

Report from the event supported by RadioNet

TITLE	ALMA2019: Science Results and Cross-Facility Synergies
DATE:	<i>14/10/2019 – 18/10/2019</i>
LOCATION:	<i>CAGLIARI, ITALY</i>
MEETING WEBPAGE:	https://indico.ict.inaf.it/event/789/overview
HOST INSTITUTE:	<i>INAF-OSSERVATORIO ASTRONOMICO DI CAGLIARI EUROPEAN SOUTHERN OBSERVATORY</i>
RADIO.NET BENEFICIARY / NO:	<i>ESO/13</i>

Report:

1. SCIENTIFIC SUMMARY

The Atacama Large Millimeter/Submillimeter Array (ALMA) is the world's most sensitive facility for millimeter/submillimeter astronomical observations, and will soon be fully operational in all of the originally planned bands. Since its first observations, ALMA has routinely delivered groundbreaking scientific results that span nearly all areas of astrophysics. Following conferences in Puerto Varas (Chile, 2012), Tokyo (Japan, 2014), and Indian Wells (USA, 2016), the ALMA partnership organised the ALMA Science Conference in Cagliari (Sardinia, Italy) on Oct 14-18, 2019, in collaboration with INAF-Osservatorio astronomico di Cagliari.

At the conference, the full breadth of ALMA science was discussed, with special emphasis on results from the first rounds of ALMA Large Programmes, the long baselines and high frequency capabilities, the new Solar and VLBI modes, as well as the synergy between ALMA and other observatories. Invited contributions were assigned to all teams of Cycle 4 and 5, and 6, when possible, large programmes: ASPECS, ALPINE, The ALMA lensing cluster survey, ALCHEMI, PHANGS, ALMA-IMF, DSHARP, ATOMIUM. Science topics included all fields of astronomy, from cosmology and galaxies in the distant Universe, nearby galaxies and the Galactic Center, interstellar medium and star formation in our Galaxy, astrochemistry, circumstellar disks, exoplanets, solar system, stellar evolution, and the Sun. For the first time in the history of the ALMA science conferences, a full session was dedicated to the Solar System. In particular, results from the first solar ALMA observations in 2017 were presented, which clearly reveal the presence of distinct particularly dark/cool areas with temperatures as low as 60% of the normal quiet Sun at 3mm. This lead the authors to speculate that ALMA is sensing cool chromospheric gas, whose presence had earlier been inferred from infrared CO spectra (Loukitcheva et al 2019, ApJL, 877, L26).

Several contributions outlined the outstanding performances that ALMA reached in the cycles after the last conference of this series, which was held in 2016 in Indian Wells, USA. Among them, the first ALMA band 10 (787–950 GHz) publications (McGuire et al. 2019), the first results of ALMA observations of the Sun (e.g., Wedemeyer 2016, The Messenger, 163, 15; Wedemeyer et al, in prep.) and of other Solar System bodies, as well as the first results from the ALMA observations as part of the Event Horizon Telescope. Outstanding results of the studies of circumstellar and in protoplanetary disks from the DSHARP large project were presented and discussed in details. Regarding circumstellar disks, ALMA has revealed that CO emission in protoplanetary disks is much fainter than expected. The recent ALMA C₂H observations from Miotello and collaborators (2019, A&A, 631, A69), which favour volatile species lock up in larger bodies leading to the low observed CO fluxes, were presented.

The synergy and complementarity of ALMA with the RadioNet facilities was the focus of several oral contributions (invited and contributed) and of the posters. At least five of the invited contributions were based on initial results from RadioNet facilities (IRAM-30m and - NOEMA, APEX, and the Global 3mm VLBI Array). In particular, the results from the EHT program, which relies on the use of ALMA and RadioNet facilities, among others, were highlighted in both the public outreach and the scientific sessions of the conference (an invited talk and a contributed oral presentations were based on the EHT program). A competition for the best posters was run, and the four selected winners did presented their poster results in special 5-min long talks. The winners (in alphabetical order) were:



Atefeh Aghababaei, Koeln University, Germany, “The role of accretion and extended SiO emission in forming high mass protocluster NGC 6334-V”; Aleksandra Hamanowicz, ESO, “Blind search for CO emission in ALMA calibration data”; Sandra Trevino Morales, Chalmers University of Technology, Sweden, “Dynamical signs of a spiral-like structure in the MonR2 hub-filament system”; Philipp Weber, Niels Bohr Institute, Denmark, “Towards constraining the migration behavior of planetary cores through highly resolved mm-observations”

Conference website: <https://indico.ict.inaf.it/event/789/overview>

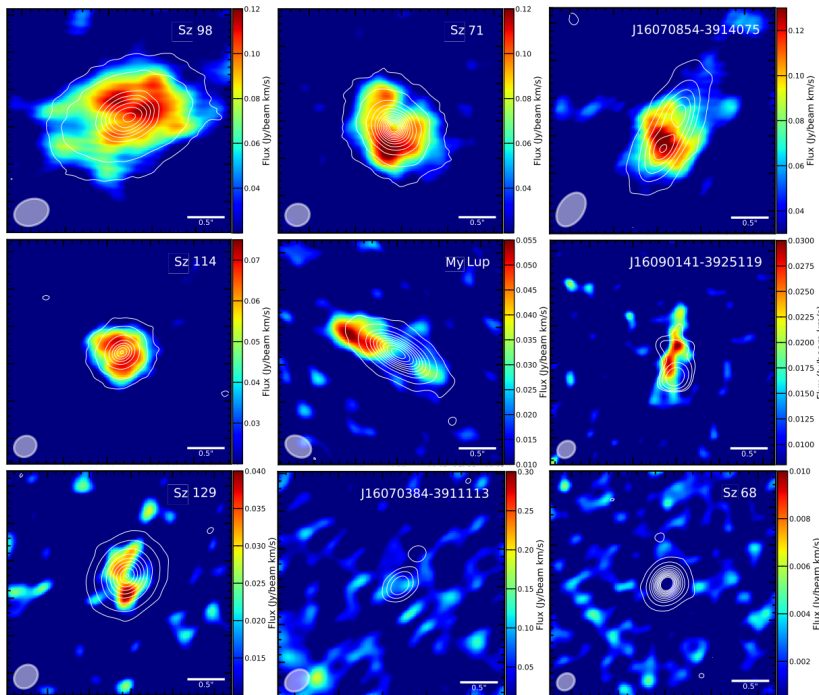


Figure 1: C₂H moment 0 maps of nine Lupus sources (from Miotello et al. 2019, A&A, A&A, 631, A69).



Figure 2: Dr. Goddi illustrates the results of the EHT campaign to groups of high school pupils during public outreach activities (credits INAF).

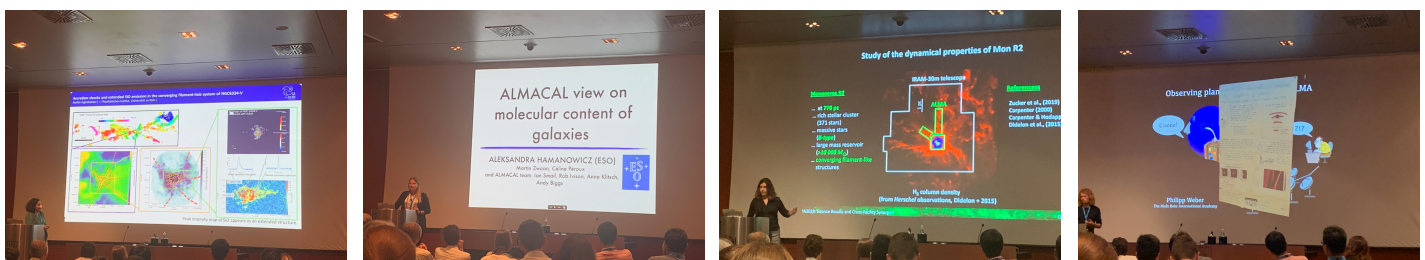


Figure 3: The four winners of the best poster selection present their contributions (from left to right: Atefeh Aghababaei, Aleksandra Hamanowicz, Sandra Trevino Morales, and Philipp Weber)

