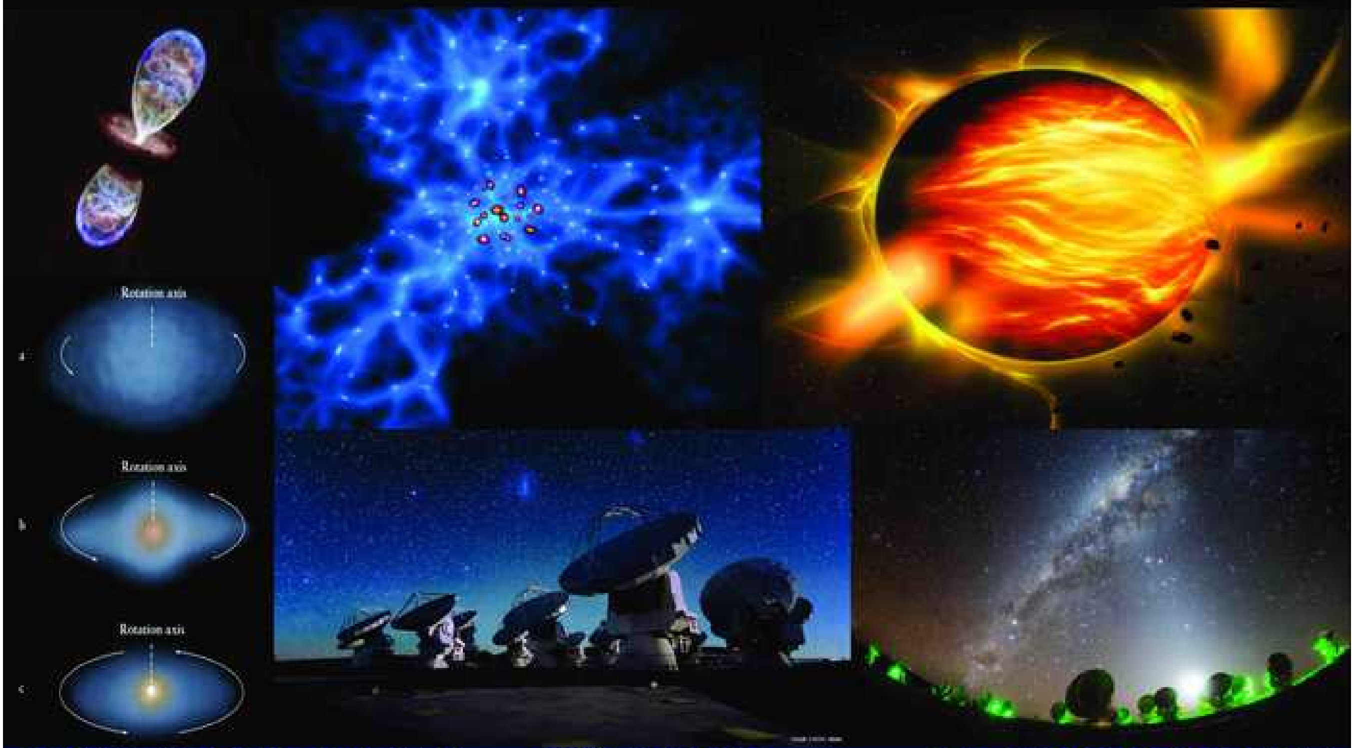
STAR FORMATION IN DIFFERENT ENVIRONMENTS 2017 (SFDE17): FROM LOCAL CLOUDS TO DISTANT GALAXIES

ICISE, Quy Nhơn, Việt Nam **06-12 August 2017**

Website: *http://rencontresduvietnam.org/conferences/2017/sfde2017/*



SCIENTIFIC ORGANIZING COMMITTEE

Francoise Combes (Observatoire de Paris, FR)
Daisuke Iono (NAOJ, JP)
Bruce Elmegreen (IBM, US)
Daniel Espada (NAOJ, JP)
Jens Kauffmann (MpifR, DE)
Guinevere Kauffmann (MPIA, DE)
Woong-Tae Kim (SNU, KR)
Mark Krumholz (ANU, AU)
Adam Leroy (Ohio State University, US)
Satoki Matsushita (ASIAA, TW) (Co-Chair)
Frédérique Motte (Grenoble university, FR)
Fumitaka Nakamura (NAOJ, JP) (Co-Chair)
Quang Nguyen-Luong (KASI, KR)
Christine Wilson (McMaster University, CA)

INVITED SPEAKER

Susanne Aalto (Chalmers, SE)
Pierre Cox (ALMA JAO, CL)
Neal Evans (UTexas, US)
Christoph Federrath (ANU, AU)
Yu Gao (PMO, CN)
Bunyo Hatsukade (NAOJ, JP)
Jacqueline Hodge (Leiden, NL)
Jens Kauffmann (MpifR, DE)
Kohno Kotaro (Tokyo Univ., JP)
Alex Lazarian (Wisconsin, US)
Elisabeth Mills (San Jose, US)
Tomoharu Oka (Keio Univ., JP)
Sachiko Onodera (Meisei, JP)
Ralph Pudritz (McMaster, JP)
Chelsea Sharon (McMaster, CA)
Naoki Yoshida (Kavli IPMU, JP)
Cara Battersby (CfA, US)

LOCAL ORGANIZING COMMITTEE

Fumitaka Nakamura (NAOJ, JP)
Quang Nguyen-Luong (KASI, KR)
Jean Tran Thanh Van (ICISE, VN)
Tran Thanh Son (ICISE, VN)

TOPICS

– Local star formation, SF in the Milky Way molecular clouds, ISM, stellar feedback, cluster formation, massive SF, galactic center, …
– Nearby galaxies Environmental effect,interacting galaxies,……..
– High-z (including primordial star formation)
– Connecting all scales of SF and the universal processes of star formation
– Pre-conference bootcamp (Sat & Sun) (lectured by Neal Evans, Alex Lazarian, Naoki Yoshida)

NAOJ RENCONTRES DU VIETNAM ICISE

ORGANIZING COMMITTEE

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Jean Tran Thanh Van (ICISE, Vietnam)
Tran Thanh Son (ICISE, Vietnam)

Contact Us

Secretary: Aimie Fong (ICISE, Vietnam)
rencontres.vietnam@gmail.com
sfde16@gmail.com

SYNOPSIS

Building upon the success of the SFDE16 conference held in ICISE, Quy Nhon, Vietnam, we will get together again in 2017 to discuss about the recent progress in star formation from local clouds to distant galaxies. The conference will highlight the recent advances in wide-field and high resolution surveys and detail numerical simulations of star formation in different environments, from individual star to galaxy systems. The idea is to search for a universal picture of star formation across all scales and also identify the characteristics of each individual scale.

The goal of the conference is to share the different views from different research communities by balancing contributions from different categories and to encourage collaborations between researchers across the Globe. Depending on the demand, we might continue as SFDExSeries in the next years. Ample time is set a side to encourage discussions and collaboration.

PRACTICAL INFORMATION

Registration

The registration for all participants will take place at 16:00 on Sunday Aug 06th at Seagull Hotel. Please register as soon as you arrive at the hotel, fill in an ARRIVAL FORM and hand it to the conference secretaries. All payments must be completed by Tuesday evening. The accommodation will bepaid to the conference secretariat and not directly to the hotel. Our conference secretariat office is located at ICISE, open from 8:15 to 12:30 and from 13:30 to 17:30.

Welcome Cocktail

All participants, their families and guests are invited to a welcome drink at 19:00 on Sunday Aug 06th at Seagull Hotel followed by a buffet dinner at 19:30.

Khách Sạn Hải Âu - Seagull Hotel:

489 An Dương Vương, Quy Nhơn, Bình Định, Việt Nam

Phone: +84 2563 846 377

Meals

- All meals are served either at Seagull hotel or at ICISE Center. You will need the daily coupon provided to you at registration time.

- For the beverage, if you wish order alcoholic or soft drinks, it will be charged toyour hotel account. If you are sharing a room, please find an arrangment with your room mate for both your telephone and beverage bills.

- Breakfast will be served at your hotel.

- Lunch for the participants will be served at ICISE. Accompanying persons can have lunch at ICISE center or at the Seagull hotel. To get lunch at the Seagull hotel, please tick your name on the paperboard in the hotel lobby, the day before. Lunch at the hotel will be served from 12:30 to 13:00 **(no lunch will be served after 13:15)**. To get lunch at ICISE center, please be there at 12:30 sharp. You can go there by taxi (10-15 minutes, cost: 100.000VND ~ 5 USD).

Directions to ICISE in Vietnamese to show to the taxi driver:

Trung tâm Quốc tế Khoa học và Giáo dục Liên ngành (ICISE) Phường Ghềnh Ráng

1. Từ đường Tây Sơn, đi theo QL 1D, đến trạm Kiểm Dịch, rẽ trái.
2. Cuối đường nhựa, Trung tâm Quốc tế Khoa học ICISE nằm bên tay phải.

- Dinner: all participants and their families take the dinner in the Phong Lan restaurant of the Hotel at 19:00, with a few exceptions to be announced.

- Please let us know your preference (vegetarian, vegan ...) so that we can inform the hotel.

- In any case, please bring along with you your meal coupons, provided to you at registration time.

The Conference Center

The conference center is located at ICISE (International Center for Interdisciplinary Science and Education):

Trung tâm Quốc Tế, Khoa Học và Giáo Dục liên ngành (ICISE)

Address: Quốc lộ 1D, Khu vực 2,Phường Ghềnh Ráng, Thành Phố Quy Nhơn, Bình Định, Việt Nam

Phone number: +84 563 540 099

Bus Shuttle from/to Hotels to/from ICISE

Shuttle bus between the hotels and the conference center From Hotels to ICISE: The first bus departure from Seagull hotel to ICISE is at 7:30. The last one is at 8:00. ICISE to hotels: The first bus back to hotel is at 17:30 and the last one is at 18:30. Exceptions: Wednesday: shuttle bus only for participants who wish to use ICISE for small-group meetingThursday July 28th : The conference banquet will be held at 19:00 on Thursday at ICISE. Bus from Seagull hotel to ICISE for accompanying persons is at 18:15.will be held at 7.00 pm on Thursday at ICISE. Bus from hotel to ICISE for accompanying persons at 18h15.

Useful Information

- Internet: WIFI is available at the hotel as well as ICISE. Password is ICISE20130812 for guests.

- Beach time: There will be sufficient time for swimming during lunch time so bring along your towel and bathing suit if you want to swim.

- Telephone: If you share a room, please keep track of your calls because there isonly one telephone per room and the billing is done for each room. Telephone bills should be settled before you leave.

- Wifi on street: If it happens that you need internet on street somewhere, you cango to any small cafe for a cup of coffee and ask for wifi password.

- Prepaid Mobile phone and 3G internet SIM cardPrepaid sim card for phone and internet data is relative cheap in Vietnam. Vinaphone, Mobilfone and Viettel are three phone and internet providers who providethe Tourist SIM which cost around 200,000 VND or 10 USD. These tourist SIM offers you around 50 minutes international call, 100 minutes domestical call, free text messages, 3G internet connection (depending on the provider). These SIM cards can be bought at the airport, electronic or phone shops. Please check thedetail here:

http://www.mobifone.com.vn/wps/portal/public/goi-cuoc/theo-doi-tuong/happy-touristhttp://www.vietteltelecom.vn/mobile.php/chi-tiet-dich-vu/tourist-goi-cuoc-danh-cho-khach-du-lichhttp://www.3gvinaphone.pro.vn/2016/07/tourist-sim-vinaphone.html

- Banking facilities: Exchange currency service is available at the hotel reception, local bank branches or any jewellery shops. ATM machines can be found on the opposite side of the hotel.

- Pick-up from the airport on Sunday August 6th: For the arrival in Quy nhon on Sunday August 06th, there will be a transfer by bus from the airport to Seagull hotel for the participants and their families for registration. There will be a welcome team at the airport at the arrival of all flights from HCM and Hanoi. The luggage arrival room is very small so you will not miss it. Please try to find the table with ICISE sign. To access to the conference bus, participants MUST inform the conference secretariat of their flight number and the scheduled arrival time before July 23th in order to secure a seat in the conference bus. For the other days: please contact the conference secretaries for a pick-up by taxi.

- Drop-off to the airport on Saturday Aug 12th For the departure from hotels to the airport on Saturday Aug 12th, there will be a transfer by bus at 7:10 from the Seagull hotel.

