Star Formation from Cores to Clusters: Conference report

Adele Plunkett, on behalf of SOC
European Southern Observatory, Alonso de Córdova 3107, Vitacura, Santiago, Chile

Abstract

The conference "Star Formation from Cores to Clusters" was hosted at ESO offices in Santiago, Chile, on March 6-9, 2017. Logistics and financial support were provided from ESO and NRAO. The aim of the conference was framed according to the question: "What constitutes a prototypical low-mass star forming region from core to cluster scales?" Here we summarize the conference rationale and logistics, scientific and social aspects of the conference, and participation demographics. Following the conference we invited participants to respond to a survey reviewing the various aspects of their conference experience, and we present the survey results here.

I. Conference Rationale and Logistics

The scientific rationale of the conference was presented as the following:

> *We aim to bring together astronomers who are pursuing a variety of strategies to contribute in answering the question: "What constitutes a prototypical low-mass star forming region from core to cluster scales?" This question refers specifically to the formation of low-mass stars, but it also can incorporate, for example, higher-mass stars that form in environments shared with low-mass stars, parallels between low- and high-mass star formation, starless cores, brown dwarfs, planetary formation simultaneous with low-mass star formation, and related topics. We suggest that all contributions present observations (from any wavelength) and/or numerical simulation to provide a perspective that is crucial for a comprehensive understanding of low-mass star forming regions.*

The momentum for the conference was initiated by the annual call for conference/workshop proposals at ESO. The timing of the conference (March) was designated to facilitate collaboration for observing proposals at ALMA and ESO facilities in 2017, also incorporating synergies among observers and theorists for such proposals. The SOC considered that in preparation for Cycle 5 of ALMA, it was time to review what has been achieved so far in the topic of star formation, and challenge how to advance the field in coming years. The SOC was composed in large part by members of the SOLA (Soul of Lupus with ALMA) collaboration, based originally at JAO and now with members around the globe. Sharing expertise from ALMA/ESO, John Carpenter (JAO) and Willem-Jan de Wit (ESO) were invited to summarize existing and new capabilities at ALMA and VLT, respectively.

While the terminology of "conference" versus "workshop" can be disputed, we aimed for a "workshop-environment" by implementing the following: intentionally

limiting registration to approximately 80 participants who could be accommodated in a single meeting room; organizing small-group discussion sessions to synthesize information on specific topics; emphasizing the important contributions of posters, including dedicated poster sessions and poster flash presentations; and scheduling "collaboration time" (read: free time) throughout.

Conference proceedings have been published online via the platform Zenodo, "an open dependable home for the long-tail of science, enabling researchers to share and preserve any research outputs in any size, any format and from any science". The greatest advantages are that these contributions are citable, discoverable via ADS (also linked on our webpage program), and archived.

Details of the conference have been made available on a webpage hosted by ESO, http://www.eso.org/sci/meetings/2017/star-formation2017.html.

II. Scientific Program

Eleven invited speakers reviewed the observational and theoretical advances of the following session topics:

SESSION 1: Molecular clouds and star forming regions (formation, evolution, chemistry, structure)
SESSION 2: Outflows, envelopes, first conditions of disk formation
SESSION 3: Pre- and protostellar 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

Most generally, the topics were organized so that they progressed from larger to smaller spatial scales during Sessions 1-5. Session 6 addressed larger scales, even extra-galactic star formation, and in effect this session was added to accommodate topics that emerged during the abstract submission process. For each session, following the invited talk(s) were 4-6 contributed talks chosen by an SOC sub-committee. While the sub-committee regrettably could not offer talks to everyone who submitted strong abstracts, they aimed for diversity in terms of research topics and other demographics of the speakers. As in any conference, the number of talks was constrained by time available, as the SOC sought to avoid "talk overload" (and appears to have done so successfully according to survey responses, see Section V).

To facilitate discussion of everyone's research, we structured the poster presentations to be an important component of the program. All posters were available for viewing during the entirety of the conference. All poster presenters were invited to give a 1 minute "flash" talk to highlight their main results, and invite further discussion during poster sessions. At least one coffee break each day was scheduled longer than the other (up to 1 hour) and dedicated as a "poster session" so that authors of posters would be available at their posters.

