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Report on the IAU Hands-on Workshop

The VLTI High angular resolution Observations Workshop

held at ESO Vitacura, Santiago, Chile, 10–21 October 2022

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As part of the International Astronomical Union's Hands-On Workshops (I-HOW) initiative, ESO Chile organised the first international Very Large Telescope Interferometer (VLTI) workshop in Vitacura. The main goal was to train young scientists from Latin American countries in accessing, analysing and using VLTI archival data for their research projects. Through a series of lectures on interferometry and instrumentation, science, and soft skills, followed by practical hands-on sessions, the attendees were given the tools they needed to start using VLTI data for their own research. The workshop provided the perfect environment in which to build a network between VLTI specialists and future users and it furnished a great experience for all the participants, students, teachers and organisers alike.

Figure 1. Workshop participants during lectures in the first week of the workshop.

The highest angular resolutions at optical and infrared wavelengths are reached not by large single-dish telescopes but by combining the light of multiple telescopes using long-baseline interferometry. With this technique, angular resolutions of milliarcseconds and below, as well as differential astrometry at tens of microarcseconds accuracy can be reached. Such high angular resolutions are required to study and understand various astrophysical objects and phenomena. Optical and infrared interferometry has thus provided fundamental contributions to different fields of astrophysics, ranging from the characterisation of planets to our understanding of the lives of stars, as well as the investigation of supermassive black holes and their surroundings.

Nevertheless, optical and infrared interferometry is not as widely used as it could be and it is often considered a complex observing technique to be employed only by specialists. To counter this perception and make the technique available to a wider community, special schools have been organised to train the community in this observing technique, predominantly in Europe in the form of so-called Very Large Telescope Interferometer (VLTI) schools (for example, Garcia, 2009; Millour et al., 2021). The VLTI is the state-of-the-art infrared interferometer built and operated by the European Southern Observatory (ESO). With its second-generation instruments (PIONIER, GRAVITY, and MATISSE) and now undergoing an upgrade to extend its capabilities to faint sources (i.e., many more scientific topics and targets), the VLTI will play a key role in the era of ESO's Extremely Large Telescope and beyond. At the same time the VLTI has a vast unexplored science archive that calls for data mining, considering that a significant fraction of the publicly available archival data have not yet been published — a true treasure chest to be opened.

Enabling early-career astronomers from Latin America to use this archival data for their science was the main goal of the VLTI-HOW[1] (The VLTI High angular resolution Observations Workshop) held at ESO's Vitacura offices in Santiago, Chile between 10 and 21 October 2022. The workshop was the first of a new series of workshops hosted by the International Astronomical Union (IAU), the IAU Hands-On Workshops[2] (I-HOW). This IAU initiative aims to train young scientists in developing countries to access, analyse and use archival data for their research projects. The workshop was funded roughly half by ESO, and half by the Gordon and Betty Moore Foundation[3] through the IAU. The school covered the board, lodging and social activities of the participants from outside Santiago for the duration of the school and provided support for travel expenses when needed. Participation in the school was in person, given the importance of the interaction between lecturers and students, not only during the lectures themselves but also informally during breaks, meals and other social activities.

Demographics

About 70 applications were received and from these a total of 37 students were selected based on academic and scientific merit. The number of students was limited to ensure a ratio of about three to five students per lecturer, especially during the hands-on activities. The countries represented by the participants were Chile (19, with 12 from Santiago and 7 from the regions), Brazil (4), Mexico (7), