of Physics, National Taiwan University/Institute of Astronomy and Astrophysics, Academia Sinica); Hauyu Baobab Liu(Department of Physics, National Sun Yat-Sen University); Sean M. Andrews(Harvard-Smithsonian Center for Astrophysics); Mark Gurwell(Harvard-Smithsonian Center for Astrophysics); Melvyn Wright(Department of Astronomy, University of California at Berkeley); Feng Long (Lunar and Planetary Lab, University of Arizona)

S6.1 **Investigating the dichotomy among early-type galaxies**
Rogerio Monteiro-Oliveira (ASIAA); Yen-Ting Lin (ASIAA); Wei-Huai Chen (NTU/ASIAA); Chen-Yu Chuang (NTHU/ASIAA); Abdurro'uf (JHU); Po-Feng Wu (NTU)

S6.2 **Elucidating the role of interactions in galaxy evolution**
A. Ranjan (1. Academia Sinica Institute of Astronomy and Astrophysics (ASIAA), No.1, Section 4, Roosevelt Road, Taipei 10617, Taiwan. 2. Korea Astronomy and Space Science Institute, 776, Daedeokdae-ro, Yuseong-gu, Daejeon 34055, Korea. 3. Institut d'Astrophysique de Paris, Sorbonne Université & CNRS, 98bis boulevard Arago, 75014 Paris, France); G. Shaw (4. Department of Astronomy and Astrophysics, Tata Institute of Fundamental Research, 1 Homi Bhabha Road, Mumbai 400005, India); R. Srianand (5. Inter-University Centre for Astronomy and Astrophysics, Post Bag 4, Ganeshkhind 411 007, Pune, India); P. Petitjean (3); Y.-K. Sheen (2); S. A. Balashev (6. Ioffe Institute, Politekhnicheskaya 26, 194021 Saint Petersburg, Russia); N. Gupta (5); C. Ledoux (7. European Southern Observatory, Alonso de Córdova 3107, Vitacura, Casilla 19001, Santiago, Chile); K. N. Telikova (6); M. Raouf (8. Leiden Observatory, Leiden University, P.O. Box 9513, 2300 RA Leiden, Netherlands); G.A. Mamon (3); M. Trevisan (9. Departamento de Astronomia, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS 91501-970, Brazil); T.X. Thuan (3, 10. Astronomy Department, University of Virginia, PO Box 400325, Charlottesville, VA 22904-4325, USA)

S6.3 **Universality in the random walk structure function of luminous quasi-stellar objects**
Ji-Jia Tang (Australian National University); Christian Wolf (Australian National University); John Tonry (University of Hawaii)

S6.4 **AGN Jet-Driven Spiral-Like Gas Features in Galaxy Clusters**
Majidul Rahaman (Institute of Astronomy, National Tsing Hua University, No. 101, Section 2, Kuang-Fu Road, Hsinchu 30013, Taiwan); Hsiang-Yi Karen Yang (Institute of Astronomy and Department of Physics, National Tsing Hua University, No. 101, Section 2, Kuang-Fu Road, Hsinchu 30013, Taiwan)

S6.5 **Clash of Titans : the impact of dense environment on massive dusty star-forming galaxies**
Yu-Jan Wang (NTU, ASIAA); Chian-Chou Chen (ASIAA), Fabrizio Arrigoni Battaia (MPA)

S6.6 **Are Odd Radio Circles virial shocks around massive galaxies?**
Shotaro Yamasaki (National Chung Hsing University); Kartick C. Sarkar (Tel Aviv University); Zhaozhou Li (The Hebrew University of Jerusalem)

S6.7 **Probing the impacts of radio-mode feedback on the properties of the CGM**
Yu-Ling Chang (NTU), Ting-Wen Lan (NTU), Jason X. Prochaska (UCSC) (DESI Collaboration)

S6.8 **Exploring the thermodynamic perturbations of the intracluster medium in cool cores of galaxy clusters**
Shutaro Ueda (ASIAA); Keiichi Umetsu (ASIAA); FanLam Ng (PKU, ASIAA); Yuto Ichinohe (Rikkyo Univ.); Tetsu Kitayama (Toho Univ.); Sandor M. Molnar (ASIAA)

S6.9 **A systematic search of distant super galaxy clusters in HSC-wide**
Tsung-Chi Chen (ASIAA/NTU); Yen-Ting Lin (ASIAA); Hsi-Yu Schive (NTU); Masamune Oguri (CFS, Chiba U.); the HSC collaboration

S6.10 **Decoding the magnetic Universe**
Alvina On (NCTS, UCL); Jennifer Chan (CITA, Toronto); Kinwah Wu (UCL); Curtis Saxton (Warwick); Lidia van Driel-Gesztelyi (UCL); Paul Lai (UCL)

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Patrick Koch (ASIAA)

S7.2 **JWST + ALMA views the earliest chemical inventory of planet-forming regions**
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S7.3 **Magnetic fields of the starless core L1512**
Sheng-Jun Lin (ASIAA); Shih-Ping Lai (NTHU); Kate Pattle (UCL); David Berry (EAO); Dan P. Clemens (Boston University); Laurent Pagani (Obs. de Paris); Derek Ward-Thompson (U. of Central Lancashire); Travis J. Thieme (NTHU)

S7.4 **Polarization in the GG Tau Ring -- Confronting Dust Self-scattering, Dust Mechanical and Magnetic Alignment, Spirals and Dust Grain Drift**
Ya-Wen Tang1, Anne Dutrey2, Patrick M. Koch1, Stephane Guilloteau2, Hsi-Wei Yen1, Emmanuel di Folco2, Eric Pantin3, Takayuki Muto4, Akimasa Kataoka5, Robert Brauer61 Academia Sinica, Institute of Astronomy and Astrophysics, Taiwan2 Laboratoire d'Astrophysique de Bordeaux, Université de Bordeaux, France3 Laboratoire CEA, IRFU/DAp, AIM, Universit\'{e} Paris-Saclay, Université, France4 Division of Liberal Arts, Kogakuin University, Japan5 National Astronomical Observatory of Japan6 Université Paris-Saclay, CNRS, Institut d’Astrophysique Spatiale, France

S7.5 **JCMT BISTRO Survey: Two Types of Filaments in NGC 2264**
Jia-Wei Wang (ASIAA), Patrick Koch (ASIAA), BISTRO Consortium

S7.6 **The JCMT BISTRO Survey: Unveiling the Magnetic Fields around Galactic Center**
Meng-Zhe Yang (NTHU); Shih-Ping Lai (NTHU); Janik Karoly (University of Central Lancashire); David Eden (Armagh Observatory and Planetarium); the BISTRO team

E1.1 **Astronomy Education for all (AE4ALL) under Taiwan Top Science Student Project (TTSS)**

Hao-Yuan Duan 段皓元 (NCU), Wing-Huen Ip 葉永烜 (NCU), Pei-Hsin Chen 陳佩欣 (NCU)

E1.2 **社區大學天文課程實作與重大天象事件結合—以「此生必見天象遺願清單」為例**

Jim Ching Chuan Hung, 洪景川台北市文山社區大學、台北市士林社區大學

E1.3 **模組化天文主題課程的規畫與實踐**

林琦峯 (臺北市立天文科學教育館)

E1.4 **「臺語天文學」：以台語進行天文教育之經驗分享**

Anli Tsai (NCU)

E1.5 **我如何用 ChatGPT 協助我撰寫「天聞的資料科學」專欄文章**

蘇羿豪 (Astrohackers in Taiwan)

E1.6 **Planetarium software localization in Chinese for effective teaching of astronomy**

Tai-Shan CHEN, Yi-Jehng KUANDepartment of Earth Sciences, National Taiwan Normal University

Posters List

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Po-Chih Chang (Department of Space Science and Engineering, NCU, Taiwan), Zhong-Yi Lin (National Central University, Taiwan),Wing-Huen Ip (National Central University, Taiwan), Jim Lee (Taipei Astronomical Museum, Taiwan), Hsin-Chang Chi (National Don Hwa University, Taiwan)

2 **Determining the heights, velocities, and other relationships of the Perseids and Geminids events without orbital parameters using a empirical model.**
Hsin-Wu Chen (1), You-Lun Lin (1), Jim Lee (2), Zhong-Yi Lin (3), Hsueh-Hui Ma (4), Chia-Hsien Liao (4), and Hsin-Chang Chi (1)1. Department of Physics, National Dong Hwa University, Hualien, Taiwan,2. Taipei Astronomical Museum,Taipei, Taiwan. 3. Graduate Institute of Astronomy. National Central University, Taoyuan, Taiwan4. KenTing Observatory of National Museum of Natural Science, Pingtung, Taiwan

3 **Searching Exomoon Candidates from TESS Light Curves**
Wen-Chi Cheng (Department of Physics and Institute of Astronomy, National Tsing Hua University, Hsin-Chu, Taiwan); Ing-Guey Jiang (National Tsing Hua University, Hsin-Chu, Taiwan; Center for Informatics and Computation in Astronomy (CICA))

4 **Machine learning in taxonomic classification of near-Earth objects according to Lulin photometric measurements**
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5 **Investigating Transit Timing Variations of Kepler Planetary Systems**
Yi-Xiu Deng (NTHU); Ing-Guey Jiang (NTHU)

6 **Magnetospheric and Exospheric Responses of Mercury to Coronal Mass Ejection Events**
Chen-Yen Hsu (Graduate Institute of Astronomy, NCU); S. Fatemi (Swedish Institute of Space Physics, Kiruna, Sweden; Department of Physics at Umeå University, Umeå, Sweden), Wing-Huen Ip (Graduate Institute of Astronomy, NCU; Department of Space Science & Engineering, NCU)

7 **Perform statistical analysis on the Gemini meteor shower from 2017 to 2022 using UA2 system and study the ZHR evolution of the main activity period for each year.**
Min-Chiao Hsu (1), Xin-Wu Chen (1), Jim Lee (2), Zhong-Yi Lin (3), Hsueh-Hui Ma (4), Chia-Hsien Liao (4), and Hsin-Chang Chi (1)1. Department of Physics, National Dong Hwa University, Hualien, Taiwan,2. Taipei Astronomical Museum,Taipei, Taiwan. 3. Graduate Institute of Astronomy. National Central University, Taoyuan, Taiwan4. KenTing Observatory of National Museum of Natural Science, Pingtung, Taiwan

8 **The TANGO network of lunar Impact flash observations update**
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9 **Collisional heating and ejection of oxygen atoms and minor gas species in the Martian atmosphere**
Hua-Shan Shih (Department of Space Science & Engineering, National Central University); Ian-Lin Lai (Institute of Astronomy, National Central University); Wing-Huen Ip (Department of Space Science & Engineering, National Central University; Institute of Astronomy, National Central University)

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Pei-Chun Tsai (Graduate Institute of Astronomy, National Central University, Taoyuan City, Taiwan); Ian-Lin lai (Graduate Institute of Astronomy, National Central University, Taoyuan City, Taiwan); Wing-Huen Ip (Graduate Institute of Astronomy, National Central University, Taoyuan City, Taiwan)

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14 **Forecasting the Impact of Future Twinkle Data on the Parameter Determination of Multi-Planet Systems**
Wei-Hsiang Yu (Department of Physics and Institute of Astronomy, National Tsing Hua University, Hsin-Chu, Taiwan); Ing-Guey Jiang (Department of Physics and Institute of Astronomy, National Tsing Hua University, Hsin-Chu, Taiwan; Center for Informatics and Computation in Astronomy (CICA), National Tsing Hua University, Hsin-Chu, Taiwan)

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17 **Giant pulses of the Crab pulsar at dual radio frequencies**
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18 **Radio spectrum of the radio magnetar XTE J1810-197**
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Minh Ngoc Le (Institute of Astronomy, NTHU), Andrew P. Cooper (Institute of Astronomy, NTHU)

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25 **A Study of Open Cluster Berkeley 27 Using Gaia Data**
Authors: Devesh P. Sariya1, Ing-Guey Jiang1, D. Bisht2,3 R. K.S. Yadav4 Geeta Rangwal21. Department of Physics and Institute of Astronomy, National Tsing-Hua University, Hsin-Chu, Taiwan2. Indian Institute of Astrophysics, Koramangala II Block, Bangalore, 560034, Indiac3. Indian Center for Space Physics, 43 Chalantika, Garia Station Rd., Kolkata 700084, India4. Aryabhatta Research Institute of Observational Sciences, Manora Peak, Nainital 263129, India

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Tom C.-C. Chien (Department of Physics, National Tsing Hua University, 101, Section 2. Kuang-Fu Road, Hsinchu, 30013, Taiwan (R.O.C.));Tomotsugu Goto (Institute of Astronomy, National Tsing Hua University, 101, Section 2. Kuang-Fu Road, Hsinchu, 30013, Taiwan (R.O.C.));Cossas K.-W. Wu (Department of Physics, National Tsing Hua University, 101, Section 2. Kuang-Fu Road, Hsinchu, 30013, Taiwan (R.O.C.));Chih-Teng Ling (Institute of Astronomy, National Tsing Hua University, 101, Section 2. Kuang-Fu Road, Hsinchu, 30013, Taiwan (R.O.C.));Seong Jin Kim (Institute of Astronomy, National Tsing Hua University, 101, Section 2. Kuang-Fu Road, Hsinchu, 30013, Taiwan (R.O.C.));Tetsuya Hashimoto (Department of Physics, National Chung Hsing University, 145, Xingda Road, Taichung, 40227, Taiwan (R.O.C.));Yu-Wei Lin (Department of Physics, National Tsing Hua University, 101, Section 2. Kuang-Fu Road, Hsinchu, 30013, Taiwan (R.O.C.));Po-Ya Wang (Department of Physics, National Tsing Hua University, 101, Section 2. Kuang-Fu Road, Hsinchu, 30013, Taiwan (R.O.C.))

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35 **The relationship between acceleration and rotation speed variations in spiral galaxies**

Hok-Sum Tam (1) ; Yong Tian (2,3) ; Chung-Ming Ko (2,4) 1.Department of Physics, National Central University, Taoyuan 320317, Taiwan 2.Institute of Astronomy, National Central University, Taoyuan 320317, Taiwan 3.Centre for Particle Astrophysics and Cosmology, National Central University, Taoyuan 320317, Taiwan 4.Department of Physics and Centre for Complex Systems, National Central University, Taoyuan 320317, Taiwan.

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60 **The Young Stellar Population in the Chamaeleon Dark Cloud Complex**
Xiang Yu Chen(1); Wen-Ping Chen (1, 2). (1) Graduate Institute of Astronomy, National Central University, Taoyuan City, Taiwan. (2) Graduate Institute of Physics, National Central University, Taoyuan City, Taiwan

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Nai-Chieh Lin(Department of Earth Sciences, National Taiwan Normal University); Yueh-Ning Lee(Department of Earth Sciences, National Taiwan Normal University, Center of Astronomy and Gravitation, National Taiwan Normal University, Physics Division, National Center for Theoretical Sciences), He-Feng Hsieh(Physics Division, National Center for Theoretical Sciences), Hsi-Yu Schive(Physics Division, National Center for Theoretical Sciences, Graduate Institute of Astrophysics, National Taiwan University)

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K.Balasubramaniam1,2 H.K.Chang1, A.Jana1 and S.Ghosh1 {1}Institute of Astronomy, National Tsing-Hua University, Hsinchu 30013, Taiwan{2} Astronomical Observatory of the Jagiellonian University, ul. Orla 171, 30-244 Krakow, Poland

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Surojit Saha, Kuo-Chuan Pan and Albert K.H Kong , Institute of Astronomy, National Tsing Hua University, Hsinchu, R.O.C

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Jen-Kai Hsu(Graduate Institute of Astronomy, National Central University, Taoyuan City, Taiwan)；Hao-Yuan Duan(Graduate Institute of Astronomy, National Central University, Taoyuan City, Taiwan)；Sandy Chen(Graduate Institute of Astronomy, National Central University, Taoyuan City, Taiwan)；Wing-Huen Ip(Graduate Institute of Astronomy, National Central University, Taoyuan City, Taiwan)；Daniela Tisach(German Aerospace Center (DLR). Institute of Planetary Research. Rutherfordstraße 2 12489 Berlin, Germany)；Thomas Roatsch(German Aerospace Center (DLR). Institute of Planetary Research. Rutherfordstraße 2 12489 Berlin, Germany)

Plenary 1

Our astrochemical origins

Director Paola Caselli (Max-Planck-Institut für extraterrestrische Physik）

All the ingredients to form stars, planets, and life are to be found in dense and cold interstellar clouds called prestellar cores. At these early stages of star formation, organic molecules thrive and dust grains grow thick icy mantles, where water and organics accumulate. Knowledge of the chemical and physical structure of prestellar cores is needed to provide the initial conditions in the process of star and planet formation. Here I will present a journey that follows the evolution of prestellar cores toward the formation of stellar systems like our own, showing the crucial role played by astrochemistry as a powerful diagnostic tool for the various steps present in the journey.

Plenary 2

Geophysical Imaging of Planetary Interiors: What makes habitable Earth Special Compared to Other Planets?

Pei-Ying LIN (NTNU)

A stabilizing feedback between the atmosphere, hydrosphere, cryosphere and geosphere is important for long-term habitability (biosphere). Studying planetary interiors can help to better understand a planet as a system, from formation and evolution, to current structure and dynamics (from center to surface). Physical and chemical processes that govern the dynamics of planetary interiors likely occur at many scale lengths. Stratification is a dominant feature of all planetary interiors. Fine-scale structure associated with layering, as well as heterogeneities holds important clues on a planet’s compositional, thermal, and dynamical state. Seismic waves recorded on planetary bodies can help to resolve structures that directly relate to the material properties of the planets, such as seismic discontinuities and seismic anisotropy. Earth, Moon and Mars are the three astronomy bodies with a certain amount of seismic available data for such analyses. In Earth, seismic anisotropy represents one of the primary mechanisms for probing deformation and melting processes. We deployed the ocean bottom seismographs (OBS) on ~70 Ma Pacific lithosphere with the aim of constraining the flow dynamics within the oceanic asthenosphere. Our results suggest that the asthenosphere is flowing on its own with smaller scale and seafloor spreading at the ridge produces a very strong lithospheric fabric. The Apollo Passive Seismic Experiment (APSE) consisted of four 3- component seismometers deployed between 1969 and 1972 that continuously recorded lunar ground motion until late 1977. We applied modern array methodologies to the legacy APSE dataset and aimed at detecting deep lunar seismic reflections. Our results suggest the presence of a solid inner and fluid outer core, overlain by a partially molten boundary layer with the lunar core radius ~ km. The Interior Exploration using Seismic Investigations, Geodesy, and Heat Transport (InSight) mission successfully landed on Mars at the end of 2018, and since early 2019, ~ 700 seismic events have been detected on the planet. Seismologists have used methodologies similar to that used to analyze OBS data to learn seismic activity on Mars. The seismic data has provided direct evidence of the detailed internal structure of Mars. Although the geophysical observations provide the snapshot for the present-day planetary interiors, a better understand of a planetary interior will guide us to know more about the formation and evolution of the habitable planets.

S1.1

Extremely dense "nucleus" embedded in the prestellar core G208.68-19.92-N2

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Dipen Sahu (ASIAA, Physical Research Laboratory, India), Ken'ichi Tatematsu (NRO, Japan), and ALMASOP team

We present the ALMA Band 6 (1.3 mm and 1,1 mm) and ACA Band 7 (0.83 mm) observations of the starless core G208.68-19.02-N2 (G208-N2) in the Orion Molecular Cloud 3 (OMC-3). The dust continuum emission shows that this core has a filamentary structure with a length of ~5000 au and a H2 volume density of ~6 x 10^7 cm^-3. At the tip of this filamentary structure, there is a compact "nucleus" with a radius of ~200 au and a mass of ~0.1 M_sun. The nucleus is extremely dense: it has a central density of ~2 x 10^9 cm^-3 with a radial density profile of r^-1.4 . The nucleus does not have a counterpart in the wavelength shorter than 70 micron. In addition, there is no signature of outflow localized to the nucleus in the CO 2-1 image. The C18O 2-1 emission is completely missed in the filamentary structure including the nucleus. The N2D+ 3-2 emission traces the filamentary structure, while it does not peak toward the nucleus. The column density of N2D+ is enhanced in the northwestern part of the filament. Furthermore, the ortho-H2D+ emission at 372 GHz does not peak toward the nucleus. Instead, the spatial distribution of the ortho-H2D+ correlates well with that of the N2D+ column density. The depletion of N2D+ and H2D+ in the nucleus could imply the possible depletion of HD, a parent molecule of H2D+. If it is the case, the nucleus is still in the prestellar phase before the onset of the first hydrostatic core formation. We also found that the very narrow (~0.2 km/s) DCO+ 5-4 emission component peaks toward the nucleus. This could imply that the small amount of CO has been desorbed from the dust due to the formation of internal heating source such as a first hydrostatic core.

S1.2

Cloud scale CO freeze-out in the giant molecular filament G214.5-1.8

Seamus Clarke (ASIAA); Alvaro Sanchez-Monge (Cologne); Ya-Wen Tang (ASIAA);
Gwenllian Williams (Leeds); Stefanie Walch (Cologne)

Herschel has revealed that filaments across spatial scales are a prominent feature of the dense ISM and are intimately connected to the star formation process. Here we present the 12CO (2-1) and (1-0), 13CO (1-0) and C18O (1-0) observations using the IRAM 30m of the outer galaxy giant molecular filament (GMF) G214.5-1.8, an unusually cold, quiescent and potentially young GMF impacted by a HI superbubble. We use the 12CO data to construct excitation temperature maps, finding that the gas temperature is very low with a median of only 7.1 K. We use these excitation temperatures to determine the 13CO and C18O column densities; combined with the Herschel derived column densities the abundance of these isotopologues are also found. A striking feature is that the entire 13 pc length spine of G214.5 is seen as a continuous region of low 13CO abundance. Radial slices show that this low abundance region is confined to the inner ~0.8 pc of the filament, where the total column density increases and the dust temperature drops noticeably. Because of this connection with increased density and decreased temperature, we attribute this drop in 13CO abundance to freeze-out, i.e. 13CO being deposited onto the dust grains as ice, making G214.5 one of the largest scale example of this phenomena more commonly seen in prestellar cores (~0.1 pc). We construct an axisymmetric model of the filament's radial H2 and CO profile using a simple freeze-out prescription, which we constrain using the filament's projected radial profiles. With this we find that due to the low central densities in the filament (~8000 cm-3), the cosmic-ray ionisation rate must also be very low, ~2e-18 /s, an order of magnitude lower than typically found. This low cosmic-ray ionisation rate is in agreement with the low gas and dust temperatures found too. Altogether, this suggests that in other cold, quiescent environments, such as the Outer Galaxy, one might expect to find widespread CO freeze-out at lower volume and column densities than previously thought.

S1.3

The drag instability in C-shocks: simulation confirmation and 2D linear analysis

Pin-Gao Gu (ASIAA); Che-Yu Chen (LLNL, Univ. of Virginia); Emma Shen (Univ. of Cambridge); Chien-Chang Yen (Fujen Catholic Univ.); Min-Kai Lin (ASIAA, NCTS)

C-type shocks are believed to be ubiquitous in turbulent molecular clouds thanks to ambipolar diffusion. We perform the linear analysis and reveal a fluid instability in both perpendicular and oblique C-shocks (Gu & Chen 2020; Gu 2021). This new instability in C-shocks, speculated and named the drag instability by Gu et al. (2004), is a local linear overstability phenomenon due to ion-neutral drag and cosmic-ray ionization. The approximate dispersion relations of the instability are derived, and the most unstable modes are identified. We shall also present the numerical results of the drag instability in 1D C-shocks from non-ideal magnetohydrodynamic simulations in comparison with the local linear theory (Gu et al. 2022). We confirm the presence of the drag instability in simulated 1D isothermal C-shocks. Furthermore, we find that the nonlinear phase of the instability is subject to wave-steepening, leading to saturated perturbation growth. Therefore, in the absence of any drivers, the turbulence in star-forming clouds may decay faster than it was previously thought.

S1.4

Infall streams in the high-mass protostellar core G336.01-0.82

Fernando Olguin (NTHU)

Numerical simulations suggest that matter can be funneled through accretion streamers formed in unstable disks, producing accretion bursts with high infall rates. This accretion mode can overcome the radiation pressure/ionization, allowing high-mass stars to continue increasing in mass. In addition, streamers can become unstable allowing the formation of stellar companions. Recent high-resolution observations with ALMA have started to show spiral-like substructures associated with accretion streamers within high-mass protostellar cores. As part of the Digging into the Interior of Hot Cores with ALMA (DIHCA) we have observed 30 high-mass star-forming regions at 100 au scales. In this presentation, we will show the first results of our high-resolution observations investigating the properties of streamers. In particular, we will show a detailed view of the high mass core G336.01–0.82, which exhibits 2 accretion streams feeding a protostellar disk. We model the observations to obtain properties like the gas temperature, and derive other properties related to the kinematics of the circumstellar matter. These results indicate that the disk/streamers system is feeding a ~10 Msun protostar at a high accretion rate (~1E-3 Msun/yr). Our observations and models also imply that gas may be building up at the outskirts of the disk and may result in future accretion burst events.

