

ALMA Science: The Dawn of a New Era



Leonardo Testi
ESO ALMA Programme Scientist

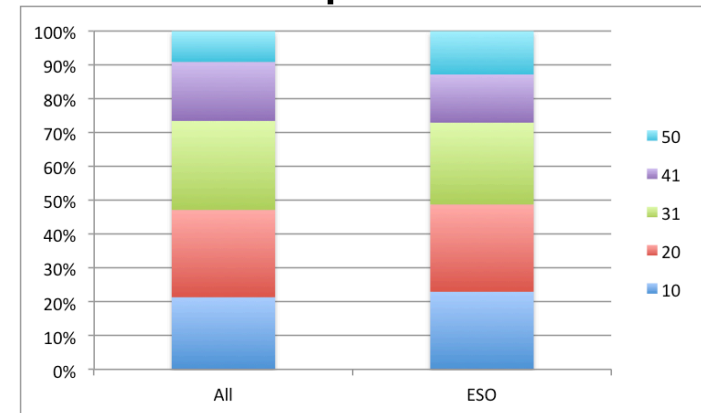
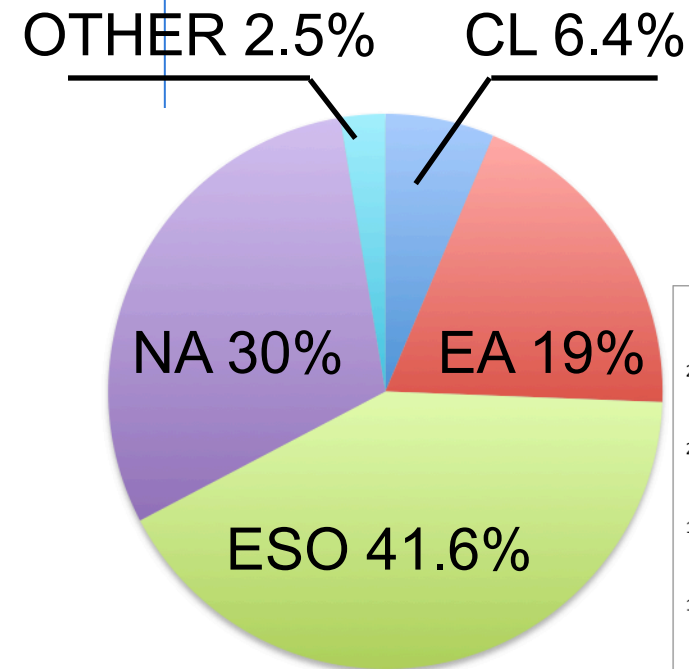
ALMA Early Science

- ALMA Early Science C0, C1 & C2
 - 30-70% of the total number of antennas
 - Maximum separation 1.5km (10% of final ALMA)
 - The most powerful submm observatory
- Enormous pressure to use ALMA worldwide
 - Requests for 7 times the available time
 - Top 10% science projects selected (ESO)

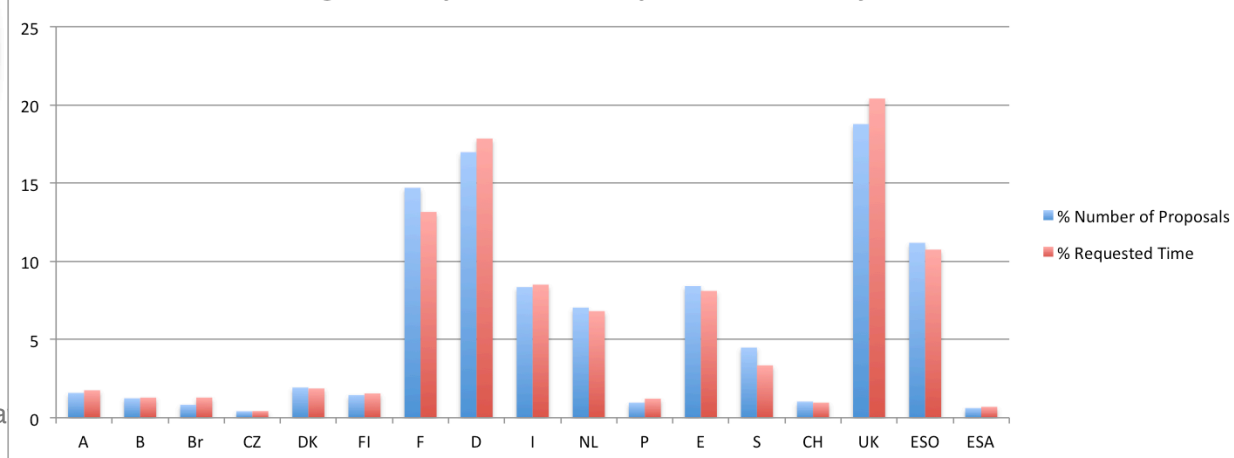


Proposals Statistics

- Statistics based on ~3500 proposals (Cycles 0, 1, and 2)
- Huge pressure on the ESO time
- Good geographical distribution in Europe