2. AGENDA OF THE EVENT

Monday 14 October 2019

09:30-09:35: Conference Opening. Official Greetings by Dr. Emilio MOLINARI (Director of INAF-Osservatorio Astronomico di Cagliari, Italy)

09:35-10:00: "Observatory Update" (Dr. Sean DOUGHERTY; ALMA, Chile)

Session 1 - Cosmology and the High-redshift Universe (10:00-10:55)

Chair of the session: Dr. Ciska Kemper (ESO, Germany)

10:00-10:25 "ASPECS: Unveiling the iver of cosmic star formation history" (Invited; Dr. Roberto DECARLI, INAF-Osservatorio di Astrofisica e Scienza dello Spazio di Bologna, Italy)

10:25-10:40: "An ALMA survey of CO in submillimetre galaxies" (Contributed; Dr. Julie WARDLOW, Lancaster University, Physics Dept., UK)

10:40-10:55: "A mm-wave view of the hot and ionised gas in galaxy clusters" (Contributed; Dr. Tony MROCKZKOWSKI, ESO, Germany)

Session 2 - Cosmology and the High-redshift Universe (11:40-12:50)

Chair of the session: Dr. Ciska Kemper (ESO, Germany)

11:40-12:05 "Interpreting the (sub)millimeter extragalactic sky: implications for obscured star-formation in the first few Gyr after the Big Bang" (Invited; Dr. Caitlin CASEY, University of Texas, USA)

12:05-12:20: "Caught in the act - massive cluster formation at $z=3-7$ witnessed by APEX/ALMA" (Contributed; Dr. Axel WEISS, Max Planck Institute for Radioastronomy, Germany)

12:20-12:35: "High-resolution studies of the SZ effect" (Contributed; Luca DI MASCOLO, Max-Planck-Institut für Astrophysik, Germany)

Session 3 - ISM, Star Formation and Astrochemistry (15:00-16:10)

Chair of the session: Dr. Misato FUKAGAWA (National Astronomical Observatory of Japan, Japan)

15:15-25: "Large program, toward the understanding of the origin of the IMF" (Invited; Dr. Fabien LOUVET, Universidad de Chile, Chile)

15:25-15:40: "Probing with ALMA the evolution of cores on the cusp of star formation" (Contributed; Dr. Rachel FRIESEN, National Radio Astronomy Observatory, USA)

15:40-15:55: "ALMA observations of extremely young star-forming cores" (Contributed; Dr. Maria Jose MAUREIRA, Max-Planck-Institute for Extraterrestrial Physics, Germany)

15:55-16:10: "Converging filaments and the formation of a super star cluster in SgrB2" (Contributed; Dr. Alvaro SANCHEZ-MONGE, University of Cologne, Germany)

Session 4 - Stellar evolution and the Sun (17:55-18:50)

Chair of the session: Dr. Misato FUKAGAWA (National Astronomical Observatory of Japan, Japan)

17:55-18:20: "Solar Astronomy with ALMA" (Invited; Dr. Sven WEDEMEYER, University of Oslo, Norway)

18:20-18:35: GARY, Dale "Probing the thermal structure of the solar chromosphere with ALMA and optical/NIR observations" (Contributed; Dr. Dale GARY, New Jersey Institute of Technology, USA)

18:35-18:50: "A cool puzzle in the solar atmosphere" (Contributed; Dr. Stephen WHITE, AFRL, USA)

Tuesday 15 October 2019

Session 5 - ISM, Star Formation and Astrochemistry (09:00-10:25)

Chair of the session: Dr. Crystal Brogan (National Radio Astronomy Observatory, USA)

09:00-09:25 “Star formation and magnetic fields in the ALMA era” (Invited; Dr. Chat HULL, ALMA JAO, Chile)
09:25-09:40: “Dissipation Scale of Turbulence Cascade Revealed by ALMA” (Contributed; Dr. Jin KODA, Stony Brook University, USA)
09:40-09:55: “ALMA Detection of a Linearly Polarised Reverse Shock in GRB 190114C” (Contributed; Dr. Tanmoy LASKAR, University of Bath, UK)
09:55-10:10: “ALMA reveals a magnetically-regulated scenario for protostellar collapse: B335 & future perspectives” (Contributed; Dr. Anaëlle MAURY, CEA-Saclay Astrophysics Dept., France)
10:10-10:25: “Tracing B-fields in protostellar targets across spatial scales with ALMA, SOFIA, BLAST, and APEX” (Contributed; Dr. Giles NOVAK, Northwestern University, USA)

Session 6 - Circumstellar Disks, Exoplanets and Solar System (11:30-12:40)

Chair of the session: Dr. Crystal Brogan (National Radio Astronomy Observatory, USA)

11:30-11:55: “The puzzle of protoplanetary disk masses” (Invited; Dr. Anna MIOTELLO, ESO, Germany)
11:55-12:10: “The demographical properties of brown dwarf disks” (Contributed; Dr. Leonardo TESTI, ESO, Germany)
12:10-12:25: “Time-Domain Astrochemistry During Planet Formation” (Contributed; Dr. Ilse CLEEVES, University of Virginia, USA)
12:25-12:40: “Probing Snow Surfaces/Lines in Protoplanetary Disks” (Contributed; Dr. Chunhua Qi, Harvard-Smithsonian Center for Astrophysics, USA)

Session 7- Galaxies and Galactic Nuclei (15:00-16:25)

Chair of the session: Dr. Eva Schinnerer (Max-Planck-Institute for Astronomy, Germany)

15:00-15:25: “Chemistry in luminous galaxies” (Invited; Dr. Nanase HARADA, ASIAA, Taiwan)
15:25-15:40: “Sub-mm Water Vapor Megamasers in Nearby AGNs” (Contributed; Dr. James BRAATZ, National Radio Astronomy Observatory, USA)
15:40-15:55: “Collimation of the relativistic jet in the quasar 3C273” (Contributed; Dr. Hiroki OKINO, University of Tokyo, Japan)
15:55-16:10: “Probing Feedback from Super Star Clusters in the Central Starburst of NGC253” (Contributed; Dr. Rebecca LEVY, University of Maryland, USA)
16:10-16:25: “Cold gas regulating the life-cycle of radio AGN” (Contributed; Dr. Filippo MACCAGNI, INAF-Osservatorio astronomico di Cagliari, Italy)

Session 8 - ISM, Star Formation and Astrochemistry (17:10-18:50)

Chair of the session: Dr. Giles Novak

17:10-17:35 “Early High-Mass Star Formation: A Comprehensive ALMA ATLAS” (Invited; Dr. Thushara Pillai, Institute for Astrophysical Research, USA)
17:35-17:50: “Sub-arcsecond (sub)millimeter imaging of the massive protostellar outburst in G358.93-0.03” (Contributed; Dr. Crystal BROGAN, National Radio Astronomy Observatory, USA)
17:50-18:05: “Dissecting high-mass protostars with SPARKS” (Contributed; Dr. Timea CSENGERI, Laboratoire d'Astrophysique de Bordeaux, France)
18:05-18:20: “Probing fragmentation and velocity sub-structure in the massive NGC 6334 filament with ALMA” (Contributed; Dr. Yoshito SHIMAJIRI, Kagoshima University, Japan)
18:20-18:35: “From the dense core edge to the disk scales” (Contributed; Dr. Jaime PINEDA, Max-Planck-Institute für Extraterrestrische Physik, Germany)
18:35-18:50: “The early stages at substellar formation in Lupus 1 and 3 clouds” (Contributed; Dr. Alejandro SANTAMARÍA-MIRANDA, Universidad de Valparaíso, Chile)

Wednesday 16 October 2019

Session 9 - Cosmology and the High-redshift Universe (09:00-10:25)

Chair of the session: Dr. Daisuke Iono (National Astronomical Observatory of Japan, Japan)

09:00-09:25: "A2C2S: The ALPINE ALMA C+ survey of galaxies at $4 < z < 6$ " (Invited; Dr. Michele GINOLFI, Observatory of Geneva, Switzerland)
09:25-09:40: "Early Metal Enrichment and Multiphase Interstellar Media in a Galaxy at Redshift 8.312" (Contributed; Dr. Yoichi TAMURA, YNagoya University, Japan)
09:40-09:55: "Quiescent carbon in the CGM of high redshift radio galaxies" (Contributed; Dr. Carlos DE BREUCK, (ESO, Germany)
09:55-10:10: "Definitive calibration of CI, CO and dust as gas mass tracers across cosmic time" (Contributed; Dr. Loretta DUNNE, Cardiff University, UK)
10:10-10:25: "Stacking analysis of CO emission based on optical spectroscopic redshifts from MUSE" (Contributed; Dr. Hanae INAMI, Hiroshima University, Japan)

Session 10 - Galaxies and Galactic Nuclei (11:10-13:00)

Chair of the session: Dr. Daisuke Iono (National Astronomical Observatory of Japan, Japan)
11:10-11:35: "The Event "Horizon Telescope: Imaging a Black Hole" (Invited; Dr. Shep DOELEMAN, Center for Astrophysics Harvard and Smithsonian, USA)
11:35-11:50: "The Size, Shape, and Scattering of Sagittarius A* at 86 GHz" (Contributed; Dr. Lindy BLACKBURN, Smithsonian Astrophysical Observatory, USA)
11:50-12:05: "The ALMA Galactic Center Molecular Cloud Survey" (Contributed; Dr. Jens KAUFFMANN, Haystack Observatory Massachusetts Institute of Technology, USA)
12:05-12:30: "ALCHEMI: The ALMA Comprehensive High-resolution Extragalactic Molecular Inventory" (Invited; Dr. Sergio MARTÍN, Joint ALMA Office, Chile)
12:45-13:00: "Galactic Dynamics and Dark Matter Profile of NGC1380 with ALMA and VLT/MUSE" (Contributed; Dr. Takafumi TSUKUI, Sokendai / NAOJ, Japan)

Thursday 17 October 2019

Session 11 - Galaxies and Galactic Nuclei (09:00-09:55)

Chair of the session: Dr. Al Wooten (National Radio Astronomy Observatory, USA)
09:00-09:25: "The star formation process on cloud-scales in nearby galaxies" (Invited; Dr. Eva SCHINNERER, Max-Planck-Institute for Astronomy, Germany)
09:25-09:40: "ALMA view of 1 pc-scale molecular-gas structures in M33: Revealing star-formation activities in molecular filaments/clumps" (Contributed; Dr. Atsushi NISHIMURA, Osaka Prefecture University / NAOJ, Japan)
09:40-09:55: "The first large, unbiased ALMA survey of CO at parsec resolution in the Small Magellanic Cloud" (Contributed; Dr. Katie JAMESON, CSIRO, Australia)

Session 12 - Circumstellar Disks, Exoplanets and Solar System (11:40-12:35)

Chair of the session: Dr. Al Wooten (National Radio Astronomy Observatory, USA)
11:40-12:05: "Small-Scale Substructures in Protoplanetary Disks" (Invited; Dr. Sean ANDREWS, Center for Astrophysics, Harvard & Smithsonian, USA)
12:05-12:20: "A path to planets: youngest known ringed structures in a protostellar disk" (Contributed; Dr. Dominique SEGURA-COX, Max-Planck-Institute für Extraterrestrische Physik, Germany)
12:20-12:35: "How small molecules betray dust evolution in planet forming disks" (Contributed; Dr. Michiel HOGERHEIJDE, Leiden Observatory, The Netherlands)

Session 13 - Circumstellar Disks, Exoplanets and Solar System (15:00-16:25)

Chair of the session: Dr. Leonardo Testi (ESO, Germany)
15:00-15:25: "Organic Molecules in Protoplanetary Disks" (Invited; Dr. Jeong-Eun LEE, Kyung Hee University, Korea)
15:25-15:40: "Observing the first phases of planet formation: measuring vertical dust settling in a sample of Edge" (Contributed; Dr. François MÉNARD, IPAG, UGA/CNRS, Grenoble, France)
15:40-15:55: "Radial variations of grain sizes and dust scale heights on the protoplanetary disk of HD 163296" (Contributed; Dr. Satoshi OHASHI, RIKEN, Japan)

15:55-16:10: “ALMA Studies the Origin and Impact of Flares in Planetary Systems” (Contributed; Dr. Rachel OSTEN, Space Telescope Science Institute, USA)

16:10-16:25: “Hydrogen Radio Recombination Line Masers observed with ALMA: Imaging of Warped Disks and Photo-evapo” (Contributed; Dr. Jlzaskun IMENEZ-SERRA, Centro de Astrobiologia (CSIC/INTA), Spain)

Session 14 - Stellar evolution and the Sun (17:10-18:35)

Chair of the session: Dr. John Carpenter (JAO/NRAO, Chile)

17:10-17:35 “ALMA observes the aftermath of mergers of non-compact stars” (Invited; Dr. Tomasz KAMINSKI, Nicolaus Copernicus Astronomical Center, Poland)

17:35-17:50: “Shaping of the stellar wind of evolved red giants and their successors by (sub-)stellar binary companions” (Contributed; Dr. Leen DECIN, KU Leuven, Belgium)

17:50-18:05: “ALMA unveils highly collimated jets in evolved stars” (Contributed; Dr. Daniel TAFOYA, Chalmers University of Technology, Sweden)

18:05-18:20: “HCN laser lines in carbon-rich evolved stars” (Contributed; Dr. Ka Tata WONG, IRAM, France)

18:20-18:35: “Tracing the mass loss history of WX Psc with ALMA and KVN” (Contributed; Dr. Youngjoo YUN, Korea Astronomy and Space Science Institute, Korea)

Friday 18 October 2019

Session 15 - ISM, Star Formation and Astrochemistry(09:00-10:25)

Chair of the session: Dr. Martin Zwaan (ESO, Germany)

09:00-09:25 “Chemical Diversity and Evolution toward Protoplanetary Disks” (Invited; Dr. Nami SAKAI, RIKEN, Japan)

09:25-09:40: “ALMA observations of the DG Tau B Class I protostar disk and CO outflow” (Contributed; Dr. Aloïs DE VALON, Institut de planétologie et d'Astrophysique de Grenoble, France)

09:40-09:55: “Chronology of Episodic Accretion in Protostars - an ALMA survey of the CO and H₂O snow lines” (Contributed; Dr. Tien-Hao HSIEH, ASIAA, Taiwan)

09:55-10:10: “Exploring the Complex Chemistry of Young Solar Systems” (Contributed; Dr. Jes JØRGENSEN, Niels Bohr Institute, University of Copenhagen, Denmark)

10:10-10:25: “Sounding diffuse molecular gas with ALMA as a mean to prove that the CO-dark gas is molecular” (Contributed; Dr. Maryvonne GERIN, LERMA, France)

Session 16 - Cosmology and the High-redshift Universe (11:10-13:00)

Chair of the session: Dr. Martin Zwaan (ESO, Germany)

11:10-11:35: “Molecular clouds in a Milky Way progenitor observed 8 billion years ago” (Invited; Dr. Miroslava DESSAUGES-ZAVADSKY, Geneva Observatory, Switzerland)

11:35-11:50: “First Identification of 10-kpc Scale [CII] 158um Halos around Star-Forming Galaxies at z=5-7” (Contributed; Dr. Seiji FUJIMOTO, University of Tokyo, Japan)

11:50-12:05: “The ALMA lensing cluster survey: initial outcomes” (Contributed; Dr. Kotaro KOHNO, University of Tokyo, Japan)

