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Report on the ESO workshop

The Role of Accretion and Ejection Variability in the Evolution of Young Stars and their Disks (RAVEYSO)

held at ESO Headquarters, Garching, Germany, 19–22 May 2025

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The workshop The Role of Accretion and Ejection Variability in the Evolution of Young Stars and their Disks (RAVEYSO) was held at the ESO headquarters in Garching, Germany, from 19 to 22 May 2025. This international event brought together experts in the field of young stellar objects to discuss the latest advances in understanding the variability of the accretion and ejection processes and their implications for protoplanetary discs, and thus for star and planet formation.

Scientific rationale

Variability in young stellar objects is a fundamental aspect of both star and planet formation, observed across a broad range of timescales (from hours to decades) and wavelengths. The workshop addressed several key questions:

- How does time-variable accretion influence the mass growth of young stars?
- What are the connections between accretion, outflows, and disc evolution?
- How does variability affect disc chemistry, temperature gradients, and the potential for planet formation?
- What is the relationship between accretion and ejection processes, and how do these shape the dispersal of protoplanetary discs?

Recent advances from major observational campaigns — such as the Hubble Space Telescope UV Legacy Library of Young Stars as Essential Standards (ULLYSES), the complementary PENELLOPE programme with ESO's Very Large Telescope (VLT), JWST's first three years of young stellar observations, and lightcurves from NASA's Transiting Exoplanet Survey Satellite (TESS) — have provided new multi-wavelength, multi-epoch datasets for hundreds to thousands of young stars. The RAVEYSO workshop[1] capitalised on these developments, as well as on the capabilities of new instruments (for example, the Enhanced Resolution Imager and Spectrograph [ERIS] and the Multi-Unit Spectroscopic Explorer [MUSE] in narrow-field mode at the VLT, and GRAVITY+ at the VLT Interferometer) and upcoming surveys (the Legacy Survey of Space and Time at Vera C. Rubin Observatory, Son Of X-Shooter at ESO's New Technology Telescope, and Atacama Large Millimeter/submillimeter Array [ALMA] Large Programmes).

The main topics that were covered during the workshop were: i) Accretion variability: spanning short (< days) to long (> decades) timescales, explored through high-cadence photometry and spectroscopy; ii) Outflow variability: including disc winds and jets, with discussions on launching mechanisms, composition, and kinematics; iii) Accretion-outflow connection: examining the ratio of mass accreted to mass ejected, and the challenges in observing and modelling these processes; iv) Connection to outer disc scales: investigating how variability impacts disc chemistry, substructure formation, planet migration and the composition of forming planets.

Programme structure

The workshop began on the afternoon of Monday 19 May and concluded at lunchtime on Thursday 22 May. It featured a welcome reception and a workshop dinner, providing ample opportunity for networking and informal discussions. The scientific programme[2] included 11 invited and 44 contributed presentations, as well as 40 posters that were shown during the daily poster sessions, fostering collaboration and the exchange of new ideas.

Demographics

The workshop was co-funded by ESO and the Deutsche Forschungsgemeinschaft (DFG, the German Research Foundation) in the framework of the YTTHACA collaboration on protoplanetary discs (469334657, project code MA 8447/1-1). The scientific organising committee (SOC) consisted of the four YTTHACA lead inverstigators (from TLS Tautenburg, Hamburg University, Tübingen University and ESO), one ESO postdoctoral researcher and five

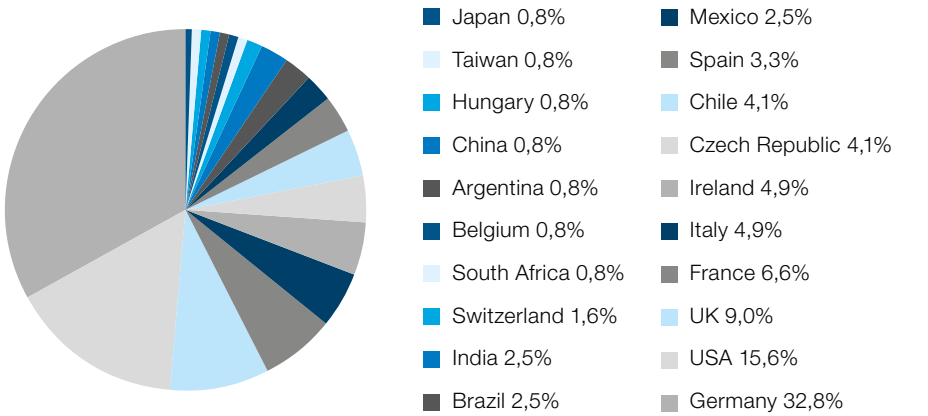


Figure 1. Participants by country.

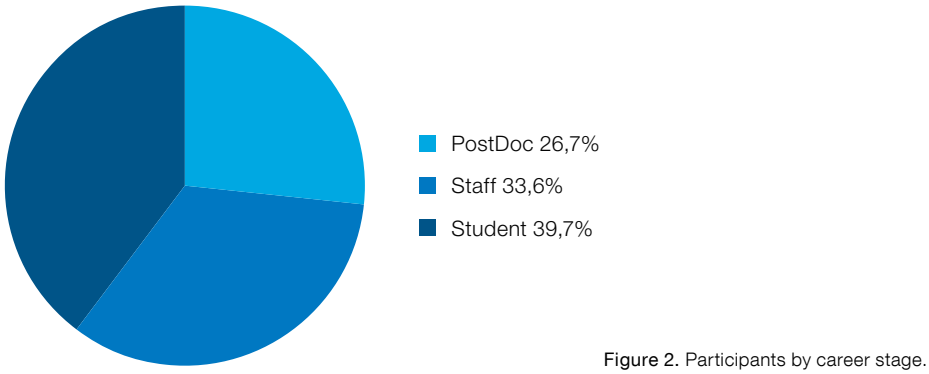


Figure 2. Participants by career stage.

external scientists, for a total of ten SOC members, four female and six male, from six countries (Germany, Italy, UK, Ireland, USA and France).

Our final number of in-person participants was 123, from 20 different countries across Europe, North America, South America, Asia and Africa. Financial support was granted to 11 attendees, with preference given to students.

We had a good level of participation from young researchers, with the following breakdown according to seniority: ~40 % students, ~27 % postdoctoral researchers and 33% tenure-track or tenured faculty (see Figure 1). Each of these groups was well represented in the talks.

The SOC sought fair representation from the community throughout the selection process. We proposed and voted on 11 invited speakers, using the primary criterion of who would give the best review and research talk for each topic of the workshop. The end result was a 64:36 percentage ratio of female to male invited speakers. Six of these were invited review talks, which set the scene for each part of the programme. The other five were invited research talks from both early and distinguished researchers, showcasing pivotal ongoing work and projects within each topic covered by the conference.

The overall gender balance for the workshop was 55% male, 40% female, 4% undisclosed and 1% non-binary. For contibutions to the conference (talks and posters) the gender balance was roughly the same as the overall conference demographics. Contributions were voted for by the SOC using only information about the surname, contribution title and abstract. In total, 44 contributed talks and 40 contributed posters were selected. The career stage of contributors was also roughly the same as that of the overall participants.

Conclusion

The RAVEYSO workshop provided a timely forum for synthesising recent observational and theoretical progress on accretion and ejection variability in young stars. By bringing together multi-wavelength data, new instrumentation, and advanced modelling, the meeting advanced the community’s understanding of the dynamic processes that govern star and planet formation.