S1.5

Multi-scale magnetic field and fragmentation of IRDC SDC18.624-0.070

Han-Tsung Lee (ASIAA & NTU), Ya-Wen Tang (ASIAA), Jia-Wei Wang (ASIAA),
Patrick Koch (ASIAA), Seamus Clarke (ASIAA)

We investigate the evolution of magnetic field from 1 pc filament scale to 0.01 pc core scale in filamentary infrared dark cloud SDC18.624-0.070 and its two clumps SDC18-N and SDC18-S using dust polarization observations of three different resolutions from JCMT and SMA. We found magnetic field preserves its mean orientation with less than 10 deg variation while displays increasing angle dispersion from filament to core scale. The magnetic field is also perpendicular to major axes of structures at all scales (filament, clumps and cores), suggesting it is dynamically important in regulating material collapse. Multi-scale estimate of gravitational energy density, magnetic pressure, and turbulent pressure shows the relative importance of gravity, magnetic field, and turbulence in clumps affects fragmentation morphology in SDC18.624-0.070, in which higher magnetization leads to lower level of fragmentation.

S2.1

Repeating rates of 36 fast radio bursts selected by machine learning

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Arthur Chen (NTHU); Tomo Goto (NTHU); Bo Han Chen (SNU); Shotaro Yamasaki (NCHU); Seong Jin Kim (NTHU);
Simon C.-C. Ho (ANU); Decmend F. J. Ling (NTU); Yi Hang Valerie Wong (CU Boulder); Tiger Y.-Y. Hsiao (JHU);
Chih-Teng Ling (NTHU); Poya Wang (NTHU); Leo Y.-W. Lin (NTHU)

Fast radio bursts (FRBs) are enigmatic radio pulses with millisecond time scales, most of which have extragalactic origins at cosmological distances. A key element in revealing the origin of FRBs is understanding their repetitive nature, i.e., testing the hypothesis of whether observationally one-off FRBs are truly non-repeating (catastrophic progenitors) or not (recurrent progenitors). However, the FRB classification requires extremely expensive long-term and high-sensitivity observations, hampering the correct understanding of the repetitive nature. To overcome this problem, Chen et al. (2022) conducted a machine-learning classification of CHIME FRBs to find repeating FRB candidates. Once proven, the machine learning approach will be extremely useful because it does not require expensive observations, but only one-time FRB detection would allow the FRB classification with machine learning. To prove this hypothesis, we conducted follow-up observations with Five-hundred-meter Aperture Spherical Telescope for 36 repeating FRB candidates selected by the machine-learning approach. In this presentation, I will discuss the repeating rates of our samples, including an FRB, which was independently confirmed to repeat in the recent CHIME survey.

A repeating Fast Radio Source in a globular cluster

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Fast Radio Bursts (FRBs) are bright (~1 Jy), ubiquitous, radio flashes with millisecond-duration from cosmological origin. About six hundred FRBs have been published since the first discovery in 2007, of which two dozen sources have been observed with complex repetitions. About twenty FRBs have been localized to their host galaxies by interferometry, and only four repeaters have been pinpointed by the VLBI to local environments, including globular clusters and persistent radio sources. This contains critical clues for the mystery of FRBs. I will discuss a recent VLBI-localized repeater in a globular cluster of M81, which favors the model of recycled pulsars instead of the popular magnetar scenario.

A new method to constrain the Hubble constant with scattering in host galaxies of fast radio bursts

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Tomo Goto (Institute of Astronomy, National Tsing Hua University);
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Measuring the Hubble constant (H_0) is one of the most important missions in astronomy as it dictates the expansion of the Universe. Nevertheless, recent studies exhibit more than 4-sigma tension among different measurements, which necessitates a new, independent method. Fast radio bursts (FRBs) are coherent radio transients with large dispersion measures (DM) at very short timescales. DM_IGM, the free electron column density along a line of sight in the intergalactic medium (IGM), could open a new avenue to probe H_0, being free of the dust extinction.However, it has been challenging to separate DM contributions from different components (i.e., IGM and host galaxy plasma), hampering the accurate measurements of DM_IGM and hence H_0. We propose a new methodology to overcome this problem by utilizing the temporal scattering (broadening) of FRB pulses due to the propagation effect through the host galaxy plasma. Scattering-inferred host galaxy DM improves the estimate of DM_IGM, which in turn leads to a better constraint on H_0. Based on a recent model for the relation between the scattering time and host galaxy DM (Cordes et al. 2022), we demonstrate how our methodology works for 14 FRB sources with both scattering and spectroscopic redshift measurements. We will also discuss the possible degeneracy between H_0 and the baryon fraction in IGM and how to solve it.

S2.4

SCUBA-2 Ultra Deep Imaging EAO Survey (STUDIES): Confusion-limited 450 μm Galaxy Number Counts and Machine Learning Identifications

Zhen-Kai Gao (ASIAA/NCU), Chen-Fatt Lim (ASIAA/NTU), Ching-Min Lo (ASIAA), Wei-Hao Wang (ASIAA), Chian-Chou Chen (ASIAA), Chorng-Yuan Hwang (NCU), Yun-Hsin Hsu (ASIAA)

The SCUBA-2 Ultra Deep Imaging EAO Survey (STUDIES) is a JCMT large program designed to study the dust-obscured portion of cosmic star formation. To achieve this goal, we conduct observations at 450 μm in the COSMOS and SXDS fields, with the goal of reaching the confusion limit. To date, we have completed 330 hours of observations in the COSMOS field and have acquired approximately 37% (119 hours) of the allocated time in the SXDS field. Using our observations and archival data, we have created a confusion-limited 450 μm map of the COSMOS field covering an area of approximately 450 arcmin2 with a noise level of around 0.6 mJy at the center. From this map, we have identified 477 sources at 3.5σ with flux densities ranging from 2 to 45 mJy, corresponding to a star formation rate range of $\sim$100 to $\sim$2000 solar masses per year at z=2, forming the deepest 450 μm galaxy samples to date. The samples allow us to construct deep source counts at 450 μm. We used Monte Carlo simulations to derive the intrinsic number counts and found that the trend of the faint-end counts shows no drop-off or flattening out. We also compared our counts to model predictions and found reasonable consistency from the faint end to around 20 mJy, but a steeper turn at the bright end in observations. In addition, we compared the integrated surface brightness down to 2.1 mJy of our counts with that measured by COBE and found that our confusion-limited SCUBA-2 image can directly resolve 41% of the 450 μm COBE extragalactic background light (EBL). Based on the results of the trend of the faint-end counts and the unresolved EBL, we conclude that there are still many faint (< 2 mJy) 450 μm sources that are unresolved by current SCUBA-2 imaging. Finally, we present our preliminary results on using machine learning to identify 450 μm-selected submillimeter galaxies (SMGs) from the COSMOS2020 catalog. By using counterparts of our 450 μm sources identified with ALMA and radio observations, we trained a model with a high level (> 0.9) of precision, recall, and f1 scores. This model allows us to identify a large sample of SMG candidates, which will be useful for studying the spatial clustering, physical properties, and morphologies of this population, as well as for source de-blending in low-resolution images.

S2.5

Exploring the faintest end of mid-infrared luminosity functions up to z~5 with the JWST CEERS survey

Chih-Teng Ling (NTHU); Seong Jin Kim (NTHU); Tomotsugu Goto (NTHU); Cossas K.-W. Wu (NTHU); Tom C.-C. Chien (NTHU); Tetsuya Hashimoto (NCHU); Yu-Wei Lin (NTHU)

Mid-infrared (MIR) light from galaxies is sensitive to dust-obscured star-formation activity because it traces the characteristic emission of dust heated by young, massive stars. By constructing the MIR luminosity functions (LFs), we quantify the overall star formation history and the evolution of galaxies over cosmic time. In this work, we report the first rest-frame MIR LFs based on 7.7, 10, 12.8, 15, 18 and 21 μm images from the James Webb Space Telescope (JWST) Cosmic Evolution Early Release Science (CEERS) survey, which contains 573 galaxies at $z=0-5$ that also have optical photometry from the Hubble Space Telescope. With the unprecedented sensitivity of the JWST, the faintest end of the LFs at $z=0-1$ bin could be probed down to $L_\odot \sim 10^7$. This is ~ 2 dex fainter than those from the previous generation of IR space telescopes. Our results connect well with and extend the faint end of the MIR LFs from the previous generation of space telescopes. The total IR LFs, integrated star formation density history and the discussion on their evolution are also presented.

S2.6

Coronal Properties of Low-Accreting AGNs

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Prantik Nandi (Physical Research Laboratory), Neeraj Kumari (Physical Research Laboratory),
Sachindra Naik (Physical Research Laboratory), Claudio Ricci (University of Diego Portales)

We studied the broadband X-ray spectra of 30 Swift/BAT selected low-accreting AGNs using the observations from XMM-Newton, Swift, and NuSTAR in the energy range of 0.5−150 keV. We extracted several coronal parameters from the spectral modeling, such as the photon index, hot electron plasma temperature, cutoff energy, and optical depth. We tested whether there exists any correlation/anti-correlation among different spectral parameters. We observe that the relation of hot electron temperature with the cutoff energy in the low accretion domain is similar to what is observed in the high accretion domain. We did not observe any correlation between the Eddington ratio and the photon index. We studied the compactness-temperature diagram and found that the cooling process for extremely low-accreting AGNs is complex. The jet luminosity is observed to be related to the bolometric luminosity as L_jet ~ L_bol^0.7.

S2.7

The Mass Assembly of High-Redshift Central Black Holes and the Emergence of Jetted AGN

Olmo Piana (NTNU); Hung-Yi Pu (NTNU)

The past few years have seen a fast-growing observational sample of high-redshift supermassive black holes. This has raised multiple questions about their early accretion rates, duty cycles, and nature of their link to the gas dynamics of the host galaxies. Most numerical simulations and semi-analytic models are able to reproduce the available high-z observables (such as the black hole and stellar mass function and the quasar and galaxy UV luminosity functions at z~5-7) despite implementing different models of early (z>10) black hole growth and feedback. Using a semi-analytic model of galaxy and black hole formation and evolution in a cosmological context, we aim to break this degeneracy by showing how different black hole growth models impact quasar and galaxy observables at z>5. We follow the mass build-up of halos covering the whole mass range between 10^8 and 10^13.5 solar masses, from z=20 to z=4, tracking the evolution of the dark matter, gas, stellar and black hole mass components. We show how Eddington-limited and super-Eddington accretion models are both consistent with observational properties of supermassive black holes and their host galaxies at z~5-7, but they become very clearly distinguishable at higher redshift and in the intermediate mass regime. Our model explicitly includes the interplay between the large-scale galactic gas cycle and the growth of the black hole, so we can study how they influence each other in both scenarios. Adding physically-motivated assumptions on the spin and magnetic flux of the black hole, we can also study the emergence of jetted AGN and their duty cycle.

S2.8

A comparison of numerical methods for computing the reionization of intergalacitc hydrogen and helium by a central radiating source

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We compare numerical methods for solving the radiative transfer equation in the context of the photoionization of intergalactic gaseous hydrogen and helium by a central radiating source. Direct integration of the radiative transfer equation and solutions using photon packets are examined, both for solutions to the time-dependent radiative transfer equation and in the infinite-speed-of-light approximation. The photon packet schemes are found to be more generally computationally efficient than a direct integration scheme. Whilst all codes accurately describe the growth rate of hydrogen and helium ionization zones, it is shown that a fully time-dependent method is required to capture the gas temperature and ionization structure in the near zone of a source when an ionization front expands at a speed close to the speed of light. Applied to Quasi-Stellar Objects in the Epoch of Reionization (EoR), temperature differences as high as 5×10^4 K result in the near-zone for solutions of the time-dependent radiative transfer equation compared with solutions in the infinite-speed-of-light approximation. Smaller temperature differences are found following the nearly full photoionization of helium in gas in which the hydrogen was already ionized and the helium was singly ionized. Variations found in the temperature and ionization structure far from the source, where the gas is predominantly neutral, may affect some predictions for 21-cm EoR experiments.

S2.9

Mock Catalogues for DESI MilkyWay Survey

Namitha Kizhuprakkat Ramachandran (Institute of Astronomy, NTHU); Andrew Cooper (Institute of Astronomy, NTHU)

Using the Dark Energy Spectroscopic Instrument (DESI), the DESI Milky Way Survey (MWS) will explore the assembly history of the Milky Way by discovering remnants of ancient dwarf galaxy accretion events and improving constraints on the Galaxy's 3D dark matter distribution. This presentation describes our work on generating mock catalogues that match the selection criteria of DESI MWS, using six cosmological magneto-hydrodynamic ΛCDM zoom simulations from the AURIGA cosmological simulation suite combined with the phase-space smoothing method of Lowing et al. (2015). Observational data can be compared to these catalogues to understand the nature of the features in the galactic stellar halo that MWS will observe and the sensitivity of the survey to galaxy-to-galaxy variance and alternative models of dark matter. I will present a comparison between the mocks and early DESI data and discuss potential applications, including calibration of measurements of the DM density profile using halo star kinematics and, tests of methods for reconstructing the Galactic accretion history from newly discovered stellar substructure.

S2.10

The Metallicity of DESI Dwarf Galaxies

Yu Voon Ng; Ting-Wen Lan

The mass-metallicity relation indicates that galaxies with higher stellar masses tend to have higher metallicities. However, the low-mass end of this relationship remains poorly understood due to the low luminosity of dwarf galaxies. In this talk, I will present a study exploring the low-mass end of the mass-metallicity relation using the latest dataset from the Dark Energy Spectroscopic Instrument (DESI) survey at redshifts within 0.1. We employ a convolutional neural network (CNN) method to identify the candidates of galaxies with ~10^7-10^8 solar masses from the images and then extract information of various gas emission lines from the DESI spectra. For systems with multiple line detections, we estimate the gas metallicity of each galaxy individually, while for systems with limited line information, we adopt stacking analysis to obtain high S/N composite spectra and measure the average gas metallicity of the galaxy population. Our results demonstrate that with the incoming DESI dataset, one will be able to explore the faint end of the mass-metallicity relation with a large statistical dataset and obtain a more comprehensive understanding of the relation.

S3.1

Structures and Time Variability of the Lunar Sodium Exosphere and Tail

Ian-Lin Lai (Graduate Institute of Astronomy, National Central University);
Chen-Yen Hsu (Graduate Institute of Astronomy, National Central University);
Yung-Ching Wang (Graduate Institute of Astronomy, National Central University);
Wing-Huen Ip (Graduate Institute of Astronomy, National Central University)

Due to the absence of a substantial atmosphere, the moon has a tenuous and collisionless exosphere. The emission of sodium D-line at 589.0 nm and 589.6 nm enables ground-based observations of the sodium exosphere. Sodium atoms are released from the lunar surface into the exosphere through ion sputtering by energetic solar wind particles, photon stimulated desorption, and micrometeoroid impact vaporization. With an escape speed of about 2.38 km/s, the low speed and non-escaping sodium atoms travel with a ballistic motion near the surface. The lunar sodium tail is a comet-like extension of the sodium exosphere, formed by the high speed and escaping sodium atoms under the influence of solar radiation pressure. In this work, we present a Monte Carlo model to study the lunar sodium exosphere with a time dependence calculation. The sodium atoms are ejected from the lunar surface with different velocity distribution base on the various mechanism of sodium sources. The trajectories of sodium atoms fallow the solar radiation pressure and the gravitational force of the Earth and Moon. We also simulate the observation images of the sodium "bright spot", which is the sodium tail focused by the Earth's gravitational force in the anti-solar direction.

S3.2

Outer Space Exploration 2nd Lunar Lander Payload Mission: Formosa Lunar Ultraviolet Telescope Experiment (FLUTE)

Yi-Chi Chang (Institute of Astronomy, National Tsing Hua University, Hsinchu 30013, Taiwan);
Aniket Hase (Power Mechanical Engineering, National Tsing Hua University, Hsinchu 30013, Taiwan);
Cheng-Fang Ho (Taiwan Instrument Research Institute, National Applied Research Laboratories, Hsinchu 300, Taiwan);
Ting-Ming Huang (Taiwan Instrument Research Institute, National Applied Research Laboratories, Hsinchu 300, Taiwan);
A. K. H. Kong (Institute of Astronomy, National Tsing Hua University, Hsinchu 30013, Taiwan)

With the support of the Taiwan Space Agency, we are going to develop an extremely compact camera system called Formosa Lunar Ultraviolet Telescope Experiment (FLUTE) as a payload on a lunar lander. The primary scientific objectives are for observing the UV sky and lunar terrain by using a pair of wide-field multispectral cameras. We aim to observe UV variable stars and derive TiO 2 and FeO contents of the lunar surface which are rare on Earth using multi-wavelength imaging. The payload is 5U in size and 5kg in weight with a ground sample distance of 0.5cm per pixel at 10 meter and the expected launch date is 2026 Q1. The facility will also serve as a pathfinder mission of future lunar facilities for mineralogy and astronomical studies.

S3.3

Characterizing the Pre-stage Orbital Properties of Dynamically Young Short Period Comets

Yu-Chi Cheng (NTNU-PHY), Kuo-Jui Wu (NTNU-PHY), and Ya-Lin Wu (NTNU-PHY)

The bimodality of Centaurs and Trans-Neptunian objects is a hint for their different origins and evolution history. Following the evolutionary track from the Trans-Neptunian region to the orbit interior of Jupiter, it is interesting to know if the dynamically young short-period comets (SPCs), the last stage of the inward migrating process, have reserved any bimodality signature after a significant orbital encounter with Jupiter. To aim for this purpose, we execute a series of dynamical simulations to trace the evolutionary history of all the known SPCs. 69 dynamically young SPCs are identified, which show significant orbital changes from a Centaur region to an orbit interior to Jupiter in the past 500 years. The orbital inclination seems to have randomly changed during the inward migrating process. Statistically, the mean inclination of the dynamically young SPCs is similar to that previously in the Centaur orbit. It represents that orbital transfer from Centaur to SPC is a complex process and may remove most of the memory of dynamical features. We also notice the dynamic young SPCs belong to the low-carbon/OH groups summarized by A'Hearn et al. (1995). More observational evidence is needed to conclude this dynamical-chemical relation.

S3.4

The Super Earth-Cold Jupiter Relations

Sridhar Gajendran; Ing-Guey Jiang; Li-Chin Yeh

Super Earths, a planet type that is ubiquitous among discovered exoplanets, remains enigmatic. They appear around nearly 30% of all Sun-like stars and can be formed around stars with a broad range of metallicities and masses. They are not predicted by planet formation models and a consensus is yet to be reached to explain their origin. The two major models explaining their formation, namely, the in situ and inward migration models, give rise to several contradicting conclusions. More particularly, these models predict, sometimes explicitly, that super Earths must present an anti-correlation with giant planets (hereafter cold Jupiters). Given the well-established fact that cold Jupiters are observed around 10% of Sun-like stars, it seems highly unlikely that these two planetary types would be anti-correlated. To reconcile these differences, we attempted to leverage our knowledge of cold Jupiters to explain super Earths. We find that cold Jupiters appear more than twice as much around hosts of super Earths than they do around field stars. This high correlation between these two planet types imply that they do not compete for material in their formation stage and that they share similar origins.

S3.5

High-order discontinuous Galerkin scheme for the coagulation/fragmentation equation

Maxime Lombart (Department of Earth Sciences, National Taiwan Normal University),
Mark Hutchison (Universitats-Sternwarte, Ludwig-Maximilians-Universitat Munchen),
Yueh-Ning Lee (Department of Earth Sciences, National Taiwan Normal University)

Particles coagulation and fragmentation are ubiquitous (raindrop formation, air pollution, combustion, polymerisation, astrophysics) and mathematically described by the Smoluchowski coagulation and the fragmentation equations. Solving these equations accurately while preserving tractable computational costs is a tremendous numerical challenge, yet critical for understanding the formation of the planets. In particular, low-order schemes do strongly overestimate the formation of large particles. We present a novel high-order discontinuous Galerkin algorithm (Lombart and Laibe 2021) that addresses all these issues. The algorithm is designed in a modular way to be coupled in other codes. In particular, we aim to perform the first 3D simulations of dusty protoplanetary discs that include realistic coagulation/fragmentation.

S3.6

Monitoring H-alpha emission from a wide-orbit brown dwarf companion

Ya-Lin Wu (NTNU); Yu-Chi Cheng (NTNU); Li-Ching Huang (NTNU); Brendan Bowler (UT Austin); Laird Close (U Arizona); Wei-Ling Tseng (NTNU); Ning Chen (NTNU); Da-Wei Chen (NTU)

Using H-alpha as an accretion tracer, we monitored mass accretion onto the wide-orbit brown dwarf companion FU Tau B with the Lulin 1-m telescope for six consecutive nights. This is the longest continuous H-alpha monitoring for a substellar companion near the deuterium-burning limit. We find that accretion onto FU Tau B is overall stable, similar to other brown dwarf companions and protoplanets that have sparsely-sampled measurements. Our observations highlight the potential of monitoring accretion in the substellar regime with small telescopes.

S3.7

A T-Dwarf Candidate from JWST Early Release NIRCam data

Poya Wang(NTHU); Tomotsugu Goto(NTHU); Simon C.-C. Ho(ANU); Yu-Wei Lin(NTHU); Tetsuya Hashimoto(NCHU); Cossas K.-W. Wu(NTHU); Chih-Teng Ling(NTHU); Seong Jin Kim(NTHU)

We present a T-type brown dwarf candidate discovered in the Cosmic Evolution Early Release Science (CEERS) fields by James Webb Space Telescope (JWST) NIRCam. In addition to the superb sensitivity, JWST has numerous filters in near-IR and thus is advantageous in finding faint, previously unseen brown dwarfs. From the model spectra in new JWST/NIRCam filter wavelengths, the selection criteria of F115W-F277W<-0.8 and F277W-F444W>1.1 were chosen to target the spectrum features of brown dwarfs having temperatures from 500K to 1300K. Searching through the data from Early Release Observations (ERO) and Early Release Science (ERS), we find 1 promising candidate in the CEERS field. The result of SED fitting suggested an early T spectral type with a low effective temperature of T_eff~1300K, the surface gravity of g~10^4.25cm s^-2, and an eddy diffusion parameter of K_zz=10^7cm^2 s^-1, which indicates an age of 50Myr and a mass of 0.01M_solar. The estimated distance of the source is 4.92+-0.32kpc, showing the JWST's power to extend the search to a much larger distance.

S3.8

Impact of stellar rotation in binary system on core-collapse supernova progenitors and multimessenger signals

Hao-Sheng Wang (Institute of Astronomy, National Tsing Hua University, Hsinchu, Taiwan);
Kuo-Chuan Pan (Institute of Astronomy, National Tsing Hua University, Hsinchu, Taiwan)

The detailed structure of core-collapse supernova progenitors is crucial for studying supernova explosion engines and multimessenger signals. In this project, we investigate the influence of stellar rotation on a binary system with a 30 solar mass donor star and a 20 solar mass accreting star using the MESA stellar evolution code. We find that the binary systems can produce fast-rotating progenitors, which are difficult to obtain with single-star systems, with thiner Si-shell and larger O-shell compared to single-star systems. In addition, we perform two-dimensional self-consistent core-collapse supernova simulations with neutrino transport for these rotating progenitors. The fast rotating progenitors show strong bounce gravitational wave signals and unique gravitational wave features due to different binary evolution history.

S4.1

Search for Gravitational Wave Emissions from Core-Collapse Supernovae

Kuo-Chuan Pan (National Tsing Hua University)

While detecting gravitational waves from a nearby core-collapse supernova (CCSN) will be the next milestone in gravitational wave and multi-messenger astrophysics, the physical mechanism that drives the supernova explosion remains elusive. In this talk, I present the results of a set of 3D flagship CCSN simulations using high-resolution hydrodynamics, self-consistent neutron transport, and approximate general relativistic gravity. In particular, I will focus on the shock dynamics and unique gravitational wave features that might be detected with the current gravitational wave detectors, e.g., Advanced LIGO, Virgo, and KAGRA.