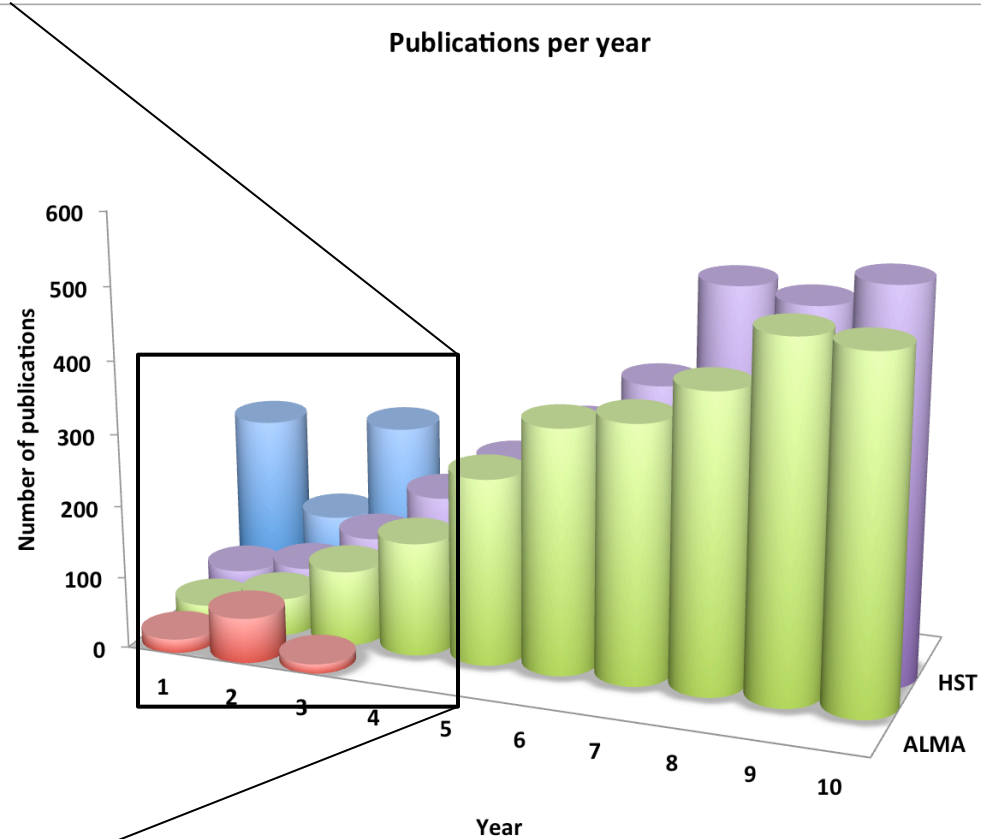
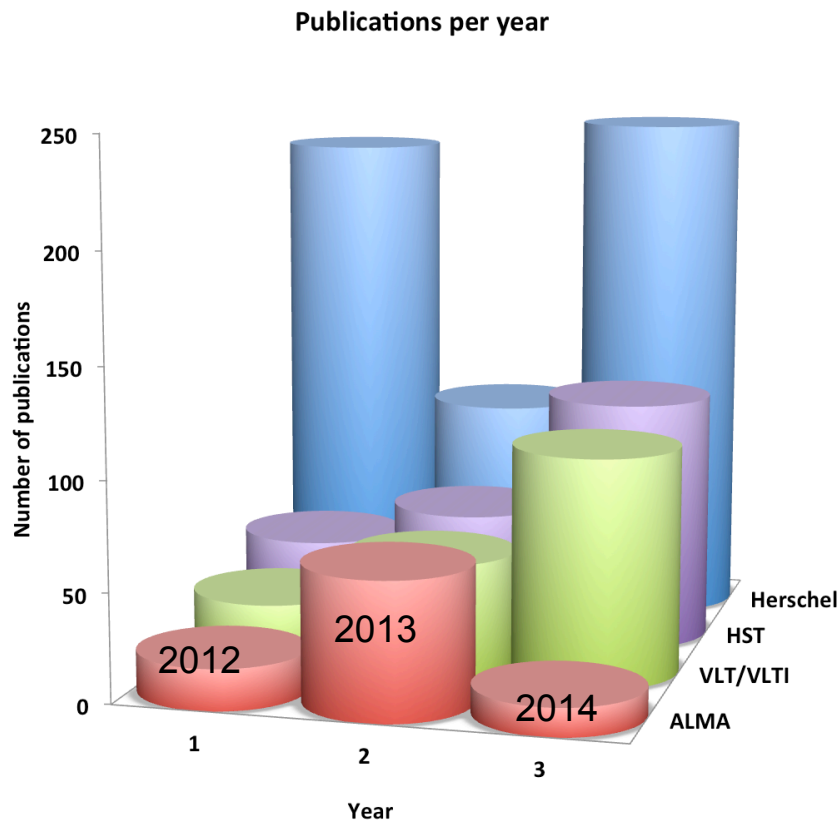
Percentage of Proposals and Requested Time - Cycles 0,1, and 2



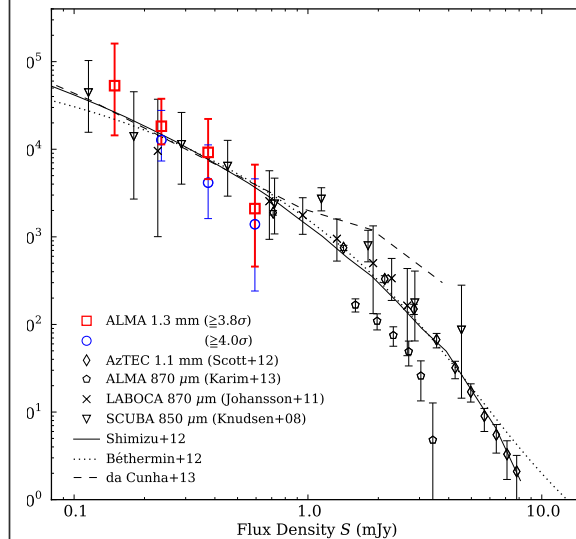
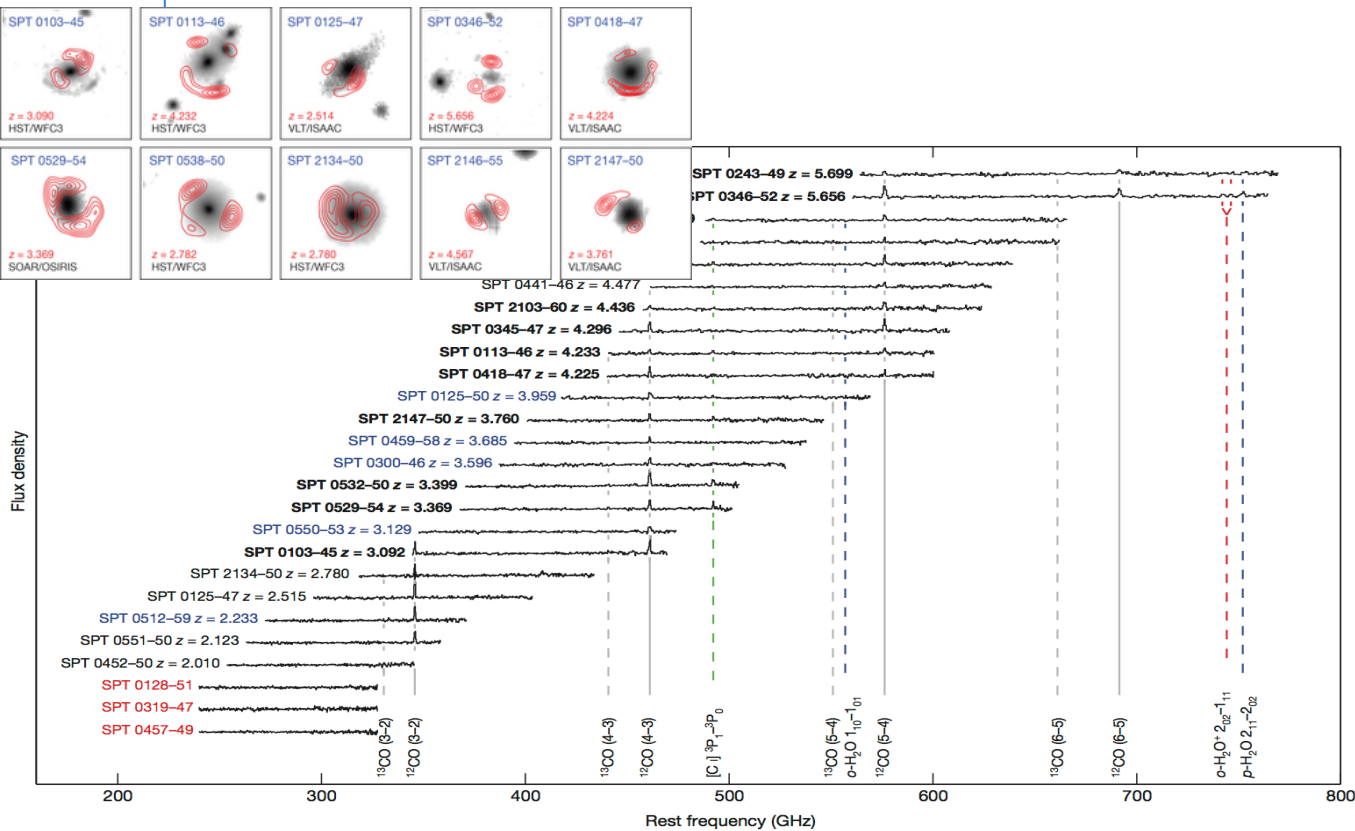
Comparison with other facilities