At 15 : 00 from the Seagull hotel For the other flights Please contact the conference secretaries for a taxi transfer. The transfer cost willbe at your charge. Please be ready on time at the hotel lobby. We will organize departure by taxi forthe other flights. DON'T FORGET TO GET BACK YOUR PASSPORT AT THE HOTEL RECEPTION DESK BEFORE YOU LEAVE!

- Special announcements: A paperboard will be at the Secretaries office in ICISE.For accompanying persons, a paper board will be at the hotel reception hall. Please check it regularly. If you would like to.

Urgent & Emergency Contacts

You can call us any time if you have any emergency request including visa at theairport, pick up, medical help...

Betty Binh : + 84 918 055 743

Thao Ly : + 84 962 617 406

LIST OF PARTICIPANTS

Invited Speakers

01 Pierre Cox (ALMA JAO, CL)
02 Christoph Federrath (ANU, AU)
03 Jens Kauffmann (MpifR, DE)
04 Elisabeth Mills (San Jose, US)
05 Tomoharu Oka (Keio Univ., JP)
06 Yu Gao (PMO, CN)
07 Susanne Aalto (Chalmers, SE)
08 Sachiko Onodera (Meisei, JP)
09 Ralph Pudritz (McMaster, JP)
10 Jacqueline Hodge (Leiden, NL)
11 Chelsea Sharon (McMaster, CA)
12 Kohno Kotaro (University of Tokyo, JP)
13 Naoki Yoshida (Kavli IPMU, JP)
14 Satoki Matsushita (ASIAA, focus group)
15 Neal Evans (UTexas, US)
16 Alex Lazarian (Wisconsin, US)
17 Cara Battersby (CfA)

SOC

Registered Participants

1	Andersen	Morten	Gemini Observatory	La Serena	Chile
2	Bemis	Ashley	Mcmaster University	Hamilton	Canada
3	Casey -Clyde	James	San Jose State University	San Jose	USA
4	Chen	Huei-Ru	National Tsing Hua University	Hsinchu	Taiwan ROC
5	Cormier	Diane	CEA Saclay	Gif-sur-Yvette	France
6	Cox	Pierre	ESO ALMA	Santiago	Chile
7	Diaz	Ruben Joaquin	Gemini Observatory	Tucson	USA
8	Duong	Tuan Anh	Explora-Science Center	Quy Nhon	Vietnam
9	Evans	Neal	The University of Texas at Austin and KASI	Austin	USA
10	Federrath	Christoph	Australian National University	Canberra	Australia
11	Fensch	Jeremy	CEA Saclay	Gif-sur-Yvette	France
12	Hensler	Gerhard	University of Vienna	Vienna	Austria
13	Ho Thi	Ly	Tay Nguyen University	Buon Ma Thuot	Vietnam
14	Ho Viet	Hai	Tay Nguyen University	Buon Ma Thuot	Vietnam
15	Hoang	Thiem	KASI and of Science and Technology	Daejeon	Korea
16	Hony	Sacha	University of Heidelberg	Heidelberg	Germany
17	Inoue	Akio	Osaka Sangyo University	Daito	Japan
18	Jameson	Katherine	Australian National University	Weston Creek	Australia
19	Kauffmann	Jens	Max-Planck-Institute for Radio Astronomy	Bonn	Germany
20	Kim	Jeong-Gyu	Seoul National University	Seoul	Korea
21	Kim	Minbae	Kyung Hee University	Gyeonggi-do	Korea
22	Kohno	Kotaro	The University of Tokyo	Tokyo	Japan
23	Ladjelate	Bilal	Aim CEA Saclay	Gif-sur-Yvette	France
24	Lee	Sungho	KASI	Daejeon	Korea
25	Louvet	Fabien	Universidad de Chile	Santiago	Chile
26	Lu	Xing	National Astronomical Observatory of Japan	Tokyo	Japan
27	Ly Thi Kim	Cuc	Quy Nhon University	Quy Nhon	Vietnam
28	Marston	Anthony	ESA STScI	Baltimore	USA
29	Matsushita	Satoki	Academia Sinica Asiaa	Taipei	Taiwan ROC
30	Messa	Matteo	Stockholm University	Stockholm	Sweden

31	Michiyama	Tomonari	National Astronomical Observatory of Japan	Tokyo	Japan
32	Mills	Elisabeth	San Jose State University	San Jose	USA
33	Nakatani	Riouhei	The University of Tokyo	Tokyo	Japan
34	Nayak	Omnarayani	Johns Hopkins University	Baltimore	USA
35	Nguyen	Dang Thanh Nhan	Tay Nguyen University	Buon Ma Thuot	Vietnam
36	Nguyen	Mai Khanh	Ho Chi Minh City University of Education	Ho Chi Minh	Vietnam
37	Nguyen	Phuong	Tay Nguyen University	Buon Ma Thuot	Vietnam
38	Nguyen	Thi Phuong	VAST	Hanoi	Vietnam
39	Nguyen	Uyen	Tay Nguyen University	Buon Ma Thuot	Vietnam
40	Nguyen Luong	Quang	KASI	Tokyo	Japan
41	Nguyen Phuoc Vinh	Son	Ho Chi Minh City University of Education	Ho Chi Minh	Vietnam
42	Nguyen Thi Thu	Huyen	Tay Nguyen University	Buon Ma Thuot	Vietnam
43	Nguyen Tien	Duc	Tay Nguyen University	Buon Ma Thuot	Vietnam
44	Nguyen Xuan Thuy	Na	Tay Nguyen University	Buon Ma Thuot	Vietnam
45	Nigoche	Alberto	Universidad de Guadalajara	Guadalajara	Mexico
46	Oka	Tomoharu	Keio University	Kanagawa	Japan
47	Okabe	Taizo	The University of Tokyo	Tokyo	Japan
48	Onodera	Sachiko	Meisei University	Tokyo	Japan
49	Orr	Matthew	California Institute of Technology	Pasadena	USA
50	Padoan	Paolo	University of Barcelona and Icrea	Barcelona	Spain
51	Pham	Tuan-Anh	Vietnam National Satellite Center VAST	Hanoi	Vietnam
52	Phan	My Hao	Tay Nguyen University	Buon Ma Thuot	Vietnam
53	Povic	Mirjana	Institute of Astrophysics of Andalucia	Granada	Spain
54	Reiter	Megan	University of Michigan	Ann Arbor	USA
55	Rigby	Andréw	Cardiff University	Cardiff	United Kingdom
56	Ritacco	Alessia	IRAM	Granada	Spain
57	Samanta	Chhanda	Virginia Military Institute	Lexington	USA
58	Seo	Woo-Young	Seoul National University	Seoul	Korea
59	Seon	Kwang-Il	KASI	Daejeon	Korea
60	Sharma	Ekta	Aryabhatta Research Institute	Nanital	India
61	Sharon	Chelsea	Mcmaster University	Hamilton	Canada
62	Stamer	Torsten	Nagoya University	Nagoya	Japan
63	Sun	Ning-Chen	Peking University	Beijing	P.R. China
64	Tanaka	Kunihiko	Keio University	Yokohama	Japan
65	Tomicic	Neven	Max Planck Institute for Astronomy	Heidelberg	Germany
66	Tran	Huong	Tay Nguyen University	Buon Ma Thuot	Vietnam
67	Tran	Phuoc Vinh	Tay Nguyen University	Buon Ma Thuot	Vietnam
68	Tran	Quynh	Tay Nguyen University	Buon Ma Thuot	Vietnam
69	Tran Thi	Hoang	Tay Nguyen University	Buon Ma Thuot	Vietnam
70	Truong	Xuan Nhut	Ifirse	Quy Nhon	Vietnam
71	Verbeke	Robbert	Astronomical Observatory Ghent University	Gent	Belgium
72	Williams	Gwenllian	Cardiff University	Cardiff	United Kingdom

73	Wu	Benjamin	National Astronomical Observatory of Japan	Mitaka	Japan
74	Yan	Qingzeng	Shanghai Astronomical Observatory	Shanghai	P.R. China
75	Yoshida	Naoki	The University of Tokyo	Tokyo	Japan

Bootcamp Participants:

1. Jeremy Fensch (CEA Saclay)
2. Siyao Xu (PKU)
3. Ly Thi Kim Cuc (Quy Nhon university)
4. James Casey-Clyde (JSJU, US)
5. Nguyen Dang Thanh Nhan (Tay Nguyen university)
6. Tran Phuoc Vinh (Tay Nguyen university)
7. Nguyen Phuoc Vinh Son (Tay Nguyen university)
8. Tran Thi Thu Huong (Tay Nguyen university)
9. Le Thi Cam Le (Tay Nguyen university)
10. Phuong Nguyen (VNSC)
11. Pham Tuan Anh (VNSC)
12.Torsten Stammer (Nagoya university)
13. Phù Sanh Thạch Thảo (Sai Gon University, Vietnam)
14. Phù Sanh Thảo Vy (Vietnam)
15. Lê Huy Văn (Quy Nhon university)
16. Phan Tố Quyên (Quy Nhon university)
17. Đinh Thành Tấn (Quy Nhon university)
18. Bùi Thị Lý Hạnh (Quy Nhon university)
19. Nguyễn Duy Khanh (Quy Nhon university)
20. Trịnh Thảo Quyên (Quy Nhon university)
21. Bui Thanh Huy (Intel, VGU)
22. Duong Tuan Anh (ICISE)
23. Nguyen Mai Khanh (Ho Chi Minh City University of Education, VN) (no email)
24. Nguyễn Thị Vy Phương (Quy Nhon university)
25. Ekta Scharma (Aryabhatta Research Institute Nanital India, IN)
26. Ning-Chen Sun (Peking university)

PROGRAM SCHEDULE

Saturday & Sunday :
Bootcamps for senior-undergraduate and graduate students

Saturday 09.00-11.00: **Nguyen Luong Quang (KASI, KR)** – bootcamp introduction

Saturday 11.00-12.00: **Torsten Stamer (Nagoya, JP)** -View from a graduate student in star formation

Saturday 18.30-21.00: **Neal Evans (UTexas, US)** – Physical conditions in regions of star formation

Sunday 08.30-12.00: **Naoki Yoshida (Kavli IPMU, JP)** - Star formation in the early universe

Saturday 14.00-18.00: **Alex Lazarian (Wisconsin, US)** – MHC turbulence and star formation

Saturday 18.00-19.00: **Ralph Pudritz (McMaster, CA)** – Massive star formation

SESSION: Local star formation in the Milky Way

08:30 – 09:00 Welcome Speeches (LSO, SOC, government, photos)

09:00 – 09:30 Break and Poster (30)

09:30 – 10:10: Special Review: **Pierre Cox (ALMA JAO)**, Star Formation in the Era of ALMA

10:10 – 10:30 (C20) **Nguyen Luong Quang (KASI, KR)** , Deviation from Larson and Schmidt-Kennicutt relations in Galactic Molecular cloud complexes

10:30 – 10:50 (C20) **Gwenllian Williams (Cardiff Univ.)** – JVLA observations of SDC13: Gravity drives the evolution of infrared dark hubs

10:50 – 11:10 (C20) **Vivien Chen (NTHU-Taiwan)** – Filamentary accretion flows in the IRDC M17SWex

11:10 – 11:30 (C20) **Andrew Rigby (Cardiff Univ.)** – Dust property variations in IRDCs: A NIKA view

11:30 – 11:50 (C20) **Anthony Martson (ESA/STScI, Baltimore)** – The conditions for the creation of massive stars and their distribution

11:50 – 13:30 Lunch and Poster (30)

13:30 – 13:50 **Megan Reiter (Univ. of Michigan)** – Unstuck in the middle with you: intermediate-mass stars are the missing link in star formation

13:50 – 14:10 **Alessia Ritacco (IRAM)**– Magnetic fields in Galactic star forming regions. Observations with NIKA and NIKA2

SESSION: Star formation inhibition in the Central Molecular Zones

14:10 – 14:50 (R40) **Jens Kauffmann (MpifR, DE)**

14:50 – 15:10 (C20) **Qingzeng Yan (SHAO, CN) empty** The three-dimensional distribution of the molecular clouds in the Galactic Centre

15:10 – 15:30 (C20) **Kunihiko Tanaka (Keio Univ.)** – Star formation conditions in the Milky Way's Galactic central region

15:30 – 16:00 break and Poster (30)

16:30 – 17:00 (I30) **Tomoharu Oka (Keio Univ.)** – Signatures of past star forming activity in the CMZ of our Galaxy

17:00 – 17:20 (C20) **Xing Lu (NAOJ)** – The molecular environment of star formation in the CMZ

17:20 – 17:40 (C20) **Woo-Young Seo (Seoul National Univ.)** – Star formation in the nuclear regions of barred galaxies

TUESDAY:

SESSION: Star formation in nearby galaxies

08:30-09:10: (I40) Invited review: **Yu Gao (PMO, CN)** Star formation laws in galaxies near and far

09:10-09:30: (C20) **Neven Tomicic (MPIA)** – A detailed view on ionized gas, dust and star formation in M31

09:30-09:50: (C20) **Tomonari Michiyama (NAOJ)** – Dense molecular outflows from the merging galaxy NGC3256

09:50-10:10: (C20) **Ashley Bemis (McMaster Unv.)** – Investigating Dense Gas and Star Formation in the Antennae Galaxy (NGC4038/39) using ALMA

10:10–10:40 Break and Poster (30)

10:40–11:10: (I30) Invited talk: **Satoki Matsushita (ASIAA)** – The Molecular Baryon Cycle of M82

11:10–11:30: (C20) **Matteo, Messa (Stockholm University)** – Environmental dependence of cluster formation and evolution in M51

11:30-11:50: (C20) **Katie Jameson (Australian National Univ.)** – Gas Temperature Demography and the HI-to-H2 Transition in the Magellanic Clouds

11:50 – 14:00 Lunch and Poster (30)

SESSION: Star formation in simulation and theory

14:00 – 14:40 (R40) Invited review: **Ralph Pudritz (McMaster, CA)** – Radiative feedback and cluster formation across the giant molecular cloud mass spectrum

14:40 – 15:00 (C20) **Jeong-Gyu Kim (Seoul National Univ.)** – Disruption of Molecular Clouds by Photoionization and Radiation Pressure

15:00 – 15:20 (C20) **Torsten Stamer (Nagoya Univ.)** – Radiation Hydrodynamics Simulation of Protostellar Collapse: Constraints on Brown Dwarf Formation Mechanisms

15:20 – 15:50 (I30) Invited talk: **Christoph Federrath (ANU, AU)** The Role of Turbulence, Magnetic Fields, and Feedback for Star Formation

15:50 – 16:20 break and Poster (30)

16:20-16:40: (C20) **Gerhard Hensler (Univ. of Vienna)** – Star formation at low rates: how a lack of massive stars may affect stellar feedback and the evolution of dwarf galaxies

16:40-17:10: (I30) Invited talk: **Paolo Padoan (Univ. of Barcelona)** – The Star Formation Rate of Molecular Clouds in SN-driven Turbulence

WEDNESDAY: Excursion and free time

THURSDAY:

SESSION: Star formation in High-z galaxies and primordial star formation

08:30-09:10: (R40) Invited review: **Jacqueline Hodge (Leiden, NL)** Star formation in high-z galaxies

09:10-09:30: (C20) **Akio, Inoue (Osaka Sangyo Univ.)** – [OIII], [CII] and dust of star forming galaxies in the reionization epoch

09:30-10:10: (R40) Invited review: **Naoki Yoshida (Kavli IPMU, JP)** – Formation of primordial stars and black holes

10:10–10:40 Break and Poster (30)

10:40–11:10: (I30) Invited talk: **Chelsea Sharon (McMaster, CA)** – The Effects of Star Formation and Gas Tracers on the Spatially Resolved Schmidt-Kennicutt Relation at High Redshift

11:10–11:30: (C20) **Tuan-Anh PHAM (VNSC)** – On the dust and gas components of the z = 2.8 gravitationally lensed quasar host RX J0911.4+0551

11:30-11:50: (C20) **Robbert Verbeke (Ghent Univ.)** – How primordial star formation shaped the present day dwarf galaxies

11:50 – 14:00 Lunch and Poster (30)

SESSION: Galactic Winds, Feedback, Magnetic field, and other processes

14:00-14:40: (I30) Invited talk: **Alex Lazarian (Wisconsin, US)** – Galactic Winds, Feedback, and Magnetic field

14:40-15:00: (C20) **Fensch Jeremy (CEA Saclay)** – High gas fraction and clustered star formation in z~2 galaxies

15:00-15:30: (I30) **Thiem Hoang (KASI/UST, Korea)** – Can we trace magnetic fields via polarized mid-infrared emission by PAHs?

15:30-15:50: (C20) **Riouhei Nakatani (University of Tokyo)** – Radiation-hydrodynamical simulations of photoevaporating protoplanetary disks with various metallicities

15:50 – 16:30 break and Poster (30)

16:30-16:50: (C20) **Siyao Xu (KIAA)** – The role of neutral-ion coupling in star formation

16:50-17:10: (C20) **Kwang-il, Seon (KASI)** – LYα Radiative Transfer and The Wouthuysen-Field effect in the Milky Way Galaxy

17:10-17:30: (C20) **Ekta Sharma (Aries, Nainital, India)** – Optical polarimetry and molecular line studies towards L1157 dark molecular cloud

FRIDAY:

SESSION: Connecting star formation at different scales

8:30–9:00: (I30) Invited talk: **Sachiko Onodera (Meisei, JP)** – Breakdown of the Kennicutt-Schmidt law at giant molecular cloud scales

9:00–9:20: (C20) **Sacha Hony (Univ. of Heidelberg)** – PAH emission across different environments in the Magellanic Cloud galaxies

9:20-9:40: (C20) **Benjamin Wu (NAOJ)** – Star cluster formation triggered by giant molecular cloud collisions

10:00–10:40 Break and Poster (30)

10:40 – 11:00 (C20) **Ning-Chen Sun (KIAA)** – A Study of Young Stellar Structures in the Magellanic Clouds with the VMC Survey

11:00 – 11:20 (C20) **Matthew Orr (Caltech)** – What FIREs Up Star Formation: the Kennicutt-Schmidt Law and Gravitational Instabilities in Cosmological Simulations

11:20 – 11:40 (C20) **Mirjana Povic (IAA, Spain)** – Star formation and AGN activity in the most luminous LINERs in the local universe

11:40-12:00: **(C20) Diane Cormier (CEA Saclay)** – The EMPIRE survey: 13CO emission across nearby disk galaxies

12:00 – 14:00 Lunch break and Poster

14:00-14:30: (I30) Invited talk: **Kohno Kotaro (NAOJ)** – Dusty star-forming galaxies explored with ALMA

14:30-14:50: (C20) **Omnarayani Nayak (John Hopkins)** – The Most Luminous Young Stellar Object in the Large Magellanic Cloud

14:50-15:10: (C20) **Morten Andersen (Gemini)** – Catching massive star cluster formation at its earliest stages

15:10-15:30: (C20) **Nguyen Thi Phuong (VNSC)** - GG Tau A: dynamics and clumps inside the cavity

15:30-16:10: (R40) Invited review: **Neal Evans (UTexas/KASI)** – Star formation from nearby clouds to distant galaxies: Common Features and Common Myths

LIST OF ABSTRACTS

Molecular Gas Winds and Feedback from Nearby Star Forming Galaxies

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Cold gas plays a central role in feeding and regulating star formation and growth of supermassive black holes (SMBH) in galaxy nuclei. Particularly powerful activity occurs when interactions of gas-rich galaxies funnel large amounts of gas and dust into nuclei of luminous and ultra luminous infrared galaxies (LIRGs/ULIRGs). These dusty objects are of key importance to galaxy mass assembly over cosmic time.

Some (U)LIRGS have deeply embedded galaxy nuclei that harbour a very active evolutionary stage of AGNs and/or starbursts. The nuclear activity will often drive mechanical feedback in the form of molecular winds, jets and outflows. This Feedback may for example remove baryons from low-mass galaxies, prevent overgrowth of galaxies, explain “red-and dead” properties of local ellipticals, and be linked to the

M$_{\rm BH}$-σ-relation. With the advent of ALMA and the NOEMA telescopes we can now study the extent, morphology, velocity structure, physical conditions and even chemistry of these cold flows at unprecedented sensitivity and resolution. We use molecules as diagnostic tools - exploiting their ability to trace dynamical, chemical and physical conditions.

I will give a brief review of the ALMA view of starburst and AGN feedback in nearby galaxies. I will show how ALMA helps reveal the link between the feedback and the molecular properties of the galaxies as well as the nature of the starburst/AGN. I will discuss the extreme environments of obscured, compact nuclei as well as gaseous bars and rings.

I will review the use of molecules (e.g. H$_2$O, H$_3$O^{+}, HCN, HCO$^+$, H$_2$S) for studying dusty nuclei and the nature of the embedded activity. We can, for example, investigate ionization rates and the impact of cosmic ray-, X-ray- and PDR-chemistry and the onset of feedback in the form of outflows and winds

Catching massive star cluster formation at its earliest stages

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The formation mechanism of massive star clusters is still poorly known, in particular the time scale of the cluster formation. Our knowledge has been hampered by the lack of regions that could be studied in detail. We have identified a massive core (at least several thousand Msun in gas) with a strong infall showing it is in the earliest stages of formation. We have target the core and the associated star formation within it across the wavelength range to characterize the star formation process in detail. Here we present the study of the embedded stellar population revealed through a combination of near-infrared VLT and HST observations. We discuss the total stellar mass already formed, the stellar spatial distribution, the disk fraction as well and the estimated age of the embedded population.

Investigating Dense Gas and Star Formation in the Antennae Galaxies (NGC 4038/39) using ALMA

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We study the relationship between dense gas and star formation in the Antennae galaxies (22 Mpc) by comparing high-resolution ALMA observations of dense gas tracers (HCN, HCO+, and HNC J=1-0) to the total infrared luminosity calculated using data from the Herschel Space Observatory. We use OVRO CO data to calculate star formation efficiencies and dense gas mass fractions for these different regions. Upper limits of dense gas emission are derived for the brightest star-forming regions where emission was expected but not detected. We confirm the results from Bigiel et al. (2015), which compares CARMA data of these dense gas tracers in the brightest regions of the overlap region and two nuclei, and extend this analysis to fainter regions of emission. In ongoing work, we extend this work to other nearby mergers using archival ALMA and Herschel data, and we include preliminary results from this analysis.

Filamentary Accretion Flows in the IRDC M17 SWex

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Although filamentary structures are ubiquitous in molecular clouds, basic observational constraints are needed to clarify the role of filaments in the mass assembly process. Using ALMA Band 3, we have observed the N2H+ (1-0) and HNC (1-0) emission in the filamentary accretion flows in the remarkable IRDC complexes, M17 SWex, where a delayed onset of massive star formation was reported in the two hubs at the convergence of multiple filaments of parsec length. The hubs are likely in the course of developing its high-mass end of the IMF. We derived gas kinematics with the N2H+ emission and found the line widths are smaller than those of ammonia, suggesting a transonic nature of dense gas in the filaments. Slow infall motions towards the hubs are detected along the filaments. Multiple velocity-coherent substructures are present in both hubs, likely not yet reaching virial equilibrium.

The EMPIRE survey: 13CO emission across nearby disk galaxies

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While extragalactic star formation is often studied via 12CO emission, isotopologues have the advantage of being more optically thin and are more direct tracers of the column densities in molecular clouds. With the IRAM large program EMPIRE (Bigiel et al. 2016), we have obtained unprecedented full maps of dense gas tracers (HCN, HCO+, and isotopologues) as well as optically thin CO lines (13CO, C18O) across entire disks of 9 nearby spiral galaxies. I will present our new results on the 13CO(1-0) emission, which is detected throughout those galaxies. We analyze variations of the 12CO/13CO ratio amongst and within galaxies, and derive molecular cloud properties, such as optical depths and filling factors, traced by 13CO. We explore how those correlate with star-formation rates, efficiencies, and radiation fields within galaxies. Finally, we calibrate a spatially-resolved 13CO-to-H2 conversion factor that shows less scatter than the 12CO-to-H2 conversion factor. Our results are promising for extragalactic studies as 13CO becomes more easily observable in the ALMA/NOEMA era.

Formation of hadronic stars mixed with self-interacting fermionic asymmetric Dark Matter

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Recent advances in cosmological precision tests indicate that the universe contains about 4.9% ordinary matter, 26.8% dark matter and 68.3% dark energy. Various theoretical models of dark matter exist, ranging from Cold Dark Matter to Warm Dark Matter to Hot Dark Matter and from Symmetric to Asymmetric Dark Matter. Since dark matter interacts with normal baryonic matter through gravity, it is quite possible for white dwarfs and neutron stars to accrete dark matter and evolve to a dark matter admixed compact star. We consider fermionic Asymmetric Dark Matter (ADM) particles of mass 1 GeV mixed with rotating and non-rotating neutron stars. These ADM particles are non self-annihilating and behaves like ordinary free particles. The gravitational stability and mass-radius relations of static rigid and differentially rotating neutron stars mixed with fermionic ADM are calculated. The maximum mass for non-rotating dark matter stars goes to $3.0279 M_\odot$ with a radius of 16.2349 kms for particle mass of 1 GeV, and that for rotating stars it goes to $3.1460 M_\odot$ with a radius of 19.2173 kms.