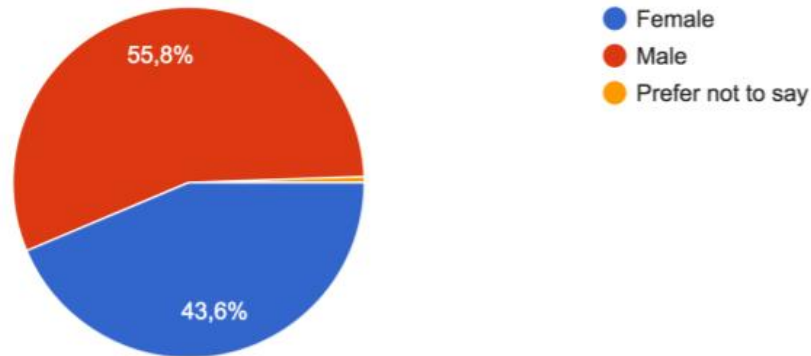
12:05-12:20: “Massive Galaxy Formation in the Reionization Era” (Contributed; Dr. Daniel MARRONE, University of Arizona, USA)

12:50-13:15: “Conference Summary” (Invited; Dr. Misato FUKAGAWA, National Astronomical Observatory of Japan, Japan)

3. PARTICIPANTS

The conference was attended by 216 people (29 students); additional 11 attendees from Japan were prevented from attending the conference by an extreme typhoon, which paralysed the Japanese air transportation the weekend before the starting of the ALMA2019 conference. The LOC kindly invited the participants to respond to an anonymous online survey to determine their gender and geographical distribution. The results of the survey are illustrated in the following pie charts and can

Gender



Continent of origin

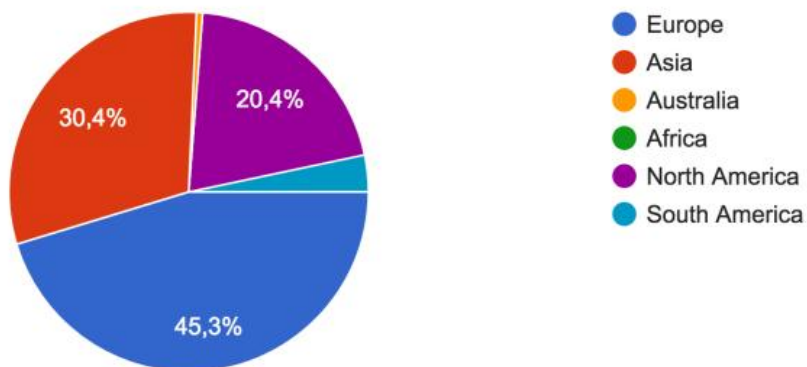


Figure 4: Gender (top) and geographical distribution of the attendees the ALMA 2019 conference based on an anonymous survey

be summarised as follows. Based on 181 answers to the survey, the gender distribution of the ALMA2019 conference was 55.8% (101) male attendees, 43.6% (79) female attendees; one participant preferred not to answer. The geographical distributions was 45.3% (82 participants) from Europe, 30.4% (55) from Asia, 20.4% (37) from North America, 3.3% (6) from South America, 0.6% (1) from Australia. On a total number of 20 invited contributions, 11 were women coming Europe (3), USA (4) and Asia (4). The funding from RadioNet covered entirely the child care costs for one of the invited speakers.

The final list of attendees, signed by the local organising committee, is included separately.



Figure 5: Group picture of the ALMA 2019 conference (credits INAF)

4. RADIO.NET FINANCIAL CONTRIBUTION

RadioNet supported the ALMA2019 conference with 1500 EURO for travel, fee and child care of RadioNet 3 eligible participants. The LOC received a total of twelve application for financial support, but only those three of them were eligible according to RadioNet rules.

5. PUBLICATIONS

In order to preserve a record of the meeting [and instead of compiling conference proceedings], the organisers will make presentation slides and posters available through Zenodo (<https://www.zenodo.org/>). In this way, the content of the conference will be **citable** as Zenodo assigns Digital Object Identifiers to all submissions, **discoverable** since the ESO Library notifies ADS about the conference “collection”, and they will harvest the metadata, and **archived** as Zenodo will preserve the material permanently.

Confirmation

I confirm that RadioNet is allowed to publish this report, incl. participants lists, statistic's details, pictures, etc.

Silvia Leurini

On behalf of ALMA2019 LOC