- Publications rate well aligned with major facilities
- Very high level of Nature/Science papers for ALMA
- High rate of Nat/Sci papers (7% vs 1-4%)

Source: telbib.eso.org Feb 2014



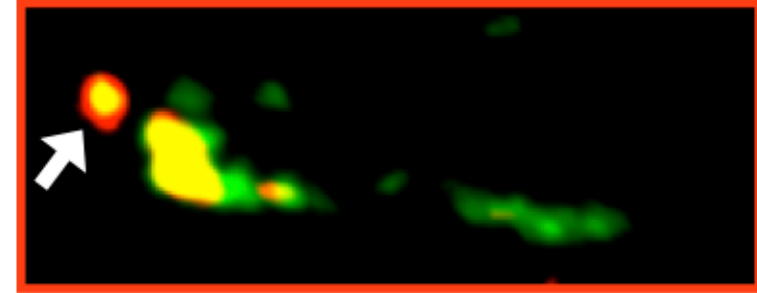
- Nature paper on the STP lensed SMGs
 - New redshift distribution
- Other results in many areas
 - Deep galaxy counts, GRBs, metals in QSOs and first galaxies



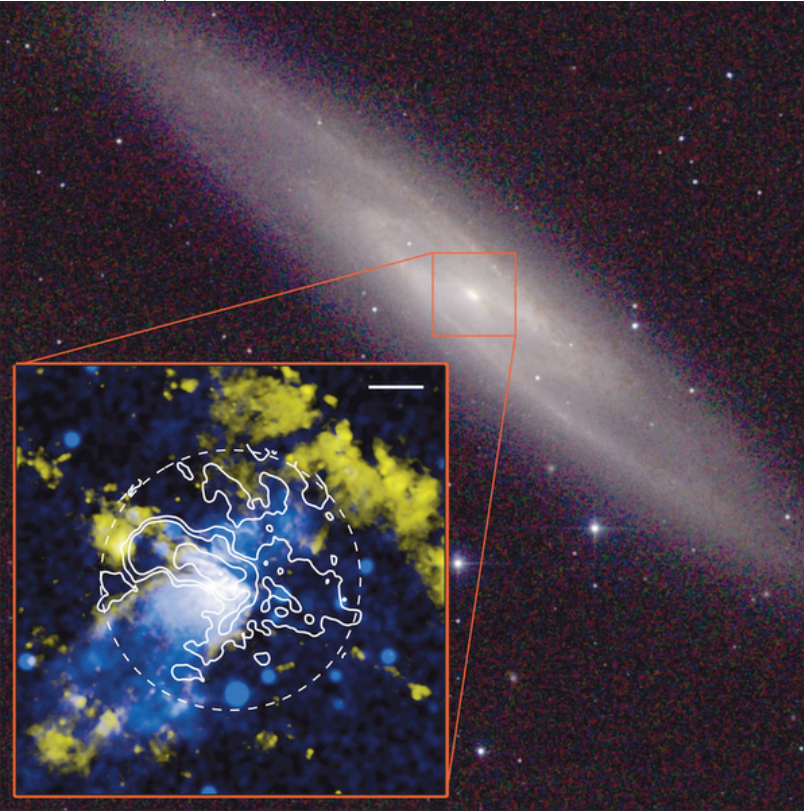
(Hatsukade et al. 2013)

Galaxies/AGN

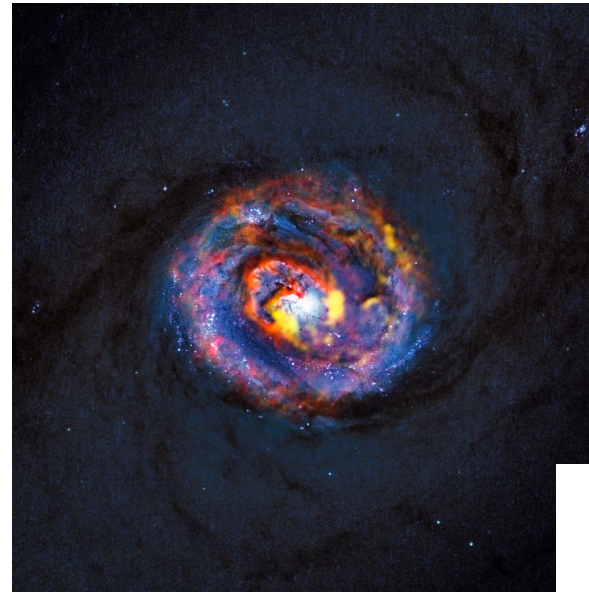
- Nature paper on NGC 253
 - Molecular wind driven by starburst
- Other results
 - Dense gas feeding AGN nuclei



(Iono et al. 2013)

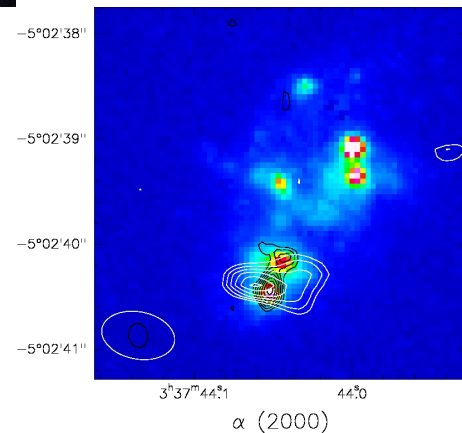


(Bolatto et al. 2013)



(Combes et al. 2013)

(Hunt et al. 2013)

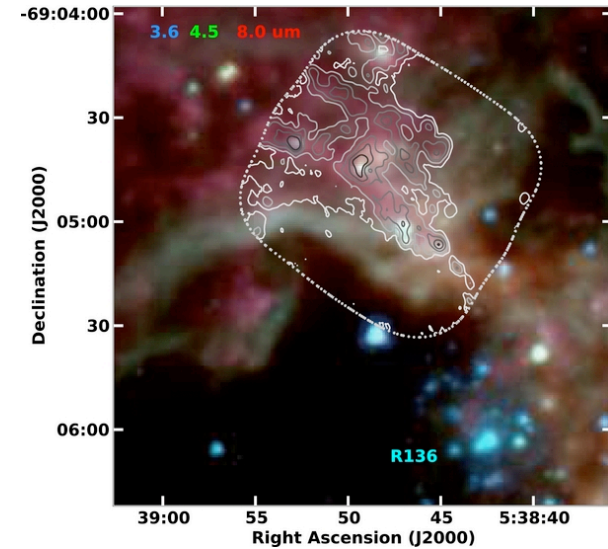
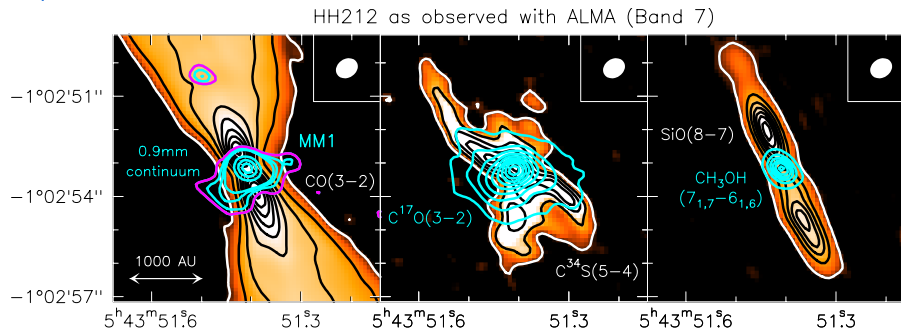


