



中央研究院  
天文及天体物理研究所  
ACADEMIA SINICA  
Institute of Astronomy and Astrophysics

# ALMA in Taiwan

Yu-Nung Su (ASIAA)  
on behalf of ALMA-Taiwan

ALMA/45m/ASTE Users Meeting  
December 19 - 20, 2016





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# ALMA in Taiwan

- \* Engineering and Developmental Projects (ASIAA labs)
- \* ASIAA CASA Development Center (ACDC, @ ASIAA)
- \* Taiwan ARC Node (@ ASIAA)
- \* Scientific and Outreach Activities (at ASIAA and Taiwanese Universities)

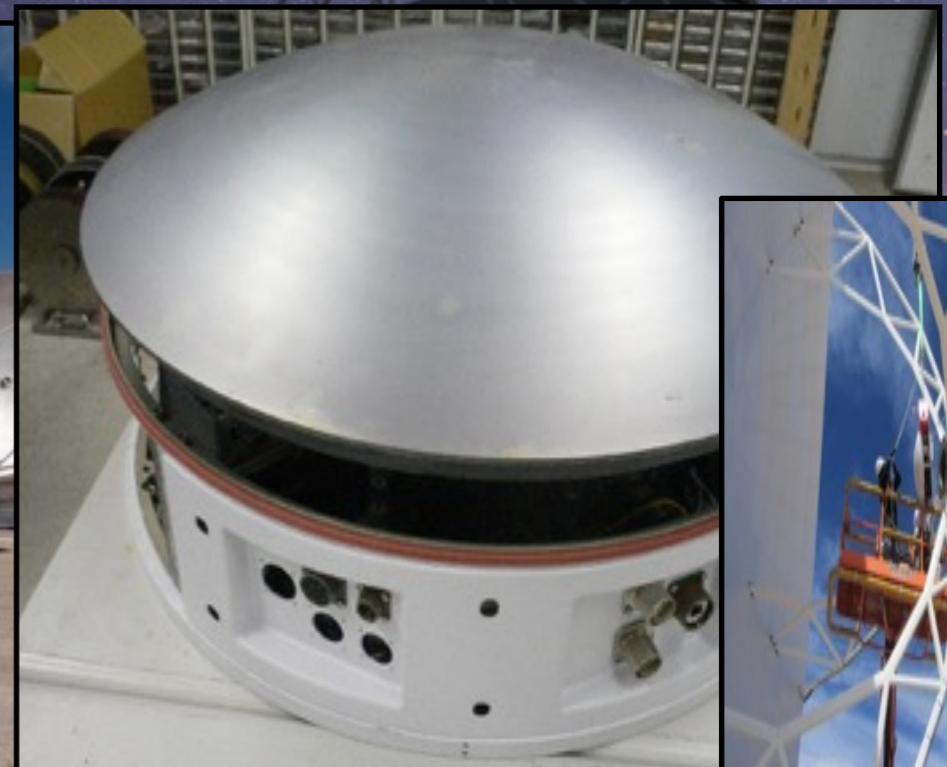




# Engineering and Developmental Projects

- completed -

- East-Asia Front End Integration Center
  - 22 (out of 69) Front End Assemblies delivered by EA-FEIC
- Two Front End Service Vehicles delivered in 2011
- Nutator Development