Throughout, an anonymous SOC sub-committee reviewed the poster "flash" talks as well as the physical posters, and questioned the authors about their research. On the final day of the conference, Vianey Camacho was announced the winner of the poster prize, and she presented a talk about her poster: "Energy Budget of Forming Clumps in Numerical Simulations of Collapsing Clouds". Honorable mentions were made for the posters by Asmita Bhandare and Lenka Zychova.

Two discussion sessions (1 hour) allowed participants to delve deeper into 10 topics in smaller groups. Those topics were decided by the SOC based on common themes that were found among the contributions and warranted further discussion. The topics were: ALMA/VLT new capabilities and synergies (held twice); star formation in extra-galactic environments; astrochemistry; variability; multiplicity, IMF, substellar regime; filaments; early stage of disks; massive star formation; magnetic fields. The SOC left these intentionally "unstructured," but assigned one person to take note of the discussion, and lead if they saw fit.

Diego Mardones and Leonardo Testi teamed up for the conference summary on the final day. The conference closed with a final discussion among all participants, at which time summaries of the different discussion sessions were presented.

Reflecting on the conference, according only to responses from the post-conference survey (see section V), the connection between topics on theory and observations, including possibilities with ALMA, were commented as important highlights of the conference.

III. Scientific summary

Filamentary structures are ubiquitous in star forming regions. This generalization seems to be commonly agreed upon, although exact terminology that is used to describe these structures, as well as their characteristics (i.e. characteristic width?) were frequent topics of discussion, especially in the clouds/cores sessions. A more robust way to interpret and characterize structures, both in observations and simulations, is needed. Accordingly, the hypothesis by some that "cores" are "pole on filaments" is doubted by others. Simulations are progressing, although still lacking some physics, and making possible systematic comparisons using statistical metrics.

The "core mass function" (and its relation to the initial stellar mass function) was shown in a number of presentations, a topic of discussion throughout, and finally appeared in the conference summary as "most abused figure". Many expressed doubt in the connection of CMF-IMF, and those in doubt did not seem to change their minds based on evidence presented this week.

The SOC commended the brave astronomers taking on the complex topics of *magnetic field, angular momentum, and chemistry.* It seems likely that soon significant observational advances will be made to constrain the role of B-field in star formation. This links to many aspects of star formation, including clouds to cores, disk-star interaction, jet and outflow. Understanding chemistry may take more time, and discussion also pointed to the need for a careful approach when analyzing observational data for a specific species before jumping to more general conclusions. In other words, chemistry is tricky.

We saw a number of interesting results on formation and early evolution *of brown dwarfs*. The sensitivity of ALMA is pushing important progress. In connection with planetary systems like TRAPPIST-1, BDs formation and the development of planetary systems around them are turning out to be a mystery in itself.

The role of environment merits more attention, especially before extrapolating star formation to a broader context. Open questions remain about environmental differences – are the differences due to our lack of understanding of the star formation process, or are they really important environmental effects? Progress has been made, especially in trying to constrain radiative feedback and dynamical effects in star formation, but we still lack an understanding of the global implications.

In other words, we haven't answered the question yet that prompted the conference "What constitutes a prototypical low-mass star forming region from cluster to core scales?" but we (SOC) appreciated conversation and debate on the topic. *(Thank you to Leonardo Testi for providing his insight and topics for this summary.)*

IV. Social Activities

Given that 62% of participants were coming from outside Chile, the LOC sought to incorporate a cultural activity in the program. The conference dinner was combined with an excursion to the Roan Jasé Astronomical Observatory in the Cajón del Maipo, about 1 hour outside of Santiago, where participants experienced the natural beauty found not far from our big city. Our hosts Manuela and Leopoldo treated the astronomers to a traditional Chilean family-style barbecue, bilingual presentations about astronomy according to the indigenous Mapuche culture, and stargazing through small telescopes (and unfortunately through intermittent clouds).

Figure 1 – Conference photo, arragned at the Observatorio Astronómico Roan-Jasé prior to a Chilean barbecue as the conference dinner.

Following the conference, 9 participants traveled to San Pedro de Atacama and the ALMA Observatory. Their host was Al Wootten (NRAO), a star formation enthusiast himself who unfortunately had observing duties that kept him from attending the conference, but fortunately for the visitors provided a thorough tour. The tour included the Operations Support Facility at 2900 meters above sea level, and a trip up to the Array Operations Site at 5000 meters above sea level. Permission from the ALMA director is required to visit the AOS (in addition to a health check), and we are grateful to the director for having granted this special request.

Figure 2 – Conference participants along with their guide Al Wootten at ALMA Array Operations Site.

V. Participation

The SOC promoted (and hopes to have achieved) diversity among its participants among several parameters. Geographically, the country most represented (see Figure 3) was Chile (33/82); among the other countries represented, no more than 6 participants came from a single country. The continents of South America, North America, Europe, Asia, and Africa were represented. In the post-conference survey (see Section V), at least one participant commented on the value of interaction with researchers from different locations.

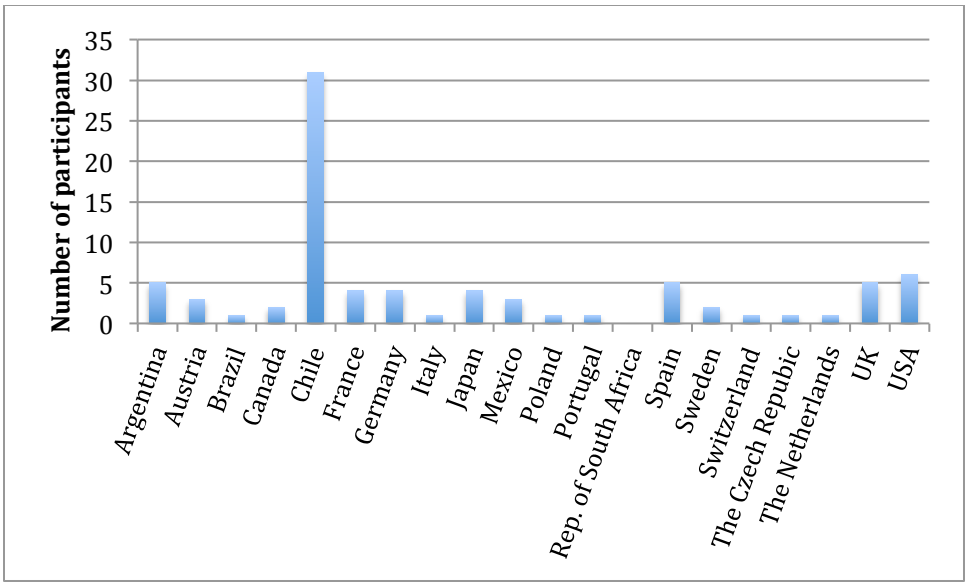

Figure 3 – Country of primary institutional affiliation as stated by the participant upon registration (not the participant's nationality).

Upon registration, participants designated one of the following options: student; postdoc; or senior astronomer. The distribution is shown in Figure 4. We made efforts to provide funding to young researchers (students and postdocs) who expressed need. In several cases, the LOC explicitly approached students to offer funding when it was suspected that this might otherwise hinder participation. 5 out of 30 participants who answered the post-conference survey questions stated that without a travel award they could not have attended, and 2 stated that a travel award had some effect. Additionally, we followed the standard ESO practice to offer a student registration fee, discounted from the general fee.

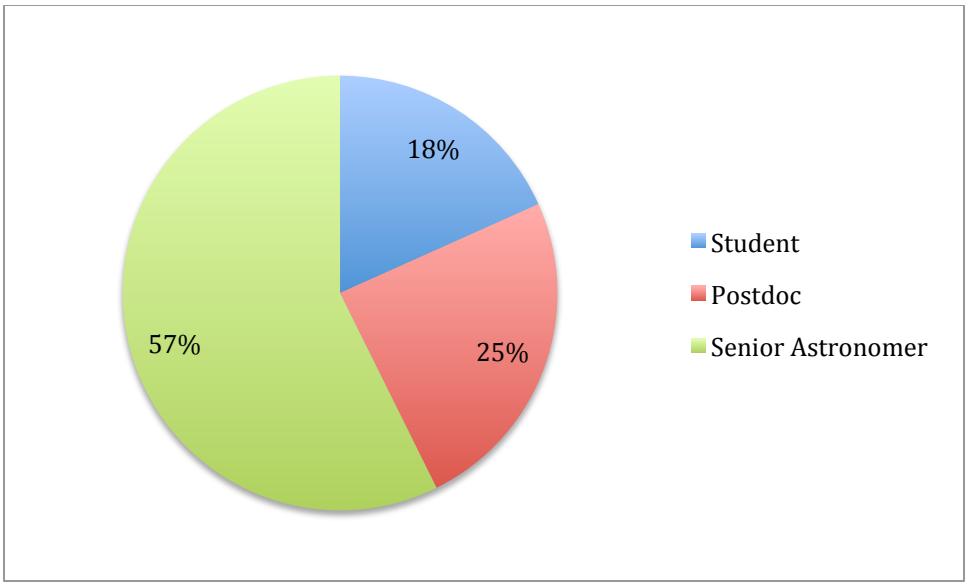

Figure 4 – Career stage of participants (self-designated upon registration).

We did not explicitly ask participants their gender identity, and therefore we refrain from presenting the corresponding statistics for general participation. The SOC actively sought a balance of gender and career stage in decisions related to invited speakers. The sub-committee who decided contributed talks made a blind review of proposals, and later verified that general gender and career stage balance were achieved as much as possible. Summing contributed and invited talks, the gender balance of presenters was 41% female, 59% male.

VI. Post-conference survey

Shortly after the conference we created a survey with two goals: evaluate the success of the conference; and provide statistical and anecdotal information for organizers of future conferences. The survey was purely voluntary, and we had 30 anonymous responses via a Google Docs form. The survey was created by Adele Plunkett, a member of SOC/LOC; she is not trained in proper survey design. We do not claim statistical significance of the results, but instead we simply provide the results as qualitative evaluation of certain aspects of the conference.

Planning for the conference:

The issues that most influenced (in a positive way) the participants' decision to attend the conference were (in order from most to least):

- Quality of the scientific program
- Location (Santiago, Chile)
- Timing (March)
- Desire to visit ESO Chile

- Because of an invitation
- One response each:
    - I was able to give a talk
    - ALMA scientific possibilities
    - Participants

Related to the location, when asked "How satisfied were you with Santiago as a conference location?", the average score was 4 (with 5 being "Very satisfied" and 1 being "Very dissatisfied").

Scientific Program:

A topic of debate among the SOC, and something that varies widely among conferences, was the appropriate length of talks, and subsequently how to best balance the number of talks versus posters. We present here the responses related to number of talks (Figure 5), as well as lengths of invited, contributed, and poster flash talks (in Figures 6-8, respectively).

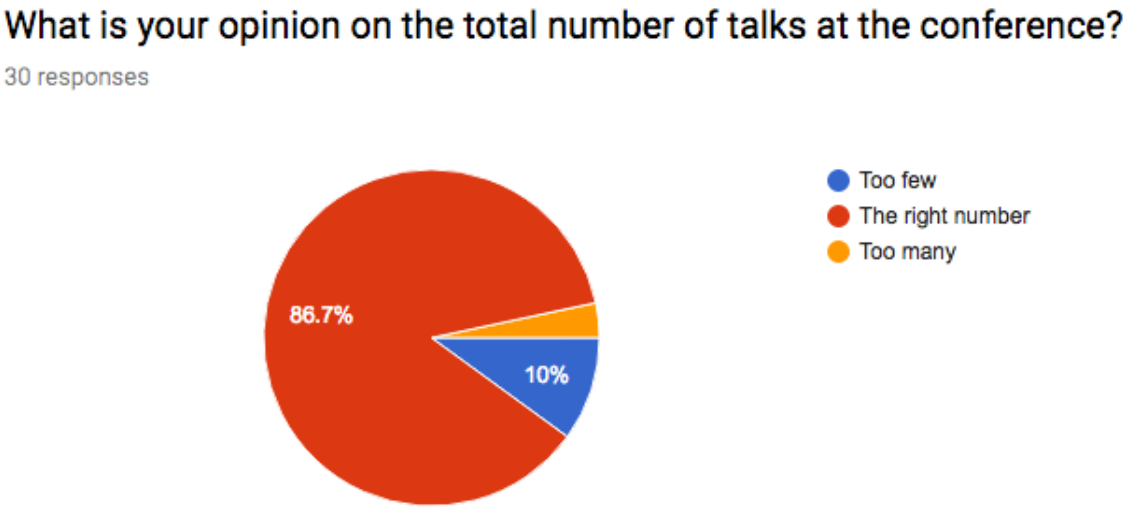

Figure 5 – Note: the conference had 11 invited talks (25 minutes + 5 minutes for questions) and 31 contributed talks (12 minutes + 3 minutes for questions).

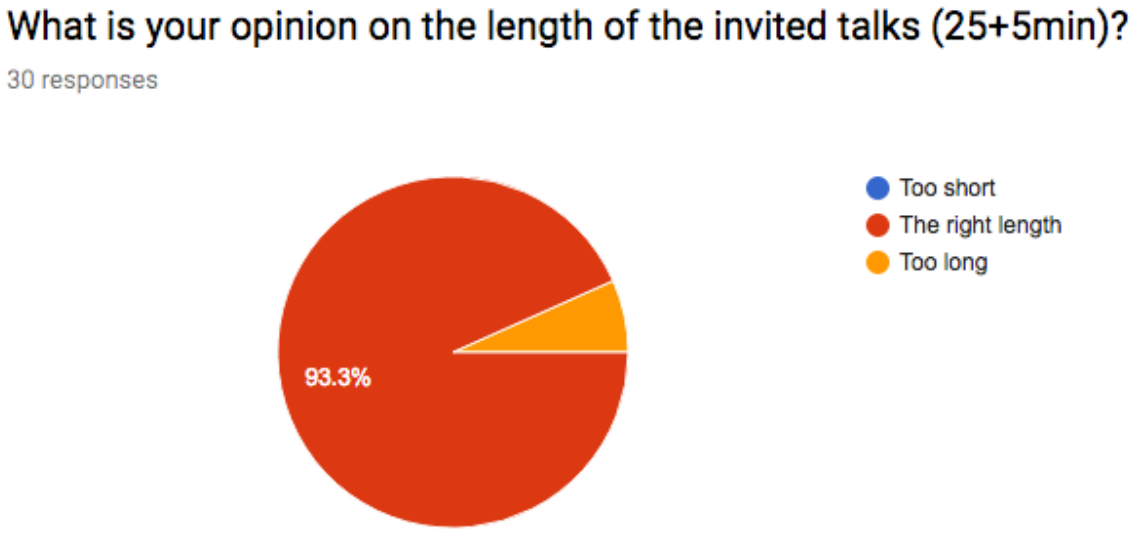

Figure 6

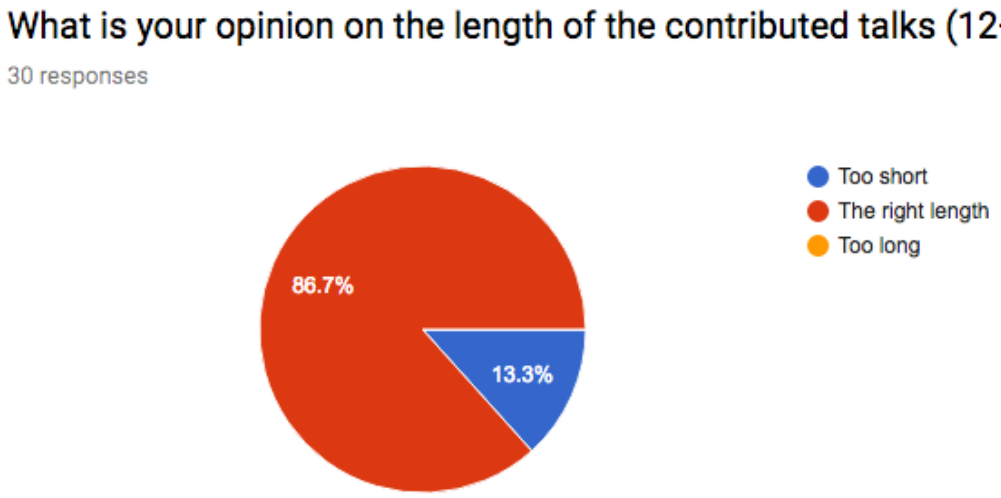

Figure 7

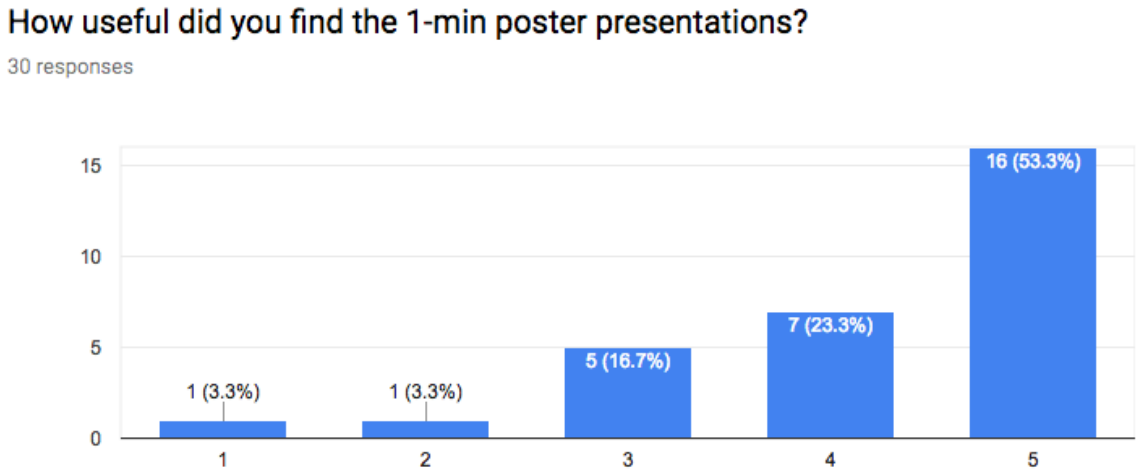

Figure 8 (1 = "not useful at all, should have been skipped"; 5 = "Very useful, should be included)

With regard to the poster flash talks, we received a comment that we should group the posters based on topic with the nearest related session. Another comment acknowledged that presentations succeeded in giving visibility, but suggested to designate 2-3 minutes each, instead of 1 minute.

The discussion sessions were another source of uncertainty in planning. We have heard anecdotes of successful and unsuccessful implementation of this in other conferences. Responses are in Figure 9, and with an average score of 3.6, we consider this a productive effort still with room for improvement. Our impression was that the most successful discussion groups had one person with knowledge of the topic to guide the discussion, and at least a few proactive participants. However, we received a comment that reminded us the possible risk that one/few person(s) dominates the discussion, and in some cases the informal organization actually provides a necessary avenue for passive voices to be heard.