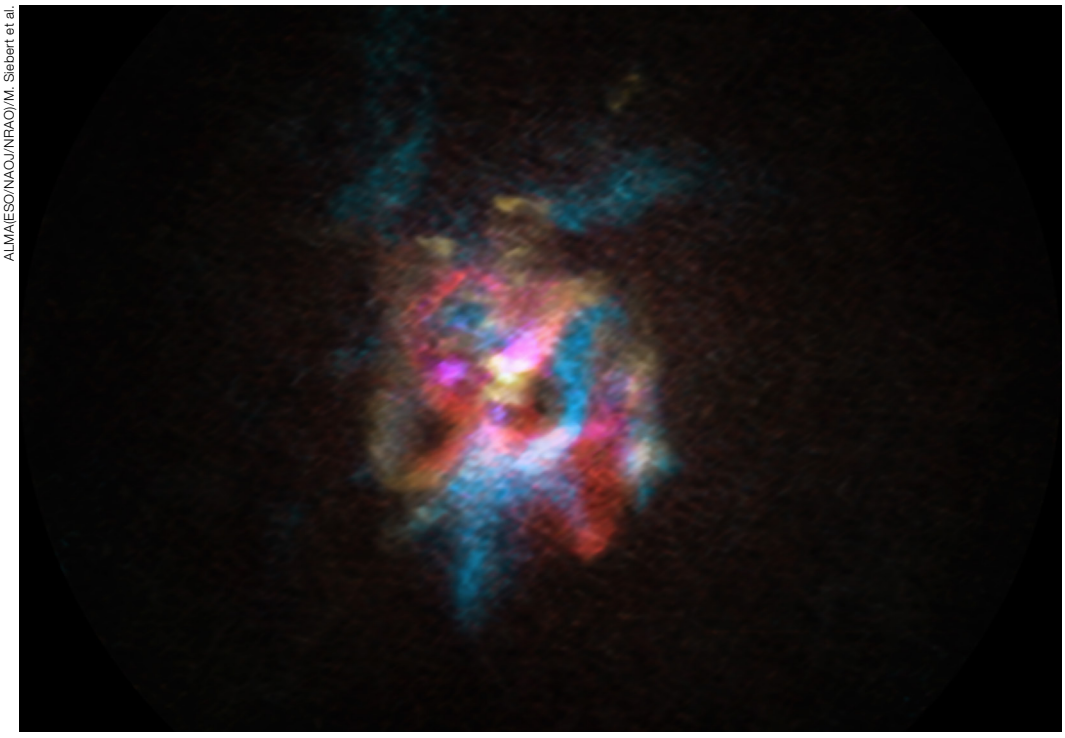
For further details, including the full programme, please refer to the workshop website[1]. All the talks will be made available on Zenodo.

Acknowledgements

We would like to thank all attendees for their active participation in the conference, which was crucial to making it such a success. We would further like to thank our SOC and LOC members for their fundamental and invaluable effort. We also thank the DFG and ESO for funding the conference. A special thanks goes to Denisa Tako for her support with the organisational aspects of the conference.

Links

[1] Workshop website: https://www.eso.org/sci/meetings/2025/raveyso.html
[2] Workshop programme: https://www.eso.org/sci/meetings/2025/raveyso/programme.html



ALMA(ESO/NAOJ/NRAO)/M. Siebert et al.

What we’re seeing in this photo is a red supergiant star expelling a cloud of gas and dust as it nears the end of its life. These nebulae are common around supergiant stars; however, this particular cloud presents an unexpected and considerable mystery for astronomers.

This is the largest cloud of ejected material to have been found around a supergiant star, at an enormous 1.4 light years across. Astronomers studied this star, Stephenson 2 DFK 52, with the Atacama Large Millimeter/submillimeter Array (ALMA). These new ALMA observations allow astronomers to measure how much material surrounds the star and how fast it is moving. The parts that are moving towards us are highlighted in blue, and the sections that are moving away, in red. The data show that about 4000 years ago the star went through an episode of extreme mass shedding, and then slowed down to its current rate, more similar to that of Betelgeuse. DFK 52 is estimated to be 10–15 times more massive than the Sun, and by now it has already lost 5–10% of its mass.