S4.2

Rapid Generation of Kilonova Light Curves Using Conditional Variational Autoencoder

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The discovery of the optical counterpart, along with the gravitational waves from GW170817, of the first binary neutron star (BNS) merger, opened up a new era for multi-messenger astrophysics. The optical counterpart, designated as a kilonova (KNe), has immense potential to reveal the nature of compact binary merging systems. Ejecta properties from the merging system provide important information about the total binary mass, the mass ratio, system geometry, and the equation of state of the merging system. In this work, we adopt KNe data to prepare a training, test, and validation data set to be fed into a conditional variational autoencoder (CVAE) to regenerate the KNe light curves for the required values of physical parameters. The KNe data are the light curves in different filter bands. For different KNe models, the physical parameters governing the light curves are different based on the pre-merger or post-merger properties of the BNS merger event. We train the CVAE on the KNe light curve data from one chosen model by conditioning the light curves on the physical parameters, with a training time of ~20 minutes, and rapidly generate light curves for the desired values of the physical parameters across the whole parameter space. Once the CVAE is trained and conditioned on the physical parameters, it takes ~1 milli-second to generate the light curves with a root mean square value of ~0.02 (AB mag) between the true and generated light curves, thus speeding up the process by ~1000 times as compared to the existing method. We have separately trained, generated, and verified the CVAE approach on two different KNe models, where one model is based on pre-merger while the other is on post-merger properties of BNS, and have obtained satisfactorily accurate results, with training time and light curves generating time of ~20 minutes and ~1 millisecond respectively while achieving a root mean square value of ~0.02 and 0.015 AB mag between the original and generated light curves for each model. This technique has the ability to provide an alternative to the time-consuming and resource-draining simulations. Using the CVAE, we can look into the extremum detection limit associated with a KN model. The merit of this approach lies in its rapid generation of light curves based on desired parameters and at the same time encompasses all the possible light curves related to KN. Keywords: Kilonova, conditional variational autoencoder, light curves.

S4.3

On the X-ray Quiescent State of Magnetars: the Relations between Non-thermal and Thermal Spectral Properties

Che-Yen Chu (National Tsing Hua University); Hsiang-Kuang Chang (National Tsing Hua University)

Magnetars are an unique class of neutron star characterized by their incredibly strong magnetic fields. Unlike normal pulsars, magnetars exhibit distinct X-ray emissions that have yet to be fully understood. While numerous theories have been proposed to explain the X-ray emission of magnetars, the exact mechanism remains a topic of debate. In this paper, we analyze the X-ray spectra of all confirmed magnetars during their quiescent state by fitting a combination of power-law and black body. We examine a total of 14 good samples and investigate the correlations between timing properties, non-thermal and thermal spectral properties. Our findings suggest a strong relationship between non-thermal and thermal X-ray emissions. These results could provide valuable insights for modeling the X-ray emission mechanisms of magnetars.

S4.4

Study of the Accretion Flow Dynamics of EXO 1846-031 during its 2019 Outburst

Dipak Debnath, Sujoy Kumar Nath, Kaushik Chatterjee, Riya Bhowmick, Hsiang-Kuang Chang

We study the recent outburst of the black hole candidate EXO 1846-031 which went into an outburst in 2019 after almost 34 years in quiescence. We use archival data from Swift/XRT, MAXI/GSC, NICER/XTI and NuSTAR/FPMA satellites/instruments to study the evolution of the spectral and temporal properties of the source during the initial rising phase of the outburst. From spectral analysis with the physical Two Component Advective Flow (TCAF) model, we observed four canonical spectral states (hard, hard-intermediate, soft-intermediate, soft) during the outburst. Evolving type-C quasi-periodic oscillations (QPOs) are observed in the NICER data in the hard, and intermediate spectral states. The nature of the outburst is categorized as multi-peaked as the source was found to be re-brightened after ~ 15 days of the start of the declining phase of the first peak. The disk configuration is found to be unstable due to receding shock of the first peak and inward shock due to the second peak. The peak intensity of the first and second peaks were found to be roughly similar. We also determine the probable mass of the black hole to be ~ 10 Solar mass from the spectral analysis with the TCAF model.

S4.5

Odd radio circles as cosmic-ray dominated AGN jets

Yen-Hsing Lin (NTHU); H.-Y. Karen Yang (NTHU/NCTS); Alvina Y. L. On (NTHU/NCTS)

Odd Radio Circles (ORCs) are newly discovered extragalactic radio objects with unknown origins. In this work, we investigate the possibility that ORCs are generated by cosmic-ray (CR) dominated active galactic nucleus (AGN) jets. We carry out three-dimensional CR magneto-hydrodynamic (3D-CRMHD) simulations using the FLASH code and predict the radio morphology, polarization, and other dynamical properties of jet-inflated AGN bubbles with both leptonic and hadronic emission mechanisms. We find that powerful and long-duration CR-dominated jets can create radio objects with similar size (~300-600 kpc) to the observed ORCS in a low-mass cluster. For the same input jet energy, long-duration jets tend to create larger bubbles since high-power jets create strong shocks that carry away a signification portion of the jet energy. The edge-brightening feature of the ORCs is naturally reproduced in the hadronic scenario, while the leptonic scenario requires enhancement of the magnetic field near bubble edges by adiabatic compression. We conclude that CR-dominated AGN jets could be a plausible origin of ORCs.

S4.6

Exploring the Observability of Surviving Companions of Stripped-Envelope Supernovae: A Case Study of Type Ic SN 2020oi

Chen, Hsin-Pei (NTHU); Rau, Shiau-Jie (UIUC); Pan, Kuo-Chuan (NTHU)

Stripped-envelope supernovae (SE SNe) were considered as the explosions of single massive stars with strong stellar winds, while later observations favor binary origins. One direct evidence to support the binary origins is to find the surviving companions of SE SNe since previous numerical studies suggested that the binary companion should survive the supernova impact and could be detectable. Recently, Gagliano et al. (2022) reported that the nearby Type Ic SN 2020oi in M100 (~17.1 Mpc) resulted from a binary system based on the HST photometric and spectroscopic observation. Based on the suggested binary properties of SN 2020oi, we conduct two-dimensional hydrodynamics simulations of supernova companion interactions and the subsequent post-impact evolution of the companion. Our results suggest that a surviving companion becomes brighter in two orders of magnitude and temporarily redder after the SN impact. The companion might be detectable with the JWST NIRCam short wavelength channel in a few years. Furthermore, the predicted magnitudes of surviving companions show a significant magnitude gradient around the peak. This could be another indicator to identify the surviving companion from a SE SN.

S4.7

MHD simulations of accretion and mass outflows around spinning supermassive black holes

Ramiz Aktar (Department of Physics and Institute of Astronomy, National Tsing Hua University, 30013 Hsinchu, Taiwan);
Kuo-Chuan Pan (Department of Physics and Institute of Astronomy, National Tsing Hua University, 30013 Hsinchu, Taiwan)

We perform axisymmetric two-dimensional magnetohydrodynamic simulations (MHD) to investigate accretion flows around spinning supermassive black holes (SMBHs). To mimic the space-time geometry of black holes, we consider effective Kerr potential (Dihingia et al. 2018), and the mass of the black holes is $10^8 M_{\odot}$. We initialize the accretion disc with a magnetized torus by adopting the toroidal component of the magnetic vector potential. The initial magnetic field strength is set by using the plasma beta parameter (β), i.e., the ratio of the gas pressure to the magnetic pressure. We observe self-consistent turbulence generated by magnetorotational instability (MRI) in the disc. The MRI turbulence transports angular momentum in the disc, and we find the angular momentum distribution becomes near the Keplerian distribution. We investigate the effect of the magnetic field on the dynamics of the torus and associated mass outflow from the disc around a maximally spinning black hole $(a_k = 0.99)$. We find that mass outflow rates enhance with the increase of magnetic field in the disc. We also investigate the effect of black hole spin on the magnetized torus evolution. Finally, we discuss the possible astrophysical application of our simulation results.

S4.8

Identification of Cosmic Voids as Massive Cluster Counterparts

Junsup Shim (ASIAA), Changbom Park (Korea Institute for Advanced Study), Juhan Kim (Korea Institute for Advanced Study), Sungwook Hong (Korea Astronomy and Space Science Institute), Ho Seong Hwang (Seoul National University)

We develop a method to identify cosmic voids from matter/galaxy density fields by adopting a physically-motivated void-cluster correspondence theory that voids are the counterpart of massive clusters. To prove the concept we use a pair of LCDM simulations, a reference and its initial density-inverted mirror simulation, and study the relation between the effective size of voids and the mass of corresponding clusters. We study the voids corresponding to the halos more massive than 10^{13}Msol/h and find a power-law scaling relation between the void size and the corresponding cluster mass. We also find that the density profile of the identified voids follows a universal functional form. Based on these findings, we propose a method to identify cluster-counterpart voids directly from the matter/galaxy density field without their mirror information. The completeness and reliability we achieve in recovering voids corresponding to clusters more massive than 3x10^{14}Msol/h are about 70-74 % for matter density fields and 60-67% for galaxy density fields. Our results demonstrate that we can apply this method to the galaxy redshift survey data to identify cosmic voids corresponding statistically to the galaxy clusters in a given mass range.

S5.1

Long-Term Monitoring Observations of Jet Ejections and Mass Accretion for Active Pre-Main Sequence Stars

Hiro Takami (ASIAA), Jennifer L. Karr (ASIAA), Youichi Ohyama (ASIAA), Chun-Fan Liu (ASIAA), Wen-Ping Chen (NCU), Hsien Shang (ASIAA), Mei-Yin Chou (ASIAA), Hauyu Baobab Liu (NSYSU) et al.

Understanding the mechanisms of mass accretion and jet ejection is one of the key issues of star formation theories. However, observational studies are hampered by the limited angular resolutions of current telescopes, which are not sufficient to resolve structure and kinematics in the jet launching region. Over the past ten years we have executed an alternative approach to tackle this important issue: that is, long-term monitoring of mass accretion and jet ejection for active young stars (RW Aur A, RY Tau, DG Tau). The executed observations include: (A) high-resolution imaging spectroscopy of [Fe II] 1.64-micron emission in extended jets using Gemini-NIFS, VLT-SINFONI and Keck-OSIRIS; (B) optical high-resolution spectroscopy at CFHT; and (C) optical photometry at the CrAO 1.3-m telescope. We will report our update since our last presentation in 2020.

S5.2

Searching for the connection between stellar activities and protoplanetary disks

Yuka Terada(ASIAA;NTU), Hauyu Baobab Liu(NSYSU), David Mkrtichian(NARIT), Jinshi Sai(ASIAA),
Mihoko Konishi(Oita Univ.), Ing-Guey Jiang(NTHU), Takayuki Muto(Kogakuin Univ.),
Jun Hashimoto(Astrobiology Center; Subaru telescope; NAOJ), Motohide Tamura(Astrobiology Center; Univ. of Tokyo; NAOJ)

Pre-main sequence (PMS) stars typically have short rotation periods of a few days. They are known to power strong magnetic fields with the geodynamo effect, which subsequently dictates stellar accretion and launch of the magnetocentrifugal winds/jets. In addition, the luminous X-ray and UV feedback from these magnetic structures (e.g., loops) may dramatically affect the protoplanetary disk mass-dispersal and the formation/evolution of prebiotic molecules, which are crucial aspects for the understanding of the origin of life. Similar to the monitoring of sunspots over solar cycles, the diagnostics of the activities of the colossal cold spots on the PMS stars will provide invaluable information about these magnetic activities on the PMS stars. Thanks to the Kepler K2 and TESS mission, it has only recently become possible to perform long-duration (e.g., a few tens of days) monitoring observations to characterize the activities associated with cold spots without interruption. In this work, we studied the activity on the stellar surface of DM Tau, one of the PMS stars, using the light curves obtained with the Kepler K2 and optical and near-infrared photometric monitoring observations. Periodic analysis of the K2 data shows that DM Tau spins for a period of 7.3 days. In addition, we found that nearly 50% of the surface of the host protostar is occupied by cold spots that are several hundred Kelvin cooler than the warmer side. We report on the analysis results of these optical observations, along with data obtained by the JVLA. The latter, which is tracing the ionized gas in the protoplanetary disk, show variability on a timescale that is similar to what we found from the optical data. In addition, we will report on the preliminary results of follow-up observations of DM Tau.

S5.3

Quantification of Sub-parsec Scale Dense Core Arrangements with Fragmentation Number

Wei-An Chen (Graduate Institute of Astrophysics, National Taiwan University;
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Ya-Wen Tang (Institute of Astronomy and Astrophysics, Academia Sinica),
Seamus Clarke (Institute of Astronomy and Astrophysics, Academia Sinica),
Patrick Koch (Institute of Astronomy and Astrophysics, Academia Sinica),
Jia-Wei Wang (Institute of Astronomy and Astrophysics, Academia Sinica),
Kaho Morii (Department of Astronomy, Graduate School of Science, The University of Tokyo;
National Astronomical Observatory of Japan, National Institutes of Natural Sciences),
Patricio Sanhueza (National Astronomical Observatory of Japan, National Institutes of Natural Sciences;
Department of Astronomical Science, SOKENDAI (The Graduate University for Advanced Studies))

The detailed process from the fragmentation of the pc scale clumps into sub-pc scale dense cores is still under debate. Models considering competitive accretion, global hierarchical collapse and inertial flow, for example, are proposed to try to better explain what we see recently in high-resolution observation. MHD simulations show that the magnetic field seems to play an important role during the process, as it is known to suppress the collapse in the direction perpendicular to the field lines. Depending on how gravity, turbulence and magnetic field compete with each other, the cores after the fragmentation can have different arrangements. These arrangements could be possibly used as a diagnosis of the cores' environment. In order to study the fragmentation conditions in star-forming filaments, we have developed an algorithm (fragmentation number, FN) to quantify these arrangements. In this talk, I will present this algorithm and its application to the high-sensitivity and high-resolution ALMA survey ASHES (ALMA Survey of 70 μm Dark High-mass Clumps in Early Stages).

S5.4

Episodic Accretion in Protostars – An ALMA Survey of Molecular jets in Orion Molecular Cloud

Somnath Dutta (ASIAA, Taiwan)Chin-Fei Lee (ASIAA, Taiwan)

Protostellar outflow and jet are almost ubiquitous characteristics during the mass accretion phase, and carry the history of stellar accretion, complex-organic molecular (COM) formation and planet formation. Episodic jets are believed to be associated with episodic accretion through the disk. Despite their importance, there is a lack of outflow/jet studies of a statistically significant sample of protostars with high-sensitivity and high-resolution observations. To explore the episodic accretion mechanisms and chronology of episodic events, we investigated 42 observed protostellar fields with ALMA observations of CO, SiO and 1.3-mm continuum. We observed that ~50 % protostars are driving confirmed molecular jets with high abundances of SiO. Jet velocity, mass-loss rates, mass-accretion rates, and periods of accretion events are found to be dependent on the internal driving forces of the jet (e.g., bolometric luminosity, envelope mass). The velocity and mass-loss rates are positively correlated with the surrounding envelope mass, suggesting that the presence of high mass around protostars increases the ejection-accretion activity. The mean periods of the ejection events are estimated to be 20 - 550 years for all protostars, which could be associated with the perturbation zones of ~ 2 - 60 AU around the protostars. Mean ejection periods are anti-correlated with the envelope mass, where high-accretion rates could have triggered more rapid ejection events. These periods of outburst/ejection are fairly smaller than the freeze-out time scale of simplest COMs like CH3OH, suggesting the episodic events largely maintain the ice-gas balance inside/around the snowline.

S5.5

Identifying YSO Candidates from an Infrared All Sky Survey : Distribution of YSOs in the Nearby Galactic Region

Ying-Chi Hu(NTHU); Shih-Ping Lai(NTHU)

The star formation rate (SFR) of molecular clouds in the galactic region is important to determine the mechanism of star formation in the interstellar medium. Our approach involves using supervised machine learning algorithms to select young stellar object (YSO) candidates from the Wide-field Infrared Survey Explorer all-sky catalogue (ALLWISE) in order to map the complete distribution of YSOs in the nearby galactic region. By doing so, we have identified approximately 35% more YSOs in the Spitzer Cores to Disks (c2d) and Gould Belt (GB) survey regions compared to Heiderman et al (2010), while the population ratio of YSOs for different Classes is similar to that observed in the same region by Evans et al. (2009). Utilizing the YSO candidates identified in our work, we were able to derive the SFR of regions in the Handbook of Star Forming Regions (Reipurth 2008). Our findings suggest that the SFR-gas relation of nearby regions (<500pc) is consistent with previous studies conducted by Spitzer (Heiderman et al 2010). Furthermore, using a CO survey of the entire northern sky (Dame & Thaddeus 2022), we calculated the relation between SFR per free fall time (SFR_ff) and virial parameters (alpha_vir) of the same star-forming regions. Our result of SFR_ff-alpha_vir relation indicates that magnetic-regulated star formation models (Krumholz & Tan 2007) dominate the low SFR in the giant molecular cloud (GMC) in the Milky Way, rather than turbulence-regulated models (Krumholz & McKee 2005).

S5.6

Subaru-HDS Observations of the Optical Forbidden Line Wind from DG Tau

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DG Tau is a classical T Tauri star with a fast collimated jet and protoplanetary disk winds. Although the jet is relatively well studied, there are still many unknowns regarding the winds. From previous studies, the low-velocity components (LVC, v < 100 km s-1) in the forbidden line profiles have been used as a proxy for the winds. Using Subaru HDS, we obtained high spectral resolution spectra (Δv ~ 2.5 km s-1) and detected 22 optical forbidden lines from DG Tau. LVCs were found in [O I] (5577/6300/6363 Å), [S II] (6716/6731 Å), [N I] 5200 Å, and possibly [Fe II] 5527 Å. In addition, high-velocity components (HVC) associated with the collimated jet were found in 20 lines ([N I], [N II], [O I], [O III], [S II], [Ca II], [Fe II]). In this talk, we focus on analysis with the bright [O I], [S II], and [N II] lines in the LVC. In their line profiles, we identify at least three sub-components (LVC-H, LVC-M, and LVC-L). We measure the angular scales for these emission lines of 0".05-0".4 (10-60 au) using spectro-astrometry. Different offsets in different emission lines suggest higher temperatures downstream both for the LVC and the HVC. Different emission components in the LVC may be attributed to turbulent/compressed layers, a wide-angled wind component, and an upper disk atmosphere.

S5.7

Dust spectral profiles of a large sample of Class II disks are barely distinguishable at 200-400 GHz

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In the planet formation process, dust grains must grow from (sub-)micron sizes to form millimeter-sized chondrules and eventually kilometer-sized planetesimals. Observational constraint on maximum grain size is essential to understand the planet formation process because it concerns our interpretations of grain growth efficiency, dust stickiness, and mass budget in the protoplanetary disk. We intend to give the constraint by a statistical study of (sub)millimeter spectra of protoplanetary disks which reveal the dust properties. Here we present the SMA 200-400 GHz surveys towards a sample of 47 Class II disks in the Taurus-Auriga region. These new observations tightly constrained the spectral indices of most sources to a very narrow region of 2.0±0.2, except that a handful of spatially resolved extended (e.g., diameter > 210 AU) disks present higher than 2.0 spectral indices. Our natural, tentative interpretation for the uniform, low spectral indices is that the optically thick disk (sub)structures dominate the (sub)millimeter flux densities. Some sources are robustly resolved with <2.0 spectral indices, indicating that the self-scattering of the 100 μm sized dust can be prominent. The result may thus provide implications for the timescale of grain growth and stickiness of icy dust.

S6.1

Investigating the dichotomy among early-type galaxies

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Chen-Yu Chuang (NTHU/ASIAA); Abdurro'uf (JHU); Po-Feng Wu (NTU)

Early-type galaxies (ETGs) are often classified into two distinct groups based on their photometry and kinematics. More luminous ETGs are expected to have boxy-shaped isophotes and show a slow or no rotation pattern. On the other hand, fast rotator ETGs are fainter and disky-shaped. Although this dichotomy leads to enormous simplifications in the description of the galaxy assembly process, this idea is not a consensus, and there is still an intense debate in the literature. To go one step further in this discussion, we analyzed a large sample of 1088 ETGs double-classified via deep learning in the MaNGA survey and visual inspection by the Galaxy Zoo DECaLS. Next, we extracted a diverse set of parameters, including chemical composition, isophote shape, stellar rotation pattern, and velocity dispersion, to which we applied the principal component analysis to check whether the ETGs show any statistical distinction in the multi-parameter space. Our analysis found no evidence of a dichotomy, suggesting that the formation process of early-type galaxies may be more complex than previously assumed.

S6.2

Elucidating the role of interactions in galaxy evolution

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Galaxies in the universe primarily evolve by either interacting with other galaxies and acquiring stars directly or by accretion of gas that can further form stars. The chemical enrichment of a galaxy can be fuelled slowly by the accretion of relatively metal-poor gas from the intergalactic medium (or IGM) or metal-rich gas stripped from another galaxy. In both cases, cycles of follow-up star formation occurring in gas within galaxies (i.e., the interstellar medium, or ISM) further helps in the chemical enrichment of the galaxies. While the global cosmic star-formation history (CSFH) that takes an average statistical SFH of all galaxies at a particular epoch is quite well constrained, the individual scatters in SFH of galaxies at any epoch vary significantly. This variance is based on their morphology, active galactic nuclei (AGN) activity, gas content, and their respective environments. In my talk, I will discuss the role of interactions in galaxies in the local and distant universe observed using different VLT spectrographs. I will also summarize how future surveys and multiwavelength observations can help better our understanding of the role of interactions in the star formation history of individual galaxies.

S6.3

Universality in the random walk structure function of luminous quasi-stellar objects

Ji-Jia Tang (Australian National University); Christian Wolf (Australian National University); John Tonry (University of Hawaii)

Rapidly growing black holes are surrounded by accretion disks that make them the brightest objects in the Universe. Their brightness is known to be variable, but the causes of this are not implied by simple disk models and still debated. Due to the small size of accretion disks and their great distance, there are no resolved images addressing the puzzle. In this work, we study the dependence of their variability on luminosity, wavelength and orbital/thermal timescale. We use over 5,000 of the most luminous such objects with light curves of almost nightly cadence from >5 years of observations by the NASA/ATLAS project, which provides 2 billion magnitude pairs for a structure function analysis. When time is expressed in units of orbital or thermal timescale in thin-disk models, we find a universal structure function, independent of luminosity and wavelength, supporting the model of magneto-rotational instabilities as a main cause. Over a >1 dex range in time, the fractional variability amplitude follows $\log(A/A_0) \simeq 1/2 \times \log(\Delta t/t_{th})$. Deviations from the universality may hold clues as to the structure and orientation of disks.

S6.4

AGN Jet-Driven Spiral-Like Gas Features in Galaxy Clusters

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X-ray observations of galaxy clusters have revealed the presence of spiraling features, found in approximately 95% of cool core (CC) clusters. These features are commonly believed to arise from the motion of the intracluster medium induced by minor mergers. While simulations of merging clusters have reproduced such features, their limitations (e.g., merging is rare in CC clusters) have prompted the investigation of alternative mechanisms. AGN feedback is one such mechanism, and its potential role in driving spiral-like features has been the focus of our research. We present evidence for spiral-like features in a cosmic ray (CR)-dominated AGN jet feedback simulation of galaxy clusters. Our magnetohydrodynamic simulation shows that jet precession could generate spiral-like features with a scale of ~100 kpc, consistent with some current X-ray observations of CC clusters. We analyzed the results using various projections and compared them with actual X-ray observations from Chandra and XMM-Newton. Our findings suggest that AGN jet feedback can drive spiral-like gas features in galaxy clusters. These findings have important implications for understanding the formation and evolution of galaxy clusters and the role of AGN feedback in shaping their properties.

S6.5

Clash of Titans : the impact of dense environment on massive dusty star-forming galaxies

Yu-Jan Wang (NTU, ASIAA); Chian-Chou Chen (ASIAA), Fabrizio Arrigoni Battaia (MPA)

How does environment impact galaxy formation remains an open question today. We have been carrying out ALMA and JCMT observations to study how the properties of the interstellar medium (ISM) of massive galaxies are affected by environments, at the epoch of cosmic noon (z~2-3). Using the SCUBA-2 camera on the JCMT, we've found overdensities of submillimeter sources around a sample of quasars that host the Enormous Lyman-alpha Nebula (ELAN). These submillimeter sources are followed up by ALMA observations and a good fraction of them are spectroscopically confirmed to be associated with the quasars on Mpc scales with detection of strong CO emission lines. Using ALMA, we measure the CO molecular line properties on SMGs around ELAN. We also performed modify back body (MBB) fitting by using the multi-wavelengths continuum data, and then derived the dust properties. Compared with those in the field, our SMG samples have higher CO luminosities at fixed line widths and infrared luminosities. Although careful modeling of selection effects suggest that the higher CO luminosity is mainly caused by observational bias. Besides that, other properties of our SMGs are consistent with those in the field, suggesting that at Mpc scales environments do not play a significant role in affecting the ISM properties of massive dusty star-forming galaxies at cosmic noon.

S6.6

Are Odd Radio Circles virial shocks around massive galaxies?