Star formation in an Extraordinary Hexagon-Like Barred Galaxy

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NGC 7020 is one of the few barred galaxies that present an hexagonal ring central structure, with ansae at its extremes, pointing to the existence of well populated hexagon-like regular orbits surprisingly centered with the galaxy nucleus. In order to study the young stellar population traced by their HII regions, we imaged NGC 7020 with narrow band Hα and nearby continuum filters with GEMINI-S+GMOS-S. The hexagon circumscribes a bunch of young clusters that present Hα line in emission, pointing to the presence of ionizing young massive stars. Outwards, at the border of the disk, appears a circular ring, which is also populated by Hα emitting young clusters. We used the program Sextractor to find more than two hundred Hα emitting condensations. We determined Hα fluxes and the equivalent width of Hα line in emission (WHα), which allows to model the HII regions ages with Starburst99. We determined that the external ring is populated with regions younger than 8 Myr, while the regions located inside the central hexagonal ring are systematically older. The disk at intermediate scales does not present HII regions and the hexagonal ring ansae do not present Hα emission, indicating that the ansae are populated by an older stellar population. We discuss the possible connection between the internal and the external cycles of young cluster formation, and cover the extremely restrictive conditions that lead to the existence of a 6:1 resonance in a disk barred galaxy.

Star Formation from Nearby Clouds to Distant Galaxies: Common Features and Common Myths

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The relations between star formation and gas have received renewed attention. We combine studies on scales ranging from local (within 0.5 kpc) to distant galaxies to assess what factors contribute to star formation. These include studies of star forming regions in the Milky Way, the LMC, nearby galaxies with spatially resolved star formation, and integrated galaxy studies.

We test which tracers provide the best predictor of star formation rate.

The star formation ``efficiency," defined as star formation rate divided by mass, spreads over a large range when the mass refers to molecular gas; the standard deviation of the log of the efficiency decreases by a factor of three when the mass of relatively dense molecular gas is used rather than the mass of all the molecular gas. We suggest ways to further develop the concept of "dense gas" to incorporate other factors, such as turbulence. We also consider whether commonly accepted ideas, such as the concept of molecular clouds as bound entities or the idea that star formation accelerates, are actually myths.

The Role of Turbulence, Magnetic Fields, and Feedback for Star Formation

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I will present an invited review talk on the role of turbulence, magnetic fields, and feedback for star formation.

Star formation laws in galaxies near and far

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One of the fundamental questions in modern astrophysics is to understand how star formation (SF) works across all star-forming systems near and far. The relations between the gas and SF rate (SFR) in galaxies, i.e., Kennicutt-Schmidt (K-S) laws are reexamined in a large sample of 181 local star-forming galaxies with far-infrared (FIR~SFR) luminosities spanning almost five orders of magnitude. The ΣSFR is a steeper function of the total gas Σgas (H2+HI) than that of molecular gas ΣH2, with uncertain power law slopes. The dense molecular gas tracers such as HCN and CS linearly correlate with the FIR for essential all star-forming systems near and far. The locally resolved FIR-HCN correlation, a local SF law in terms of dense molecular gas across the disks is also established. Herschel SPIRE/FTS observations of high-J CO lines in ~170 galaxies reveal all linear correlations between the FIR and high-J CO. Such tight linear FIR - dense molecular gas correlations suggest that the SFR depends linearly upon the mass of dense molecular gas. This is drastically different from the traditionally established K-S laws that relate the total gas and SFR in galaxies and there are no unique correlations in these K-S laws. Finally, we introduce the MALATANG large program on the JCMT to map the HCN and HCO+ J=4-3 line emission in over 20 nearest IR-brightest galaxies. This survey will bridge the gap, in terms of physical scale and luminosity, between extragalactic (i.e., galaxy-integrated) and Galactic (i.e., single giant molecular clouds) observations. A primary goal of the survey is to delineate for the first time the distributed dense gas star formation relations, as traced by the HCN and HCO+ J=4-3, on ~kpc scales.

Star formation at low rates: how a lack of massive stars may affect stellar feedback and the evolution of dwarf galaxies

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In recent years dedicated observations have uncovered star formation at extremely low rates in dwarf galaxies, tidal tails, ram-pressure stripped gas clouds, and the outskirts of galactic disks. At the same time, numerical simulations of galaxy evolution have advanced to higher spatial and mass resolutions, but have yet to account for the underfilling of the uppermost mass bins of stellar initial mass function (IMF) at low star-formation rates. In such situations, simulations may simply scale down the IMF, without realizing that this unrealistically results in fractions of massive stars, along with fractions of massive star feedback energy (e.g., radiation and SNII explosions). Not properly accounting for such parameters has consequences for the self-regulation of star formation, the energetics of galaxies, as well as for the evolution of chemical abundances.

Here we present numerical simulations of dwarf galaxies with low star-formation rates allowing for two extreme cases of the IMF: a "filled" case with fractional massive stars vs. a truncated IMF, at which the IMF is built bottom-up until the gas reservoir allows the formation of a last single star at an uppermost mass. The aim of the study is to demonstrate

the different effects on galaxy evolution with respect to self-regulation, feedback, and chemistry. The case of a stochastic sampled IMF is situated somewhere in between these extremes.

Star Formation in Dwarf Galaxy Evolution: The Impact of numerical Recipes

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The implementation of star formation (SF) in numerical simulations on galaxy scales and cosmological structures is still a matter of debate and of multiple indispensable experiments, because of the sub-grid physics of SF and stellar feedback. A large variety of different methods have been developed and applied over the last decades. Nevertheless, it becomes clear that no universal law but scale-dependent parameterizations must be implied. Nonetheless, careful tests are necessary in which way parameter sets affect the models. \\

In order to examine this issue further, we perform N-body/SPH simulations of isolated dwarf galaxies (DGs) for different SF recipes, one with the commonly used SF threshold prescription and another one derived analytically under the assumption of SF self-regulation. Using the publicly available SPH code Gadget-2 with self-implemented sub-resolution physics, we explore differences between the SF recipes but also of further free-parameter variations on SF rates, gas dynamics, and galactic chemical evolution. Moreover, in contrast to the generally applied single-phase gas description we develop an advanced multi-phase chemo-dynamical particle code and compare the models of both treatments. \\

The main conclusions are: Arbitrarily implied parameters, like e.g. the cooling shut-off time, show strong effects on both different SF recipes; the systems react very sensitively on the choice of the gravitational softening length, which also affects the SF; if the supernova efficiency is chosen too high, a DG can be easily disrupted. Finally, we demonstrate that the energetical and chemical evolution of DGs are much properly reproduced by a multi-phase gas treatment.

Can we trace magnetic fields via polarized mid-infrared emission by PAHs?

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Polarized mid-infrared emission from polycyclic aromatic hydrocarbons (PAHs) can open a potential new window into studying magnetic fields. In this talk, I will present a new model of polarized PAH emission that takes into account the effect of PAH alignment with the magnetic field due to resonance paramagnetic relaxation. I will then present our predictions for the polarization level of the strong PAH emission features from the interstellar medium. I will present the first detection of polarization of PAH emission at 11.3 micron which supports our theoretical prediction. Finally, I will discuss potential implications of this work for tracing magnetic fields via mid-IR PAH features.

Star formation in high-z galaxies

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Understanding how galaxies formed their stars over cosmic time is one of the most fundamental questions in astronomy. Yet until recently, our knowledge of high-redshift star formation was largely limited to the unobscured stellar populations observable in the (rest-frame) optical/UV, with details of the star-forming interstellar medium either missing entirely or limited to unresolved observations. Now, the advent of new radio/millimeter telescopes is allowing dramatic advances in our view of star formation at high-z. I will review recent progress in these long-wavelength studies, which not only reveal the molecular gas reservoirs and obscured star formation in distant galaxies, but allow detailed studies of their kpc-scale properties and dynamics. I will end by highlighting future prospects for shedding new light on star formation at high-z.

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zPAH emission across different environments in the Magellanic Cloud galaxies

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Polycyclic Aromatic Hydrocarbon (PAH) emission is a powerful probe of the physics inside star forming complexes, that is set to regain the forefront with the advent of JWST. Because PAHs are excited predominantly in the photon dominated regions (PDRs), i.e. the places where a strong radiation field illuminates the neutral ISM, their emission provides a unique window into how newly formed stars affect

their environment. PAH molecules play a pivotal role in the heating of the neutral gas through the photo-electric effect.

I will present the results from our Spitzer/IRS mapping analysis of the LMC and SMC galaxies (PIs Kemper and Bolatto). We have targeted more than 30 star-forming regions with extensive (20-50pc size), spatially resolved (pc scale resolution) mid-IR spectral mapping to determine the response of the PAH emission to the radiation of the luminous young stars. We find:

1) very strong variations in the local PAH to continuum ratios directly related to the radiation environment

2) significant variations on the PAH ionisation state (traced by band ratios) that correlation with the dust continuum colour temperature

3) significant differences in the median PAH band ration from star-forming region to star forming region and galaxy to galaxy, related to the predominant excitiation state of the ISM

4) a significant dependence of the median observed band ratios with the spatial resolution of the observation

These results serve as templates for studying the radiative feedback from massive star formation and form a solid basis for planning and interpreting the enormous wealth of mid-IR spectroscopy that JWST will perform.

[OIII], [CII] and dust of star forming galaxies in the reionization epoch

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ALMA has opened new windows for probing star formation activity in galaxies even at z>7, deep into the cosmic reionization epoch, through [OIII] 88 micron emission, [CII] 158 micron emission and dust continuum. A galaxy population characterized with a strong hydrogen Lyman alpha emission, called Lyman alpha emitters (LAEs), have been detected in [OIII] and show an extremely high [OIII]-to-[CII] line ratio which is never observed at lower-z. But they are not detected in dust. Another galaxy population selected by a UV continuum break, called Lyman break galaxies (LBGs), have been detected in dust even at z>8 as well as in [OIII]. I will discuss what the origin of such diversity is in the reionization era.

Gas Temperature Demography and the HI-to-H2 Transition in the Magellanic Clouds

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Not only is the transition from warm to cold neutral gas a rate limiting step to the formation of molecular gas, but it appears to influence star formation efficiency globally and we still do not understand how metallicity affects this transition. Given their proximity and low metallicity, the Magellanic Clouds provide the ideal laboratory to study the evolution of gas in the interstellar medium. We present first results from a new HI and OH absorption line study using the ATCA to measure the warm-to-cold atomic fraction and the atomic-to-molecular transition in the Large and Small Magellanic Clouds (LMC and SMC, respectively). The survey targets 48 sources in the LMC and 29 sources in the SMC, which doubles the number of existing observations and with at least $3\times$ greater sensitivity and higher spectral resolution than previous absorption line measurement studies. We decompose the emission and absorption spectra using the autonomous gaussian decomposition software GaussPy (Lindner et al. 2015), which allows us to measure the spin temperature and optical depth of the HI gas. These measurements of the optical depth allow us to constrain the amount of ``CO-faint'' gas that is optically thick HI gas. Initial analysis indicates that we measure higher spin temperatures than the previous studies (Dickey et al. 1994, Marx-Zimmer et al. 2000), and cold atomic gas fractions of $\sim20\%$. We currently have no detections of OH absorption and an upper limit on the column density of molecular gas in the targeted lines of sight of $\sim$few $\times10^{22}$ cm^{-2}, which is consistent with the dust-based molecular gas estimates.

High gas fraction and clustered star formation in z $\sim$ 2 galaxies.

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Star forming galaxies at the peak of the cosmic star formation history (z $\sim$ 2) are characterized by a high gas fraction, which accounts for around 60\% of the baryonic mass (see e.g. Tacconi et al. 2010), in comparison to $\simeq$ 10\% for z = 0 galaxies. We propose to use parsec-scale hydrodynamical simulations of isolated galaxies with different gas fractions to study the impact of this sole parameter on the conditions of star formation on galactic scales.

We first show that the high-gas fraction is responsible for the instability of the disk structure and lead to the formation of massive ($\simeq 10^{8-9}$ M$_{\odot}$) and long-lived (>100 Myr) gaseous clumps. By testing different models of stellar feedback, including supernovae and radiative pressure from HII regions, we see that their evolution is more sensitive to the galactic shear and gas fraction than to stellar feedback.