ISM Star Formation

Several important results

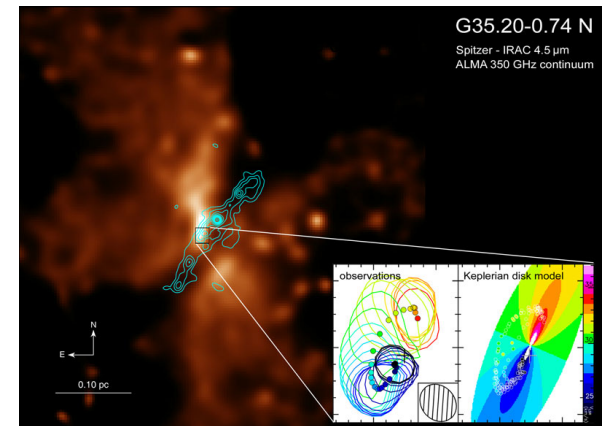
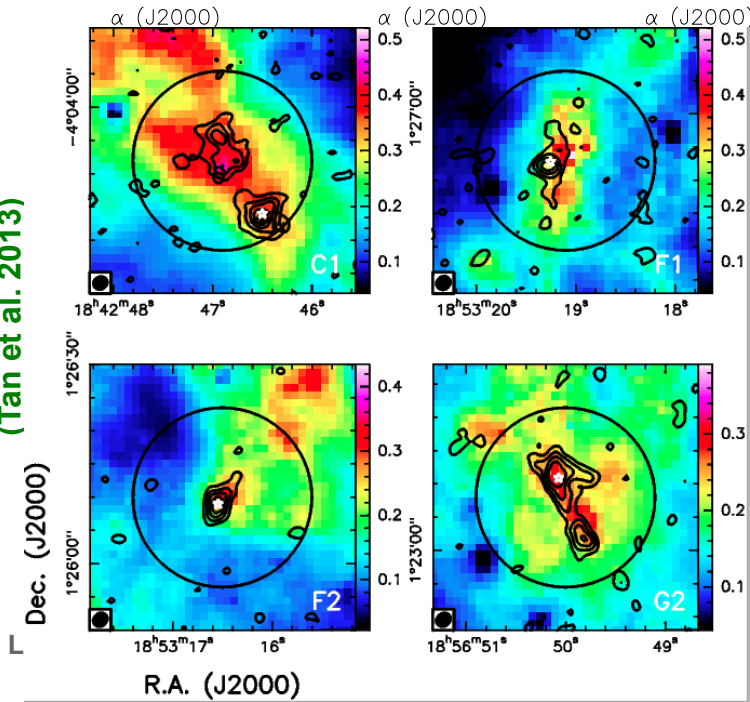
- Molecular outflows, disks around high mass protostars, IRDCs

(Codella et al. 2014)



(Indebetouw et al. 2013)

(Tan et al. 2013)



(Sanchez-Monge et al. 2013)