Shotaro Yamasaki (National Chung Hsing University); Kartick C. Sarkar (Tel Aviv University);
Zhaozhou Li (The Hebrew University of Jerusalem)

Odd Radio Circles (ORCs) are a mysterious population of circular radio (～GHz) objects that have been recently discovered at high Galactic latitudes. A fraction of the ORCs encircles massive galaxies in the sky with stellar mass 10^11 Msun situated at z=0.2-0.6, suggesting a possible physical connection. We find that the physical size and morphology of the ORCs could be explained by accretion shocks/virial shocks around massive (~10^13 Msun) dark matter halo at z<0.5. We calculate the synchrotron emission from such shocks using an analytical model assuming that the shocks deposit fractions of their thermal energy in relativistic electrons with power-law energy distribution and in sub-microgauss magnetic fields. Our calculations show that the radio flux density of the emitting shell could be marginally consistent with ORCs. We also find that pure advection of electrons results in a radio-emitting shell width considerably smaller than the one observed due to the strong inverse-Compton cooling of electrons by CMB photons. Instead, we show that the diffusion of cosmic-ray electrons plays a significant role in virial shocks, thereby inferring a diffusion coefficient as high as 10^30 cm^2/s, which is consistent with the low-density CGM values. Finally, we show that the apparent discrepancy between ORC and halo number density can be mitigated by considering the incomplete virialization of haloes and poor radiation efficiency of shocks. Our results suggest that if ORCs are indeed associated with virial shocks, it would open new avenues to study the nature of accretion shock formation and non-thermal particle acceleration in massive galaxies in a cosmological context.

S6.7

Probing the impacts of radio-mode feedback on the properties of the CGM

Yu-Ling Chang (NTU), Ting-Wen Lan (NTU), Jason X. Prochaska (UCSC) (DESI Collaboration)

Radio-mode feedback from supermassive black holes may profoundly impact the evolution of massive galaxies by suppressing star formation and maintaining the heat content of their circumgalactic medium (CGM). While the effects of radio jets on the hot gas observed by X-ray have been extensively studied, their influence on the cooler CGM is still not well understood. In this talk, I will present the latest measurements of the properties of the cool gas around radio galaxies and compare them with those around a sample of control galaxies without radio emission. To this end, we build a statistical sample of ~2,000 radio galaxies with background quasars for probing the properties of the CGM, including gas distribution, covering fraction, and gas kinematics by utilizing a large catalog of radio sources detected by LOFAR and a vast number of high-quality galaxy spectra measured by the Dark Energy Spectroscopic Instrument (DESI). Our results shed light on the interaction between radio-mode feedback and the CGM, yielding novel observational constraints on the models of black hole feedback.

S6.8

Exploring the thermodynamic perturbations of the intracluster medium in cool cores of galaxy clusters

Shutaro Ueda (ASIAA); Keiichi Umetsu (ASIAA); FanLam Ng (PKU, ASIAA); Yuto Ichinohe (Rikkyo Univ.); Tetsu Kitayama (Toho Univ.); Sandor M. Molnar (ASIAA)

Galaxy clusters are known as the largest and most massive gravitationally bound objects in the Universe. X-ray observations discovered a large amount of diffuse, hot X-ray emitting gas with temperature of 10^7-8 Kelvin (so-called intracluster medium; ICM) trapped in deep gravitational potential wells of galaxy clusters. Cool cores are often found at the center of galaxy clusters. The cool cores are in the form of the dense, relatively cool, metal enriched ICM. The presence of cool cores poses a challenge for our understanding of the thermal evolution of the ICM. In this talk, I will present our recent findings that the cool cores exhibit the thermodynamic perturbations of the intracluster medium, indicating that the thermal evolution of the ICM in the cool cores is linked to the continuous mass growth of galaxy clusters.

S6.9

A systematic search of distant super galaxy clusters in HSC-wide

Tsung-Chi Chen (ASIAA/NTU); Yen-Ting Lin (ASIAA); Hsi-Yu Schive (NTU);
Masamune Oguri (CFS, Chiba U.); the HSC collaboration

Superclusters are groups of galaxy clusters. In a matter dominated universe, they represent the top level in hierarchical structure formation. Encompassing environments across a wide range of overdensity, they can be regarded as a unique laboratory for studying galaxy evolution. With the aid of the extraordinary depth and wide field of the HSC survey, we are poised to detect and study superclusters beyond z=0.7 systematically for the first time. In this work, we aim to construct a supercluster catalog from CAMIRA cluster sample, using a friends-of-friends (FoF) algorithm. We apply a physically motivated supercluster definition that superclusters should eventually experience gravitational collapse even in the presence of dark energy, which causes an accelerating expansion of the universe. The critical parameters of the FoF algorithm are calibrated by evolving N-body simulations to the far future to ensure high purity. With our approach, we identified around 830 supercluster candidates at redshift between z=0.5 and z = 1.0 over an area of 1100 square degrees. Here we introduce our methodology and present an overview of the CAMIRA supercluster catalog.

S6.10

Decoding the magnetic Universe

Alvina On (NCTS, UCL); Jennifer Chan (CITA, Toronto); Kinwah Wu (UCL); Curtis Saxton (Warwick);
Lidia van Driel-Gesztelyi (UCL); Paul Lai (UCL)

Magnetic fields are ubiquitous, permeating across all scales from interstellar space to cosmic voids. Yet their origins and evolution remain as open questions. On galactic scales and beyond, Faraday rotation measure (RM) at radio wavelengths is commonly used to diagnose large-scale magnetic fields. It is proposed that the length scales on which the magnetic fields vary can be inferred from correlations in the observed RM. RM is a quantity derived from the polarised radiative transfer equations under restrictive conditions. In this talk, I will assess the usage of rotation measure fluctuation (RMF) analyses for magnetic field diagnostics in the framework of polarised radiative transfer. I will demonstrate how density fluctuations affect the correlation length of magnetic fields inferred from the conventional RMF analyses. The spatial correlations are generally dissimilar along the line-of-sight and across the sky plane, hence the context of RMF must always be clarified when inferring from observations. In complex astrophysical situations, a covariant polarised radiative transfer calculation is essential to properly track the radiative and transport processes. Otherwise, the interpretations of magnetism in galaxy clusters and larger scale structures would be ambiguous. I will also highlight the physical conditions under which depolarisation of radio point sources may occur, such as those lying behind an intra-cluster shock or a hot bubble. Lastly, I will discuss the implications of our work on future radio observations, particularly with the upcoming telescope in Taiwan (BURSTT) and the Square Kilometre Array (SKA).

S7.1

Multi-Scale Picture of Magnetic Field and Gravity in High-Mass Star-Forming Region W51

Patrick Koch (ASIAA)

We present a suite of dust polarization observations in the high-mass star-forming region W51. These observations image the magnetic (B-) field morphology with progressively higher-resolutions from the pc-scale envelope, to globally collapsing cores, to the fragments within cores, and down to a network of core-connection streamers with the currently highest ALMA resolution around 500au (0.1”). These observations cover a range in resolution of about a factor 1,000 in area. Together with these scale-dependent B-field morphologies we analyze the gravitational vector field. We find recurring similarities in the magnetic field structures and their corresponding gravitational vector fields. These self-similar structures point at a multi-scale collapse-within-collapse scenario. At the highest ALMA resolution, we find B-field orientations that are prevailingly parallel to the core-connecting streamers. This key structural feature is analyzed together with the gravitational vector field. We derive a stability criterion that defines a maximum magnetic field strength that can be overcome by an observed magnetic field-gravity configuration. Equivalently, this defines a minimum field strength that can stabilize streamers and fibers against a radial collapse. We find that the detected streamers are stable, hence possibly making them a fundamental component in the accretion onto the central regions in cores.

S7.2

JWST + ALMA views the earliest chemical inventory of planet-forming regions

Daniel Harsono (NTHU), Melissa McClure (Leiden), John Tobin (NRAO), Jes Jorgensen (Copenhagen), Jon Ramsey (Virginia), Per Bjerkeli (Chalmers) , et al.

The chemical inventory of the planet-forming disks is set during the earliest stages of star formation. With JWST, we can now probe the ice composition in the darkest part of a protostar. I will present the first results from the JWST ERS program Ice Age where we have detected a rich inventory of molecular ices in the Chameleon cloud before forming a protostar. Meanwhile, ALMA has observed the water emission toward an outbursting protostar in Orion. Since water vapor traces the earliest ice composition, the two results together strongly support the idea that chemical complexity is set in the ice during the formation of a dense core. These two results have been published in Nature Astronomy and Nature, respectively.

S7.3

Magnetic fields of the starless core L1512

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The magnetic fields at the center of starless cores are rarely measured due to the low polarized intensity. We will present JCMT POL-2 850um dust polarization observations toward a quiescent starless core L1512. Our observation shows a highly-ordered core-scale magnetic field, of which the field orientation is consistent with the Planck-scale magnetic fields, suggesting the large-scale fields thread from the low-density region to the dense core region in this cloud. Using the Davis–Chandrasekhar–Fermi method, we find the core region is under the magnetically supercritical condition, while the cloud scale of L1512 was suggested to be in the subcritical condition, hinting at the early stage of the star formation. Our results capture the early stage of the magnetic field morphology of the core.

S7.4

Polarization in the GG Tau Ring -- Confronting Dust Self-scattering, Dust Mechanical and Magnetic Alignment, Spirals and Dust Grain Drift

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We report ALMA polarization observations at 3 and 0.9 mm toward the GG Tau A system. In the ring, the percentage is relatively homogeneous at 3 mm, being 1.2%, while it exhibits a clear radial variation at 0.9 mm with a mean increasing from 0.6% to 2.8% toward larger radius (r). The polarization orientation at r > 1.85" appears nearly azimuthal at both wavelengths. At r<1.85", the pattern remains azimuthal at 3 mm but becomes radial at 0.9 mm. Dust self-scattering model with a_max of 1 mm could reproduce the observed polarization orientation and percentage at 0.9 mm, but the expected polarization percentage at 3 mm would be 0.2%, much smaller than the detected 1.2%. Dust alignment with poloidal magnetic field could qualitatively reproduce the flip in polarization at r<1.85" and also the detected polarization percentage. A closer inspection of the nearly azimuthal pattern reveals that polarization orientations are systematically deviating by -9.0 +-1.2 deg from the tangent of the orbit ellipses. This deviation agrees with the direction of the spiral pattern observed in the NIR, but it is unclear how dust grains could be aligned along such spirals. For the scenario where the -9 deg deviation (-7.3 deg after considering the inclination effect) measures the radial component of the dust drift motion, the expected inward drifting velocity would be ~12.8% of the Keplerian speed, a factor of 2.8 larger than the theoretical predictions. Possible additional interpretations of the polarization are discussed, but there is no single mechanism which could explain the detected polarization simultaneously.

S7.5

JCMT BISTRO Survey: Two Types of Filaments in NGC 2264

Jia-Wei Wang (ASIAA), Patrick Koch (ASIAA), BISTRO Consortium

Hub-filament systems (HFSs) are potential sites of protocluster and massive star formation, and play a key role in mass accumulation. We report the new JCMT B-fields In STar-forming Region Observations (BISTRO) survey results toward a well-known HFS NGC 2264. The polarization map reveals an organized B-field, while the filament orientations and the projected gravitational fields all share a common prevailing orientation as the B-fields, suggesting that the evolution of this system might be regulated by magnetic fields. We further find that filaments in this system can be categorized into two types: (1) filaments perpendicular to B-field with sufficient self-gravity to accumulate nearby materials and (2) filaments parallel to B-field dominated by the global gravitational field. We propose a scenario based on the radial and longitudinal collapsing timescale to explain the origin of the two types and the possible influence of B-field.

S7.6

The JCMT BISTRO Survey: Unveiling the Magnetic Fields around Galactic Center

Meng-Zhe Yang (NTHU); Shih-Ping Lai (NTHU); Janik Karoly (University of Central Lancashire); David Eden (Armagh Observatory and Planetarium); the BISTRO team

We obtain the 450μm and 850μm dust continuum polarization observations around inner part of Central Molecular Zone (CMZ) in Milky Way, which are parts of the James Clerk Maxwell Telescope (JCMT) B-Fields In Star-Forming Region Observations (BISTRO) survey with POL-2 instrument. The directions of magnetic fields are perpendicular to the polarization orientations, while the magnetic field strength can be obtained through the Davis-Chandrasekhar-Fermi (DCF) method. The magnetic field orientation is well aligned with the filament directions of the dust material, and the overall position angle dispersion is roughly 7 degree. The average magnetic field strength is roughtly roughtly 1.7mG, and the magnetic field strength can achieve 7mG in the central region of 20km/s cloud and 50km/s cloud. We evaluate the alignment efficiency by comparing the 450μm & 850μm polarization percentage with intensity. The alignment efficiencies are 0.395 and 0.354 at 450μm and 850μm, suggesting the dust grains are well aligned.

E1.1

Astronomy Education for all (AE4ALL) under Taiwan Top Science Student Project (TTSS)

Hao-Yuan Duan 段皓元 (NCU), Wing-Huen Ip 葉永烜 (NCU), Pei-Hsin Chen 陳佩欣 (NCU)

The talk will be given in Chinese. We are running an educational project called Taiwan Top Science Student Project (台灣科學特殊人才提升計畫), TTSS, at National Central University (NCU), which is supported by the Ministry of Education. In the talk, I will introduce a series of sub-projects aimed at Astronomy Education for all (AE4ALL) under TTSS and discuss future plans. The AE4ALL includes: Astronomy for Kids (storytelling and picture drawing), an astronomy carnival festival in Taoyuan City, (online) courses for senior high school students, training camps for high school teachers, public online lectures such as exploring the starry sky in 500 seconds (instructor: Prof. Wen-Ping Chen), and night-time open houses and day-time school visits to the NCU Observatory. We are very interested in promoting these astronomical education and public outreach activities in other places in cooperation with local governments and organizations. In addition, we successfully organized a K-12 astronomy education forum last year in Chiayi City and will hold the second forum this year in Kaohsiung on November 25. We are also organizing the International Conference on 2023 K-12 Astronomy Education, which will take place at NCU from August 14 to 17, 2023. In the future, we would like to coordinate all the astronomical observation facilities of schools at different levels in Taiwan to form a working group to cultivate students' scientific interests with joint projects proposed or implemented by the schools themselves.

E1.2

社區大學天文課程實作與重大天象事件結合一以「此生必見天象遺願清單」為例

Jim Ching Chuan Hung, 洪景川台北市文山社區大學、台北市士林社區大學

臺北市文山與士林兩所社區大學為全台灣地區最早開設天文課程的終身學習社會成人教育機構。筆者任教的 「天文觀測－星空之美」課程已開班分別達 24 年與 22.5 年。Covid19 疫情嚴重期間之 2022 暑期班課程中曾以［此生必見天象攻略］為主題,探討業餘天文愛好者此生不可錯失的四大天象的所謂「遺願清單」(BUCKET LIST). 學員們普遍感到興致高昂，深感收穫豐盛。本文以社大學員 20 多年來每每提早籌備觀察「日全食」、「大彗星」、「流星暴」與「極光」等重大天象的過程與遭遇之困難及問題的解決為前提 ，分析社大學員積極籌畫、分工合作，與自主學習的天文學習體驗，探討成人天文學教育的多樣性與潛力發展。 關鍵字: 社區大學，自主學習，終身教育，重大天文事件

E1.3

模組化天文主題課程的規畫與實踐

林琦峯 (臺北市立天文科學教育館)

一個天文知識是由多重複雜概念所組成，將天文知識拆解成不同單元的基礎 概念，再依天文主題中科學概念的需求，重新整合不同的基礎概念，而後建構 一個正確的天文主題知識，最後可以透過不同類型教學方法及輔助教具，規劃 出不同模組化推廣教育方案。本研究將模組化天文主題課程，類比為積木遊戲 ，天文知識的基礎概念，就如同積木遊戲中，最基本的單元磚，單元磚的形狀 多樣且具有獨特特功能；天文主題知識是由多重複雜概念組成，就如利用各種 形狀的單元磚，依主題需求組裝成不同物件；而不同類型的模組化推廣教育方 案，就像是在操作板上，布置上同類型的物件，期望透過模組化天文主題課程 ，可以建立學習者的正確天文概念。

E1.4

「臺語天文學」：以台語進行天文教育之經驗分享

Anli Tsai (NCU)

「臺語天文學」為本學年台師大地科系新開的選修課程，以台語、台文為教學工具，傳授基礎天文知識。本課程不只訓練學生具備台語的基本聽說讀寫能力，更訓練學生能以台語吸收天文知識，並能以台語簡述天文議題。本主題將分享以台語從事天文教育的經驗以及成效給大家參考。

E1.5

我如何用 ChatGPT 協助我撰寫「天聞的資料科學」專欄文章

蘇羿豪 (Astrohackers in Taiwan)

「天聞的資料科學」專欄以臺北天文館、臺南南瀛天文館等網站的天文新聞為題材，介紹相關的開放資料及開源軟體，並引導讀者使用 Python 程式來取得、前處理、分析及視覺化這些資料。透過上述資料科學步驟，讓群眾能夠藉由動手體驗天文知識的發現過程，拉近與星空的距離。本演講將分享我如何用 ChatGPT 協助我撰寫「天聞的資料科學」專欄文章。

E1.6

Planetarium software localization in Chinese for effective teaching of astronomy

Tai-Shan CHEN, Yi-Jehng KUAN Department of Earth Sciences, National Taiwan Normal University

The popular planetarium software StellaNavigator, developed by AstroArts* in Japan using the StellaTalk language engine from the Global Planetarium Association, has been on the market for 31 years. The unique features of StellaNavigator, which combines astronomy and planetarium, include three-dimensional astronomical concept of the entire celestial sphere as realistic starry sky and full-dome animation, and spaceflight scenarios for dynamic simulations. Such an intuitive approach adopted by StellaNavigator helps teaching astronomy significantly thus achieves its objectives for more effective learning. The StellaNavigator was constantly improved and upgraded every three years; the latest release of version 12 was in March 2023. The StellaNavigator is thus a widely used astronomy teaching tool in many primary and middle schools in Taiwan. The self-narrative function while showing the starry sky was highly praised in particular. However, this highly acclaimed astronomical teaching software is only available in Japanese, which poses a major difficulty for its effective use in teaching. With a user interface in Chinese, it would be a great boon to school teachers in promoting and educating astronomy. Therefore, the localization of the StellaNavigator software becomes an urgent issue. We hence consider to create a user-friendly environment in StellaNavigator for the lecture habit of Taiwan's school teachers together with specialized astronomical terms, both in Chinese, suitable for local teaching needs and applicable to planetary and astronomy teaching in primary and middle schools. In this meeting, we will report the progress we made and the difficulties we encountered in StellaNavigator localization in Chinese. * https://www.astroarts.co.jp/

System overview and the systematic analysis of the Taiwan meteor detector system (TMDS)

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Jim Lee (Taipei Astronomical Museum, Taiwan), Hsin-Chang Chi (National Don Hwa University, Taiwan)

An overview is provided of the first systematic analysis presented by TMDS, Taiwan Meteor Detector System. This is a network of five stations from Fushoushan, Hehuan, Qingjing Farm, Kenting observatory, and Lulin observatory in Taiwan that use UFOCapture, UFOAnalyser, and UFOOrbit to capture and analyze meteor data. TMDS is intended to supplement the increasing number of observational teams worldwide using similar techniques. Many of these networks have been established to ascertain if the suspected meteor showers listed on the International Astronomical Union's Meteor Data Center exist and, if so, determine if they can be associated with known parent bodies. This paper describes the equipment used and the techniques employed to collect and analyze the data. The results from 2016 to 2022 are presented, with a specific focus given on the most spectacular meteor showers of the year (i.e. Geminids meteor shower). These meteor showers are well-characterized and were selected to verify if the results from TMDS were consistent with currently accepted parameters.

Determining the heights, velocities, and other relationships of the Perseids and Geminids events without orbital parameters using a empirical model.

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We integrated the data of Geminids in 2017 to 2022 and Perseids in 2018 to 2022. For the events without orbital parameters, we added the height term and velocity term to UFOAnalyzer by using the empirical model of velocity on altitude, and brightness on altitude given by previous studies. After that, we studied the relationship among height, speed and brightness, and finally found some association between them.

P-3

Searching Exomoon Candidates from TESS Light Curves

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In addition to monitoring known planetary systems to provide a great number of useful light curves, Transiting Exoplanet Survey Satellite (TESS) has detected many more new exoplanets. Given that many Solar system planets have moons and a few exomoon candidates were reported in literature, it is expected there could be many more exomoon candidates among these newly detected exoplanets. In order to examine this possibility, simple box-like light-curve models are used to fit the TESS light curves. Both the cases without and with exomoon are considered and compared. Through this, exomoon candidates can be identified and their properties would be studied through realistic modeling.

P-4

Machine learning in taxonomic classification of near-Earth objects according to Lulin photometric measurements

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Wing-Huen Ip(Institute of Astronomy National Central University)

A photometric investigation of near-Earth asteroids (NEAs) at Lulin Observatory has started since 2010. The early results covering the time interval from 2010 to 2014 have been reported by Lin et al. (2018). The photometric measurements are useful in taxonomic classification of the surface compositions of NEAs. The corresponding sta-tistical distribution based on the observations of 196 objects shows that the Q-type objects are almost as many as the S-type even though they are of similar composition (i.e., the ordinary chondrites). From spectroscopic measurements, it is known that the surface composition of the S-type asteroids and that of the Q-type asteroids are basically characteristic of the ordinary chondrites. The difference in the spectral fea-tures might have come from the different levels of space weathering with the surfac-es of Q-type objects being relatively younger. In this work, we explored the use of machine learning algorithms in the taxonomic classification of NEOs based on pho-tometric measurements. The study used a dataset of photometric observations from Lulin to train and test several machine learning models, including decision tree, sup-port vector machine, and logistic regression. This ML method will be applied to the photometric data of asteroidal colors to be acquired by the multi-color camera on the NCU 2m telescope in Mexico.

P-5

Investigating Transit Timing Variations of Kepler Planetary Systems

Yi-Xiu Deng (NTHU); Ing-Guey Jiang (NTHU)

The Transit Timing Variation (TTV) is known to be a useful tool for exoplanet detection, constraining planetary orbits, and studying the configuration of multi-planet systems. In order to further understand the nature of the systems observed by the Kepler Space Telescope, we model their observed TTVs through the analytic equations in Lithwick et al. (2016). The results of planetary parameters will be presented and their degeneracy will be discussed.

P-6

Magnetospheric and Exospheric Responses of Mercury to Coronal Mass Ejection Events

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Wing-Huen Ip (Graduate Institute of Astronomy, NCU; Department of Space Science & Engineering, NCU)

Being the closest planet to the Sun, Mercury's exosphere is extremely affected by solar activities. Mercury's sodium exosphere has been studied for decades. From ground-based observations, the optical emission and spatial distribution of sodium atoms around Mercury were found to be highly variable. This could be drawn by the variability of solar wind dynamic pressure and the orientation of interplanetary magnetic field (IMF) at Mercury. In Fatemi, Poppe & Barabash, 2020, it is reported that the bimodal distribution of Mercury's sodium is dominated by the x component of IMF instead of z component. It may explain the north-south asymmetry on Mercury. We simulate the Mercury's sodium exosphere with the solar wind proton precipitation data generated from Amitis simulation code, which is a three-dimensional time-dependent hybrid model of plasma (Fatemi et al., 2017; Fatemi, Poppe & Barabash, 2020). The datasets are generated based on Helios data to trace the realistic solar wind conditions at Mercury and how the Mercury's magnetosphere and sodium exosphere change with the environment. Our results show the morphology of sodium in pre-CME, CME and post-CME phase. The relative flux in northern and southern cusps is correlated with Bx. However, the total production rate is still controlled by Bz.

P-7

Perform statistical analysis on the Gemini meteor shower from 2017 to 2022 using UA2 system and study the ZHR evolution of the main activity period for each year.

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We performed a statistical analysis on the Gemini meteor shower from 2017 to 2022 using UA2, and calculated the ZHR for the three days before and after the peak period, including the peak period, using the obtained parameters. We obtained the corresponding ZHR using different methods to get the limiting magnitude, population index, and field of view correction factor. Then we compared them with each other and finally conclusion the best method for calculating ZHR.

P-8

The TANGO network of lunar Impact flash observations update

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Light flashes produced by meteoroids impacting the night side of the Moon have been identified mostly during the peak activity of several major meteor showers. Routine impact monitoring has been carried out with an automatic system at NASA Marshall Space Flight Center (MSFC) since 2006. During the first five years, they found a total of 240 impacts; on average one flash for every two hours of observation, with dramatically higher rates during meteor showers. In December 2017 and 2018, we participated for the first time in the monitoring campaign of lunar impact flashes by using two small telescopes at the Lulin Observatory during the Geminid meteor storms. Lucky, we got a few detections. In 2022, we reconstructed the observational system at Lulin observatory and set up the Taiwan Astronomical Network of Ground-based Observations (TANGO) which is a network of small telescopes located at Lulin, National Central University Observatory, Kinmen Senior High School Observatory, Kenting Astronomical Observatory plus several amateur astronomers in Taiwan. In this work, we will give an update on our monitoring system, data processing pipeline and future plan. If there is any detection of lunar impact flashes, the estimation of some physical properties will be presented.