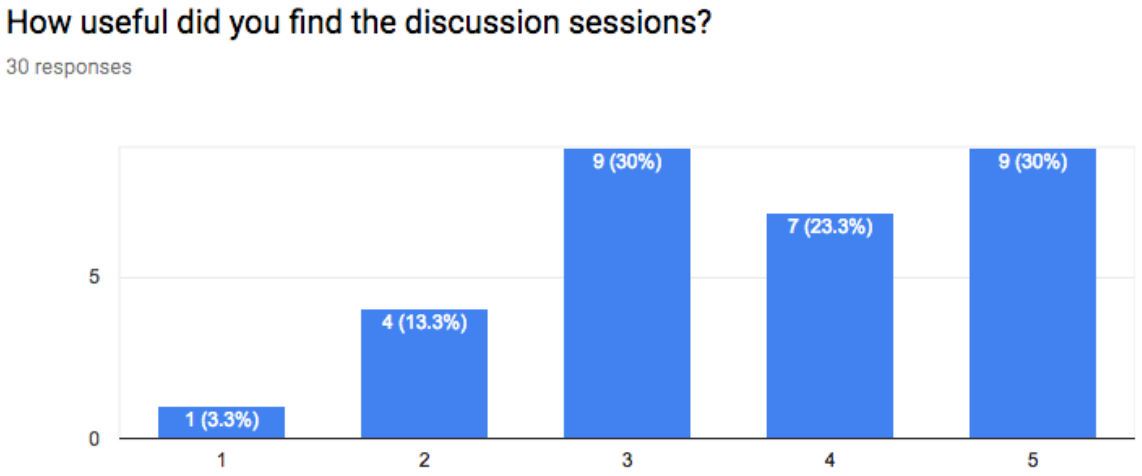

Figure 9 (1 = "not useful at all, should have been skipped"; 5 = "Very useful, should be included)

Social events:

The majority of responses to rate the conference excursion and barbecue indicated "OK", "High quality", or "Extremely high quality", but we also recognize that opinions of conference social events are highly unique to the given situation. More generally, we present the following plot in Figure 10, where it is apparent that most participants think that it is important to have a social event at a scientific conference. We leave it to the reader to interpret what does "significant" mean. In the case of our conference, we did not charge participants extra for the conference excursion and barbecue (combined in one event), and we provided transportation. One possible detriment of this event was that it involved a bus ride of more than 1 hour each way, and participants had to leave and return at predetermined times. On the other hand, we received a comment that the cultural experience and interaction with locals was a positive experience.

