

Report on the ESO Workshop

Star Formation from Cores to Clusters

held at ESO Vitacura, Santiago, Chile, 6–9 March 2017

Adele Plunkett¹
 Fernando Comerón¹
 Leonardo Testi¹

¹ ESO

This conference on star formation explored the synergies between observations and theory and was timed to facilitate collaborations to prepare observing proposals to use ALMA and ESO facilities. The aim of the conference was to review recent progress and to identify how to advance the field over the coming years with observations and numerical simulations.

Conference organisation

The workshop Science Organising Committee was composed for the most part of members of the SOLA (Soul Of Lupus with ALMA) collaboration, which was originally based at the Joint Atacama Large Millimetre/sub-millimetre Array (ALMA) Observatory but now has members around the world (Principal Investigator: I. De Gregorio-Monsalvo, ESO/JAO – Joint ALMA Observatory).

The scientific programme¹ was organised into the following six sessions:

- Session 1: Molecular clouds and star-forming regions (formation, evolution, chemistry, structure);
- Session 2: Outflows, envelopes, first conditions of disc formation;
- Session 3: Pre- and proto-stellar cores;
- Session 4: Earliest stages of the sub-stellar regime;
- Session 5: Multiplicity at early stages of star formation, small clusters;
- Session 6: Star formation at larger scales, surveys.

The first five sessions were chosen to progress from large to small spatial scales in order to address the following question: “What constitutes a prototypical low-mass star-forming region from cluster to core scales?” The last session was added to reflect the content of submitted abstracts and concerned larger scales, including extragalactic star formation.



Figure 1. Conference photo.

Eighty two participants from 20 countries attended and there were 11 invited speakers. There were 4–6 contributed talks in each session as well as “flash” poster talks (with poster viewings held throughout the week). The SOC awarded the poster prize to Vianey Camacho, who presented a poster entitled “Energy Budget of Forming Clumps in Numerical Simulations of Collapsing Clouds”.

John Carpenter (JAO) and Willem-Jan de Wit (ESO) summarised existing and new capabilities at ALMA and the Very Large Telescope (VLT), respectively. In addition there were two discussion sessions, which allowed participants to explore topics in smaller groups, and finally Diego Mardones and Leonardo Testi teamed up for the conference summary. Proceedings based on the conference contributions are available through Zenodo² and linked on the programme webpage, which is also searchable via the ADS (SAO/NASA Astrophysics Data System).

Scientific summary

Filamentary structures are ubiquitous in star-forming regions. However, the exact terminology used to describe these structures and their characteristics (for example, characteristic widths) was a frequent topic of discussion and it was felt that a more robust way to interpret and characterise structures is needed. Some suggested that the projection of the filament on the plane of the sky could affect its appearance, suggesting, controversially, that some cores may actually be pole-on filaments. Simulations are

progressing and enable systematic comparison with observations using statistical metrics. However, they are still lacking some physics (for example, the effects of magnetic fields, chemistry and feedback).

The core mass function (CMF) and its relation to the stellar initial mass function (IMF) were shown in a number of presentations and were a topic of much discussion. In particular, a plot showing the CMF with an arrow pointing to the IMF was subsequently named the “most abused figure” in the conference summary, with many expressing doubts about the direct connection between the CMF and the IMF.

The SOC commended those brave astronomers who tackled the complex topics of magnetic field, angular momentum, and chemistry. It seems likely that significant observational advances will soon be made towards constraining the role of magnetic fields in many aspects of star formation, from clouds and cores, to disc-star interaction, and in driving jets and outflows. Understanding the chemistry may take more time, and discussions revealed the need for caution when analysing observational data for a specific species before more general conclusions can be drawn.

A number of interesting results on the formation and early evolution of brown dwarfs were presented, with ALMA’s sensitivity driving progress in this area. The particular challenges posed by the recent

discovery of the planetary system around TRAPPIST-1, were a source of discussion.

The role of the environment needs to be established before extrapolating star formation to different regions, such as galactic centres, spiral arms, and massive complexes compared to smaller clouds. Open questions remain about observed environmental differences; it remains unclear whether these differences are significant or simply due to our lack of understanding of the star formation process. Progress has been made with constraining radiative feedback and dynamical effects in star formation, but we still lack an understanding of the global implications. Despite much debate and healthy discussion, the main question that prompted the conference still remains unanswered: "What constitutes a prototypical low-mass star-forming region from cluster to core scales?"

Post-conference survey

Following the conference, we conducted an online survey to evaluate the success of the conference and identify areas for improvement. The results are summarised in a report which is available as a resource for organisers of future ESO workshops³. The results of the survey indicate that the participants found the poster flash talks and discussion sessions useful and offered several suggestions on how to improve their impact.



Figure 2. A photo taken during the tour of ALMA antennae at Chajnantor, at an altitude of 5000 metres.

Social

The conference dinner included an excursion to the beautiful Roan Jasé Astronomical Observatory in the Cajón del Maipo, about an hour outside Santiago. Our hosts Manuela and Leopoldo treated the astronomers to a traditional Chilean family-style barbecue, bilingual presentations about astronomy from the perspective of the indigenous Mapuche culture, and stargazing using small telescopes. Following the conference, some participants travelled to San Pedro de Atacama and the ALMA Observatory (Figure 2), hosted by star-formation enthusiast Al Wootten (NRAO).

Acknowledgements

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Links

¹ Conference website: <http://www.eso.org/sci/meetings/2017/star-formation2017.html>

² Zenodo: <https://zenodo.org/>

³ Conference report based on the participants survey: http://www.eso.org/sci/meetings/2017/StarFormation2017/Report_SF2017.pdf

EWASS 2017 Special Session SS18: The ELT Project Status and Plans for Early Science

held at Charles University, Prague, Czech Republic, 29 June 2017

Chris Evans¹
Isobel Hook²
Giuseppe Bono³
Suzanne Ramsay⁴

¹ UK Astronomy Technology Centre, Edinburgh, United Kingdom

² Department of Physics, Lancaster University, United Kingdom

³ Department of Physics, University of Rome "Tor Vergata", Italy

⁴ ESO

A special session was organised at the 2017 European Week of Astronomy and Space Science (EWASS 2017) this summer. The twin aims of highlighting progress on the ELT Programme to the whole European community and of engaging early-stage researchers