Collisional heating and ejection of oxygen atoms and minor gas species in the Martian atmosphere

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Institute of Astronomy, National Central University)

Non-thermal escape via hot oxygen production from electron recombination dissociation of O2+ is seen as the main atmospheric loss mechanism on Mars, with significant impact on the atmosphere. These oxygen atoms interact with other atmospheric particles, such as helium and other minor species, altering their kinetic energy and distribution. It's proposed energy transfer from hot oxygen is considered the dominant mechanism driving helium escape from the Martian atmosphere. A recent study suggested that the portion of the atmosphere below the exobase contributes significantly to helium escape, with a dayside flux of (1–2) × 10^6 cm−2 s−1 (Gu et al.,2020). In this theoretical study, we investigates the collisional thermalization of hot oxygen atoms, helium, and neon at various altitudes in the neutral atmosphere through Monte Carlo simulation. This study aims to analyze the loss of hot oxygen and evaluate the potential impact on the abundance of other gases in the Martian atmosphere.

ALMA Observations of the Chemical Composition of Ceres' Exosphere

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Ceres is a dwarf planet in the asteroid belt, a relic of the early Solar system. Because Ceres is at a distance of 2.7 AU from the Sun, it is within the H2O snow line of the Solar system (Combe et al., 2016). Therefore, Ceres is able to keep water, and its upper mantle is brine rich which may erupt salty water onto the surface from impact craters (Nathues et al., 2020). Salts left on the surface, forming bright spots, are called faculae (Zolotov, 2017). The space mission of Dawn reported a probable global subsurface ocean in the upper mantle of Ceres (Nathues et al., 2020). The regional haze, which can be a potential origin of Ceres' exosphere, was discovered in the Occator crater during the daytime (Thangjam et al., 2016). Moreover, an exosphere may also be caused by sputtering due to solar wind and/or high-energy particles. In our study, we use ALMA to observe Ceres in Band 7, searching for molecules in Ceres' exosphere to determine its chemical composition, which can lead to a better understanding of the early history of our solar system.

P-11

Radiolysis effects on the Saturnian inner icy satellite Mimas

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The ice-covered surfaces of the inner moons of Saturn, Janus, Epimetheus, and Mimas, are subject to bombardment of MeV to tens of MeV protons and electrons. One famous feature is the Pac Man-like pattern on the surface of Mimas which is the result of intense irradiation by MeV-electrons. In this study, we will report on a comprehensive treatment of the global radiolysis process of these icy moons by using a numerical code taking into account the drift motion and bounce motion of energetic electrons and ions of different energies. This model can be further coupled to the satellite micro absorption effect observed by the Cassini spacecraft which is mediated by a time-dependent large-scale electric field. Finally, the thermal conductivity of the surface ice is significantly modified by the MeV electron irradiation as indicated by the Pac Man pattern. A thermal conductivity distribution model is constructed to simulate the global surface temperature distribution from which the limit to the total thermal sublimation rate (including the component generated by ion sputtering) can be estimated. We believe that this type of theoretical investigation is useful to the future search for mini-gas jets on Mimas that might exist on its surface.

P-12

A comprehensive 3D model of nano-dust electrodynamics in the heliosphere

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Li-Ping Yang (National Space Science Center, China); Wing-Huen Ip (National Central University, Taiwan)

For decades, information on the near-solar dust cloud has been acquired through not only remote-sensing observations but also the detections of high-speed nanodust impacts by spacecraft, such as Ulysses, Wind, SOHO, and more recently, the Parker Solar Probe (PSP). These nanodust impact measurements are generally believed to result from the so-called hyperbolic beta-meteoroids, which break apart from larger bodies through collision or sublimation in the near-sun region. These tiny particles can be propelled radially forward by solar radiation pressure. Moreover, when fragmented small enough, they can also be accelerated by electromagnetic forces. Note that while the brightness distribution of the near-solar dust cloud in terms of F-corona has an outer limit on its latitudinal extension to no more than 40°, the Ulysses spacecraft detected β-meteoroid impacts during its polar passage(s). Several studies suggested that the electromagnetic force in the heliosphere is the leading cause of these high heliolatitude β-meteoroids. In other words, the electrodynamics of nanodust is essential to reveal the three-dimensional (3D) trajectories of the nanodust ejected from the near solar dust cloud. With the planned near-sun approach of PSP and the high inclination orbits of the Solar Orbiter (SolO), we believe it is timely to conduct more in-depth studies of the nanodust electrodynamics in the near-sun region in preparation for more detailed analyses of the Parker Solar Probe and Solar Orbiter observations in 3D. Here we therefore present a comprehensive study of the charged nanodust behavior originating from the vicinity of the Sun, based on a 3D MHD solar-wind model by taking into account Lorentz force and solar radiation pressure acceleration General results on the 3D spatial distributions and dynamical behaviors with of tiny grains of different sizes at different phases of the solar cycle will be described.

P-13

Azimuthal-drift streaming instabilities in accreting protoplanetary disks

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The streaming instability (SI) is one of the key mechanism to form km-sized planetesimals from dust grains or pebbles, which is a critical step in the standard core accretion scenario of planet formation. By enhancing the local dust-to-gas ratio to the point of gravitational collapse, the SI can overcome the collisional and radial drift barriers to grain growth. Recent study finds that there is a new form of SI driven by the azimuthal velocity difference between dust and gas, which results from the gas undergoing accretion due to magnetic torques. This azimuthal-drift SI (AdSI) can remain effective even without a radial pressure gradient, unlike the classical SI. In this work, we extend previous simulations of the AdSI by carrying out a large parameter survey. We investigate how the dust and gas evolutions vary with dust-to-gas ratios and grain sizes. We place focus on the low dust-to-gas ratio regime, where the classical SI is weak, but the AdSI is still effective, to study whether or not the AdSI can facilitate planetesimal formation in dust-poor environments.

P-14

Forecasting the Impact of Future Twinkle Data on the Parameter Determination of Multi-Planet Systems

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Twinkle Space Telescope will monitor hundreds of planet-hosting stars during their planet transit events in order to investigate the exoplanet atmospheres and obtain high-precision transit timings. To understand how much the uncertainty of planetary masses of multi-planet systems can be narrowed down by the future Twinkle transit data, the synthetic Twinkle light curves with Gaussian photon noise are generated. The sources of error in mid-transit time derived from light-curve fitting are studied. Some known systems are employed as examples. These results will be helpful for Twinkle target selection and observation planning.

P-15

Evolution of the ZHR during the Perseids main event period

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Use the meteor data of UA2 to calculate the Zenithal Hourly Rate (ZHR) during the main event period, discuss the numerical changes of the ZHR caused by the parameters obtained by different methods, and compare with the calculation results of IMO, and finally observe the ZHR during the main event period internal evolution.

P-16

Searching for Lensing Candidates

Hsiao-Cheng Chou (NCU); Chorng-Yuan Hwang (NCU)

Strong lensing can be a powerful tool in astrophysics. To look for possible lensing objects, we investigate close binary point sources by limiting the angular separations between 2 and 15 arcsec and color differences smaller than 0.01. There are excess pair sources with similar magnitudes in both the samples obtained from Pan-STARRS and SDSS catalogs, and this suggests a possible physical correlation between these pair sources or there is a selection bias in the magnitude-limited sample. Some pairs with diffuse image or identified variable star are discussed with light curves and color-color diagrams.

P-17

Radio spectrum of the radio magnetar XTE J1810-197

Sujin Eie (ASIAA; NAOJ); Toshio Terasawa (UTokyo; NAOJ); Takuya Akahori (NAOJ; SKAO), Tomoaki Oyama (NAOJ); Tomoya Hirota (NAOJ; SOKENDAI); Yoshinori Yonekura (Ibaraki Univ.); Teruaki Enoto (Kyoto Univ.; RIKEN); Mamoru Sekido (NICT); Kazuhiro Takefuji (JAXA; NICT); Hiroaki Misawa (Tohoku Univ.); Fuminori Tsuchiya (Tohoku Univ.); Shota Kisaka (Hiroshima Univ.); Takahiro Aoki (Yamaguchi Univ.); and Mareki Honma (NAOJ; UTokyo; SOKENDAI)

Radio magnetars are only a few examples of evidence that magnetars can emit standard radio pulses. However, their intermittency in emission hinders correlated radio observations at multi-frequency and a better understanding of their radio pulsations in a wide band. Among them, XTE J1810-197 was revived in the radio band in late December 2018. We conducted multi-frequency observations at 0.3 - 22 GHz of the magnetar quasi-simultaneously using radio telescopes located in Japan. Even though there were strong daily fluctuations in intensity, our wide-band spectra, when collated with flux densities in the literature, suggest that XTE J1810-197 may possess a time-variant bimodal spectral feature in the frequency range between 0.3 GHz to 260 GHz. The double-peaked spectra have also been suggested from two other radio magnetars (Chu et al. 2021), which may imply that magnetars require two or more different emission mechanisms to understand their radio behavior. Only simultaneous observations can confirm the puzzling spectral features of radio magnetars; therefore, we emphasize the importance of fast follow-up, simultaneous broad-band observations of future radio outbursts from magnetars.

P-18

Giant pulses of the Crab pulsar at dual radio frequencies

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The Crab pulsar is one of the best sources for studying giant pulses of radio pulsars. In this study, we investigate giant pulses from the Crab pulsar at frequencies of 2.3 GHz and 8.4 GHz through ~98-hr observations using Usuda 64-m and Kashima 34-m telescopes located in Japan. Our findings include significant numbers of giant pulses at different phases and frequencies, with negative spectral indices observed across the frequency range. Both the main pulses and interpulses at 2.3 and 8.4 GHz have power-law intensity distributions that are consistent with earlier studies. However, the power-law slopes of the intensity distributions are different between the main pulse and the interpulse at 8.4 GHz. Given that the interpulses at 8.4 GHz are mostly high-frequency interpulses, our results suggest the presence of a potential different emission mechanism for interpulses at different phases. Lastly, we present our preliminary results on the comparison of spectral indices and pulse luminosity for giant pulses, magnetar radio pulses, and fast radio bursts.

P-19

Deriving the gri-band Period-Luminosity Relation for Anomalous Cepheids

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We derive the gri-band period-luminosity (PL) relations for field anomalous Cepheids using light curves from Zwicky Transient Facility (ZTF) and parallax measurements based on Gaia DR3. We first derived the pulsation periods of our sample of anomalous Cepheids from the ZTF light curves, then we estimated the mean magnitudes from fitting the low-order Fourier expansion to the ZTF light curves. Our derived gri-band PL relations could be applied in the era of Vera C. Rubin Observatory's Legacy Survey of Space and Time (LSST) to dwarf galaxies hosting anonymous Cepheids.

P-20

Flare and Chromospheric Activity of Low-mass Stars and Binaries

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Stellar flare activity plays an important role in the habitability of planets. Previous studies proposed that the star-star or star-planet interaction cause the chromospheric and flare activities on the exoplanet host stars. However, Maehara et al. (2012) and Shibiyama et al. (2013) didn’t find exoplanet transiting features in the solar type flare stars’ lightcurves in Kepler observation. To exam if there are star-planet magnetic interaction causing chromospheric activity and flare events, we selected 4,199 G and K type stars and binaries. With the low-medium resolution spectra obtained from LAMOST and LISA onboard Lulin One-meter Telescope, we measure their chromospheic activity using H-alpha emission level and identify their flare and photospheric activity with Kepler or TESS lightcurves. In this work we find that exoplanet host stars have similar chromospheric active level with the non-flaring stars. It shows that exoplanet host stars are magnetically inactive, and this result agrees with Maehara’s and Shibiyama’s results.

A novel search for young stellar and substellar objects in Perseus star-forming regions: IC 348 and Barnard 5

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Brown dwarfs, with masses < 0.08 Msun, fill in the gap in mass between low-mass stars and giant planets. Brown dwarfs and planet-mass objects, having no sustainable nuclear fusion reactions, are relatively bright and warm at birth, thereby readily detectable in star-forming regions or young clusters. These substellar objects are also vital tracers of star formation versus planet formation and serve as key analogues to exoplanets around stars. We have applied the technique of on-off imaging of the 1.45 µm H2O absorption band seen in typical spectra from late M to L, T, and Y-type objects to identify the substellar population in IC348 and B5 (LDN-1471), both located at the eastern edge of the Perseus cloud complex at a distance of 300 pc and 350 pc, respectively. IC348 (~3 Myr old) comprises 478 cluster members with the most massive star being a B5 star. Barnard 5 is also known to have ongoing star formation, harboring a group of protostars, fragmenting cloud filaments, and Herbig-Haro objects; however, its low-mass membership is much unexploited. The 1.45 µm imaging together with J and H photometry renders a reliable way to select water-bearing objects relatively free of reddening. We report the first discovery of brown dwarf members in Barnard 5 and use complementary data from WISE, 2MASS, and Pan-STARRS to look for possible young stellar members. Analyzed by Gaia DR3 parallaxes and kinematics of the cloud members across the Perseus region, we propose the star formation scenario of the complex under influence of the nearby OB association.

Primordial globular cluster formation models could explain globular cluster number – halo mass relation

Minh Ngoc Le (Institute of Astronomy, NTHU), Andrew P. Cooper (Institute of Astronomy, NTHU)

The initial conditions that give rise to Globular Clusters (GCs) are still mysterious. Significant progress has been made in the last decade: a clear correlation has been found between the total number (or mass) of GCs in a galaxy and the mass of its host dark matter halo, which appears to hold over many decades in halo mass and so provides an important constraint on models; meanwhile, detailed hydrodynamical models of GC populations in a cosmological context have shown that substantial fraction may have formed in the turbulent ISM of massive, gas-rich galaxies at $1 < z < 4$. However, a subdominant population of primordial GCs may also have formed as `nuclear clusters' in low-mass dark matter halos, before the epoch of reionization. If primordial clusters exist, their cosmic abundance may be a useful probe of the earliest epoch of galaxy formation, and hence of cosmology (as first suggested by Peebles in 1984 \cite{Peebles1984}). In this work, we apply parameterized models of primordial GC formation to Extended Press-Schechter merger trees and attempt to constrain their allowed parameter space through statistical comparison to the observed relation between cluster number and halo mass. A novel feature of our work is a new version of the halo mass relation, derived by extrapolating the trend of cluster counts with stellar mass (based on a currently small sample of deep cluster counts for individual galaxies) to large galaxy group catalogs. We explore several straightforward models in CDM and WDM cosmogonies. We will report our work in progress on this approach, which can be extended to more complex GC formation scenarios in the future.

Getting Old with Most Siblings: Unusually Aged but Populous Open Cluster NGC 6819

Chia-Ching Lin (National Central University); Wen-Ping Chen (National Central University);
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Members in a star cluster form coevally from the same molecular cloud, thereby sharing the same distance, chemical composition, and evolutionary history. Star clusters at different ages hence serve as testbeds for stellar evolution for different masses. Soon upon emergence from the cloud, an open cluster continues to experience disintegration, by internal relaxation to “evaporate” the least-massive members at the time, and by external tidal stripping. The open clusters we see today must be the survivors. We combined two Galactic open clusters catalogs with the properties derived from Gaia data to present the Galactocentric positions. After the qualitative analysis of the influence of Galaxy disk, we figured out that some of the old survival clusters with the abundant number of members are away from the Galactic plane, with an average vertical height larger than 500 pc. Here we present the characterization of such an unusual system, the Galactic open cluster NGC 6819, which has an age rivaling to those of globular clusters, yet is metal rich and hosts thousands of members. Using the latest Gaia DR3 data, we determined the cluster having the stellar surface density center at (295.323±0.002, 40.186±0.002), with a radius of 17.8±0.5 arcmin. After subtracting the density of field stars, a total of 3551±90 member candidates are accounted for. The proper motion candidates, centering at (-2.92±0.01, -3.87±0.01) mas/year within 0.5 mas/year, suggest an average parallax of 0.37 mas (or a reciprocal distance of 2.6 kpc), which is consistent with the main-sequence fitting of 2.4 kpc, but defies the mean distance of 1.3 kpc to 1.6 kpc listed in the Gaia data, indicating a significant statistical bias. Isochrone fitting to the post-main sequence track indicates an age of 2.9 Gyr, and we will derive the mass function to shed light on the possible nature of this elusive star cluster.

Exploring flare temperature in M dwarfs based on the simultaneous spectroscopic and photometric observations

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Flare temperature is an essential parameter used to estimate the bolometric energies of flares in M dwarfs, which in turn has a direct impact on the habitability of terrestrial exoplanets. An empirical value of 9,000 K has been commonly used in literature over the last decade to estimate the energy of flares in low-mass stars. However, in recent years, it has been found that the temperature of flares in low-mass stars can vary significantly from a few thousand Kelvin to as high as 40,000 K, as determined by simultaneous observations with two bands in optical wavelength. It may depend on the energy level of the flare, the sub-spectral type of stars, or more. To better understand the temperature of flares and their relationship with various stellar parameters, simultaneous multiband observation is an effective approach. For instance, we conducted simultaneous optical spectroscopic plus U- band photometric observation for Wolf 359, an M5 low-mass star, which gave a temperature of 7300 K for a flare. Similarly, the multiband (sdss-g, -r, -I, and -z) observation of Trappist-1 carried out by Mass et al. also determined a lower-than-expected temperature of around 8000 K for two flares. These suggest that flare temperature in late—type M dwarfs may be generally lower than the empirical values. Nevertheless, a large dataset of simultaneous multiband observation is necessary. The collaboration between ET-2.0 and LAMOST may present a good opportunity to obtain such a dataset and significantly contribute to our understanding of space weather and exo-solar system habitability. By combining the observational capabilities of these two telescopes, we can capture the wide range of wavelengths needed to study flares in detail, from the U-band to the NIR. Expanding the wavelength coverage to the ultraviolet (UV) range would also provide valuable information about the behavior of flares, as UV observations are sensitive to the highest temperatures reached during a flare. We are looking for collaboration between observatories with UV capabilities to obtain such observations, as the lack of such collaboration remains a challenge.

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A Study of Open Cluster Berkeley 27 Using Gaia Data

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We study open cluster Berkeley 27 using Gaia data. Making use of the high precision of Gaia proper motions, we determined membership probability of stars in the regions of the studied cluster. The membership catalogues could successfully decontaminate cluster stars from field stars. The most likely cluster members were then used to determine parameters such as radius, distance, age and metallicity etc for the Berkeley 27. Furthermore, Galactic orbit for the studied star cluster was also determined, which helps to understand the kinematics of the Galactic disk.

P-26

Searching for the Youngest Hot Jupiters Around T Tauri Stars – Tracing Spot Variability Using OH/Fe Lines

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The best way to understand planet formation is to look for planets still forming. Planetary systems that host hot jupiters are especially intriguing because of hot jupiters' large sizes and peculiar short orbital periods. Moreover, the formation history of hot jupiters is vital to the development of habitable worlds. Searching for hot jupiters around pre-main sequence stars using the radial velocity (RV) method, however, is challenging because of the strong stellar activity of the host star. Large cool spots (as large as 80% of the visible disk) can overwhelm and mimic RV induced by planets. The Gaussian Process Regression (GPR) technique has been used widely to isolate the RV signal produced by the stellar activity; however, prior knowledge of the stellar rotation period, spot(s) lifetime, and spot(s) variability period is essential for GPR to model the activity signal properly. Knowing these stellar properties is even more critical for applying GPR to young stellar systems where the RV signal from the extreme stellar activity can be several times larger than the planet. Here, we present the results of a new way to trace spot variability on T Tauri stars' (TTSs') surface using the OH/Fe line depth ratio. We found that the short-term Teff variation (in one rotation period) can be as large as 100 K for the Weak-line TTS and 200 K for the Classical-TTS. As for the long-term (seasonal) variation, on average is about a 50 K difference. We will also present a simulation model to reproduce the observed periodicity in the line depth ratio and the radial velocity.

Searching for Diffuse Interstellar Bands Outside

Chih-Yuan Chang (Department of Physics, National Taiwan University);
Ting-Wen Lan (Department of Physics & Institute of Astrophysics, National Taiwan University)

Diffuse interstellar bands (DIBs) are weak absorption features found ubiquitously in the interstellar medium (ISM) of the Milky Way. While DIBs have been detected for over a century, the carriers of most DIBs remain unidentified. To better understand the nature of DIBs, one can explore the properties of DIBs in various environments. In this talk, I will present the results of probing DIBs in low-density regions outside of galaxies, i.e. the circumgalactic medium (CGM). I will show that by combining tens of thousands of individual SDSS spectra with detected metal absorption lines that trace the intervening CGM, we can obtain composite spectra with S/N>1000 and search for weak DIB absorption line features with fluctuations at the 10^-3 level. Finally, I will present our findings, compare the DIB signals in the CGM with the expected signals based on the properties of DIBs in the ISM, and discuss the implications of the results.

Mapping the 3D gas distribution of the Milky Way

Bo-An Chen (Department of Physics, National Taiwan University);
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Our Milky Way is a unique laboratory for exploring the flows of gas from the local interstellar medium (ISM) into the circumgalactic medium (CGM). A line of sight of an extragalactic source, such as a quasar, will intercept the Milky Way ISM and CGM and therefore the absorption line features will contain gas information of the two components simultaneously. However, it has been challenging to separate these two components due to the fact that a non-negligible fraction of the ISM and CGM has similar velocities and their gas absorption features are often blended in the velocity space. To overcome this limitation, we are developing a new method utilizing all the spectroscopic measurements of sources, including stars and quasars, along a line of sights as background for probing the ISM and CGM gas absorption. These sources are at different distances from us and therefore one can utilize the distance information to differentiate the location of the gas giving rise to the observed absorption lines. In this poster, I will present preliminary results obtained by applying this method to the spectroscopic dataset from the Sloan Digital Sky Survey (SDSS) and show that after removing the intrinsic stellar features with machine learning techniques, one can reveal the 3D gas distribution of our Milky Way with this proposed method.

P-29

Compact Disc Galaxies with High Surface Brightness in the Sloan Digital Sky Survey

Cheng-Yu Chen (Graduated Institute of Astronomy, National Central University);
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We detected high-surface-brightness compact disk galaxies (CDGs) from the Sloan Digital Sky Survey (SDSS) data and analyzed their surface profiles, comparing them to those of normal-sized disk galaxies (NDGs). The CDGs were found to have higher central brightness and older stellar age than the NDGs. In addition, the brightness profiles of the CDGs fit a Sérsic model with n = 2.11, while the NDGs fit an exponential profile. These results suggest that the CDGs and NDGs have different structures and stellar populations. We propose that the CDGs are ancient galaxies in the quenching phase following an initial central starburst.

P-30

Harvesting the Lyman alpha forest with convolutional neural networks

Ting-Yun Cheng (Durham University); Ryan Cooke (Durham University); Gwen Rudie (Carnegie Observatory)

Lyman alpha (Lyα) forest is a collection of neutral hydrogen absorption lines on a quasar spectrum. Specifically, the Lyα absorbers with low HI column density (NHI<1017 cm-2) provide important probe of the distribution of baryonic matters and the thermal state of the low-density intergalactic medium (IGM). Despite the challenges due to the contamination of metal lines and other Lyman series lines within the Lyα forest, this work, for the first time, successfully perform an automated identification and characterisation of these low HI density absorbers from a quasar spectrum using convolutional neural networks (CNNs). Our pipeline correctly classifies 78% Lyα absorbers with NHI<1017 cm-2 from 15 spectra observed by the High Resolution Echelle Spectrometer (HIRES) on the Keck I observatory, and extract their physical properties, including the redshift, Doppler width, and HI column density (validated with the catalogue built by Rudie et al. 2012). Compared to the laborious task of the Voigt profile fitting, our pipeline produce results in a matter of minutes; this opens up the possibility to analyse hundreds of high spectral resolution quasar observations in data archives, and study the properties of the IGM in much greater detail than has hitherto been possible. As one of the follow-up projects, we have constructed catalogues of low HI column density Lyα absorbers from hundreds of high-resolution quasar spectra in the archive data such as KODIAQ/Keck-HIRES and SQUAD/VLT-UVES.