We further show that these clumps are the birth nests of young massive star clusters. This clumpy distribution of star formation is consistent with the observed UV rest-frame light clumpy morphology of galaxies at z $\sim$ 2, along with the obtained masses and survival times (see e.g. Guo et al., 2014, 2015).

We note that the survival of the gaseous clumps against star formation feedback permits a continuous gas accretion from the ISM, and leads to a long-lasting (> 100 Myr) star formation history for their hosted young massive star clusters. Whereas these star clusters tend to migrate inwards and eventually merge with the galactic center, we show that galaxy interactions are able to expel them to the halo of the galaxy merger remnant, where they can survive for several Gyrs and might become the progenitors of globular clusters.

Disruption of Molecular Clouds by Photoionization and Radiation Pressure

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We report the results of simulations of star cluster formation including turbulence, self-gravity, sink particles, and radiative transfer, focusing primarily on the effect of UV radiative feedback in setting the star formation efficiency (SFE) and lifetime of giant molecular clouds. We examine the combined effects of photoionization and radiation pressure for a wide range of cloud masses (10^4--$10^6\;M_{\odot}$) and radii (2--$80\;{\rm pc}$). In all simulations, stars form in densest regions of filaments until feedback becomes strong enough to clear the remaining gas out of the system. We find that the SFE depends weakly on the cloud mass, but strongly on the cloud surface density Σ, such that SFE increases from 7\% to 50\% as Σ increases from $30\; M_{\odot}\,{\rm pc}^{-2}$ to $10^3 M_{\odot}\,{\rm pc}^{-2}$. Comparison of SFE between control runs with either radiation pressure or photoionization only shows that photoionization is the dominant feedback mechanism for clouds typical in normal disk galaxies, while they are equally important for more compact clouds. All clouds become unbound within $\sim$0.5--2.5 initial free-fall times after the first star-formation event, implying that cloud dispersal is rapid once massive star formation takes place. We briefly discuss limitations of our work in relation to observations.

The effect of bar-driven gas inflow on the AGN triggering in SDSS disc galaxies

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We explore the role of bars in AGN activities using a volume-limited face-on disc galaxy sample with $\mathrm{M_{r}<-19.5}$ and $0.02<z<0.055$ selected from SDSS DR7.

In this study, we investigate how the fraction of galaxies having strong bar is related to the amount of cold gas at galactic center (~1kpc scale) required for triggering AGN activity.

To understand how directly the bar presence is related to triggering AGN activity, we measure a relative probability defined as the ratio of the probability of AGN triggering in barred galaxies to the probability of the AGN triggering in a comparison, non-barred galaxies, for fixed central SFR (central gas fuel) and velocity dispersion of galaxies (black hole mass).

We find that bars are one of the mechanisms that trigger AGN, and the effect is pronounced in less massive and lasts even in galaxies with little central gas.

We also suggest a concentrated bulge as a morphology that contributes to the AGN triggering although the effect is not as great as bars.

Dusty star-forming galaxies explored with ALMA

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Deep unbiased surveys at millimeter and submillimeter wavelengths, where strong negative K-correction gives a flat selection function of dusty galaxies up to z ~10, have revolutionized observational cosmology by uncovering a new population of submillimeter galaxies (SMGs); dusty, extreme star-forming populations in the early universe (e.g., Casey et al. 2014). Recent extensive follow-up studies of SMGs using ALMA have brought new insights into the nature of these extreme sources, such as their redshift distributions, multiplicity (revising the number counts), and source sizes (e.g., Karim et al. 2013 for APEX/LABOCA sources in ECDF-S, Simpson et al. 2015 for JCMT/SCUBA2 sources in UDS, and Ikarashi et al. 2015 for ASTE/AzTEC sources in SXDF). However, despite their enormous IR luminosities (LIR ~10^13 Lsun), the contribution of SMGs to the extragalactic background light (EBL), which represents the integrated unresolved emission from extragalactic sources and contains vital information on the history of galaxy formation, is rather minor (e.g., ~10 – 20% at 1.1 mm; Scott et al. 2012).

Now ALMA has been extensively used to uncover faint mm/submm galaxies

($S_{1.1\text{-}1.3mm}$= 0.02 - 1 mJy), which are significantly fainter than ``classical submillimeter galaxies'' (e.g., Hatsukade et al. 2013, 2016; Ono et al. 2014; Carniani et al. 2015; Oteo et al. 2016; Fujimoto et al. 2016; Aravena et al. 2016a; Dunlop et al. 2017;

Gonzalez-Lopez et al. 2017), suggesting that such faint sources are the major 1.2 mm EBL contributors. However, still little is known about the physical properties of these faint submm galaxies, such as their redshift distribution, stellar masses and morphologies, and halo masses.

In my talk, I will introduce ALMA 26 arcmin^2 survey of GOODS-S at one-millimeter (ASAGAO), one of the on-going unbiased ALMA Band-6 deep surveys in GOODS-S/HUDF. Because ALMA sources tend to have extremely red colors and magnitudes which exclude ground-based follow-up, availability of deep HST/WFC3 and IRAC data is crucial. I will also present recent outcomes of ALMA deep surveys in other fields including SXDF, SSA22, and (gravitationally-lensed) clusters of galaxies.

Development of the GMT Instruments and Infrared Spectrographs at KASI

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The Optical Astronomical Technology Group at the Korea Astronomy and Space Science Institute (KASI) is making important contribution to the development of the Giant Magellan Telescope (GMT) including the telescope system and observational instruments. KASI is developing the GMT Fast-steering Secondary Mirror (FSM) and two of the first generation GMT instruments; the GMT-Consortium Large Earth Finder (G-CLEF) and GMT Near-Infrared Spectrograph (GMTNIRS).

G-CLEF is the very First Light science instrument of the GMT. It is a fiber-fed optical band echelle spectrograph that is capable of extremely precise radial velocity measurement, and is being developed through the consortium consisted of five international astronomical institutes including Smithsonian Astrophysical Observatory (SAO) and KASI. Flexure Control Camera (FCC), Calibration Light Source subsystem (CLS), Dichroic Mirror Assembly (DMA) are KASI's principal contributions to the instrument project.

GMTNIRS is another first generation instrument of the GMT, which covers all ground-accessible spectral bands from 1.12 to 5.3 μm with R=50,000 (1.12-2.5 μm) and R=90,000 (3-5.5 μm). GMTNIRS is fed by the GMT Adaptive Optics system and has a single 85 milli-arcsecond slit. The instrument includes five separate spectrographs for the different atmospheric windows. By use of dichroic mirrors, it observes the entire spectral grasp in a single exposure mode without using a cryogenic moving component.

As a forerunner instrument to the GMTNIRS, the Immersion Grating Infrared Spectrometer (IGRINS) is the first astronomical spectrograph that uses a silicon immersion grating. IGRINS covers the full H and K astronomical bands in a single exposure. It is a high-resolution cross-dispersion spectrometer whose spectral resolution R is 45,000. The use of a silicon immersion grating and a compact white pupil design allows the spectrograph to be contained in a moderately sized (1m x 0.6m x 0.4m) Dewar. IGRINS on the 2.7m Harlan J. Smith Telescope at McDonald Observatory is nearly as sensitive as CRIRES at the 8m Very Large Telescope. However, IGRINS has more than 30 times the spectral grasp of CRIRES in a single exposure. Proven for its excellent performance, IGRINS has been invited to the 4.3m Discovery Channel Telescope at Lowell Observatory from September 2016 to February 2017, and to the 8.1m Gemini South Telescope in May 2018.

The molecular environment of star formation in the Central Molecular Zone

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Star formation in the Central Molecular Zone (CMZ) is not well understood. We have used observations from the Submillimeter Array (SMA), the Very Large Array (VLA), and complementary data from single-dish telescopes to study deeply embedded star formation in massive molecular clouds in the CMZ. Dense cores are identified with the SMA dust emission, and signatures of star formation are traced by free-free emission and masers from the VLA observations. We have found a sample of star formation candidates based on these observations, which have not been known before. Here we use molecular line data from SMA/VLA to study the molecular gas environment in these clouds: heating of gas by turbulence or protostars; enhancement of molecular emission by shocks or star formation; correlation between dust and different molecular species; and a comparison to Galactic disk clouds.

The Conditions for the Creation of Massive Stars and their Distribution

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The conditions under which high mass stars form is of great astronomical importance due to the influence and feedback they have on their host galaxies. Feedback from massive stars is disproportionate to their numbers and can have extreme effects when created in large numbers, as is believed to be the case in the early universe.

We present results from a set of star formation studies of our own Galaxy using data from the Herschel Space Observatory. Our observations provide a spatial resolution of typically 0.1pc for most of the regions studied and allow us to pick out cores showing the earliest stellar evolutionary phases. Regions studied included local and outer galaxy high mass star formation regions, including W3. We show that high mass stars form under certain specific environmental conditions that allow high convergent and localized accretion rates, and are heavily influenced by the environmental conditions in which they form. We compare our results to current theoretical models.

We show that feedback can provide conditions for an enhanced and distributed star formation, increasing the possibility of finding relatively “isolated” high mass stars. Our findings indicate that rather than considering high mass stars as forming in clusters we should perhaps consider that clusters form in the vicinity of high mass stars.

The Molecular Baryon Cycle of M82

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Stars form from molecular gas, but the stellar feedback often affects the molecular gas itself, sometimes blows it away from the star forming regions or from the host galaxy. But the molecular gas may come back to the host galaxy due to the gravity pull, and forms stars again. Such molecular baryon cycle is important for the evolution of galaxies. Here, we present the CO(1-0), (2-1), and (3-2) interferometric maps of the central region of M82. We successfully imaged filamentary structures at the edge of the molecular gas disk, together with the known molecular superbubble. We calculated the physical conditions of the molecular gas using a Bayesian analysis and the radiative transfer code RADEX. Combine this information with the molecular gas kinematics and the [Fe II] image, we suggest that one of the filamentary structures is an infalling streamer, with its inflow rate of 3.5 Mo/yr. Compared with the current star formation rate and the molecular gas outflow rate, inflow rate is much smaller and the molecular gas will deplete within 8 Myr, unless there are additional sources of molecular gas.

Environmental dependence of cluster formation and evolution in M51

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It has been recently pointed out that the galactic environment can affect the star formation process, especially in the formation of massive bound structures like stellar clusters.

Using the high-resolution NUV and U band HST observations from LEGUS (Legacy Extra Galactic UV Survey), we study the nearby interacting spiral galaxy M51 at the scale of star cluster. The huge star cluster population sample of the galaxy, counting around 3000 sources, allows a cluster analysis in different environments inside the galaxy. The goal is to understand how cluster properties change as function of the environment where they form and interact.

The cluster mass distribution follows a power-law behavior, as expected from a hierarchical star formation model, but it also reveals a mass truncation (around 10^5 M$_{\odot}$) above which very few cluster are formed. Both the general shape and the truncation are similar at all radii inside the galaxy, implying that even if average (molecular) gas properties change with galactocentric distance, the cluster formation process produces the same mass distribution.

On the other hand, cluster evolution is affected by the environment, as the timescales for disrupting clusters are shorter in denser environments, suggesting that there are parts of the galaxy more favorable than others to cluster survival.

Investigating the Relation between CO (3-2) and Far Infrared Luminosities for Nearby Merging Galaxies Using ASTE

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We present the new ASTE CO (3-2) observation toward 19 early stage and 7 late stage nearby merging galaxies. Combining with the previous studies, we investigate the relation between the CO (3-2) luminosity (L’CO(3-2)) and the far Infrared luminosity (LFIR) in a sample of 29 early and 31 late stage merging galaxies, and 28 nearby isolated spiral galaxies. We find that normal isolated spiral galaxies and merging galaxies have different slopes in the logL'CO(3-2)-logLFIR plane (0.79 for spirals and 1.12 for mergers). The large slope (>1) for merging galaxies can be interpreted as an evidence for increasing Star Formation Efficiency (SFE=LFIR=L'CO(3-2)) as a function of LFIR. Comparing our results with sub-kpc scale local star formation and global star-burst activity in the high-z universe, we find deviations from the linear relationship in the logL'CO(3-2) - logLFIR plane for late stage mergers and high-z star forming galaxies. Finally, we find that the average SFE gradually increases from isolated galaxies, merging galaxies, and to high-z SMG/QSOs. By comparing our findings with the results from numerical simulations, we suggest; (1) inefficient star-bursts triggered by disk-wide dense clumps occur in the early stage of interaction and (2) efficient star-bursts triggered by central concentration of gas occur in the final stage. A systematic high spatial resolution survey of diffuse and dense gas tracers is a key to confirm this scenario.