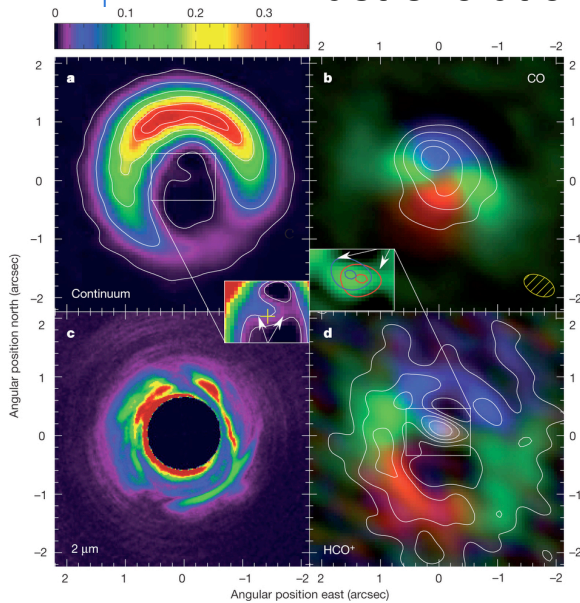
Protoplanetary disks



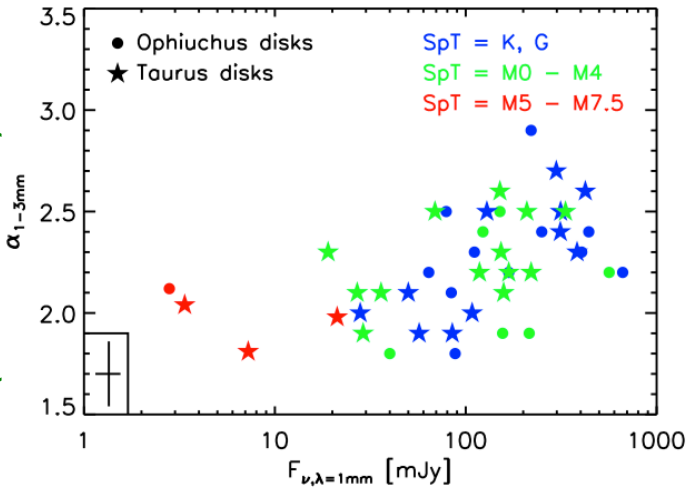
■ 2 Nature, 2 Science papers

➤ Dust evolution, gaps, gas chemistry and snowlines

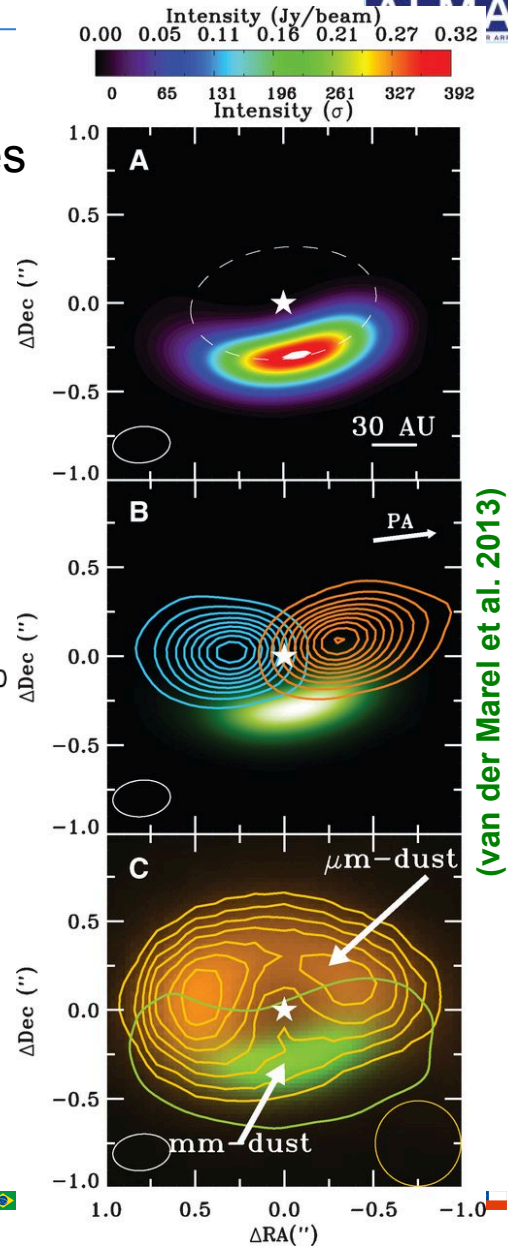
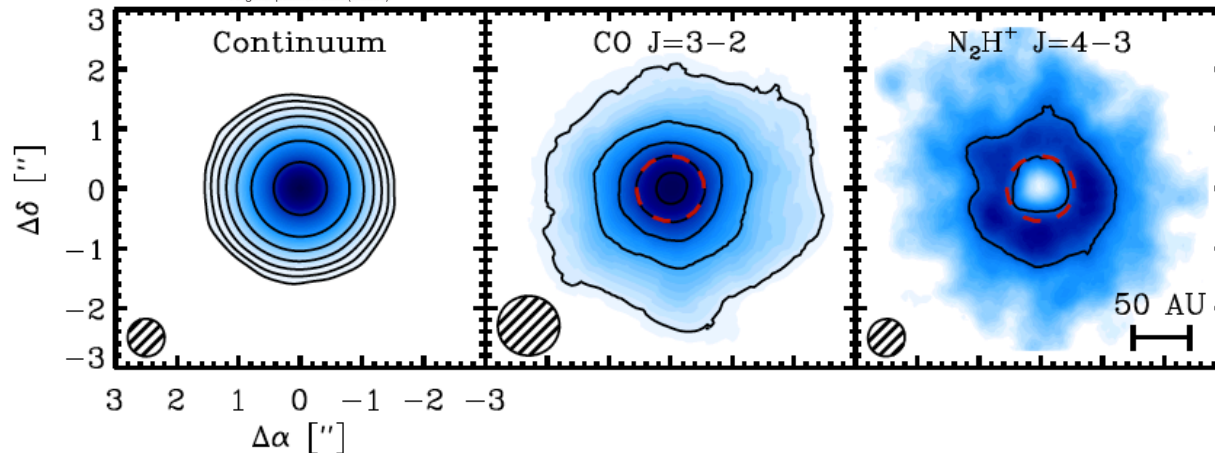
(Casassus et al. 2013)



(Ricci et al. 2014)



(Qi et al. 2013)

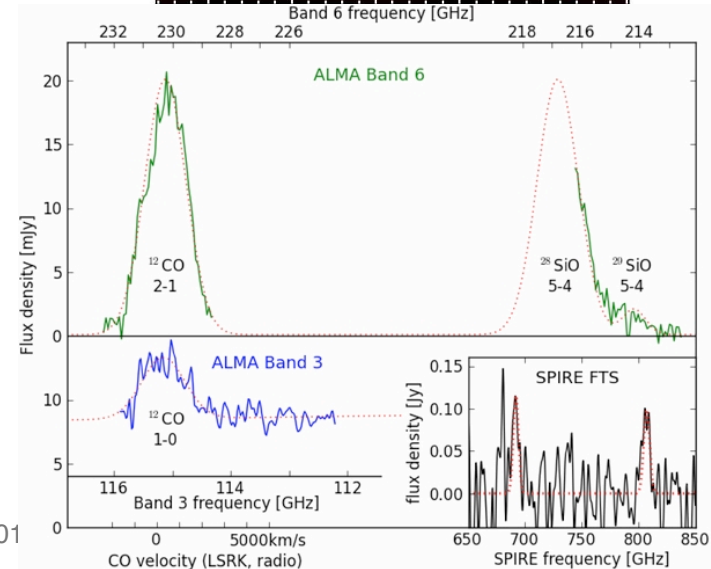
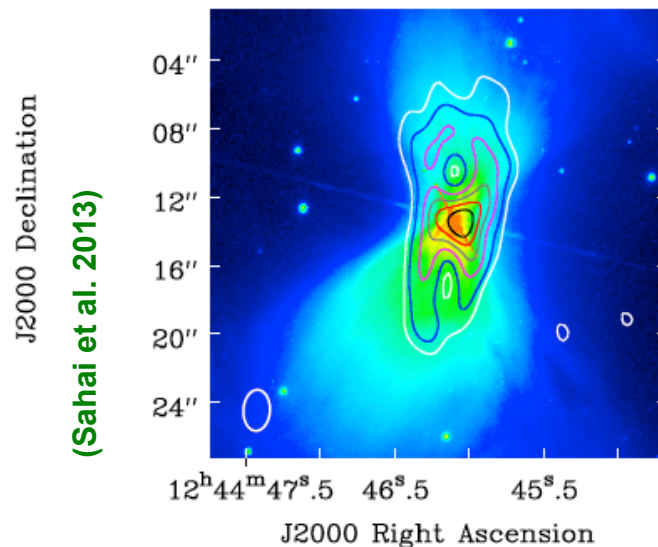
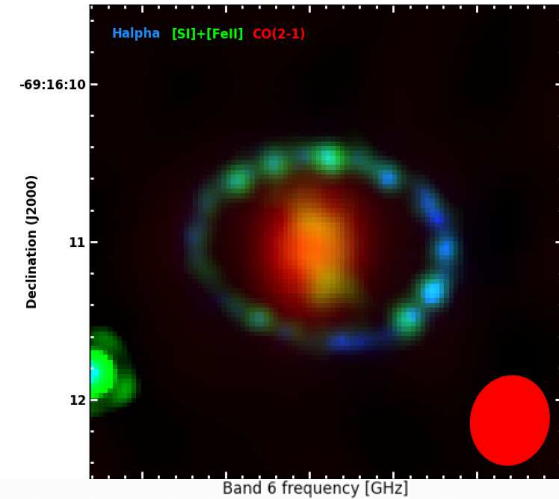
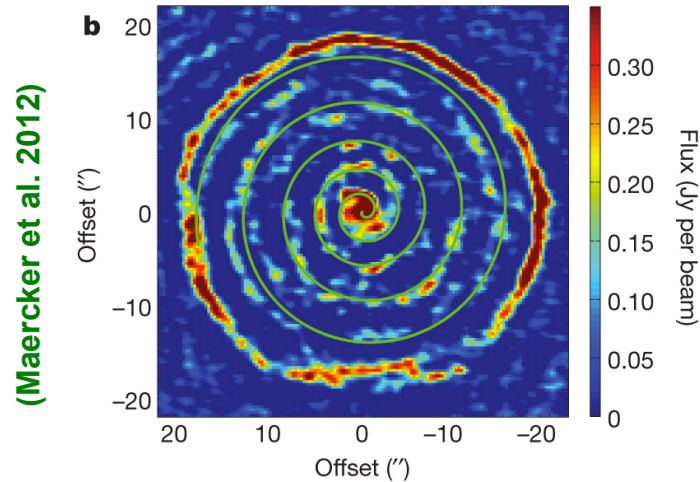


(van der Marel et al. 2013)

Stellar evolution

■ Nature paper on AGB mass loss

➤ Post AGB stars, pre-planetary nebula, SN 1987



(Kamenetzky et al. 2013)

May 201



Science conferences/workshops



- EWASS 2014
 - Eu Science workshop
- ESO-ESA workshop
 - Herschel and ALMA Archive research
 - Nov 2014
- ALMA Science: the third year
 - Tokyo Dec 2014
- ALMA Science in the EELT era
 - Garching winter 2015