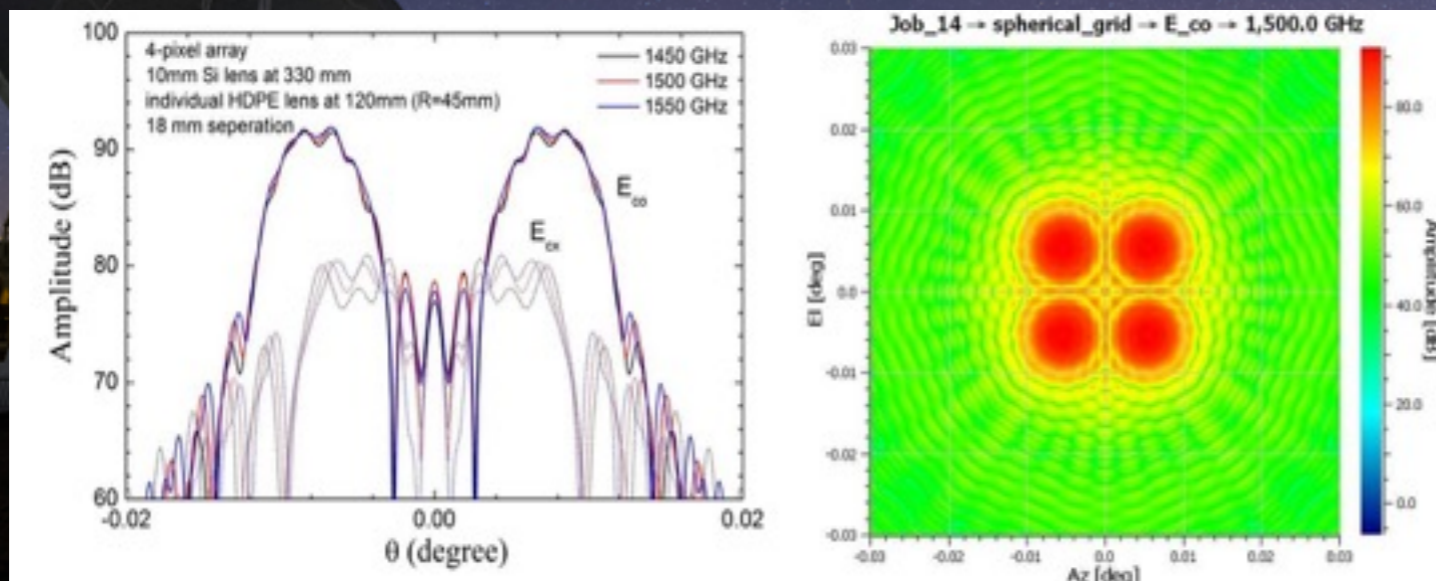




# Engineering and Developmental Projects

- in progress -

- Band 1 Receivers (30 - 50 (52) GHz)
  - in collaboration with NAOJ, NRAO, HIA, and Univ. of Chile.
  - Approved officially by ALMA board in mid 2016
  - 1st prototype tested at site in 2017 spring
  - 1st cartridge delivered to site in mid-2017
  - Production of 73 cartridges completed by end of 2019
- Multi-Pixel Receiver at 1.5 THz band





# ASIAA CASA Development Center

- ASIAA CASA Development Center (ACDC)
  - established on 2016 August 1st.
  - in collaboration with NRAO, with the funds of the Ministry of Science and Technology (MoST)
  - Chin-Fei Lee is the ACDC manager
    - Currently 4 full time staffs work for ACDC, including two software engineers, one system manager, and one support scientist.
    - The number of software engineers is expected to increase to 5 in 2019
  - More information can be found from [http://alma.asiaa.sinica.edu.tw/acdc\\_intro.php](http://alma.asiaa.sinica.edu.tw/acdc_intro.php)





# ASIAA CASA Development Center

- **Technical Work Areas**

- Development at the ACDC will be fully integrated and coordinated with the CASA team.
- For the initial year, the ASIAA team will augment the effort of NRAO on the next generation CASA image viewer; **CARTA** (Cube Analysis and Rendering Tool for Astronomy).
  - expected to deliver core features in the first year time scale, and enhanced features (e.g., PV diagrams, 3D rendering) in the 2nd year time scale.
  - The goal is to replace CASA viewer in CASA.
- During the second year (depending on our CARTA progress and hiring), the ASIAA center will add a component of high performance computing (HPC) to the development targets.



# Taiwan ARC Node

- established in November 2009, connecting to EA ARC and NA ARC
- working with EA ARC for user support core functions (i.e., P2G, QA2, CS, Helpdesk, TA, AoD)
- working with NA for enhanced functions
- currently 9 ARC members
- organizing workshops / tutorials on-island in Taiwan, together with universities in Taiwan





# Taiwan ARC Node

- Two days' CY4 users workshop in March 2016 to
  - introduce ALAM science and basic interferometry to new users
  - update the status and introduce new capability to the local community
- Tiara Summer School on Radio Astronomy to provide a broad overview of radio astronomy to students

## ALMA Cycle4 Users Workshop 2016

March 19 (Sat) 2016 - ALMA science and (sub)millimeter synthesis imaging

March 26 (Sat) 2016 - ALMA cycle4 proposal preparation

ASIAA R1203, AS/NTU Astronomy-Mathematics Building

### Program

#### (Day 1) Mar 19, 2016

##### ALMA science and (sub)millimeter synthesis imaging

09:30-10:00	Nearby galaxies	Satoki Matsushita
10:00-10:30	High-z, cosmology	Wei-Hao Wang
10:30-10:45	Coffee Break	
10:45-11:15	Star-formation, ISM	Vivien Chen
11:15-11:45	Circumstellar disk, planet	Shih-Ping Lai
11:45-13:00	Lunch	
13:00-14:00	Basics of (sub)mm interferometry	Chin-Fei Lee
14:00-16:30	CASA imaging simulation (Part I   Part II)	Kuo-Song Wang Yu-Ting Wu
	Coffee Break at 15:00 for 15m	
16:30-17:00	General discussion	

#### (Day 2) Mar 26, 2016

##### ALMA cycle4 proposal preparation

09:30-10:10	ALMA cycle4 info	Yu-Nung Su
10:10-10:40	Polarization	Shih-Ping Lai
10:40-10:55	Coffee Break	
10:55-11:15	ACA stand alone	Sheng-Yuan Liu
11:15-11:35	VLBI-ALMA	Keiichi Asada
11:35-11:50	Proposal review process	Satoki Matsushita
11:50-12:20	Writing good proposals	You-Hua Chu
12:20-13:30	Lunch	
13:30-16:30	OT step by step	Alfonso Trejo-Cruz Pei-Ying Hsieh
	Coffee Break at 15:00 for 15m	
16:30-17:00	General discussion	



# Scientific and Outreach Activities

## ALMA-Taiwan Proposal Statistics

	Total proposals submitted worldwide	Total proposals accepted	Taiwan proposals submitted	Taiwan proposals accepted
Cycle 0	919	112	45	8
Cycle 1	1133	196	56	14
Cycle 2	1381	353	73	20 (+7 filler)
Cycle 3	1578	401	79	23 (+14 filler)
Cycle 4	1573	473	91	33 (+12 filler)

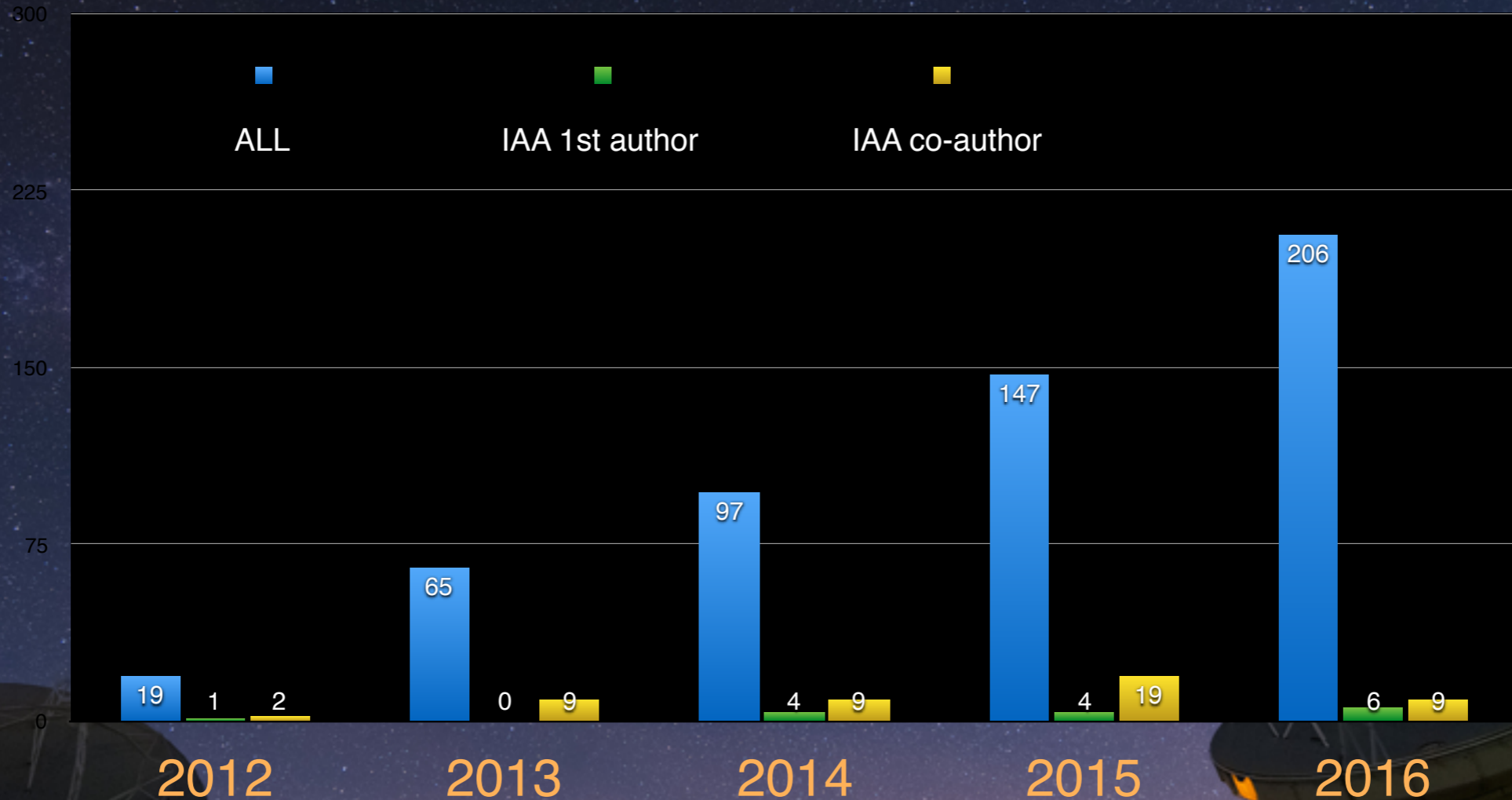
*Table 5: Comparison of proposal numbers submitted and accepted both worldwide and in Taiwan over all previous ALMA Cycles.*

For ALMA Cycle 4, Taiwan users submitted a total of 91 proposals, of which 7 received grade A, 26 grade B, and 12 grade C. **In short, about 7% accepted proposals from Taiwan**



# Scientific and Outreach Activities

## ALMA-Taiwan Publication Statistics



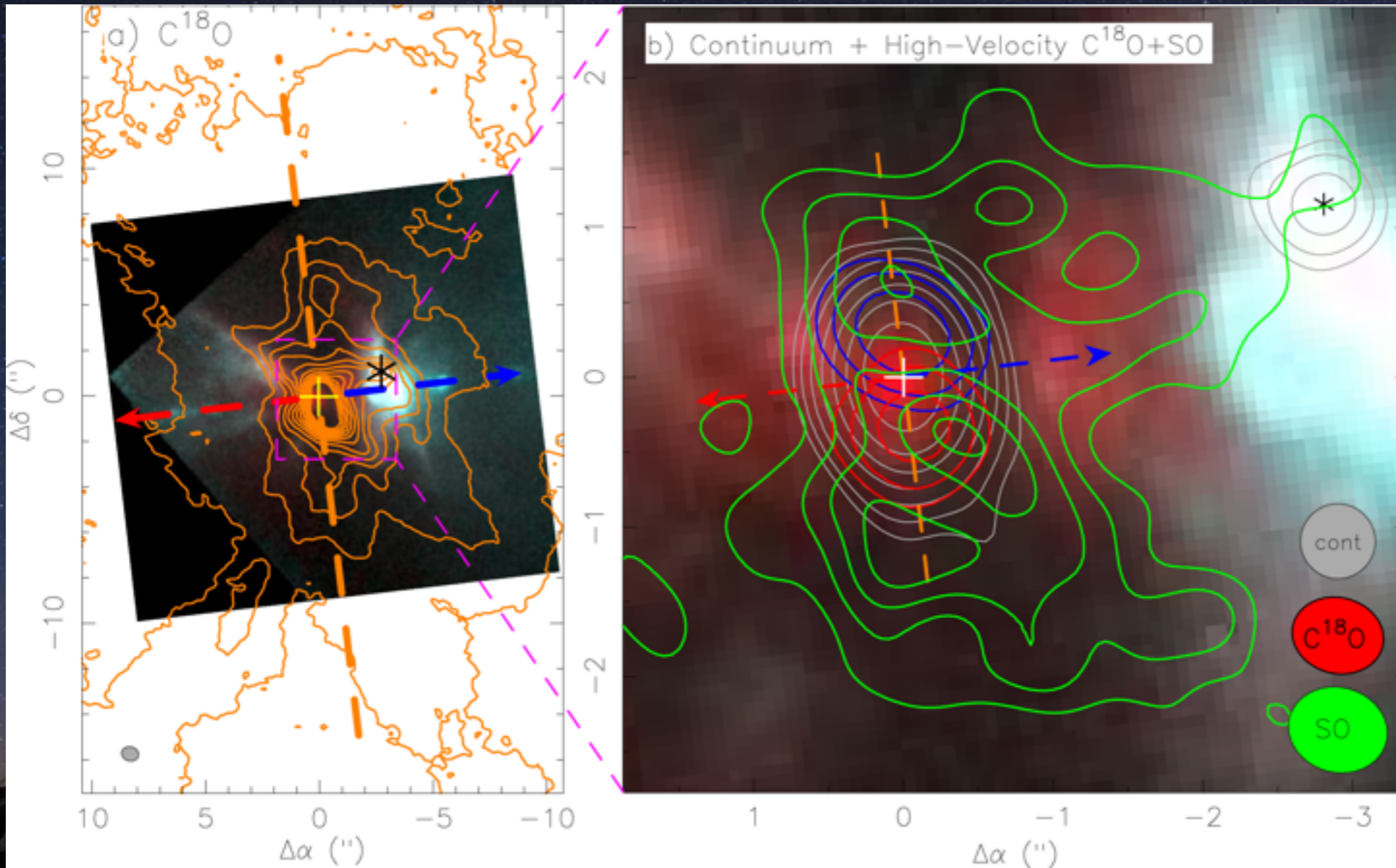
As of Today, 15 First-Author Papers; 48 Co-Author Papers