Dense molecular outflows from the merging galaxy NGC3256

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We report the new ALMA Cycle 3 results of line survey towards a late stage merging galaxy NGC 3256. NGC 3256 hosts two merging nuclei and the starburst and AGN activities are strongly affecting the chemical and physical properties of the ISM. We have detected more than 20 molecules (e.g., c-C3H2, H13CN, H13CO+, SiO, CCH, HCN, HCO+, HNC, CH3OH, CS, HC3N, CH3CCH, C18O, 13CO) at 2" angular resolution, which is high enough to resolve the double nuclei. In this presentation, we focus on CO, HCN and HCO+ to discuss the high velocity components detected only by those bright molecular lines. Such high velocity components are though to be molecular gas outflow from northern and southern nuclei. Including the CO(1-0) and CO(3-2) archived data, the line ratios suggest that (1) The excitation condition become weak towards edge of the outflow in the starburst triggered outflow. (2) In the case of low luminous AGN like southern nucleus in NGC 3256, the outflowing gas is associated with AGN jet, and warm and dense gas can be newly formed due to interaction between jet and ISM interaction. In addition, we conducted radiative transfer modeling. By using a Bayesian likelihood analysis, we found that the CO column density and filling factor of outflowing gas is smaller than the gas around nuclei.

Radiation-hydrodynamical simulations of photoevaporating protoplanetary disks with various metallicities

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We present our recent 2D radiation-hydrodynamic simulations of the photoevaporation of protoplanetary disks with various metallicities, motivated by recent observations suggesting that a disk has a shorter lifetime in lower-metallicity environments (e.g., Yasui et al. 2010). We solve the time-dependent hydrodynamics with various chemical and thermal processes, also along with the transfer both of the extreme and far ultraviolet (i.e., EUV and FUV) irradiation from a central star. The grain temperature is determined by the balance between the irradiation and (re-)emission, which are solved with a hybrid scheme using the radial ray-tracing and flux-limited diffusion. Our simulations cover a broad range of the different metallicities, from $10^{-4} ~Z_\odot$ to $10 ~Z_\odot$.

We show that the photoevaporation rate, or the disk lifetime, largely varies with different metallicities owing to different efficiencies of the FUV photoevaporation. Interestingly, the resultant photoevaporation rate does not show a monotonic trend of the metallicity dependence but has a peak around the sub-solar metallicity around $Z\sim0.5~ Z_\odot$. For the upper side of $Z > 0.5 ~Z_\odot$, the photoevaporation rate decreases with increasing the metallicity because the FUV photons cannot enter the deep interior of the disk with the larger dust extinction. For $Z < 0.5~ Z_\odot$, on the other hand, the photoevaporation rate sharply declines with decreasing the metallicity because the photoelectric heating becomes inefficient with the smaller amount of grains. With extreme low metallicities of $Z < 10^{-2}~ Z_\odot$, the evaporation rate takes an almost constant value that is set only by the EUV photoionization. Our results are in good agreement with the observations showing the short disk lifetimes in an outer part of the Galaxy where the metallicity is $Z \sim 0.2~ Z_\odot$. We predict that the disk lifetime should become longer with the even lower metallicities, $Z < 0.1 Z_\odot$.

The Most Luminous Young Stellar Object in the Large Magellanic Cloud

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The Large Magellanic Cloud has been the subject of star formation studies for decades due to its proximity to the Milky Way (50 kpc), a nearly face-on orientation, and a low metallicity (0.5 solar) similar to that of galaxies at the peak of star formation in the universe (z~2). The most luminous young stellar object (J72.971176-69.391112) is located in the N79 region of the Large Magellanic Cloud and has a luminosity of 1.5 x 10^6 L☉ . It is surprising that this massive and luminous object is on the opposite side of the Large Magellanic Cloud from 30 Doradus, one of the most active and most massive giant molecular clouds in the Local Group. How can a massive star like J72.971176-69.391112 form in a seemingly quiescent environment far away from an active star formation region like 30 Doradus? Is the N79 region

actually quiescent? We will present a comprehensive multi-wavelength analysis of J72.971176-69.391112: SED fits to Spitzer and Herschel photometry, near-IR and mid-IR spectroscopy from Magellan/FIRE and Spitzer/IRS, low-J CO data from ALMA, high-J CO data and a [CII] map from SOFIA/GREAT. Spectral energy distribution (SED) fits show this object is a O5V star. ALMA images indicate that J72.971176-69.391112 could be at the center of colliding filaments. A near-IR spectrum from Magellan/FIRE shows H, H2, He, and [Fe II] emission lines tracing radiative and shock excitation. Our results from SOFIA allow us to probe the photodissociation region (PDR) surrounding this massive young stellar object. We compare our results on J72.971176-69.391112 to other massive YSO candidates in the Large Magellanic Cloud as well as the Milky Way. How do massive stars form? What is the impact of outflows on the local environment? What role does the local environment (metallicity, nearby star formation, molecular clump distribution) play in the creation of massive stars?

Luminous and dark matter in early-type galaxies as function of environment.

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We study the behaviour of the dynamical and stellar mass inside the effective radius (re) of early-type galaxies (ETGs). We use several samples of ETGs - ranging from 19 000 to 98 000 objects - from the ninth data release of the Sloan Digital Sky Survey- We consider Newtonian dynamics, different light profiles and different initial mass functions (IMF) to calculate the dynamical and stellar mass. We assume that any difference between these two masses is due to dark matter and/or a non-universal IMF. The main results are: (i) the difference between dynamical and stellar mass as function of local density does not follow an homogeneous distribution; (ii) the density distribution has a maximum about 50%-60% of the difference between dynamical and stellar mass; (iii) the amount of luminous and dark matter inside ETGs appears to depend on the local environment; (iv) the amount of dark matter inside ETGs in the most dense environments is approximately 50-60% of the dynamical mass depending on the impact of the IMF on the stellar mass estimation.

Star Formation in a Pristine Environment

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We present a multiwavelength investigation of a region of a nearby giant molecular cloud that is distinguished by a minimal level of star formation activity. With our new 12CO(J = 2 − 1) and 13CO(J = 2 − 1) observations of a remote region within the middle of the California molecular cloud, we aim to investigate the relationship between filaments, cores, and a molecular outflow in a relatively pristine environment. An extinction map of the region from Herschel Space Observatory observations reveals the presence of two 2-pc-long filaments radiating from a high-extinction clump. Using the 13CO observations, we show that the filaments have coherent velocity gradients and that their mass-per-unit-lengths may exceed the critical value above which filaments are gravitationally unstable. The region exhibits structure with eight cores, at least one of which is a starless, prestellar core. We identify a low-velocity, low-mass molecular outflow that may be driven by a flat spectrum protostar. The outflow does not appear to be responsible for driving the turbulence in the core with which it is associated, nor does it provide significant support against gravitational collapse.

Deviation from Larson and Schmidt-Kennicutt relations in Galactic Molecular cloud complexes

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The Larson scaling relations and Schmidt-Kennicutt star formation laws for molecular cloud complexes (MCCs) in the Milky Way, that are large (R>50 pc), massive ($\sim 10^6$ $M_\odot$) gravitationally unbound cloud structures are investigated. Variations in the slopes and coefficients of these relations are found at individual scales, signifying different physics acting at different scales. Additionally, there are breaks at the MCC scale in the s–R relation and between starburst and normal star-forming objects in the SFR–Mgas and SSFR–SM gas relations. Therefore, they can be used to distinguish starburst from normal star-forming structures by applying a Sigma_{Mgas} threshold of $\sim 100 M_\odot\ \mathrm{pc}^{-2}$ and a Sigma_{SFR} threshold of $1 M_\odot\ \mathrm{yr}^{-1}\ \mathrm{kpc}^{-2}$. Mini-starburst complexes are gravitationally unbound MCCs that have enhanced Sigma_{SFR} ($>1 M_\odot\ \mathrm{yr}^{-1}\ \mathrm{kpc}^{-2}$), probably caused by dynamic events such as radiation pressure, colliding flows, or spiral arm gravitational instability. Because of dynamical evolution, gravitational boundedness does not play a significant role in regulating the star formation activity of MCCs, especially the mini-starburst complexes, which leads to the dynamical formation of massive stars and clusters.

GG Tau A: dynamics and clumps inside the cavity

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GG Tau A is a triple star located at 140 pc in the hole of Taurus molecular cloud with estimated age of ~1.5 Myr. The system consisting of a single star and a close binary owns a circumbinary disc of gas and dust with a ring extending from ~190 to 280 au and an outer disc extending up to ~800 au from the central protostar. With its brightest, densest CB disk and spectacular ring of dust and gas encircling the central star, it has become a unique laboratory for investigating the physics of circumsystem (evolution of gas and dust), calibrating star formation and constraining theories. GG Tau A also reveals a cavity devoid of some mm emission whose exact origin is not fully understood. In this presentation, I am presenting a study of the dynamics of the system and clumps in side the cavity using ALMA observations at mm-wavelengths.

Signatures of Past Star Forming Activity in the Central Molecular Zone of Our Galaxy

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The central molecular zone (CMZ), a region within 200 pc from the center of our Galaxy, is characterized by a large amount of dense and warm molecular gas. Molecular gas there shows highly turbulent and complex kinematics, having large velocity dispersion. In the CO {\it J}=1--0 and {\it J}=3--2 surveys of the CMZ with the NRO 45 m telescope and ASTE, we discovered four high CO J=3-2/J=1-0 intensity ratio regions at the Galactic longitudes; l=+1.3d, 0d, -0.4d, and -1.2d. All of the high ratio regions show extraordinary broad velocity widths. Two of them at l=+1.3d and -1.2d contain several expanding shells, suggesting young (<30 Myr) massive star clusters are embedded there. The l=-0.4d region contains a featureless broad velocity width cloud, CO-0.40-0.22. Follow-up observations with ALMA revealed its kinematics and detected a point-like continuum source near its center, suggesting an IMBH of 100 thousand solar masses lurks in CO-0.40-0.22. These could be signatures of past active star foirmation in the central 200 pc of our Galaxy.

Far-infrared emission from SDSS galaxies in AKARI all-sky maps

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Thermal dust emission of galaxies is important to investigate the star formation obscured by dust. Since temperature of dust in galactic disks is typically 20~40K, their thermal emission is observed in far-infrared wavelength as long as they are at z<1 The infrared dust emission from individual galaxies however is very difficult to detect in infrared generally except for bright sources. Thus, the statistical fashion such as image stacking analysis is useful to characterize their thermal dust emission.

We perform image stacking analysis of Sloan Digital Sky Survey (SDSS) photometric galaxies over the AKARI Far-Infrared Surveyor (FIS) maps at 65μm, 90μm, and 140μm.

The resulting image profiles are decomposed into the central galaxy component (single term) and the nearby galaxy component (clustering term), as a function of the r-band magnitude of the central galaxy. The FIR amplitude of the 90μm clustering term is consistent with that expected from the angular-correlation function of the SDSS galaxies, but galaxy morphology dependence needs to be taken into account for a more quantitative conclusion. We also fit the spectral energy distribution of stacked galaxies at 65μm, 90μm, and 140μm, and derive the mean dust temperature as ~40K. This is consistent with the typical dust temperature of galaxies that are FIR luminous and individually detected.

Breakdown of the Kennicutt-Schmidt law at giant molecular cloud scales

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We investigated the relationship between the surface density of molecular gas mass and that of star formation rate (SFR) in an external galaxy (Kennicutt-Schmidt law) in the local group galaxy M33 with the high spatial

resolution ($¥sim¥!80¥pc$), which is comparable to scales of giant molecular clouds (GMCs). At positions where CO is significantly detected, the SFR surface density exhibits a wide range of over four orders of magnitude, from $¥Sigma_{¥rm SFR}¥lesssim10^{-10}$ to $¥sim¥!10^{-6}¥mo¥yr^{-1}¥,¥pc^{-2}$, whereas the

$¥Sigma_{¥rm H_2}$ values are mostly within $10¥textendash40¥mo¥pc^{-2}$. The surface density of gas and that of SFR correlate well at a $¥sim$1-kpc resolution, but the correlation becomes looser with higher resolution and breaks down at GMC scales. The scatter of the $¥Sigma_{¥rm SFR}$--$¥Sigma_{¥rm H_2}$ relationship in the $¥sim¥!80$-pc resolution results from the variety of star forming activity among GMCs, which is attributed to the various evolutionary stages of GMCs and to the drift of young clusters from their parent GMCs. This result shows that the Kennicutt-Schmidt law is valid only in scales larger than that of GMCs, when we average the spatial offset between GMCs and star forming regions, and their various evolutionary stages.