Leonardo Testi: ALMA Science: the Dawn of a New Era, SALT, 16 May

Revolution in Astronomy with ALMA - The 3rd Year -

ALMA

Tokyo International Forum
Tokyo, Japan
December 8 - 11, 2014

Scientific Organizing Committee :

- Paola Andreani (ESO)
- Alberto Bolatto (University of Maryland)
- John Carpenter (California Institute of Technology)
- Simon Casasus (University of Chile)
- Stuart Corder (JAO)
- Pierre Cox (JAO)
- Tetsuo Hasegawa (NAOJ)
- John Hibbard (NRAO)
- Satoru Iguchi (NAOJ)
- Daisuke Iono (NAOJ)
- Rob Ivison (ESO, Edinburgh)
- Kelsey Johnson (University of Virginia)
- Jongsoo Kim (KASI)
- Sheng-Yuan Liu (ASIAA)
- Jesus Martin-Pintado (CSIC-INTA)
- Raphael Moreno (Observatory of Paris)
- Kentarō Motohara (University of Tokyo)
- Roberto Neri (IRAM)
- Lars Nyman (JAO)
- Nagayoshi Ohashi (NAOJ)
- Tomoharu Oka (Keio University)
- Dick Plambeck (University of California Berkeley)
- Douglas Scott (University of British Columbia)
- Ken'ichi Tatematsu (NAOJ, Chair)
- Leonardo Testi (ESO)
- Huib van Langevelde (JIVE/Leiden University)
- Al Wootten (NRAO)

Local Organizing Committee:

- Eiji Akiyama
- Tetsuo Hasegawa
- Bunyo Hatsukade
- Masaaki Hiramatsu
- Satoru Iguchi
- Daisuke Iono (Chair)
- Shinya Komugi
- Yuichi Matsuda
- Erik Muller
- Hiroshi Nagai
- Kazuya Saigo
- Hiroko Shinnaga
- Ken'ichi Tatematsu

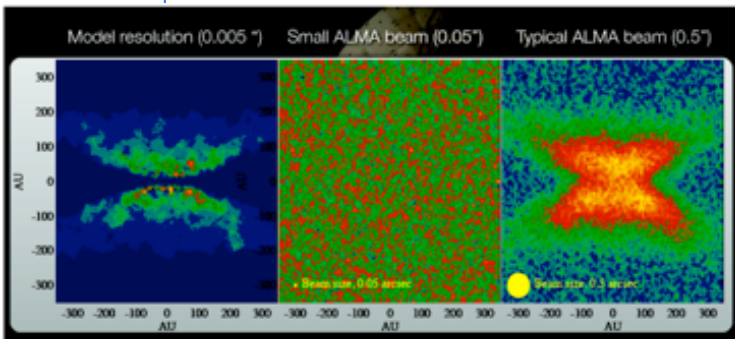
Composite view of the galaxy NGC 1432 from ALMA and Hubble
Credit: ALMA (ESO/NAOJ/NRAO)/NASA/ESA/Hubble

<http://www.almasc2014.jp>

ESO, NAOJ, NRAO, RadioNet

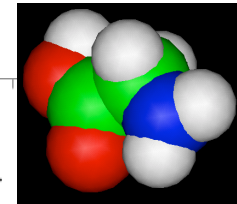
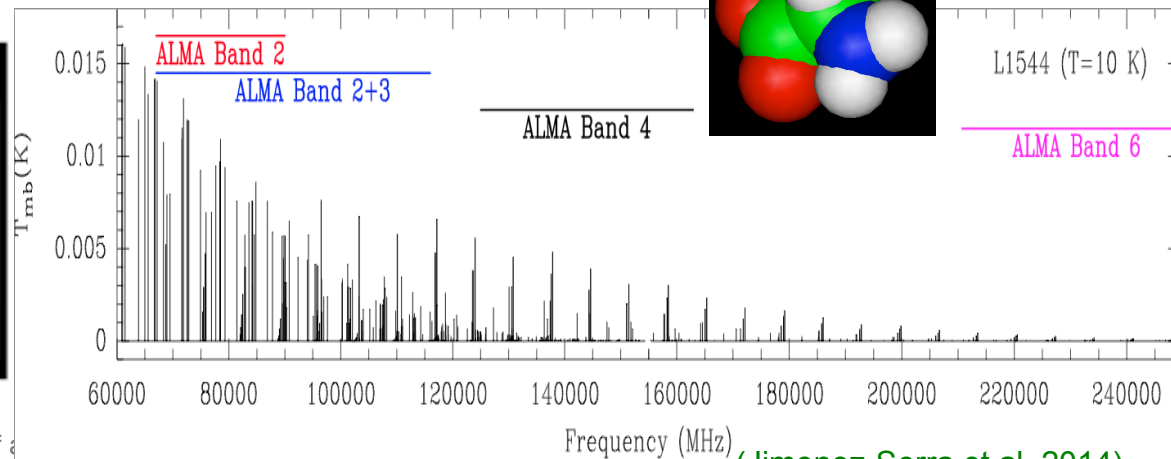
Science Priorities for the Future

- Resolve planet formation in protoplanetary disks
 - Full sensitivity (antennas) and angular resolution (baselines)
- Statistical census of Star Formation at high- z
 - Full sensitivity, efficient spectral scans
- Chemistry of Complex Organic Molecules and Water
 - Full sensitivity, full frequency coverage, spectral flexibility
- Resolve Event Horizon of Supermassive Black Holes
 - Full sensitivity, mmVLBI