# Scientific and Outreach Activities

HH 111: Envelope/Disk in C<sup>18</sup>O J=2-1 + SO transition

The envelope is well seen in C<sup>18</sup>O, extending to ~7000 AU out from the central source, with the innermost part overlapping with the dusty disk. It has a differential rotation.

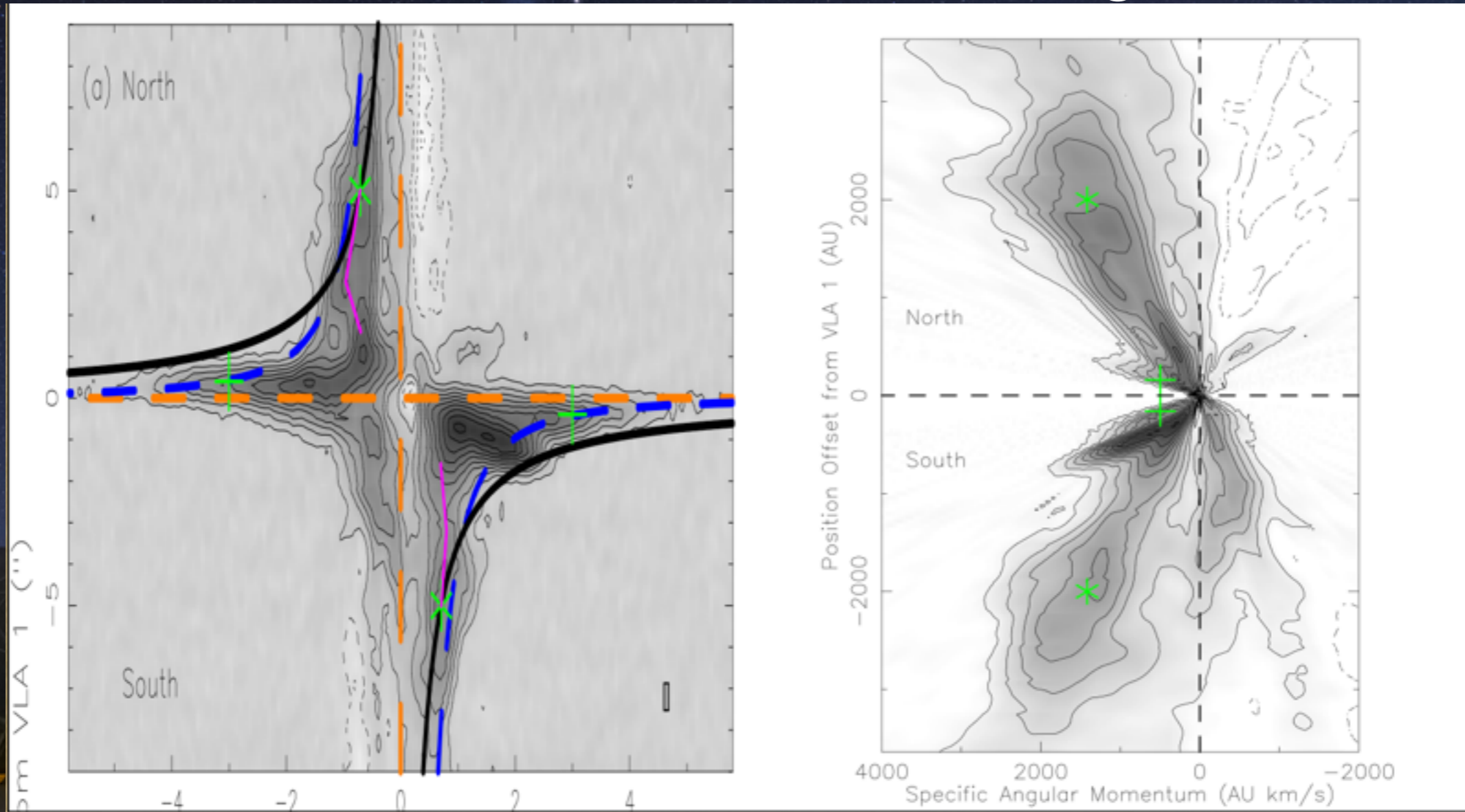


Lee 2010,2011; Lee et al. 2016



# Scientific and Outreach Activities