Tracing the kpc-scale CO-to-H2 Conversion Factor with Dust in Galaxy Centers

I-Da Chiang (ASIAA); Karin M. Sandstrom (UCSD); z0MGS Collaboration

The Low-J CO emission lines are the primary tracer for molecular gas in extragalactic studies. Our understanding of how observed CO converts to molecular gas mass, i.e. the CO-to-H2 conversion factor, has become the factor that limits our ability to precisely study molecular ISM and star formation. We measure the CO-to-H2 conversion factor in the ISM of 30 nearby galaxies at 2 kpc resolution. We use dust as a tracer for total gas mass, assuming a constant dust-to-metals ratio (D/M). We found that the CO-to-H2 conversion factor scales with the stellar mass surface density as a power law in the high-surface-density regime. The power-law index is approximately -0.5, and it is invariant of assumed D/M and perturbation of the samples. Our observations imply that at high surface densities in galaxy centers, the support of external pressure on molecular clouds can cause increased line widths and more CO emission escape, or the molecular gas is more widespread than isolated clouds, leading to CO velocity dispersion reflecting the gravitational potential.

Finding dusty AGNs from the JWST CEERS survey with mid infrared photometry

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Active galactic nuclei (AGNs) are one of the most intriguing and challenging phenomena in modern astronomy. The nature of the interaction between AGNs and their host galaxies remains an unsolved question. Therefore, conducting an AGN census is crucial to AGN research. However, many AGNs are obscured by their environment, which can block UV and optical observations due to the dusty torus surrounding the central supermassive black hole (SMBH). To overcome this challenge, mid-infrared (IR) surveys have emerged as a valuable tool for identifying obscured AGNs, as the obscured light is re-emitted in this range. In this work, we investigate AGN candidates in the Cosmic Evolution Early Release Science (CEERS) fields selected by the SED models from CIGALE. We report the relationships between the AGN luminosity contribution and AGN number fraction with redshift and total infrared luminosity, respectively. Our findings show that both the AGN luminosity contribution and AGN number fraction exhibit increasing trends as a function of redshift in certain total IR luminosity bins. Furthermore, with the high sensitivity of the James Webb Space Telescope (JWST), we extend the previous results on ULIRGs in Wang et al. (2020) to less luminous AGNs.

P-33

Leaving no branches behind: An accurate model for predicting galaxy properties from full sets of merger trees of host dark matter halos

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Galaxies have played a key role in our endeavor to understand how structure formation proceeds in the Universe. For any precision study of cosmology or galaxy formation, there is a strong demand for huge sets of realistic mock galaxy catalogs. For such a daunting task, methods that can produce a direct mapping between dark matter halos and galaxies are strongly preferred, as producing mocks from full-fledged hydrodynamical simulations or semi-analytical models (SAMs) is way more expansive. Here we present a Graph Neural Network (GNN)-based model that can accurately predict key properties of galaxies such as stellar mass, g-r color, star formation rate, gas mass, stellar metallicity, and gas metallicity, purely from dark matter properties extracted from halos along the full assembly history (i.e., the merger trees) of the galaxies. Tests based on the IllustrisTNG300 simulation show that our model can recover the key galactic properties to high accuracy, over a wide redshift range (z=0-2), for all galaxies and their progenitors.

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Classifying MaNGA Velocity Dispersion Profiles by Machine Learning

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We present a machine learning (ML)-based classification of velocity dispersion (VD) profiles for elliptical galaxies in the Mapping Nearby Galaxies at Apache Point Observatory (MaNGA) survey. Previous studies employing ML to classify spectral data of galaxies have provided valuable insights into galaxy formation and evolution. In the literature, elliptical galaxies typically exhibit declining one-dimensional VD profiles, whereas brightest cluster galaxies (BCGs) surprisingly demonstrate flat VD profiles. We investigate the kinematics of 2,624 MaNGA samples using integral field spectroscopy (IFS) by classifying their one-dimensional VD profiles. Our study utilizes 1,266 MaNGA DR15 elliptical VD profiles and applies a combination of unsupervised and supervised learning methods. The unsupervised k-means algorithm classifies the VD profiles into four categories based on the shape of the one-dimensional profile: flat, decline, ascend, and irregular. We then train a supervised ensemble of bagged decision trees classifier (TreeBagger) using visual tags. The TreeBagger classifier achieves 100% accuracy on the training set and 88% accuracy on the test set. The flat VD profiles identified in our analysis can potentially serve as BCG candidates, warranting further investigation in the context of galaxy formation and evolution.

The relationship between acceleration and rotation speed variations in spiral galaxies

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We explore the existence of a transition radius (and its properties) of the rotation curve of different spiral galaxies. The anticipated transition radius is a characteristic radius as presenting flat rotational curve which occurs where local baryonic radial acceleration approximates the fundamental acceleration scale. In elliptical galaxies, a tight correlation has been discovered between the transition radius and the velocity dispersion. However, it is not clear for such a correlation evidenced in spiral galaxies in the literature. Wherefore we select spiral galaxies such as 175 disk galaxies with high-quality rotation curve from Spitzer Photometry & Accurate Rotation Curves (SPARC) database is catalogued as different groups between the observational and the baryonic acceleration. We choose the transition radius of every galaxy and then test its relationship between two radial accelerations, rotation velocity, and other measured quantities. We find that the relationship shows generic features like the radial acceleration relation over most galaxies of different groups.

P-36

Large Sample Studies of Broad-band Spectral Energy Distribution of Blazars

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Blazars have been studied from low to high energy windows for several decades. However, many questions regarding their nature and physics remain unanswered. One effective way to gain a comprehensive understanding of blazars is through the use of multi-frequency data, which combines observational data from radio, optical, infrared, ultraviolet, X-ray to γ-ray wavelengths. In our study, we used blazar sources from the 5-th edition Roma-BZCAT Multifrequency Catalog of Blazars (Roma-BZCAT, Massaro et al. 2015) and multi-frequency archival data to perform spectral anergy distribution (SED) study. There are 1255 blazars, including 227 BL Lac objects and 1028 flat spectrum radio quasars; totally 1012 sources have redshift measurements. We used “agnpy” (Nigro et al., 2022), an open-source python numerical SED modeling package, to fit the broad-band SEDs of these sources. We set electron normalization constant, variability timescale, Doppler factor, and magnetic field strength (B) as free parameters. By performing the statistics of these fitting parameters, we can compare the difference between BL Lac objects, low-z FSRQs, and high-z FSRQs.

The HI gas properties in the host galaxy of non-repeating FRB 190714 with the MeerKAT radio telescope

Tzu-Yin Hsu (NTHU), Tetsuya Hashimoto (NCHU), James. O. Chinbueze (NWU),
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Fast radio bursts (FRB) are mysterious, enigmatic, millisecond time-scale transients with large dispersion measures. To shed light on their origin, it is important to understand the environments of their host galaxies and identify any distinct physical properties that may constrain the possible progenitors of FRBs. Previous studies have mainly focused on the stellar components of host galaxies based on optical observations, but no definitive properties have been found for both non-repeating and repeating FRBs. To address this, we investigate the significance of HI gas, which is free of dust extinction, as one of the primary fuels for star formation, offering a crucial link to the recent star-formation history of galaxies and possible links to progenitor formation. In this work, we analyze the HI gas properties of the host galaxy of non-repeating FRB 190714A at z = 0.2365 with the MeerKAT radio telescope, comparing the atomic gas mass as a function of star formation rate and stellar mass of the host galaxy of FRB 190714A with three other repeating FRB hosts with HI detection.

A new measurement of the Hubble constant with fast radio bursts

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The Hubble-Lemaitre law is the relationship between the recession velocities of galaxies and their distances, describing the expansion speed of the Universe, i.e., the Hubble constant. Recent studies suggest more than 4 sigma tension between the Hubble constants derived by different methods, making the Hubble-Lemaitre law still one of the main foci in astronomy. Fast radio bursts (FRBs) are short-duration transients in radio. Their unique observable, dispersion measure (DM), can be used as a distance indicator by subtracting a DM component in an FRB host galaxy (DM_host) and DM in the Milky Way from the observed DM. Therefore, FRBs provide us with unique measurements of the Hubble constant by combining with the recession velocities, i.e., redshifts of FRB host galaxies. However, DM_host includes significant uncertainty due to the poor understanding of FRB host galaxies so far. In this presentation, I review our new method to use the pulse-broadening effect, so-called scattering (see Tsung-Ching Yang's presentation for the details). Scattering most likely happens in FRB host galaxies. Therefore, it provides additional information on the plasma state in FRB host galaxies, which allows better estimates of DM_host and the Hubble constant. We note that Tsung-Ching Yang will focus on the details of the new methodology, and I will focus on the latest measurement of the Hubble constant using all available FRB host galaxies identified so far. Abstract (end): In modern astronomy, this is the so-called Hubble-LemaîtreHubble's law, and the expansion speed is parameterized as a Hubble constant in units o km s-1 Mpc-1.And from now on, the Hubble constant is the very important thing to calculate or infer, so that the method to know the Hubble constant is also essential mission. Fast radio bursts(FRBs) are transient radio pulse, and its duration is about a millisecond to 3 seconds.DM_cosmic is also called DM_IGM, it means integrated column density of free electrons between an observer and a pulsar.Using it could constrain the Hubble constant by the integrated mathematic formula. (Zhou et al. 2014) Scattering time is also called scattering tail.The tau (scattering time) caused by multi-propagate of FRBs in plasma, and make the FRB pulse to be broaden.Using tau could presume the DM_host(the disper measure of host galaxy).And under the premise of knowing DM from milky way, the result could be get by the minus DM_host, DM_mw from the observation of DM.So, we could use the newly calculated number of DM_IGM to constrain the Hubble constant.

Supernovae Ia Data Miner

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Type Ia supernovae (SNe Ia) are one of the best cosmological distance indicators after applying the relation of luminosity and light-curve shapes (Phillips 1993) – slower declined SNe Ia are more luminous than faster decliners. However, light curve shape alone cannot fully explain the diversities of SNe Ia. Their spectra also present apparent heterogeneities. In our previous work (Lee et al. 2023), we focused on studying the SN ejecta velocity via Si II λ6355 line (V_Si II) and analyzed their properties with both low-redshift (low-z) and high-redshift (high-z) samples. The distribution reveals two V_Si II groups and this bimodality reveals the possibility that SNe Ia may have different populations originated from different mechanisms and evolve through different paths under different environments. In order to further study the SN Ia populations and their evolution, we propose a SN Ia Data Miner (SIAM), with a Provider-Worker-Goal infrastructure (as illustrated in Figure 1), to study the physics of SN Ia. The objective in this proposed work is to provide model distributions, sub-types, and an eigenset for investigating the SN Ia homogeneity, through processing various spectral/photometric features using statistical and machine learning techniques, to understand the explosion mechanisms of SNe Ia and their application in cosmology.

Why do galaxies rejuvenate? A view from gas-phase metallicity.

Ting-Xuan Li (NTU); Po-Feng Wu (NTU)

It is believed that galaxies evolve from star-forming galaxies to quiescent galaxies, as the evolution of galaxies, the star-formation rate (SFR) changes from high to low. However, very few galaxies were observed to evolve from low SFR to high SFR. We want to explore where the “rejuvenated” gas comes from, inside the galaxy or the intergalactic space. We use the SDSS DR17 MaNGA data, which uses integral field unit (IFU) spectroscopy to observe ~10000 nearby galaxies and obtain the spatially-resolved spectra for each galaxies. We select the rejuvenated galaxies from absorption features that are sensitive to recent star-formation histories. Then, we use BPT diagrams to ensure these spaxels (spatial are actually star-forming regions. We have identified 39 rejuvenated galaxies. Among them, 22 are single galaxies and 17 are merging galaxies. The high proportion of merging galaxies suggests that the rejuvenation may be driven by the gravitational interaction. We compare the spatial-resolved metallicity in the rejuvenated regions with that of non-rejuvenated regions within the same galaxy, then we see there’s no significant difference in the metallicity between these. That might mean that the rejuvenated gas is from the galaxy itself, not from the intergalactic space. The integrated metallicity also shows no significant tendency for rejuvenated galaxies and non-rejuvenated galaxies.

Finding galaxies with accurate redshifts in the Siena Galaxy Catalog

Li-Wen Liao (NTHU); Andrew Cooper (NTHU)

Dwarf galaxies, galaxies with low mass or low luminosity, are believed to be the most abundant galaxies in the universe. Studying dwarf galaxies could help us understand the baryonic process in galaxy formation, such as the star formation process and feedback of stars and supernovae. However, due to their low surface brightness, dwarf galaxies are hard to observe. Thanks to the recent large photometric sky survey, such as the Sloan Digital Sky Survey (SDSS) and the DESI Legacy Imaging Survey (LS), we now have more dwarf galaxy candidates. Now, the new challenge is finding dwarf galaxies in these surveys. Therefore, we start from the Siena Galaxy Atlas (SGA) catalog in LS, which selects galaxies with large effective radii, to search for dwarf galaxies. The first step is to find the redshift of these galaxies. With the redshift information, we can further compute the absolute magnitude of the galaxies which meet the requirements of dwarf galaxies. This poster will focus on the method we used to find galaxies with fairly accurate redshift and the resultant catalog.

Polycyclic aromatic hydrocarbon (PAH) luminous galaxies in JWST ERO data

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With the advent of the state-of-the-art, James Webb Space Telescope (JWST), infrared (IR) galaxies that were too faint to be detected by previous space telescopes (e.g., AKARI and Spitzer) are now being observed. Much larger primary mirror (6.5m) and highly improved (∼100 times better) sensitivity of JWST enable us to detect very faint IR galaxies that have prominent polycyclic aromatic hydrocarbon (PAH) features in the mid-IR wavelengths. Polycyclic aromatic hydrocarbon (PAH) is a valuable tracer of star formation and dust properties in the mid-infrared wavelength. The JWST Cosmic Evolution Early Release Science (CEERS) fields provide us with wavelength coverage from 7.7 to 21 um using six photometry bands of the mid-infrared instrument (MIRI). Using the JWST multi-band photometry catalogue we created, we identify galaxies whose mid-IR emission is dominated by PAHs, i.e., PAH galaxies. We selected 10 PAH galaxies with high flux ratios in 15-to-10 um of > 8. Our SED fitting analysis indicates that they are star-forming galaxies with total IR luminosities of 10^10 ~ 10^11.5 L_(sun) at z~1, ten times fainter than previous IR telescopes can detect. Our result demonstrates that JWST can detect PAH emissions from normal star-forming galaxies at z ∼ 1, in addition to LIRGs/ULIRGs.

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The elephant in the room: Why are dusty star-forming galaxies dusty at cosmic noon?

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Modern infrared observing facilities are now capable of finding dusty star-forming galaxies (DSFGs) up to z~4, forming stars at a rate comparable to that of typical star-forming galaxies, defined as galaxies located on the star-formation rate - stellar mass main sequence. However, why dusty galaxies are dusty is one outstanding question in galaxy formation theory that is so far unresolved. We tackle this problem by investigating DSFGs uncovered by our ultra-deep SCUBA-2 450 micron survey (STUDIES) and exploiting the rich ancillary multi-wavelength data available in the COSMOS field. In particular, we used spectroscopic data taken by Keck/MOSFIRE and VLT/KMOS and measured gas-phase metallicity via strong optical emission lines on our DSFG sample. We also make the same measurement on a control sample of galaxies matched to our DSFGs in sample size, redshift, stellar mass, and star-formation rate. Via this experiment we find that DSFGs are indeed higher in gas-phase metallicity, suggesting that faster or more efficient dust grain growth is responsible for DSFGs being dusty. Intriguingly, we also find that compared to the control sample DSFGs are on average shifted toward the AGN part in the BPT diagnostic diagram, suggesting that the infrared luminosity of DSFGs may be partly contributed by AGN heating, instead of all coming from star-forming regions as typically assumed.

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Tracing the Evolution of Gas and Star Formation Properties along the Offset from the Star-forming Main Sequence

Hsi-An Pan (TKU), Lihwai Lin (ASIAA), Sara Ellison (UVic), Mallory Thorp (University of Bonn), Sebastian Sanchez (UNAM), Asa Bluck (FIU), William Baker (University of Cambridge), and Joanna Piotrowska (University of Cambridge)

Quenching of star formation is one of the key drivers of galaxy evolution. We use 34 galaxies selected from the ALMaQUEST survey to study the change of gas and star formation properties as galaxies moving away from the star-forming main sequence toward the passive regime. Our spatially-resolved analysis shows that the radial profiles of local SFR (ΣsSFR), molecular gas fraction (fgas), and star formation efficiency (SFE) show a clear ranking with the distance to he star-forming main sequence at all the galactic radii we explored, suggesting that star formation quenching is a global phenomenon. As the molecular gas and star formation continuously vary when galaxies moving away from the main sequence, the appearance of the corresponding scalling relations of galaxies change gradually. In addition, our integrated analysis favors a scenario that the lower fgas toward lower-global-sSFR galaxies is a result of decreases in both molecular and atomic gas mass rather than a significant change in molecular-to-atomic gas mass ratio. Finally, we find that the reduce of star formation in the ALMaQUEST sample may be driven by secular (e.g., bar formation) and environmental processes. There is no obvious correlation between the presence of AGN and star formation activity in our sample, but the role of AGN feedback cannot be ruled out completely yet.

Submillimeter Extragalactic Background Light Resolved by SCUBA-2 with Galaxy Cluster Lensing

Qi-Ning, Hsu (NTU); Chian-Chou, Chen (ASIAA)

The extragalactic background light (EBL) is the cumulative radiation outside the Milky Way and plays a crucial role in understanding the cosmic history of star formation and black hole accretion. However, the origin of the EBL at submillimeter wavelengths, particularly close to the peak of the cosmic infrared background, remains uncertain. To investigate this, we conduct a study to determine the origin of the 450 micron EBL using SCUBA-2 observations in 10 massive galaxy cluster fields. The strong gravitational lensing provided by these clusters enables us to construct ultra-deep number counts that are over five times deeper than those obtained from blank fields. By carefully accounting for possible systematics, we obtain significant counts down to ~0.3mJy. Comparing our measurements to those made by the COBE satellite, we found that at this flux density level, the 450 micron EBL is entirely resolved. Therefore, we have found the first evidence that discrete sources, likely of extragalactic origin, contribute fully to the 450 micron EBL, and that about half of it comes from sources with sub-mJy flux densities. Our results provide valuable insights into galaxy formation theory and demonstrate the usefulness of galaxy number counts as a tool for studying the origin of EBL.

Molecular distribution in the central region of M87

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The central molecular gas of M87, a nearby giant elliptical galaxy has been observed by Atacama Large Millimeter and sub millimeter array (ALMA) several times to observe and resolve the CO (J=1-0), CO (J=2-1) and CO (J=3-2). We present ALMA CO(1-0), CO(2-1), CO(3-2) and HCO+(1-0) observation of M87 circumnuclear molecular gas which shows faint molecular absorption features towards it nucleus indicating the existence of cold molecular clouds/gas which were used to make image cube at a velocity resolution of 30km/s. We show the molecular distribution in the central region of M87. The absorption feature of CO (J=2-1) occurs at a velocity ~ 1200 km/s. These clouds are moving with very high velocity and have apparent motion in the range of 400 km/s to 2000 km/s relative to the central super massive black hole which has a systemic velocity of ~ 1290 km/s. The optical depth was found to be approximately 0.401 +/- 0.002 for the absorption feature centered at 1152 km/s for CO(1-0). CO (J=2-1) optical depth was found to be 0.45 +/- 0.03. We estimate an excitation temperature of about 6.5 +/-0.03K. Assuming a temperature of 6.5 K we estimated a CO column density of 2.8 x 10^15 cm^-2 and a corresponding H2 column density of about 0.3 x 10^20 cm^-2. We also find signs of CO emission in the direction of Jet, we find the gas mass from the emission observed in the central area and the jet direction, which was found to be ~ 10^8 , 2.2 x 10^6 and 5.7 x 10^6 respectively.

Investigating constraints on the maximum boundaries of Kaluza-Klein particles as potential cold dark matter candidates in the galaxy clusters

Zuhairini Rizqiyah (National Central University); Chorng-Yuan Hwang(National Central University)

This study calculates the radio flux density from dark matter annihilations in galaxy clusters. The research assumes that the dark matter in these clusters is composed of Kaluza-Klein particles (KKDM). KKDM refers to particles moving in the universal extra dimensions and is one of the cold dark matter candidates. Self-annihilation of KKDM could result in relativistic electron-positron pairs, which can generate significant synchrotron radio emission in galaxy cluster with high magnetic field. To set the upper limit constraints on these diffuse radio emissions, we analyzed the flux density in channels producing high particle pairs, such as e+e-, mu+mu-, and t+t-. The study found that a rich cluster, such as the Coma cluster might create possible detectable diffuse radio emission from KKDM annihilation if the KKDM is the main dark matter in the cluster. This research offers valuable insights into the properties of KKDM in galaxy clusters and provides further understanding of the implications of cosmology and dark matter searches.

Classification of CMD of globular cluster using ML.

Bishnu Kumar Sharma (National Central University), Chow-choong Ngeow (National Central University)

We use data from Gaia DR3 to construct color-magnitude diagram (CMD) for the Galactic globular clusters (GCs). Our aim is to classify the GCs according to their CMD morphology, such as main-sequence, red giant branch and horizontal branch, using a purely Unsupervised machine learning (ML) approach, as well as learning the properties of GCs based on the ML classifications. Our first step presented here is to construct a clean CMD using the Gaia DR3 data, including information on positions, proper motions, photometry, and data qualities, extracted using the astroquery package. After that we use ML to classify the GCs based on their morphology.

Characterizing the Low Surface Brightness structures of galaxies in the DESI Legacy Imaging Survey

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The stellar halo is a diffuse, roughly spherical component of a galaxy that is made up of low surface brightness (LSB) stellar structures. These structures include stellar shells and tidal streams (both associated with disrupting satellites) and remnants of tidal arms formed in major mergers. The properties of halo stars, such as their age distribution and metallicity, may provide important clues about the formation and evolution of the host galaxy. The influence of assembly history on galaxy formation could be constrained by trends in stellar halo properties (such as the mass, size and color of the diffuse light) with galactic observables (such as the total galaxy mass, color or gas fraction). Most previous work on images of extragalactic stellar halos has focused on identifying and classifying individual LSB features. We are exploring a different approach: our goal is to develop uniform , automated measurements of bulk stellar halo properties that are easier to apply to large datasets and to compare with models. As a first step, we have analyzed the diffuse light around 36 Milky Way-like galaxies from the Satellites Around Galactic Analogs (SAGA) Survey using images from the Dark Energy Spectroscopic Instrument Legacy Imaging Survey (DESI-LS). This survey provides images for large numbers of low-redshift galaxies that are two magnitudes deeper than SDSS and have twice the angular resolution. In this poster we describe our sample, the DESI-LS data and the basis of the methods we are developing. In future, we will apply these methods to much large numbers of galaxies in DESI-LS to study large-scale trends of stellar halo properties.

Kinematic substructure of the intracluster light in simulations of massive galaxy clusters

Ming-Jian Teh, Andrew Cooper

Diffuse intracluster light (ICL) observed in galaxy clusters is thought to originate from the tidal disruption of cluster members. Many definitions have been proposed to separate the ICL from the central Brightest Cluster Galaxy (BCG). The idea of these definitions is that the BCG and ICL are separate components of the stellar mass in the cluster. However, it is not obvious that this idea is always helpful or necessary. We are exploring this issue from a kinematic perspective. We present predictions for the kinematic structure and substructure in 9 N-body simulations of massive galaxies clusters post-processed with the STINGS semi-analytic particle tagging technique. We examine the radial velocity dispersion and line-of-sight velocity dispersion (LOSVD) profiles in these clusters. Our results so far show good agreement with measured BCG velocity dispersion profiles, although we find offsets between the simulations and observed size-mass and mass-velocity dispersion relations for surviving cluster galaxies. We separate the contributions of the top 5 most massive accreted progenitors of the BCG+ICL.

Flare Observations of the Nearby Red Dwarf LP245-10 Using Photometry and Polarimetry

Anli Tsai (NCU), Tanvi Sharma (NCU), Bhavana Lalchand (NCU), Wen-Ping Chen (NCU), Chen-Yen Hsu (NCU), and the flare observation team from 7 telescopes

We monitored the stellar flares of the nearby red dwarf LP245-10, also known as GJ3147 from November 11 to 17, 2021 using photometry and polarimetry from seven observatories in Asia. We have obtained R-band and I-band photometric data as well as polarimetric data. Flare activity has been detected by several telescopes, and we will present our preliminary results.

The Weirdos of Type Ia Supernova Explosions

Pin-Han Wang (NCU); Yen-Chen Pan (NCU)

Type Ia supernovae (SNe Ia) have many subtypes. The normal types can be used as standard candles to measure the expansion of Universe, because they are assumed to explode at similar mass, and thus their absolute luminosities are similar. However, there are still some peculiar subtypes of SN Ia, such as SN 1991T-like and SN 1991bg-like explosions. SN-1991T and SN-1991bg are quite common at lower redshift, and we would like to know whether these peculiar types at higher redshift are common as well. Our sample contains ~400 SNe Ia discovered by the Pan-STARRS1 medium deep survey (PS1-MDS). Firstly, we use a supernova classification software “DASH” to classify the subtypes. DASH contains ~4000 SN Ia spectral templates. We input our observed spectra into DASH and make a comparison with the templates to decide the best SN type. DASH also estimates the phase of the spectrum and host-galaxy information. Second, we focus on 91T-like events and employ the spectroscopic criterion (Phillips et al. 2022) for classifying the 91T-like events. This method adopts a criterion on pEW of Si II λ6355 to perform the classification. In the future, we would like to remove those subtypes from the cosmological sample and improve the SN Ia distance measurement.