What FIREs Up Star Formation: the Kennicutt-Schmidt Law and Gravitational Instabilities in Cosmological Simulations

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We present an analysis of the global and spatially-resolved Kennicutt-Schmidt star formation relation in the FIRE (Feedback In Realistic Environments) suite of cosmological simulations, including halos with $z = 0$ masses ranging from 10^{10} -- 10^{13} M$_{\odot}$. We show that the Kennicutt-Schmidt (KS) relation emerges robustly due to the effects of feedback on local scales, independent of the particular small-scale star formation prescriptions employed. This is true for the KS relation measured using all of the gas and using only the dense (molecular) gas. We demonstrate that the time-averaged KS relation is relatively independent of redshift and spatial averaging scale, and that the star formation rate surface density is weakly dependent on metallicity ($\propto Z^{1/4}$). Finally, we show that on scales larger than individual giant molecular clouds, the primary condition that determines whether star formation occurs is whether a patch of the galactic disk is thermally Toomre-unstable (not whether it is self-shielding): once a patch can no longer be thermally stabilized against fragmentation, it collapses, becomes self-shielding, cools, and forms stars. This occurs regardless of environment or epoch, and is useful in its universality.

The Star Formation Rate of Molecular Clouds in SN-driven Turbulence

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We compute the star formation rate (SFR) in molecular clouds (MCs) that originate ab initio in a simulation of supernova-driven turbulence. Because of the large number of well-resolved clouds with self-consistent boundary and initial conditions, we obtain a large range of cloud physical parameters with realistic statistical distributions, an unprecedented sample of star-forming regions to test SFR models and to interpret observational surveys. We confirm the dependence of the SFR per free-fall time, SFRff, on the viral parameter, αvir, found in previous simulations, and compare a revised version of our turbulent fragmentation model with the numerical results. The dependence on Mach number, M, gas to magnetic pressure ratio, β, and compressive to solenoidal power ratio, χ at fixed αvir are not well constrained, because of random scatter due to time and cloud-to-cloud variations in SFRff. We find that SFRff in MCs can take any value in the range 0 ≤ SFRff ≤ 0.17, and its probability distribution peaks at a value SFRff ≈ 0.025, consistent with the observations. Because of the dependence of αvir on cloud mass, the range of values of SFRff (as well as the range in αvir) becomes narrower with increasing cloud mass, being 0.01 < SFRff < 0.1 for clouds with mass Mcl > 104 M⊙. The SFRs of the clouds selected from the simulation are shown to be consistent with recent determinations of the SFR in nearby MCs and in clouds near the Galactic center, also reproducing the observed scatter in the SFRff–αvir relation. Although not modeled by the theory, the scatter is consistent with the physical assumptions of our revised model and may also result in part from a lack of statistical equilibrium of the turbulence, due to the transient nature of MCs.

Star formation and AGN activity in the most luminous LINERs in the local universe

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We will present the properties of 42 objects in the group of the most luminous, highest star formation rate (SFR) low-ionization nuclear emission-line regions (LINERs) at z = 0.04 - 0.11. We obtained long-slit spectroscopy of the nuclear regions for all sources, and FIR data (Herschel and IRAS) for 13 of them. We measured emission-line intensities, extinction, stellar populations, stellar masses, ages, active galactic nuclei (AGN) luminosities, and SFRs. We found considerable differences from other low-redshift LINERs, in terms of extinction, and general similarity to star-forming galaxies. We confirmed the existence of such luminous LINERs in the local universe, after being previously detected at z ~ 0.3 by Tommasin et al. (2012). The median stellar mass of these LINERs corresponds to 6 - 7 × 10^{10} M⊙ which was found in previous work to correspond to the peak of relative growth rate of stellar populations and therefore for the highest SFRs. Other LINERs although showing similar AGN luminosities have lower SFR. We found that most of these sources have LAGN ~ LSF suggesting co-evolution of black hole and stellar mass. In general, we saw that the fraction of local LINERs on the main sequence of star-forming galaxies is related to their AGN luminosity.

On the dust and gas components of the z = 2.8 gravitationally lensed quasar host RX J0911.4+0551

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Observations by the Atacama Large Millimetre/sub-millimetre Array of the 358 GHz continuum emission of the gravitationally lensed quasar host RX J0911.4+0551 have been analysed. They complement earlier Plateau de Bure Interferometer observations of the CO(7-6) emission. The good knowledge of the lensing potential obtained from the Hubble Space Telescope observations of the quasar makes a joint analysis of the three emissions possible. It gives evidence for the quasar source to be concentric with the continuum source within 0.31 kpc and with the CO(7-6)

source within 1.10 kpc. It also provides a measurement of the size of the continuum source, 0.76$\pm$0.04 kpc full width at half-maximum, making RX J0911.4+0551 one of the few high-redshift galaxies for which the dust and gas components are resolved with dimensions being measured. Both are found to be very compact, the former being smaller than the latter by a factor of $\sim$3.4$\pm$0.4. Moreover, new measurements of the CO ladder $-$ CO(10-9) and CO(11-10) $-$ are presented that confirm the extreme narrowness of the CO line width (107 $\pm$ 20 km s^{-1} on average). Their mere detection implies higher temperature and/or density than for typical quasar hosts at this redshift and suggests a possible contribution of the central active galactic nucleus to gas and dust heating. The results are interpreted in terms of current understanding of galaxy evolution at the peak of star formation. They suggest that RX J0911.4+0551 is a young galaxy in an early stage of its evolution, having experienced no recent major mergers, star formation being concentrated in its centre.

Radiative feedback and cluster formation across the giant molecular cloud mass spectrum

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Star clusters form within dense filaments within giant molecular clouds. The radiative feedback from the more massive clusters may shut off gas accretion, limiting cluster mass. These processes may also disperse molecular clouds thereby accounting for the low star formation efficiency in galaxies. We have explored these hypotheses using state of the art, Adaptive Mesh Refinement (FLASH code) simulations of turbulent, self-gravitating molecular clouds that compute the heating and ionization of clouds by forming clusters, using ray tracing techniques. We investigate cluster formation across the whole mass spectrum, from 10^4-10^7 solar mass clouds. We find that clouds in the range of 10^5 solar masses are indeed dispersed by cluster formation within 5 Myr, but that more massive clouds survive. I will show how a wide variety of cluster properties are affected by radiative feedback effects across the GMC mass spectrum.

Magnetic fields in Galactic star forming regions. Observations with NIKA and NIKA2

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NIKA2 (New Instrument of Kids Array) is the next generation continuum camera allowing to map fluxes and linear polarization with the IRAM 30 meters telescope at Pico-Veleta (Granada, Spain). It is a high resolution dual-band camera, operating with frequency multiplexed LEKID (Lumped Element Kinetic Inductance Detectors) cooled down to about 100 mK. Dual color imaging is obtained thanks to the simultaneous readout of a 616 pixels array at 2 mm (150 GHz) and 2x1140 pixel arrays at 1.15 mm (260 GHz).

The two arrays at 1.15 mm combined to a continuously rotating half wave plate and a polarizer will allow us to measure the linear polarization of the incoming light.

The NIKA2 camera has several scientific goals in intensity and in particular for the polarization channel the objective is to observe star forming regions in our Galaxy, trace magnetic fields and answer to the outstanding questions related to the early stages of the star formation process.

%the observation of galaxy clusters via Sunyaev Zel'dovitch effect, the detection of early stages of star formation in molecular clouds in our galaxy and mapping of dust and free-free emission in nearby galaxies. For the polarization channel the scientific objective is to clarify the role of the magnetic fields in the star formation process observing galactic regions.

NIKA, the previous camera, with reduced number of detectors and FoV, has been successfully operated at the IRAM 30 telescope in several open observation campaigns. NIKA obtained several scientific results in intensity observations of various astrophysical sources, in particular tracing the Sunyaev-Zeldovich effect in galaxy clusters.

NIKA has also been a test-bench for the techniques used to measure polarization, which have been implemented in the NIKA2 instrument.

The polarization measurements obtained with the NIKA camera revealed the ability of this technology to detect the polarization of nearby galaxies, weak quasars and star forming regions like the Orion Molecular Cloud OMC-1. The observation of the Crab nebula, the most intense calibration source and highly polarized in the microwave sky, allowed us to obtain the first high-resolution polarized map at 150 GHz and to estimate its Spectral Energy Distribution in polarization. Thanks to its angular extension of few arcminutes, the Crab nebula is particularly interesting for the calibration of CMB experiments as well.

This contribution aims at presenting an overview of NIKA/NIKA2 instruments together with the results obtained in polarization with NIKA during the observational campaign of February 2015 and also at giving the first preliminary results of NIKA2, which is currently commissioned.

Dust property variations in IRDCs: A NIKA view

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Constraining dust properties is key to star formation studies, and this for a number of reasons: i. Dust emission is often used as a proxy for gas mass; ii. Dust is a major coolant of the interstellar medium; iii. Dust plays a major role in facilitating the formation of new molecules in space. The new fast-mapping and high-sensitivity millimetre continuum camera on the 30m IRAM telescope, NIKA2, which observes simultaneously in 1.2 mm and 2.0 mm continuum wavebands has been recently commissioned. NIKA2 will contribute to major breakthroughs in our understanding of dust evolution. In this talk, we present new observations of two Spitzer Dark Clouds made using the IRAM 30m prototype instrument, NIKA. We investigate what constraints simultaneous 1.2 mm and 2.0 mm observations can provide on the spatial variations of the dust emissivity index in IRDCs. In addition, we will show the first images of GASTON, a NIKA2 large programme aiming at mapping a fraction of the Galactic plane and providing the highest sensitivity view of the Milky Way ever obtained from a ground-based millimetre telescope.

Unstuck in the middle with you: intermediate-mass stars are the missing link in star formation

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Intermediate-mass stars are the missing link in star formation. Recent observational efforts have produced large, statistical surveys of local low-mass star formation, and high-mass star-forming clumps throughout the galactic plane. In the intermediate-mass range between these two extremes are stars of ~2-10 Msun that sample changes in the internal stellar structure and the conditions under which they form. By targeting this neglected demographic, we are probing star formation in the transition where accretion may no longer be magnetically mediated and the transfer of material from circumstellar disks to the protostar may look markedly different. Most efforts in this direction have targeted famous Herbig Ae/Be stars - intermediate-mass pre-main-sequence stars that have largely finished accreting. These objects represent a heterogenous sample of objects with Kelvin-Hemholtz times that may vary by as much as two orders of magnitude. Targeting young, actively accreting intermediate-mass objects allows us to probe accretion and outflow at the boundary between the well-observed low-mass case and the highly-obscured high-mass case. We are undertaking a multi-wavelength campaign to measure the accretion and outflow of young, intermediate-mass stars in order to determine if a different underlying physical pathway is required for low- and high-mass stars.

Star formation in the nuclear regions of barred galaxies

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The central regions of barred galaxies contain interesting gaseous structures such as dust lanes and nuclear rings with intense star formation. To study star formation in a realistic environment, we use the mesh-free hydrodynamic code GIZMO and run fully self-consistent 3D simulations of barred galaxies with live stellar disks and dark matters. In the early phase of bar formation, star formation takes place explosively near the center due to rapid gas inflows. A ring-shaped gaseous structure forms as the bar grows, and star formation is distributed across the ring. During 1~2 Gyr after the formation, the bar grows in size and strength and causes massive gas inflows, making the star formation rate (SFR) in the ring remain larger than few solar mass per year. After then, the ring SFR declines to less than one solar mass per year due to lack of gas in the bar regions that was already consumed to star formation, even if the bar continues to grow. We compare our 3D results with the results of the previous 2D simulations where the stellar disk and halo were treated as being fixed.

LYα Radiative Transfer and The Wouthuysen-Field effect in the Milky Way Galaxy

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A three-dimensional (3D), Lyα radiative transfer code is developed to study the Wouthuysen-Field effect in the Milky Way Galaxy and the escape fraction of Lyα from the Galaxy. The Monte Carlo code is capable of treating arbitrary 3D distributions of Lyα source, neutral hydrogen and dust densities, gas temperature, and velocity field. It is demonstrated that the resonance-line profile at the center approaches to the Boltzmann distribution with the gas temperature. A plane-parallel ISM model, which is appropriate for the neutral ISM of our Galaxy, is used to calculate the the Lyα radiation field strength as a function of height above the Galactic plane. We also use a two-phase, clumpy medium model which is composed of the cold and warm neutral media (WNM). It is found that the Lyα radiation field is strong enough to thermalize the 21 cm spin temperature in the WNM to the gas kinetic temperature. The escape fraction of Lyα is found to be a few percent, which is consistent with the Lyα observations of our Galaxy and external galaxies.