## PV toward the transition region

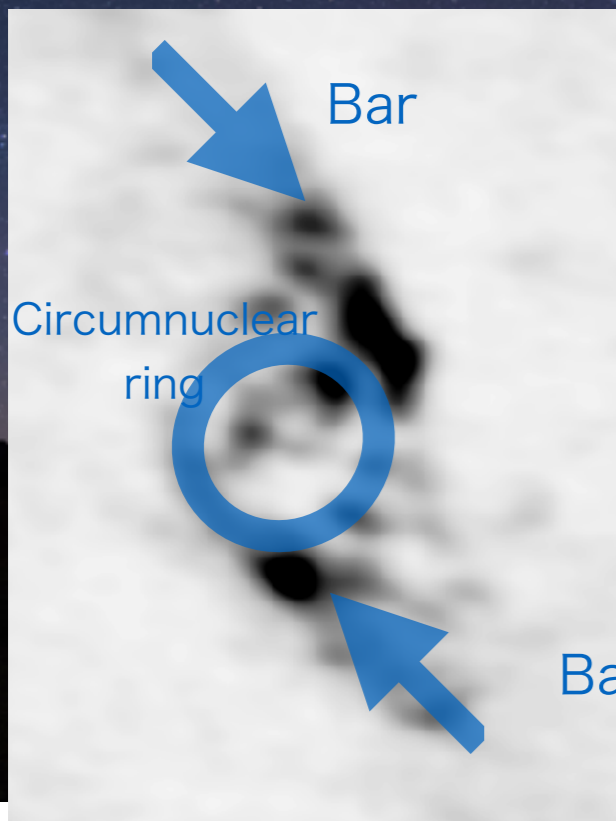
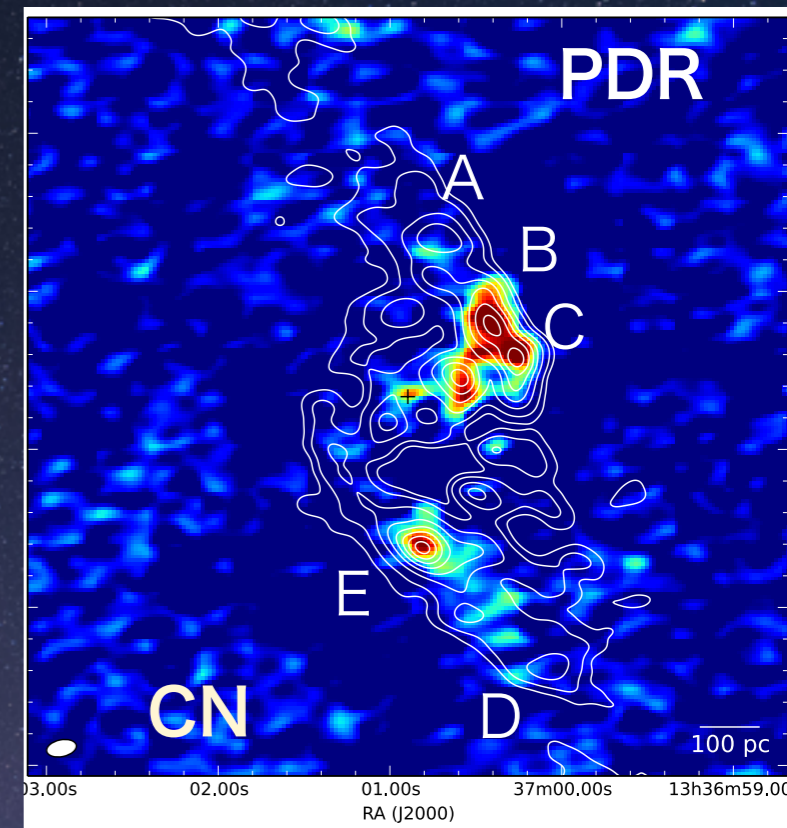
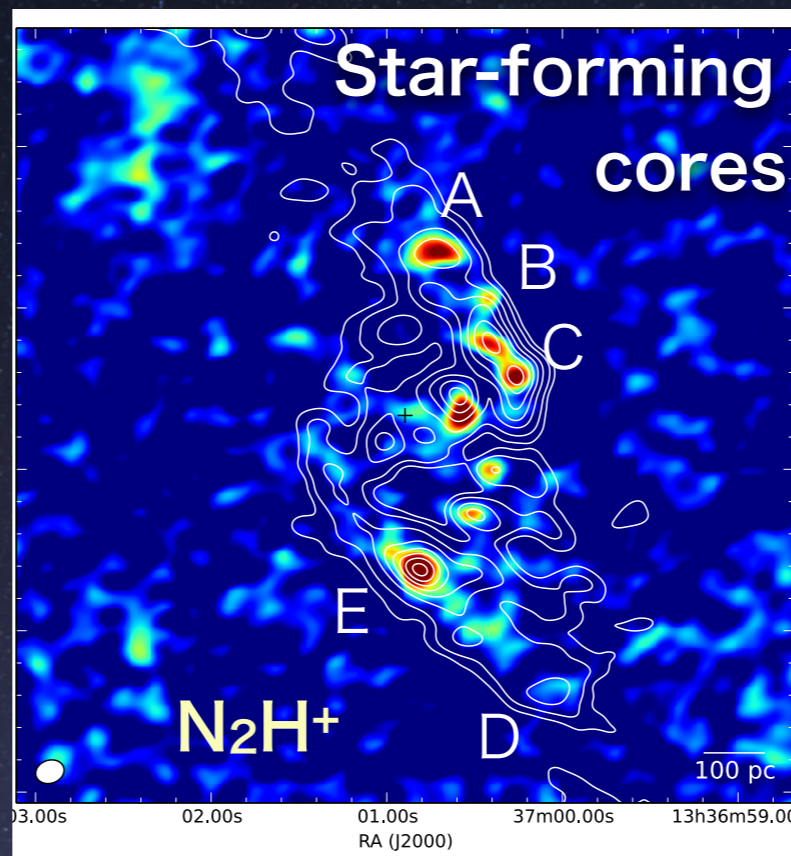
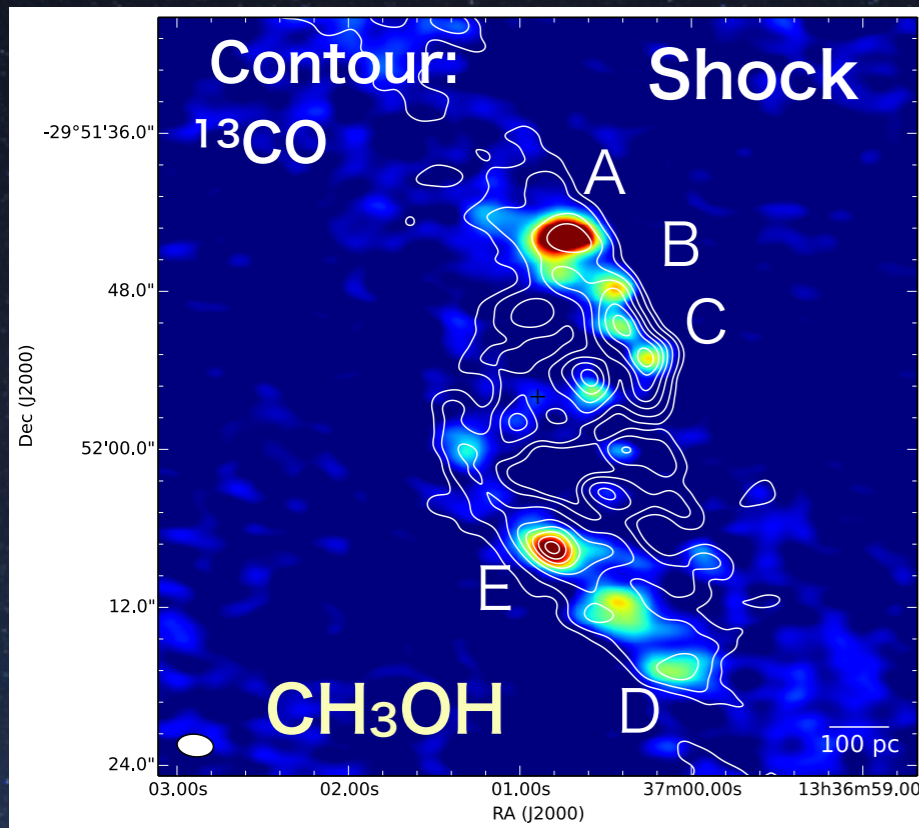