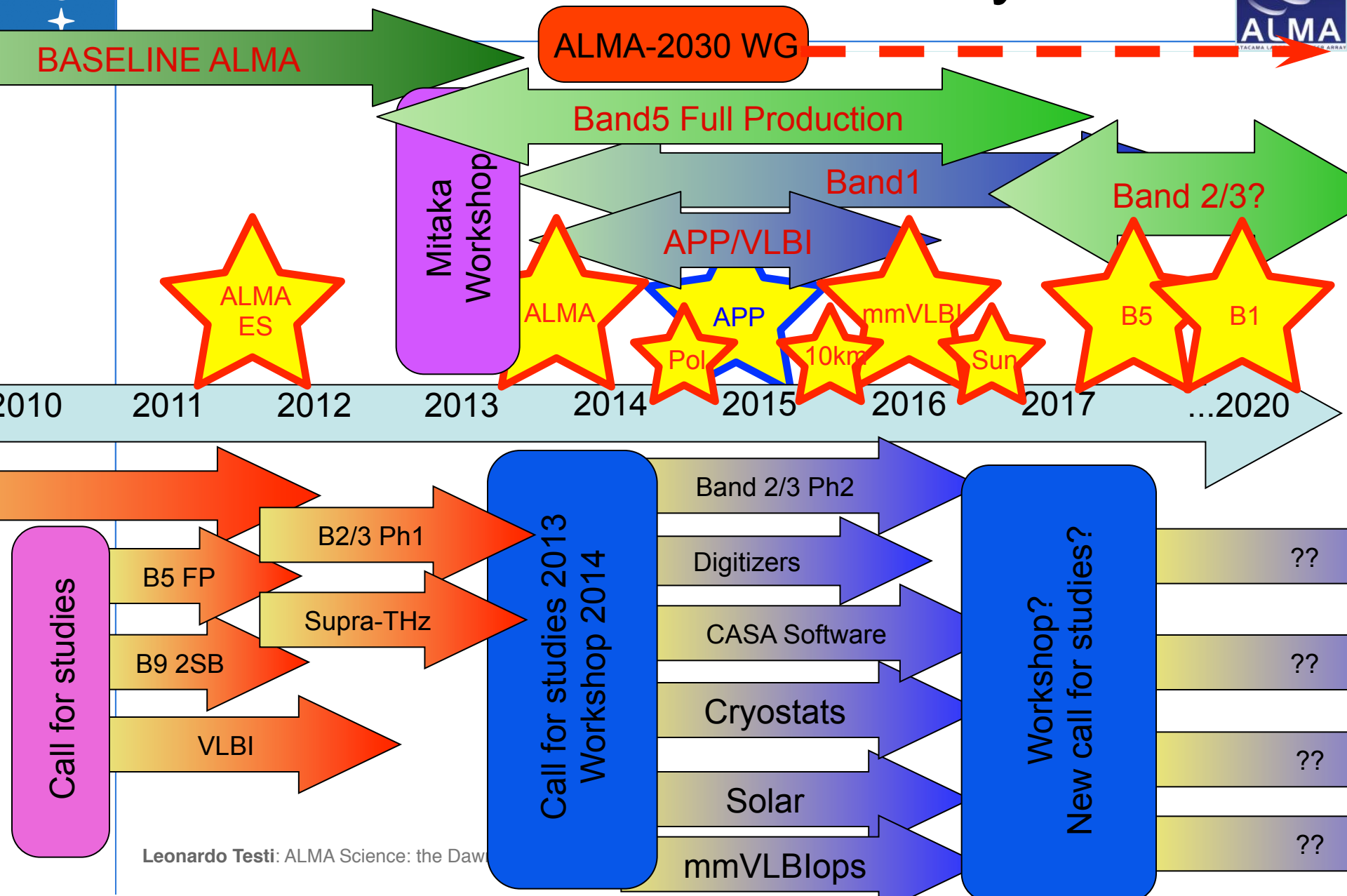
(Brinch et al. 2010)

Leonardo Testi: ALMA Science: the Dawn of





Timeline summary





Premiale iALMA

- 4-year programme. Goals:
 - Develop synergy between Lab Astrophysics, ALMA Observations of Complex Organic Molecules, develop the next generation of ALMA receivers
 - Develop the ALMA Regional Centre Node in Italy
 - Train a new generation of ALMA users in Italy
 - Coordinate ALMA outreach in Italy
 - Develop options for Green Energy production for ALMA



iALMA – first year

- New lab setup at OA-Catania for COM in ices
- New cryo facility for receivers at IASFO/IAPS
- Design/testing of passive comp at OA-Arcetri
- Expansion of ARC node capabilities at IRA
- 3 PhD students and 3 postdocs
 - Lab astrophysics
 - Observations of Complex Organic Molecules
 - mmVLBI/Extragalactic (sub)mm astrophysics
- Outreach, Green Energy for ALMA