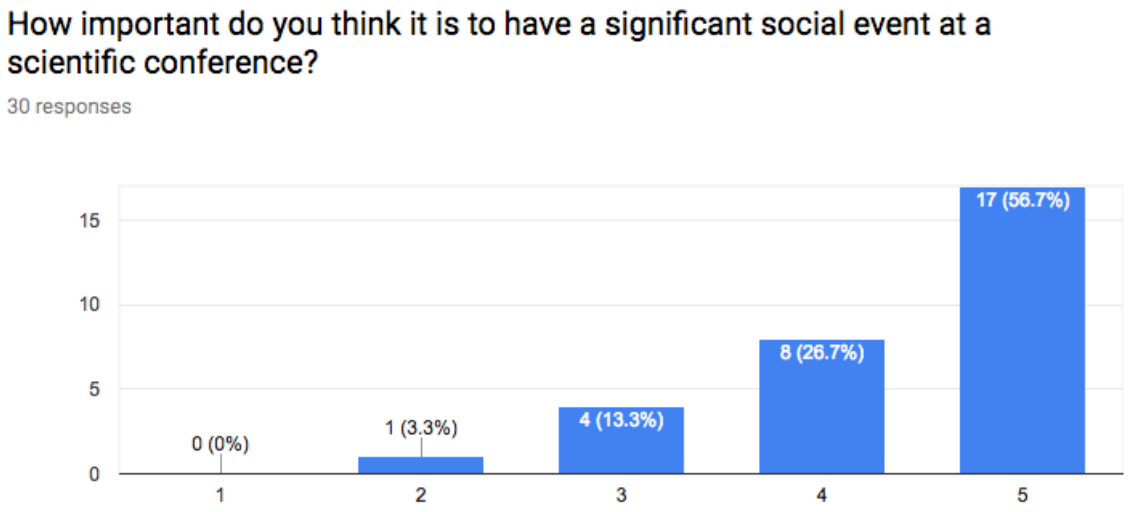

Figure 10 (1 = "Extremely unimportant"; 5 = "Extremely important")

We also note that several participants stated their gratitude that we included the following (free-response) question: "Do you have any concerns of harassment/discrimination during the conference that you would like to make the LOC aware of?" We received no indications of harassment/discrimination.

We thank the 30 participants who responded to our survey, and hopefully the results will assist in providing positive conference experiences in the future. If you would like to see the survey and/or results, for example to use as a template in a future conference, please contact Adele Plunkett, aplunket@eso.org.

Acknowledgments

We based this report and our conference survey on a previous conference report by Joe Anderson and the organization team of Supernova Through the Ages (sn2016). We thank Joe for providing these templates, as we feel it important to continue to transfer knowledge from SOC to SOC.

We thank the SOC for their contributions: Fernando Comerón, ESO; Paulo Cortes, NRAO/ALMA; Rebekka Grellmann, University of Cologne; Itziar de Gregorio-Monsalvo, ESO/ALMA; Lewis Knee, NRC Herzberg; Diego Mardones, Universidad de Chile; Koraljka Muzic, CENTRA, University of Lisbon, Portugal; Adele Plunkett, ESO/ALMA; Javier Rodón, Onsala Space Observatory; Satoko Takahashi, NAOJ/ALMA; Leonardo Testi, ESO/INAF-Arcetri; John Tobin, University of Oklahoma. The LOC provided important support: Paulo Cortes, NRAO/ALMA; Itziar de Gregorio-Monsalvo, ESO/ALMA; Antonio Hales, NRAO/ALMA; Diego Mardones, Universidad de Chile; Koraljka Muzic, CENTRA, University of Lisbon, Portugal; Adele Plunkett, ESO/ALMA; Satoko Takahashi, NAOJ/ALMA; Willem-Jan de Wit, ESO. **We especially emphasize the important support from LOC members María Eugenia Gómez and Paulina Jirón, as well as the IT and administrative support at ESO Vitacura.**

Funding for the conference was provided ESO and NRAO, as well as conference registration fees.