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A Discussion on Generalized Gauss's Law of Lines of Gravitational Force as a Non-relativistic Limit of Modified Newtonian Dynamics/Gravity

Te Chun Wang, Li-Chih High School

A gravitational field flux conservation and redistribution picture is formulated by generalizing the Integral Gauss's law of gravity at non-relativistic limit. 1/r dependence along with a disk thickness dependence of gravitational field and the flat rotation curves are obtained by a Gaussian surface with cylindrical symmetry, where most of the gravitational fluxes are assumed to be distributed eventually along the disk plane. Gaussian disk thickness as a hidden dynamical variable is proposed with observational evidences. A spherical to cylindrical transition, across a critical field strength, of the Gaussian surface symmetry is shown to give directly the algebraic M ∝ v^4 baryonic Tully-Fisher relation. The transition implies that the 10^-10 m/s2 acceleration scale, or field strength of the unit of N/kg, can be interpreted as a critical field strength where lines of gravitational force redistribution occurs. The universal structural-dynamical relations revealed by the radial acceleration curve from Spitzer Photometry and Accurate Rotation Curves (SPARC) data are compared to the field flux distribution picture. The Newtonian dynamics above the critical field of ~10^-10 N/Kg near the bulge region of High Surface Brightness Galaxies (HSBGs) can be explained by the spherical distribution of the gravitational flux while the Non-Newtonian behaviors of both the Low Surface Brightness Galaxies (LSBGs) and the outskirts of the HSBGs can be attributed to the cylindrical flux distribution below the critical field. A discussion on the integral formulation of the gravitational flux-redistribution is made to compare the Gauss's law to the theories of Modified Newtonian Dynamics/Gravity. Reference: AIP Conference Proceedings (Vol.2319, Issue APPC2019) of 14th Asia-Pacific Physics Conference: https://aip.scitation.org/doi/pdf/10.1063/5.0037429

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Dropout sources in the most distant Universe with HST/JWST Imaging

Cossas K.-W., Wu (NTHU); Chih-Teng, Ling (NTHU); Tomotsugu Goto (NTHU); Tetsuya Hashimoto (NCHU)

The Lyman-break dropout technique is a well-known probe of the galaxies/quasars due to the existence of the neutral hydrogen absorption in the vast Universe. In this work, we aim to search for high-z Lymann-break galaxies using JWST NIRCam/MIRI data obtained by the Cosmic Evolution Early Release Survey (CEERS) and HST data in the Extended Groth Strip (EGS) field. We present some of the most promising sources of interest from the CEERS/EGS fields with their spectral energy distributions (SEDs) using CIGALE. By using a combination of NIRCam, MIRI, and HST data, we could determine/constrain their physical properties, mass, SFR, etc., more precisely and accurately. As more JWST NIRCam/MIRI data become avaliable in the near future, we could further use them to study the early stages of galaxy formation and evolution.

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3µm-Dropout Sources in the JWST CEERS field: Candidates for the Most Distant Galaxies and Other Interesting Sources

Jacob Yen (NTHU), Tomotsugu GOTO (NTHU), Tetsuya Hashimoto (NCHU), Seong Jin Kim (NTHU), Yu-Wei Lin (NTHU), Cossas K.-W. Wu (NTHU), Po-Ya Wang (NTHU)

Formation of the first galaxy and star is the final frontier in extragalactic astronomy, identifying candidates for the most distant galaxies is the key to exploring the early Universe. To serve this purpose, the Lyman break technique is a prominent and efficient method for obtaining candidates for high-redshift galaxies. While some works have produced candidates of 1-2 µm dropout galaxies, not many have gone above 3µm. In this work, I aim to obtain 3.56 µm dropout and 4.1µm dropout in the JWST CEERS3 field. After careful handling of source matching and apparent cutout images, we present interesting sources only detected in F444W, with color F356W-F444W > 2 and F410M-F444W > 2. Possible physical origins of these sources include z~30 LBGs, or z~9 passive galaxies, extremely dusty galaxies, or objects we have not seen before.

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Barred and Unbarred Narrow-Line Seyfert 1 Galaxies

Po-Chieh Yu (YZU)

Feeding mechanisms of AGNs, such as large-scale bars are still under debate. Recent studies show inconsistent results of comparison of barred and unbarred AGNs. One explanation is that the bars might play different roles in different phases/types of AGNs. Therefore, AGNs in early stages, such as narrow-line Seyfert 1 (NLS1) could provide important clues of driving material from kpc regions into nuclear regions. We identify more than 2000 barred and unbarred NLS1 galaxies based on ellipticity using Pan-STARRS images. By fitting SED of barred and unbarred NLS1 galaxies using CIGALE, we compare their AGN power, tours properties, average SFR, black hole masses, and line strength. Detailed of method and results will be shown in this study.

The Host Galaxies of Type Ia Supernovae Discovered by the Pan-STARRS1 Medium Deep Survey

Kuang-Jie Zeng (NCU); Yen-Chen Pan(NCU)

Type Ia supernovae (SNe Ia) are standardizable candles that have been frequently used to probe the cosmic expansion. However, their progenitor system and explosion mechanism are still unclear. Host-galaxy environment has been a profitable route to probe the nature of SN Ia explosion. Previous studies have also shown that their luminosities are tightly correlated with the host-galaxy properties, such as the stellar mass, star-formation rate, and metallicity. These relations can be used to further reduce the scatter of Hubble diagram. Here we study the host galaxies of ~400 SNe Ia discovered by the Pan-STARRS1 Medium Deep Survey (PS1-MDS). We will use advanced galaxy SED fitting code (e.g., Prospector) to determine the host-galaxy parameters and examine their relations with SN properties.

Identifying types of galaxy morphology by machine learning

Ye-Chi Zheng; Yu-Yen Chang

Structures of galaxies and their classifications can help us to understand galaxy evolution, which has always been a key issue in the study of our universe. After the advancement of science and technology, the increasing speed of data is much faster than the analysis. AI technology has begun to be a useful tool for astrophysical researches, and makes data analysis much more convenient and faster. Therefore, data organization and generation become a very crucial and first step. In the past, visual analysis was used to classify galaxy morphology, but visual classification is too subjective and time-consuming. At present, there are many parameters that are extremely useful but cannot be observed by human eyes, such as the rotational speed, stellar mass, and other physical properties of galaxies. If the galaxy parameters are classified and predicted by machine learning, it will be fast and effective as unified standards, which can be convenient for future galaxy research. The goal of this study is to use machine learning to classify galaxy morphology, and investigate the relationship between galaxy parameters and structures. By combining image and visual inspection, we compare the pros and cons of different machine techniques. The results were obtained to analyze the physical relationship between important parameters and the structures of the galaxy.

A Unified Model for Bipolar Outflows from Young Stars: Kinematic Structures in HH 30

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We demonstrate how a magnetized wind bubble, as proposed in the unified wind model of Shang et al. in 2023, is applied to the well-known edge-on protostellar system of HH 30 for interpreting the overall structure of its outflow lobes. The material ejected from the protostar sweeps up the ambient gas and produces a low-density cavity enclosed by compressed high-density shells. Different components within the outflow, each exhibiting diverse kinetic properties, can be traced by emission lines excited by varying environmental conditions. We obtain radio and optical data from archive observed by ALMA and HST to cover both high- and low-velocity components. Three primary structures can be distinguished based on the distribution along the positional axis on transverse position--velocity diagrams i.e. a large line width extreme high-velocity component observed in optical, a low-velocity magnetized ambient, and an intermediate region of compressed wind observed in 12CO. The nested mixing velocity structures expected in bubble model are capable to explain the elongated area of compressed wind and the knotty velocity bullets in extremely high-velocity component, which are the consequences of magnetic interplay inside the bubble.

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The Young Stellar Population in the Chamaeleon Dark Cloud Complex

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We present the young stellar membership in the Chamaeleon molecular clouds. Despite the southern polar position, the individual clouds have been reasonably surveyed. Cha I, at a distance of about 190 pc, known to be the most active in star formation hosting more than 200 young stars. Some young stars are also found in Cha II, whereas Cha III is devoid of any starbirth. Here we diagnose the possible young membership of a 7 deg squared coverage, including the intercloud regions previously overlooked, plus the elongated Musca cloud located to the northeast of the Chamaeleon clouds, using photometric and kinematic sky survey data of Gaia DR3, 2MASS, WISE, etc. in order to study the overall star-forming history in this cloud complex.

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An Examination of G204NE's Chemical Stratification: Evidence of An Early Class 0 Protostar

Hsuan-I (Ethan) Chou (ASIAA, KCIS); Naomi Hirano (ASIAA); Masayuki Yamaguchi (ASIAA)

We present the Atacama Large Millimeter/Submillimeter observational results of G204.4-11.3NE (G204NE) in the Orion B giant molecular cloud. G204NE is a low-mass molecular cloud core (M_core = 3.0 M_sun) and has an embedded class 0 protostar with a bolometric luminosity of 1.42 L_sun. The protostar is likely early in the class 0 stage because of its low bolometric temperature (T_bol = 26.4 K). We observed the 1.3 mm continuum, N2D+ (J = 3–2), DCO+ (J = 3–2), and C18O (J = 2–1) molecular lines at an angular resolution of 0''.13, which corresponds to a linear resolution of 52 au. Analysis of the continuum visibilities reveals three components with different size scales having FWHM of 2''.16 (870 au), 0''.23 (93 au), and 0''.07 (28 au), respectively. The very compact continuum component suggests the presence of a small circumstellar disk with a radius of ~15 au. The spatial resolution of the molecular lines shows significant chemical stratification: N2D+ is the most extended (FWHM ~2660 au), C18O is the most compact (FWHM ~335 au), and DCO+ is in-between (FWHM ~1220 au). The spatially-compact C18O suggests a limited area of CO evaporation around the protostar. The N2D+ fractional abundance ([N2D+]/[H2]) derived from N2D+ and H2 column densities tends to decrease toward the center; it is ~10^-11 at a radius of 800 au, while dropping to 3x10^-13 at the center. The observed chemical stratification is consistent with the explanation that the early-phase protostar starts to heat the gas and evaporate CO from the dust, which then reacts with N2D+ to form DCO+.

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Chemical Conditions of the Cores Before and After the Onset of Star Formation

Tsung-Han Chuang (TKU/ASIAA); Naomi Hirano (ASIAA); Masayuki Yamaguchi (ASIAA)

We present the Atacama Compact Array (ACA) 7m array observations of the N2H+ 4-3, ortho-H2D+ 1 (1,0)-1(1,1), and DCO+ 5-4 line emission from one prestellar core and one protostellar core in the Orion molecular complex. G209.29-19.65-S1 (G209-S1) is considered to be an evolved prestellar core with high density (~10^7 cm^-3). G204.4-11.3A2-NE (G204-NE), is a protostellar core harboring a very young protostar with a bolometric luminosity and temperature of 1.42 L_sun and 26.4K, respectively. The angular resolution of the ACA 7-meter array observations is ~6.0"×3.0" which corresponds to ~2400×1200 au at a distance of ~400 pc. In G209-S1, the N2H+ and H2D+ exhibit centrally peaked distributions that correlate well with the 360 GHz continuum emission. On the other hand, DCO+ shows its peak near the edge of the continuum suggesting that CO depletes at the center. The CO depletion factor, derived from the archival C18O 2-1 data, is ~25 in this source. The N2D+/N2H+ ratio of this source derived using the archival N2D+ 3-2 data, is around 0.4, which corresponds to the highest value in the prestellar cores with N2D+/N2H+ ratio measurements. In G204-NE, the H2D+ reveals two velocity components; one at V_LSR ~1.3 km/s is in the vicinity of the continuum source, and the other at V_LSR ~1.8 km/s peaks at ~10" northeast of the continuum peak. The 1.3 km/s component shows two peaks at ~5" east and west of the continuum peak, and lower emission toward the continuum peak. On the other hand, the DCO+ and N2H+ show a good correlation with the continuum. The N2D+/N2H+ ratio and the CO depletion factor in G204-NE are around 0.06 and 9.1, respectively. These results suggest that the H2D+ abundance starts to decrease, once the protostar heats its surroundings and returns CO into the gas phase, resulting in a significant decrease in the N2D+/N2H+ ratio. The H2D+ is remaining in the G204-NE core. This supports that the central protostar is in the very early evolutionary phase. We also compare the physical and chemical properties of these two sources with those of the prestellar and protostellar cores in the Orion region observed with the ALMASOP project.

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Star Formation And Fragmentation in Dense Cores in Orion A

Jo-Shui Kao, Hsi-Wei Yen

When dense cores in molecular clouds collapse and form stars, they may fragment and result in multiple systems. However, the key mechanisms controlling fragmentation and determining the mass and separation of fragments remain observationally unclear. In this project, we measure the physical condition of dense cores in Orion A to find the condition of fragmentation. First, we investigate the relationship between turbulence, magnetic field, and fragmentation. Our results suggest that magnetic field suppresses fragmentation in dense cores, consistent with theoretical simulations. Then, we calculate the Jeans mass and find that the dense cores with masses larger than the Jeans mass tend to fragment.

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Effective equation of state of a radiatively cooling gas

Yueh-Ning Lee (Department of Earth Sciences/Center of Astronomy and Gravitation, National Taiwan Normal University)

The temperature of the interstellar medium (ISM) is governed by several physical processes, among which radiative line cooling, external UV/cosmic ray heating, and the mechanical work by compression and expansion. In regimes where the dynamical effect is important, the temperature deviates from that derived by simply balancing the heating and cooling functions. We hereby present a self-similar collapse solution that describes a clump that is contracting and losing energy through radiation. This yields an effective equation of state (eos) that can be generally applied to various ISM context, where the cooling function is available from first principles, and expressed as powerlaw product of the density and temperature. Our findings suggest that a radiatively cooing gas under self-gravitating collapse and easily manifest an effective isothermal eos. This model provides theoretical justification for the simplifying isothermal assumptions of simulations at various scales, and can also provide a more realistic thermal recipe without additional computation cost.

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Investigating the Relation Between Fractal Dimensions and Density Probability Density Function in Star-Forming Molecular Clouds

Hung-Lin Liao(NTNU); Yueh-Ning Lee(NTNU)

It's commonly accepted that the density probability density function (PDF) of a star forming molecular cloud is a lognormal distribution with a power-law tail at high density. Additionally, studies have suggested that interstellar medium can be well described by fractal dimensions. This study aims to explore the connection between the fractal characteristics and density PDF of molecular clouds. To accomplish this, we use dendrogram to identify dense, gravitationally collapsing substructures. We then analyzed the properties of these substructures, such as the density PDF, power spectrum, and fractal dimensions. By examining the correlation between these properties and the power-law region of the density PDF, the study sheds light on the relation between fractal dimensions and the density PDF in star-forming clouds.

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Thermodynamics coupled to dynamics in the interstellar medium

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In this study, we investigate the impact of cooling and heating processes on the thermodynamics and dynamics of the cold interstellar medium (ISM). The widely accepted polytropic equation of state describes the relationship between temperature and density of the cold ISM in star forming molecular clouds, with a polytropic index of $\gamma \sim 0.7$ when $n < 10^4$ and $\gamma \sim 1$ when $n > 10^4$. However, there are discrepancies between observational results and theoretical predictions that assume that the heating or cooling timescales are smaller than the dynamical timescale and do not account for the work done by compression or expansion. To address this issue, we use the adaptive mesh refinement (AMR) code RAMSES to conduct numerical simulations and determine the effective polytropic index. Our simulations adopt the atomic-molecular cooling function and parametric cooling function. When atomic-molecular cooling functions are used, the molecular cloud rapidly reaches equilibrium. However, when the cooling power is reduced to mimic low metallicity abundance, the molecular cloud deviates from the polytropic equation of state. We also explore the use of a parametric cooling function and find specific parameter settings that satisfy the cloud criteria where the effective polytropic index is $< 4/3$. Our results suggest that when studying the primordial cold ISM, the work done by dynamical processes should be included in the theoretical model since cooling is not efficient in low metallicity scenarios. Overall, our study highlights the need for a more comprehensive understanding of the dynamics and thermodynamics of the cold ISM and the importance of considering the effects of cooling and heating processes on these systems.

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Formation and evolution of a protostellar disk in a proto-multiple system

Shang-Jing Lin; Hsi-Wei Yen

Stars often form in multiple systems, but the number of studies of multiple systems is still very limited due to the complex dynamics. In this project, we use 12CO(2−1) and C18O(2−1) to trace the gas in a young triple system, Per-emb-8, Per-emb-55 A and Per-emb-55 B and study the gas dynamics in this multiple system. From analyzing the SMA and ALMA archival data, we discover an outflow associated with Per-emb-8, and its axis is along a direction at an position angle of 130 deg. The major axis of the disk in the continuum emission is measured to be 50 deg, which is almost perpendicular to the new outflow. We identify the Keplerian rotation of the disk in the C18O emission, and the central stellar mass is measured to be 2 solar mass. In addition, we find warped structures around the disk in the C18O emission.

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The impact of magnetic fields in the formation of Hub-filament systems

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Hub-filament structure (HFS) is the destination that filaments merge together. Many studies shows that star formation usually appears in HFS and the magnetic field could guide the gravitational contraction along the filaments. Our goal is to make the statistics of the angle difference between magnetic field and filament in the HFS of 850μm image from the JCMT large project, B-field In STar Formation Region (BISTRO). We use the Discrete Persistent Structures Extractor (DisPerSE) package to locate positions of the filaments and identify the HFS with 3 criteria from Kumar et al. (2020) . After the identification of HFS, we consider the NGC1333, OphA, SerpensMain are the HFS. We then trace the angle difference and find that there are the spatial ‘oscillation’ in angle difference along the filament major axis. We consider there are spatial contraction along the filament with spatial period.

The impact of shear on turbulence and star formation in Galactic molecular clouds

Raffaele Rani (NTNU)

The nature of turbulence in molecular clouds is one of the driving factors that influence star formation. It is speculated that the high star formation efficiency observed in spiral-arm clouds is linked to the prevalence of compressive (curl- free) turbulent modes, while the shear-driven solenoidal (divergence-free) modes appear to be the main cause of the low star formation rate that characterises clouds in the Central Molecular Zone (CMZ). Similarly, the analysis of the Orion B molecular cloud confirmed that, although, turbulent modes vary locally and at different scales within the cloud, the dominant solenoidal turbulence is compatible with its low star formation rate. This evidence points to inter-and intra-cloud fluctuations of the solenoidal modes being an agent for the variability of star formation efficiency. We present a quantitative estimation of the fraction of momentum density (ρ v) power contained in the solenoidal modes of the turbulence in a large sam- ple of plane molecular clouds in the 13CO/C18O ($J = 3 \rightarrow 2$) Heterodyne Inner Milky Way Plane Survey (CHIMPS). Our goal is to investigate how the relative fraction of solenoidal modes may probe the variation of the star forma- tion efficiency in different Galactic molecular environments by comparing the “solenoidal fraction” across clouds with varying features to the clouds’ star- formation efficiency, derived independently. In addition, we study the impact of the shear arising from the Galaxy’s differential rotation on star formation effieciency and solenoidal turbulence.

The W Band Survey: Water-bearing Brown dwarfs in the Rho Ophiuchi Complex.

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W Band team

Brown dwarfs, with spectral types later than about M6, have cool atmospheres (< 2800K) that allow formation of molecules such as water or methane. Here we report identification of brown dwarf candidates in the Rho Ophiuchi complex with the W-band method, i.e., by imaging photometry on and off the water absorption band near 1.45 microns, using a custom-made spectral (W) filter adapted to the CFHT/WIRCam. Combining with the broad-band photometry at J and H bands, we are able to distinguish water-bearing brown dwarfs from reddened field stars. We diagnosed proper-motion membership of faint candidates with multi-epoch (spanning 6 years) CFHT/WIRCam images bootstrapped with astrometry of bright sources retrieved from Gaia DR3. We present the methodology, the confirmed and highly probable substellar sample, and constrain the age of the sample by comparison with model isochrones.

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The Dizzying Magnetic Field Morphology of the OB Cluster G31.41+0.31

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Shih-Ping Lai (NTHU), Yuxin Lin (MPE), Maria Jose Maureira (MPE)

The evolution of high-mass star formation has remained a mystery over the years as successful observations are limited due to observational challenges. We present the first successful Karl G. Jansky Very Large Array (JVLA) dust-polarization observations at ~7 mm wavelengths towards a high-mass star-forming region, G31.41+0.31. Our target source represents the best studied case in the previous Submillimeter Array (SMA) and Atacama Large Millimeter Array (ALMA) observations at <1.3 mm wavelengths. Intriguingly, the B-field morphology resolved at 7 mm and 1.3 mm wavelengths appears dramatically different. Possible explanations to the angle offset include different polarization mechanisms, and large-scale and small-scale fields probed by different wavelengths. We make use of radiative transfer modeling to construct a magnetic field model that can consistently explain the two sets of polarization angles. This can provide information on the polarization mechanisms and the magnetic field structures in regions of different densities and scales of the clump. Our observation results indicate that dust polarization observations at long wavelengths are essential to understand the structure of magnetic fields and their roles in high-mass star-forming regions. We foresee that the ALMA Band 1 receivers (30-50 GHz) will lead to a breakthrough in this area in near future.

P-72

Early Planet Formation in Embedded Disks (eDisk): Investigating the Dynamical Properties of the Class 0 Protostar IRAS 15398-3359

Travis Thieme (NTHU)

Protostellar disks are a ubiquitous part of the star formation process and the future sites of planet formation. We present ALMA observations of the young protostar, IRAS 15398-3359, as part of the Early Planet Formation in Embedded Disk (eDisk) large program. The small-scale dust emission traces a compact, dusty disk with a radius of 4.5 au and gives a total (gas+dust) disk mass of 1.2 Mjup. The SO (JN = 65 - 54) molecular transition traces a compact, rotating structure around the protostar, which is inferred to be a protostellar disk. The dynamical protostellar mass of IRAS 15398 is constrained to be between 0.022 - 0.045 $M_\odot$ from our high velocity single power-law fitting, indicating that this source could be very young. The protostellar gas disk radius is estimated to be 20 au from a double power-law fitting. These results confirm the low-mass nature of IRAS 15398 and highlight the importance of high resolution observations to infer dynamical properties of protostars in the deeply embedded stages.

The impact of magnetic fields on accretion flows

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Meng-Zhe Yang(NTHU); Hao-Yuan Duan(NTHU)

The magnetic field is an indispensable factor in the early stages of star formation, as it plays a crucial role in decelerating the protoplanetary disk, enabling the material to flow into the protostar. Consequently, the study of magnetic fields is pivotal to our understanding of star formation. In this paper, we aim to investigate the effect of magnetic fields on disk accretion. To this end, we employ simulation data of protoplanetary disk formation and utilize the yt python package to visualize our findings. Through our analysis, we identify the presence of a filamentary structure in the accretion flow, prompting us to examine the correlations between the gas velocity, magnetic field, and filamentary structure using three angles. Our results provide valuable insights into the intricate interplay between magnetic fields and the disk accretion process during star formation, highlighting the critical role played by magnetic fields in facilitating the formation of stars.

Increasing mass-to-flux ratio from the dense core to the protostellar envelope around the Class 0 protostar HH211

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To study the transportation of magnetic flux from large to small scales in protostellar sources, we analyzed the Nobeyama 45m N2H+ (1-0), JCMT 850 um polarization, and ALMA C18O (2-1) and 1.3 and 0.8 mm (polarized) continuum data of the Class 0 protostar HH 211. The magnetic field strength in the dense core on a 0.1 pc scale was estimated with the single-dish line and polarization data using the DCF method, and that in the protostellar envelope on a 600 au scale was estimated from the force balance between the gravity and magnetic field tension by analyzing the gas kinematics and magnetic field structures with the ALMA data. Our analysis suggests that from 0.1 pc-600 au scales, the magnetic field strength increases from 40-107 uG to 0.3-1.2 mG, and the mass-to-flux ratio increases from 1.2-3.7 to 9.1-32.3. The increase in the mass-to-flux ratio could suggest that the magnetic field is partially decoupled from the neutral matter between 0.1 pc and 600 au scales, and hint at efficient ambipolar diffusion in the infalling protostellar envelope in HH 211.