Current instrumentation

Ion beam

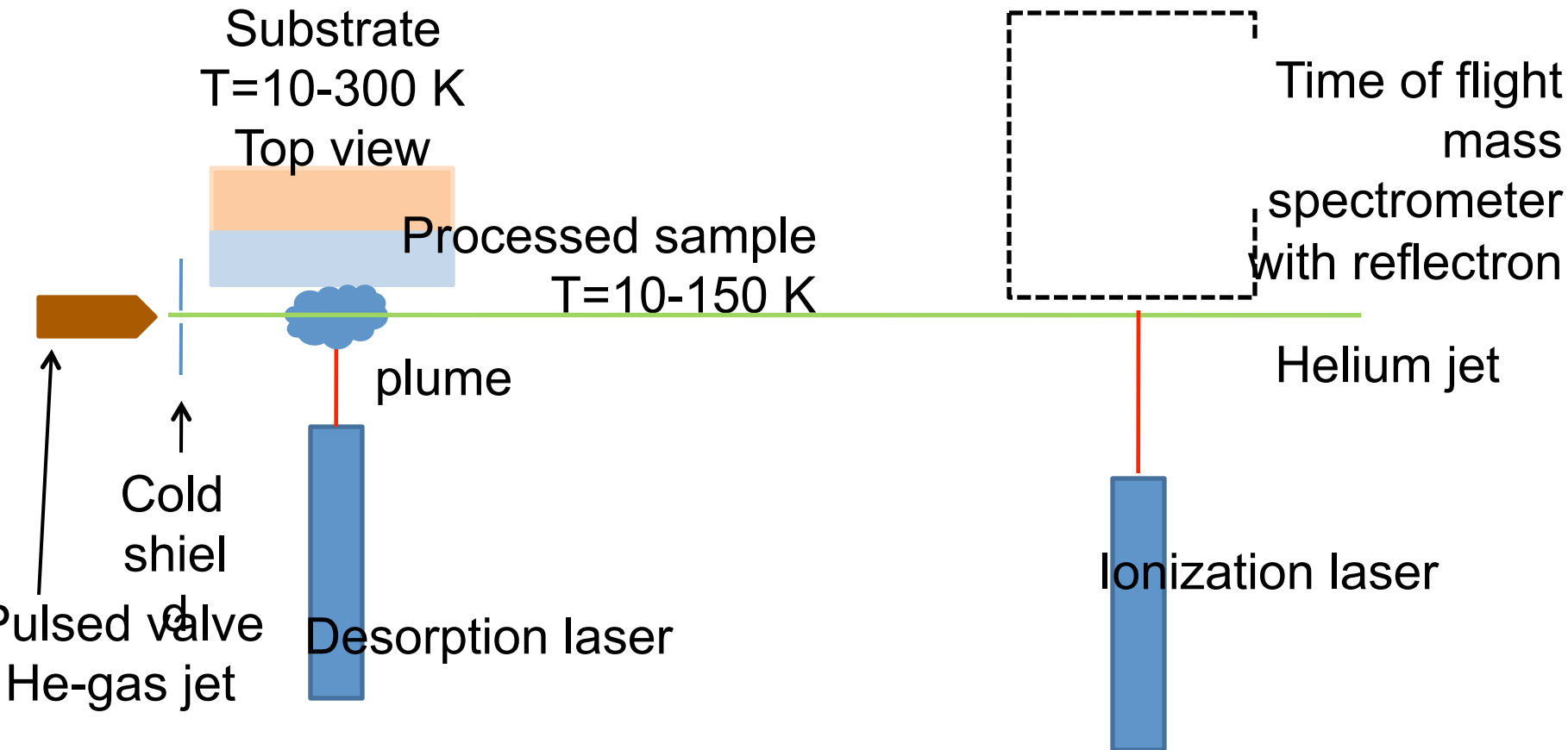
Vacuum chamber

FTIR spectrometer



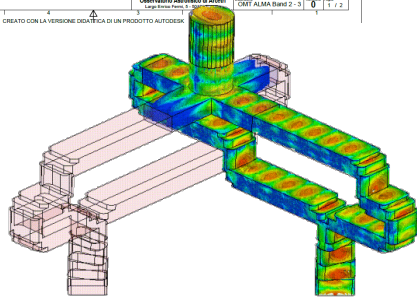
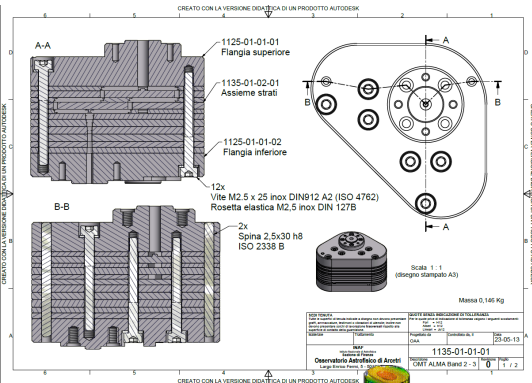
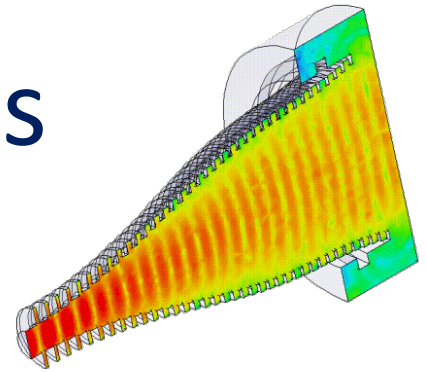
**Laboratorio di Astrofisica Sperimentale
Catania**

Future experimental set-up

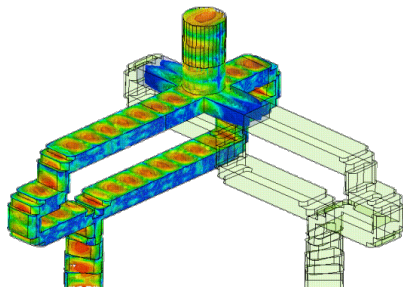


Passive components

Circular Corrugated Feed Horn

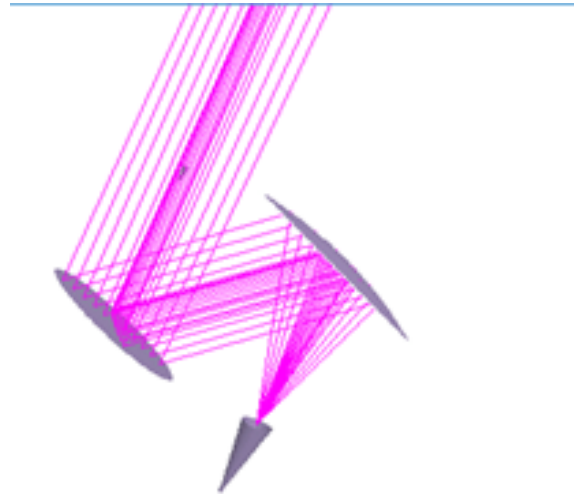


Ortho Mode Transducer

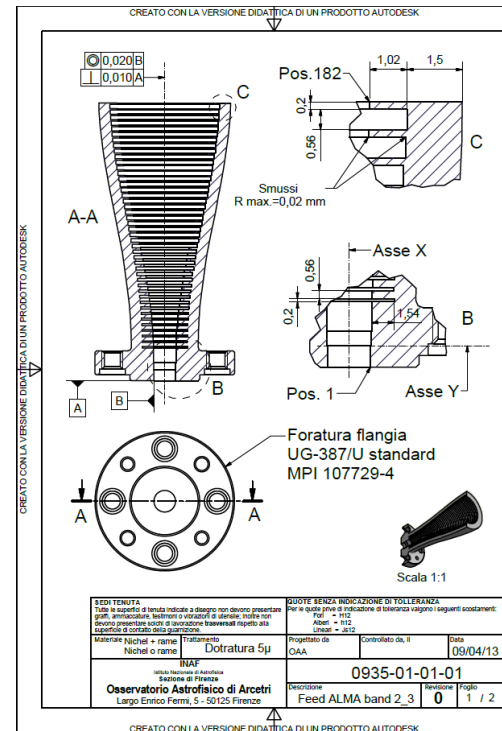


16/06/2014

Leona



Optics: Refocusing Mirrors





The Italian ARC

- Italian ARC node, one-stop shop for all ALMA user support in Italy: training, data analysis, science...

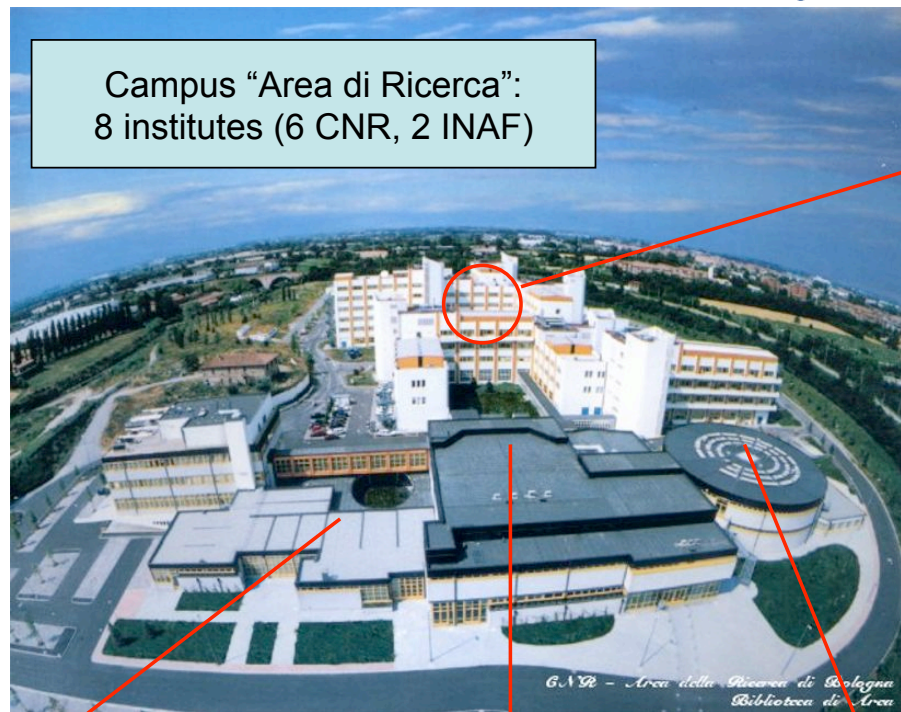


EUROPEAN ARC
ALMA Regional Centre || Italian

- Face to face and web training sessions
- Contact Scientists
- Face to face data reduction support
- Dedicated hardware and storage
- New ALMA capabilities: polarization, mmVLBI

IRA

Campus "Area di Ricerca":
8 institutes (6 CNR, 2 INAF)



Mensa

Conference rooms

Central Library

ce - SAlt





ALMA Band 2/3 coordination

- Significant funding, interest and progress in various ALMA regions
 - Premiale iALMA in Italy
 - ESO study contract to IRAM, STFC, and INAF
 - NRAO Band 2 project, NAOJ interest
- Workshop to discuss progress and coordination
 - March 27-28, 2014, Galileo's house near Arcetri



Marco Testi





ALMA Science in the 2020s

- The first 10 years of ALMA Science
 - Evolution of the star formation in the Universe
 - Origin and evolution of the Solar System
 - Pre-biotic chemistry frequency of life in the Universe
- Transformational science in synergy with ELTs and the SKAs
 - Long term upgrade and development plan
- Italy is well placed to develop these synergies