Optical polarimetry and molecular line studies towards L1157 dark molecular cloud

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Filamentary structures in dark clouds are preferential sites of star formation. The high density, cold regions evolve through different stages to eventually become stars. L1157 dark cloud contains a low mass class 0 protostar associated with well collimated bipolar outflow has been studied using optical polarimetry and molecular line observations. The polarized absorption of background starlight seen through the cloud is used to trace the projected magnetic field geometry of the clouds. The relationship between the magnetic field geometry, the outflow orientation and the cloud morphology are studied. Molecular emission lines of various tracers are used to study the kinematics in clouds. Our molecular line data in 12CO, C18O, N2H+, HCN, HCO+, 13CO lines are used to understand the dynamical nature of L1157. However, the results of optical polarimetry traces the magnetic field geometry of the low density parts of the cloud. Both these studies will be discussed in the talk.

The Effects of Star Formation and Gas Tracers on the Spatially Resolved Schmidt-Kennicutt Relation at High Redshift

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In order to understand the evolution of galaxies, it is important to accurately characterize both dust obscured star formation and the molecular gas that fuels galaxy growth at high redshift. Comparisons to local galaxies using well-known correlations like the Schmidt-Kennicutt relation have been complicated by several factors, including missing corrections for either obscured or unobscured star formation for different high-redshift populations, differences in line excitation for the molecular gas tracer (i.e. CO(1-0) vs. CO(3-2)), and a lack of spatially resolved mapping at high redshift. The latter is particularly important for strongly lensed galaxies where differential magnification and integrated measurements may disguise the true galaxy conditions. Overcoming these challenges to measure gas and star formation rate surface

densities using identical techniques in different samples is critical for testing typical assumptions of a universal supply-limited star formation law with a constant efficiency. I will present VLA and ALMA observations of a strongly-lensed UV-bright disk galaxy at z=2.26, SDSS J0901+1814. Our resolved observations span the UV through FIR and include several CO lines, allowing us to evaluate the biases of different star formation and gas tracers at high redshift. These observations, in conjunction with the limited number of other resolved high-redshift Schmidt-Kennicutt measurements, demonstrate the clear need for larger samples of resolved gas and star formation observations earlier in cosmic history.

Radiation Hydrodynamics Simulation of Protostellar Collapse: Constraints on Brown Dwarf Formation Mechanisms

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The dominant mechanism of brown dwarf formation is still an open question. The typical mass of brown dwarfs is only a few percent of the solar mass, but in order to be Jeans-unstable, a molecular cloud core with such a low mass would need to have an exceptionally high density, two to three orders of magnitude above what is typically observed. The radial collapse and fragmentation of unstable filaments can conceivably create such high densities, in which case brown dwarf formation would work essentially the same as low-mass star formation. However, other theories have also been proposed, such as gravitational instabilities in protoplanetary discs, photo-evaporation of initially higher-mass cores in the vicinity of massive stars, and external compression of cores due to turbulence in the cloud. While all of these scenarios probably occur in nature, it is currently unknown how common they are relative to each other.

In this work, we investigate the turbulent compression scenario. Using a newly developed method of radiative transfer, we perform radiation hydrodynamical simulations of spherically symmetric, low-mass cores. The cores are initially Jeans-stable, but can be made to collapse by sufficiently large and long-lasting external pressures. However, we find that the required pressures and time scales seem to be relatively difficult to achieve in typical molecular cloud cores, indicating that this method of formation may not be very common. We also discuss observational implications.

A Study of Young Stellar Structures in the Magellanic Clouds with the VMC Survey

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It has been proposed that star formation is a hierarchical process, generating young stellar structures on various scales, from large complexes and aggregates to small associations and clusters. However, many related questions remain to be answered: their origin, evolution and the roles of gravity and turbulence.

Thanks to their proximity, the Magellanic Clouds (MCs) serve as unique laboratories for studies on this topic. The VISTA Survey of the Magellanic Clouds, or the VMC survey, is a multi-epoch, uniform, and homogeneous photometric survey of the Magellanic system performed in the near-infrared Y, J and Ks bands. In this talk I will introduce our work on young stellar structures in the MCs based on upper main-sequence stars selected from the VMC survey. We find that star-forming regions in the MCs contain significant amount of substructures. Physical properties of these substructures are investigated, and the role of different physical processes are also explored. Our results are in agreement with the scenario of hierarchical star formation.

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Star formation conditions in the Milky Way's Galactic central region

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The Milky Way's galactic central (GC) region is known for its peculiar mode of star formation (SF), characterized by combination of a few highly active cluster-forming regions and curiously inactive GMCs that occupy the vast majority of the GC clouds. To understand the physics underlying this deviation from the SF scaling law, it is prerequisite to know the exact distribution and fundamental physical/chemical properties of dense molecular gas there.

We report the results of our HCN 4-3, HNC 1-0, H13CN 1-0, and HC3N 10-9 mappings for the central 100 pc region of MW performed with the ASTE 10-m telescope and the NRO 45-m telescope, and spatially-resolved excitation measurements using them and other GC survey data taken from literature. We measured the gas kinetic temperature, hydrogen volume density, and fractional abundances of 8 popular molecules (HCN, HNC, HC3N, HCO+, H2CO, SiO, CS, and N2H+) on 2.4 pc and 10 km/s spatial and velocity grids. This analysis is made possible by employing a new developed method with the hierarchical Bayesian inference, which has successfully suppressed strong artificial correlations among the parameters that appear in the standard maximum likelihood method.

We perform statistical analysis with the results of the excitation analysis, and thereby show that the physical/chemical properties of the GC clouds are significantly affected by the fast supersonic turbulence widespread across the region. Distribution of warm dense gas is well correlated with SiO, HC3N, and H2CO abundances, indicating the importance of shock chemistry and mechanical heating in the GC clouds. Principal component analysis with HCN4-3 clumps has found a clear trend that clumps with low virial parameters (M_VT/M) have higher volume densities and higher probability of having signatures of star formation (HII regions, masers, and IR source). These results are consistent with the picture that the generally high turbulent pressure provided by frequent shock interaction in the GC clouds hinders their self-gravitational collapse, resulting in the deviation from the SF scaling law.

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A detailed view on ionized gas, dust and star formation in M31

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Good understanding of the relation and distribution of different ISM phases is important when trying to study star formation in nearby galaxies. Here we focus on two aspects: attenuation of light and estimation of star formation rates. We combine optical IFU data from five 0.6 kpc x 0.9 kpc fields in the disk of the local spiral galaxy M31 together with infrared data from the Spitzer and Herschel observatories at a common resolutions 100 pc.

The attenuation of light carries information of the true 3-dimensional distribution of dust and gas. Comparison of attenuation obtained from Balmer lines to that expected from the dust mass distribution suggests that the dust distribution in M31 is roughly consistent with a screen geometry and a different relative distribution of diffuse ionized gas is in stark contrast to previous results from nearby galaxies at lower resolution.

In order to test the robustness of star formation rate estimates using Balmer lines and in particular (attenuation-corrected) Halpha line emission, we are currently comparing estimates from widely-used calibrations (UV, WISE 22 micron and MIPS 24 micron) at 30-50 pc resolution to quantify consistencies between methods, search for systematics and study the impact of angular resolution.

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How primordial star formation shaped the present day dwarf galaxies

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Low-mass dwarf galaxies are very sensitive test-beds for theories of cosmic structure formation since their weak gravitational fields allow the effects of the relevant physical processes to clearly stand out. Using computer simulations, we show that the first population plays an important role in the evolution of (dwarf galaxies), owing to their different IMF. Indeed, properly modeling the formation of Population III stars in simulations allows us to form dwarf galaxies that strongly resemble the present day population of local dwarfs (Verbeke et al. 2015).

We stress the importance of analyzing simulated galaxies in a similar way as an observer would as closely as possible. As a recent result, we discuss the difference between star formation histories derived from synthetic color-magnitude diagrams and the ones taken directly from the particle data.

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JVLA observations of SDC13: Gravity drives the evolution of infrared dark hubs

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In recent years, Herschel observations of the Galactic interstellar medium has revealed the ubiquity of dusty filamentary structures. In some clouds, filaments are organised in hubs, i.e. small networks of converging filaments. Understanding the link between the evolution of these hub systems and the formation of cores/stars inside them is at the heart of current star formation research. We have mapped the density and kinematic structure of SDC13, a $1000M_{\odot}$ filament hub system of 4 parsec-long filaments 3.6kpc away in the galactic plane, with the JVLA and GBT in NH_{3}(1,1) and NH_{3}(2,2) emission lines, probing 0.07pc scales with our high angular resolution of 3.3$''$.

We find large scale kinematic differentiation between the filaments, along with smaller scale radial and longitudinal velocity gradients. Furthermore, we find the gas velocity dispersion is mostly sub-sonic in the diffuse parts of the filaments and becomes super-sonic towards (starless) cores. The three most massive cores are located at filament junctions, and on average, all identified cores are regularly spaced along the filaments, typical by 0.4pc, suggesting gravitational instabilities of these super-critical filaments are responsible for their fragmentation.

Altogether, we present a scenario for the evolution of SDC13 in which filaments first form as post-turbulent-shock structures where gas is mostly subsonic, then gravity takes over and starts shaping the evolution of the hub, both fragmenting filaments and pulling gas towards the centre of the gravitational well. Doing so, gravitational energy is converted to kinetic energy in both local (cores) and global (hub centre) potential well minima.

Star cluster formation triggered by giant molecular cloud collisions

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Most stars form in clusters within giant molecular clouds (GMCs). However, the dominant processes that induce the collapse and fragmentation of GMCs into star-forming clumps are poorly understood. One major driver of star formation activity in galactic disks may be triggering via converging molecular flows, i.e., GMC-GMC collisions. Cloud collisions are difficult to observationally verify, but the list of candidates is growing. We carry out 3D, magnetohydrodynamics (MHD), adaptive mesh refinement (AMR) simulations to study how cloud collisions trigger formation of dense filaments, clumps, and star clusters. We include heating and cooling based on photo-dissociation region (PDR) models, supersonic turbulence, magnetic fields, and a magnetically-regulated star formation model. Comparing and contrasting non-colliding and colliding GMCs, we characterize morphologies of dense gas, magnetic field vs. filament structure, kinematic signatures, star cluster properties, and overall star formation rates (SFR). We present key observational diagnostics of cloud collisions and find that typical collisions indeed trigger earlier and enhanced star formation, resulting in 10 times higher SFRs and efficiencies.

The role of neutral-ion coupling in star formation

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Star formation takes place in partially ionized, turbulent, and magnetized molecular clouds (MCs). The distribution of electron density fluctuations inferred from the scattering measurements of highly dispersed pulsars is consistent with the distribution of neutral (e.g., CO, HI in absorption) density fluctuations obtained from spectroscopic observations. This is expected by the advanced theory of MHD turbulence and suggests the strong coupling state between the two species on the spatial scales of MCs. Besides (1) the neutral-ion coupling and the role of MHD turbulence in MC dynamics, I will also talk about (2) the importance of decoupling of neutrals from ions in core and filament formation; and (3) the neutral-ion re-coupling during the evolution of cores and its effect on the spatial distribution and evolution of protostars. This talk is intended as an exemplification of applying modern turbulence theory to studying the star formation problem and explaining diverse observations.

The three-dimensional distribution of the molecular clouds in the Galactic Centre

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The Centre of the Milky Way is a unique place of star formation within our Galaxy. The star formation efficiency is much lower than anywhere in the disk, yet it harbours many of the super star clusters of our Galaxy. A new theory of the star formation in this region (also called the Central Molecular Zone, or CMZ) has recently been formulated (Kruijssen et al. 2015) that attempts to explain the unusual star formation. This theory relies on the dynamics and structure of the CMZ. In order to test this theory, I am constructing a 3-dimensional model of the CMZ, using observations of OH and CO. This method allows us to place star forming clouds along the line of sight, within the CMZ and thus allows us to gauge the distance to these clouds, independent of dynamics. We find that a molecular bar is clearly present in the CMZ. I will introduce this method and present the results on our understanding of the 3-dimensional structure of the centre of our Galaxy.

Directions to ICISE in Vietnamese to show to the taxi driver: (Fare: about 5 USD)

Trung tâm Quốc tế Khoa học và Giáo dục Liên ngành (ICISE) Phường Ghềnh Ráng

1. Từ đường Tây Sơn, đi theo QL 1D, đến trạm Kiểm Dịch, rẽ trái.
2. Cuối đường nhựa, Trung tâm Quốc tế Khoa học ICISE nằm bên tay phải