Large decrease of angular momentum due to Magnetic Braking Effect and thus produces a disk with a small radius?

Lee et al. 2016



# Evolution of chemistry along the circumnuclear ring (Harada et al. in prep)



**M83** nearby face-on starburst galaxy

Chemistry evolve from the gas inflow from the bar  
 → Shock tracer → Star-forming core tracer  
 → PDR tracer

→ Evidence on collision-induced star formation on NW lobe?



# Scientific and Outreach Activities

- Lots of Taiwanese News & TV Media Reports  
(visit <http://www.asiaa.sinica.edu.tw/news/newsrelease.php>)



科学人 (Scientific American in Taiwan) 2015 July



台視新聞 (News TV) 2014 Dec.



聯合報 (Newspaper) 2016 Jun 23



中視新聞 (News TV) 2015



# Scientific and Outreach Activities

- The ALMA website for kids in Chinese  
(visit <http://kids.alma.cl/?lang=zh>)

English Español 中文

ALMA DISCOVERIES MULTIMEDIA GAMES

ALMA discovers that planets are born quicker than thought

Welcome to the ALMA website for kids!  
Discover the world's largest observatory with Talma

ALMA Kids Art Gallery The electromagnetic spectrum ALMA Kids Art Gallery Comic: Talma & ALMA

NEW DISCOVERIES  
View all

**Surprise: ALMA finds lots of gas around heftier stars**  
Morning fog disappears when the sun rises. Can you imagine what happens when the sun would be much hotter and brighter? The fog will disappear

**Stellar cocoon doesn't contain ingredients for recipe of life**  
If you want to cook up a nice meal, you need the right ingredients. Without beans, you can't make a good chili. And to bake

**ALMA discovers that planets are born quicker than thought**  
Adapted from Space Scoop - UNAWA. It takes nine months for a human baby to grow and 22-months for a baby elephant. But how long

English Español 中文

ALMA 新發現 多媒體 動手玩遊戲

在新生恆星周圍發現嬰兒行星的腳印

歡迎光臨ALMA兒童網站！讓Talma同學陪你探索世界最大的天文臺！

美術館 電磁波譜 美術館 漫畫書: Talma 逛 ALMA

新發現  
看全部

**意外了: ALMA在較重的恆星周圍發現大量氣體**  
旭日東昇, 晨霧沒兩下子就驅散了。不難想像——要是我

**恆星繭中沒含生命重要成分?**  
想做出好吃的東西, 前提是備齊做菜要用的材料。譬如麵

**在新生恆星周圍發現嬰兒行星的腳印**  
人類的嬰兒需要在母親的肚子裡待9個月然後誕生。大象

TALMA陪你認識更多  
看全部