P-75

Spectral and Temporal Variations of the Optical Linear Polarization of T Tauri and Herbig Ae/Be Stars

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We present simultaneous g', r', and i' polarization measurements, mostly spanning different epochs, of a list of 35 T Tauri stars, and 15 Herbig Ae/Be stars, i.e., solar-type and intermediate-mass pre-main sequence stars. Our results confirm the literature that these objects are moderately polarized, typically less than 4%, being stronger among the dustier and more nebulous Herbig Ae/Be stars. A large fraction of our targets exhibit time variability in either the polarization level or the polarization angle, signifying changes in dust clump locations, some also in wavelength dependence, a diagnosis of grain size information.

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CARTA: Cube Analysis and Rendering Tool for Astronomy

Kuo-Song Wang (ASIAA); CARTA development team (ASIAA, NRAO, IDIA, Dept. of Physics Univ. of Alberta)

CARTA is the Cube Analysis and Rendering Tool for Astronomy, a new image visualization and analysis tool designed for the ALMA, the VLA, and the SKA pathfinders. As the image size increases drastically with modern telescopes in recent years, viewing an image with a local image viewer or with a remote image viewer via the ssh protocol becomes less efficient. The mission of CARTA is to provide usability and scalability for the future by utilizing modern web technologies and computing parallelization. Through this poster presentation, the CARTA development team would like to update the development status to the community, including what we have achieved, what we are working on, and what we have planned to do.

A petrology, mineral chemistry, microstructural and isotopic study on CV3 Allende CAI and Wark-Lovering rims.

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Hsien Shang(ASIAA); Der-Chuen Lee(Institute of Earth Sciences, Academia Sinica)

The Ca-Al-rich inclusion (CAI) is the earliest condensate from the solar nebula. It usually consists of a series of high temperature phases, e.g., melilite, perovskite, spinel, hibonite, pyroxene, and olivine, that condensed directly within the protoplanetary disk, and is thus a great tool to study the evolution of early solar system. Surrounding the CAI, the WL rim formed during high temperature reactions between the CAI and the nebula, and formed a series of mineral phases with up to 50 mm in width, providing additional clues about the earliest evolution history of the solar system. This study carried out the petrography, mineral chemistry, and isotopic measurements of three CAIs and its WL rims extracted from the CV3 meteorite Allende. The CAI interior mineral and sequences of each WL rim were first verified via SEM. Subsequently, the elemental mineral compositions for each mineral phase were quantified via EPMA, using EBSD to obtain information about the origin of the rims and the CAIs. Lastly, NanoSIMS will be employed to study the isotopic compositions, e.g., O, for mineral phases within the CAIs and the respective WL rims, in order to better constrain the chemical reactions, the sources, as well as the timing that led to the formation of the WL rims.

History of SF and BH accretion inferred from the JWST MIR source counts

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With the advent of the James Webb Space Telescope (JWST), Ling et al. (2022, 2023) and Wu et al. (2022) probed extra-galactic source counts down to sub-μJy at the mid-infrared (MIR), which is several tens of times fainter than the previous-generation infrared (IR) telescopes achieved in the MIR. In this work, we physically interpret these JWST number counts and constrain cosmic star-formation history (CSFH) and black hole accretion history (BHAH). We employ the backward evolution of local luminosity functions (LLFs) of galaxies to reproduce the observed source counts from sub-μJy to a few tens of mJy in the MIR bands of the JWST. The given shapes of the LLFs in the MIR bands are produced using the model templates of the spectral energy distributions (SEDs) for the five representative galaxy types (star-forming galaxies, starbursts, composite, AGN type 2 and 1). Fitting our model simultaneously to all the source counts in six MIR bands together with the previous results enables us to determine the best-fit evolutions of MIR LFs for each of the five galaxy types, and thereby, CSFH and BHAH are estimated. Thanks to the JWST, our estimates are based on several tens of times fainter MIR sources, whose existence was just an expectation in previous studies.

P-79

Revisiting the Mysterious Origin of FRB 20121102A with Machine-learning Classification

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Fast radio bursts (FRBs) are strong and rapid radio waves from the universe. Even though more than 50 physical models have been proposed, the origin and physical mechanism of FRB emissions are still unknown. The classification of FRBs is one of the primary approaches to understanding their mechanisms, but previous studies have been limited by small and heterogeneous samples. The FRB classification has been conducted conventionally using only a few observational parameters, such as fluence and duration, which might miss some new FRB classes. To overcome this problems , we use homogeneous 977 FRB samples of FRB 20121102A detected by the Arecibo telescope in this work. We adopt a machine-learning approach to classify, allowing us to handle more than 10 parameters simultaneously, including time of arrival, amplitude, linear temporal drift, drifting time, time duration, center frequency, bandwidth, scale energy, fluence, and dispersion measure. Our machine-learning analysis identified four distinct clusters, indicating the possible existence of four different physical mechanisms responsible for the observed FRBs from the FRB 20121102A source. This research will be a benchmark for future FRB classifications when dedicated radio telescopes such as the Square Kilometer Array(SKA) or BURSTT discover about two orders of magnitude more samples than before.

P-80

Exploring Centaurus A's Enigmatic Giant Radio Lobes: Preliminary Findings from Chandra Pointings

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Centaurus-A, as the nearest radio galaxy to Earth, offers a unique opportunity to study a wide range of astrophysical processes, such as high-energy gamma emissions, dust clouds, jet properties, star formation, and accretion and outflows from the galactic nucleus. Centaurus-A has been studied at a variety of wavelengths, but due to its high emissivity at radio frequencies, the vast majority of research has been done at shorter wavelengths. Its massive north-south radio lobes are especially intriguing because they have only been briefly explored in the X-ray spectrum. We present a statistical analysis of the properties of the identified sources and compile a catalogue of point-like sources from Chandra X-ray observations in five Suzaku collocated areas in these northern and southern lobes. The preliminary inventory of point-like sources is compiled by first calibrating and processing archived ACIS-I data using the Caldb-4.10.2 calibration database and using Wavdetect point source detection algorithm which is then cross-matched with CAT-Wise and Gaia DR3 catalogues in various energy bands to produce a catalogue with the broadest spectral coverage possible. The hardness ratios, spectral fitting, and light curve analysis for intra-observational variability that were discovered then provide us with a better understanding of the physical properties of these objects, which may help improve current theoretical models of X-ray emissions in radio galaxies.

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Black Hole Spins in AGNs: A Systematic Perspective

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Black holes are intricate astronomical objects defined by their mass and angular momentum. Despite significant research efforts over the last decade, many questions about the distribution of spin in black holes remain unanswered. In this study, we use the relativistic reflection method, which involves analyzing the X-ray spectra given off by matter falling into a black hole, to look at the spin of several known black holes in active galactic nuclei (AGNs). This includes black holes whose spins have been measured by X-ray reflection spectroscopy in the past and those that haven't. Our preliminary findings shed new light on the relativistic reflection method and highlight potential sources of uncertainty that may affect our measurements. We will gain a more profound understanding of these enigmatic objects and the extreme conditions that exist in the universe by better understanding the distribution of spin in black holes.

P-82

TIME RELATION BETWEEN GAMMA-RAYS AND OPTICAL LIGHT OF 17 NOVAE

Jhih-Ling Fan (NCKU) ,Kwan-Lok Li (NCKU)

Classical nova is an explosion on the surface of a white dwarf which accretes in a binary star system. In 2010, NASA's Fermi Gamma-Ray Space Telescope detected gamma-rays from a nova for the first time, and since then, 17 novae have been detected in gamma-rays. One of these novae is V906 Carinae, and the multi-wavelength observations showed that the optical and gamma-ray light curves are related. However, it is unknown whther this time relation applies to other gamma-ray novae. In this project, we aim to investigate whether other gamma-ray novae had the corelation by comparing the Fermi gamma-ray observations and optical data from AAVSO and ASAN-SN.

P-83

A KiloHertz Gravitational Wave Signature from the Low T/|W| Instability in Rapidly Rotating Core-Collapse Supernovae

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We present self-consistent, three-dimensional core-collapse supernova simulations of a rapid rotating 20 solar mass progenitor model with neutrino transport and various initial rotation rates, using the smoothed particle hydrodynamics code (SPHYNX). We find, for the first time, that a ~1.2 kilohertz gravitational wave signature is excited at ~20-100 ms postbounce for models with initial rotation rates ranging from 1.5 to 3.0 rad/s. By analyzing the spherical harmonic modes of the proto-neutron star, we show that this kilohertz feature can be associated with the m=1 mode from the proto-neutron star modulation induced by the low T/|W| instability. In addition to the bounce signal, this kilohertz signal can be another diagnosis for understanding the angular momentum distribution of collapsing cores.

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Simulating the Effects of the Magnetized Active Galactic Nucleus Jets on the Intracluster Medium

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In the core region of the galaxy clusters, the cooling flow due to radiative cooling in the intracluster medium (ICM) is not observed as much as expected, causing the well-known "cooling flow problem". The outburst from the active galactic nuclei (AGN) has been considered as the best candidate for resolving this problem, although the energy composition of AGN jets is still unknown. We simulated the AGN outburst with the 3D magnetohydrodynamic (MHD) code to study the influence of AGN jets with magnetic energy. The magnetic field injected in our simulations effectively interacts with the ambient ICM magnetic field, while the simulated Faraday rotation maps also suggest the possibility of observing the existence of this interaction.

Rapid spin changes around a magnetar bright radio burst

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Fast Radio Bursts (FRBs) are bright radio transients arriving from cosmological distances and their nature remains unknown. An X-ray burst in 2020 coinciding with an FRB from the galactic magnetar SGR 1935+2154 provided evidence that strongly magnetized neutron stars are involved. However, the mechanisms of magnetar FRBs are not well understood. Here we report X-ray detections of two spin-up glitches of SGR 1935+2154, which occurred 4.4 hours before and after a bright radio burst detected on October 14, 2022. At these two glitches, the magnetar spin frequency suddenly increased at one of the largest rates observed to date from known neutron stars. Between these two glitches, the magnetar entered a rapid spin-down phase accompanied by a sudden increase in the persistent X-ray emission and X-ray burst rate, which reached their peaks two hours prior to the FRB. Following the peak of the enhanced X-ray activity, the emission steadily declined through the second spin-up glitch. This provides evidence that the FRB trigger is causally associated with the neutron star interior, with glitch activity coupling to the crust and magnetosphere, influencing the burst rate and the peculiar magnetospheric states that may lead to the emission of FRBs.

GRB Detection Efficiency and Localization Capability of the Gamma-ray Transients Monitor (GTM) on board Formosat-8B

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The scientific purposes of GTM are to monitor Gamma-Ray Bursts (GRBs) and other bright gamma-ray transients in the energy range from 50 keV to 2 MeV. Base on detailed simulations, the 50% detection efficiency happens at the fluences (in the energy range from 10 keV to 1 MeV) of 3.4×10^{-6} erg/cm^2 and 2.5×10^{-6} erg/cm^2 for long and short GRBs, respectively. GTM is therefore expected to detect about 40 GRBs per year, according to the Fermi/GBM 10-year GRB-fluence distribution. For localization capability, the localization uncertainty at 3 sigma confidence level of long GRBs with the fluences of 4×10^{-5} erg/cm^2 and 4×10^{-6} erg/cm^2 are about 3 and 30 degrees, respectively.

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Optical and X-ray band correlation of tMSP J1023+0038

Shu-Mi Huang (NCKU), Kwan-Lok Li (NCKU)

A millisecond pulsar (MSP) is a pulsar whose rotational period is less than 30 milliseconds. It is widely accepted that an MSP was in a binary system in which the neutron star accretes matter from its companion, gaining angular momentum and being spun up. A transitional millisecond pulsar (tMSP) is a special MSP that exhibits transitions between being a low-mass X-ray binary (LMXB) and a rotation-powered MSP (RMSP), and therefore could be an important class for the study of the spin-up process aforementioned. In this project, we aim to investigate the correlation between the optical and X-ray band observations of PSR J1023+0038, one of the only three tMSPs known. The result could help us understand the accretion process of tMSPs in the LMXB phase and possibly shed light on the causes for its transition phenomenon.

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Orbital Period Evolution of Low Mass X-ray Binary 4U 1820-30

Yao-Wun Jhang (NCU); Yi Chou (NCU)

4U 1820-30, a low mass X-ray binary (LMXB), located near the center of the globular cluster NGC 6624, consists of a neutron star and a white dwarf. It has the shortest orbital period of 685 s in all of the known LMXBs. For its orbital period derivative, the theoretical value evaluated by Rappaport et al. (1987) should be positive, but the observational results showed that it is negative. This discrepancy is possible due to the gravitational acceleration in the globular cluster. The purpose of this study is to investigate the orbital period evolution of 4U 1820-30. We used light curves collected by NICER from 2017 to 2022. The orbital modulation profiles were obtained by folding the light curves with the linear ephemeris proposed by Peuten et al. (2014) and the maximum of the profiles, evaluated by fitting a single sinusoidal function, were selected as the fiducial point of the orbital phases. Combined with previous results from 1976 to 2011, we obtained the orbital phase evolution with a time span of 46.3 years. Using a quadratic function to fit the orbital phase evolution, we obtained the observed orbital period $P = (685.011968 \pm 0.000021)\ s$ and the orbital period derivative $\dot{P}/P = (-5.21 \pm 0.14) \times 10^{-8}\ yr^{-1}$. From the fitting of a cubic function, we found there is no second order orbital period derivative is significantly detected with the 2-sigma upper limit $5.72 \times 10^{-22}\ s s^{-2}$. We further discuss the possible intrinsic orbital derivative and argue that the observed orbital period derivative is improper to infer the gravitational acceleration of 4U 1820-30 in NGC 6624 because there are too much uncertainty in it. Furthermore in the X-ray light curve collected by NICER, we also detected the superhump modulation, which was first discovered from the Hubble Space Telescope in the far-ultraviolet band reported by Wang & Chakrabarty (2010).

High-Resolution Radio Study on the Youngest Pulsar Wind Nebula Kes 75

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Kwan-Lok Li (National Cheng Kung University, Taiwan)

We conducted a study on Kes 75, the youngest pulsar wind nebula (PWN) ever observed in the Galaxy, using the latest Very Large Array (VLA) observation in C-band (4-8 GHz). Our results revealed a more detailed microstructures observed in radio than those detected in X-rays with the Chandra Observatory. There is a strong correlation between the microstructures and the polarization features in the central PWN. Additionally, we found notable differences in the radio continuum image and polarization map between the south-east and south-west supernova remnant lobes, which are likely attributed to varying dust-to-gas ratios. Our findings provide valuable insights into the physical processes at work in Kes 75 and improve our understanding of pulsar wind nebulae in general and at the evolutionary early stage.

Simulating AGN feedback in galaxy clusters with pre-existing turbulence

Jia-Lun Li (NTHU)

Feedback from active galactic nuclei (AGN) is believed to play a significant role in suppressing cooling flows in cool-core (CC) clusters. However, recent research based on the analysis of Chandra X-ray surface brightness fluctuations in the Perseus cluster suggests that turbulent heating alone may already be sufficient to balance radiative cooling. In this study, we aimed to compare the heating effects of turbulence and AGN feedback by conducting 3D hydrodynamic simulations in a Perseus-like cluster with and without pre-existing turbulence. Our results show that the entropy in both simulations remains nearly the same, indicating that turbulence has a limited impact on entropy. Besides, although shocks and sound waves are hard to observe, their presence can still be found through examining X-ray perturbations. Additionally, our investigation into the velocity field shows that turbulence has little interaction with the AGN feedback mechanism.

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Probing the short gamma-ray burst jet structure using GW170817, GW190425 and electromagnetic observations

En-Tzu Lin, Fergus Hayes, Gavin P. Lamb, Ik Siong Heng, Albert K.H. Kong

The short gamma-ray burst event GRB170817A discovered in coincidence with the binary neutron star (BNS) coalescence GW170817 has allowed such systems to be investigated under a new light. However, comparing to all other short GRBs detected so far, the isotropic luminosity of GRB170817A, of the order of ~10^47 erg/s, is more than two magnitudes lower than the rest of the population. In this work, assuming all BNS mergers produce short gamma-ray bursts and the non-detection of the EM counterpart of GW190425 was due to observation limits, we perform a multi-messenger study on the jet geometry of short gamma-ray bursts. Datasets under investigation consist of the posterior information inferred from both gravitational wave triggers, observed fluxes of GRB170817A, including the gamma-ray prompt emission detected by Fermi GBM and the X-ray afterglow by Chandra X-ray Observatory, as well as the observed rate of short GRBs from Swift's ~10 years' observation. We present the log Bayes factors to compare different jet models and place a constraint on neutron star merger rate.

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Performance Studies of a Small Compton Polarimeter Flying on a CubeSat

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In this study, we build up two Compton polarimeter models to observe the gamma-ray polarization of Cygnus X-1 and Crab. One of the Compton polarimeters called GRAC-1 (Gamma Ray Astronomy Cubesat) contains two layers of Gadolinium Aluminum Gallium Garnet (GAGG) scintillators as its detectors. In the other model, we change the upper layer of GAGG in GRAC-1 to four layers of double-sided silicon strip detectors (DSSD). Results show that the minimum detectable polarization (MDP) for Cygnus X-1 and Crab in the low-energy band (80-160 keV) reaches lower values with the DSSD detectors (8.8% for Cygnus X-1 and 8.1% for Crab) than with the GRAC-1 model (18.5% for Cygnus X-1 and 16.7% for Crab). On the contrary, in the high-energy band (400-2000 keV), MDP reaches lower values with the GRAC-1 model (46% for Cygnus X-1 and 19.5% for Crab)than with the DSSD detectors (77.7% for Cygnus X-1 and 30.5% for Crab). This result implies GAGG scintillators can scatter more higher-energy photons than DSSD.

Constraining the composition of AGN bubbles using the Sunyaev-Zel'dovich effect.

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Active Galactic nucleus (AGN) feedback is the most promising solution for the cooling-flow problem in cool-core clusters. However, the composition of AGN jets is uncertain. The thermal Sunyaev-Zel'dovich (tSZ) effect is proposed to be a new way to constrain the composition of AGN jet-inflated bubbles, because the tSZ effect for cosmic rays (CRs) is expected to be much smaller than that for the thermal gas. Using 3D magnetohydrodynamic simulations of CR dominated AGN jets, we analyze the tSZ effects of the simulated bubbles. Our results show that CR dominated bubbles indeed would appear as "cavities" on the tSZ map, confirming the feasibility of using SZ effect to constrain the bubble composition. We also quantified the amount of the tSZ decrements as a function of different viewing angles.

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Investigating the Effect of r-Process Heating Feedback on Disk Outflow from Binary Neutron Star Merger

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The multimessenger detections of kilonova GW170817, resulting from the merger of two neutron stars, reveal several interesting questions about the properties of radioactively powered ejecta. The merger ejecta can produce elements heavier than iron through r-process nucleosynthesis. The heavy element abundances are sensitive to the ejecta properties, which may be affected by the feedback from r-process heating. In this project, we use viscous hydrodynamic simulations to investigate the impact of r-process heating feedback on disk outflow. Starting from an equilibrium torus surrounding the central remnant black hole, we use a parameterized nuclear heating method based on the local electron fraction on the disk outflow and analyze the resulting outflow dynamics and nucleosynthesis yields.

Possible Generation of Gravitational Waveforms from Core-Collapse Supernova Using Conditional Variational Autoencoder

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Detecting gravitational waves (GW) from the core-collapse supernova (CCSN) will be one of the most awaited events in gravitational wave astronomy. Till now, there has been no confirmed detection of the GW from the CCSN, which makes it more interesting and challenging to understand the exact nature of such an emission mechanism. There are a few existing CCSN simulations that provide waveforms for some progenitor mass however, these simulations are computationally expensive, especially in the domain of parameter estimation. In this work, we take the advantage of conditional variational autoencoder (CVAE), a machine learning approach, to train and generate CCSN waveforms. We chose waveforms from the available CCSN waveforms as the training data and condition the CVAE on the parameters of the waveforms. For the current work, we have 804 waveforms having seven different equations of state (EOS), and we have considered differential rotation and rotational profile as the conditioning parameters for the training data. For the training, 600 waveforms have been used and the remaining were equally divided into test and validation data. After the training is completed, we generate waveforms based on the required physical parameters while remaining agnostic about the EOS. For the current scenario, training 600 waveforms takes ~3 hours to finish the training and requires ~milliseconds to generate the waveforms. Once trained, the CVAE can generate CCSN waveforms for a wide range of required conditioned parameters on a rapid timescale and accepted accuracy. Generating CCSN waveforms using CVAE would reduce computation time and resources while providing consistent results. Keywords: Core-collapse supernova, gravitational waveforms, conditional variational waveforms.

An unknown bright X-ray source near PSR J0613-0200

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A bright, yet unknown source was found in the data taken by XMM/EPIC in a March 22, 2007 observation. It is consistent with a point source and we designate this source as XMM J0614-0159. From GAIA EDR3, we found an optical source located about 1 arcsec away from the central position of the XMM source. This might be the optical counterpart of the source, which was also observed in the Pan-STARRS (optical), ALLWISE, and 2MASS (IR) archival data. Our study reveals that the optical source is a M-type star with the GAIA g-band apparent magnitude of 15.08, a mean surface temperature of 3400 K, and a distance of 233 +/- 15 pc. Whether this optical source is a counterpart to the X-ray source is being investigated. We also report this X-ray source's XMM spectral and timing analysis results and discuss its possible nature.

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NICER Data Analysis for Improved Spectral Analysis of Supersoft X-ray Sources through Optimization of Background Models using XSPEC

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Supersoft X-ray sources (SSSs) emit X-rays primarily within the energy range of 0.1 to 1 keV, some sources may also emit X-rays with energies outside of this range. SSSs are a fascinating class of astronomical objects that are typically associated with the accretion of material onto compact objects like white dwarfs. Accurate spectral analysis of SSSs is essential for understanding their emission mechanisms, but complex background signals can complicate this process. In this study, we leverage NICER data analysis to investigate the effectiveness of various background models in XSPEC for improving the spectral analysis of SSSs. We compare the performance of different background models, including the widely-used 3C50, Space Weather, and SCORPEON models, using a comprehensive set of X-ray data from a known SSS. We apply these models to a set of NICER data from a known SSS and analyze the resulting spectra using XSPEC. Our results show that the choice of background model can have a significant impact on the accuracy of spectral fits, with 3C50 ,Space Weather X-ray background model providing the best overall results for SSS analysis. This study showcases the power of NICER data analysis in advancing our understanding of SSSs and highlights the importance of optimal background modeling in X-ray spectral analysis. By providing valuable recommendations for enhancing the accuracy of such analyses, our research paves the way for further discoveries and insights into the fascinating world of SSSs

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Detection of Gravitational Waves Using Empirical Mode Decomposition and Convolutional Neural Network

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We have developed a gravitational wave detection algorithm that combines empirical mode decomposition (EMD) and convolutional neural network (CNN). The EMD decomposes the input signal into several intrinsic mode functions, allowing us to highlight the frequency and power evolution of Compact Binary Coalescence signals, and effectively creates a two-dimensional map for CNN input. We evaluated the performance of our model by analyzing the relationship between signal-to-noise ratio (SNR) and model accuracy, and the results showed that there was no significant correlation between SNR and accuracy on our validation dataset, with an average accuracy of 82.5%. In the future, we will work on addressing the domain shift problem between simulated and real data, and continuously improve the accuracy of our model.

A Mars City in Taiwan - An astronomy outreach project

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The "Taiwan Mars City - Astronomy Outreach Project" aims to collaborate with the High-Resolution Stereo Camera (HRSC) team onboard the Mars Express spacecraft to introduce the various features of Mars and its moon, Phobos, to the public and provide basic scientific education. As two of the closest celestial bodies in our solar system, Mars and Phobos have long been the focus of scientists and space enthusiasts alike. By showcasing photos and 3D models of these objects, the 'Taiwan Mars City' project seeks to display the geologic, geophysical, and geochemical features of the Martian surface, as well as potential signs of life. It is worth noting that the French-German rover to Phobos is a part of the Martian Moons eXploration (MMX) mission of JAXA, which further highlights the importance of studying this fascinating moon. Additionally, the "Taiwan Mars City" project will use exhibitions to introduce the public to the most advanced space technology and exploration projects around the world, including human missions to Mars, building Martian bases, and exploring deep space. Through these displays and introductions, the "Taiwan Mars City" project aims to inspire the next generation of scientists and space enthusiasts to develop an interest and passion for space exploration. In the final stage of the project, the "Taiwan Mars City" project will also hold a student competition. The purpose of this competition is to guess the landing site of the moon rovers from the French National Center for Space Studies (CNES) and the German Aerospace Center (DLR) on Phobos. Through this competition, we hope to further promote scientific inquiry and understanding, as well as the development of space exploration. Additionally, we hope to use this opportunity to promote international cooperation in space, and to collaborate further with the Mars Express project and/or the German Aerospace Center.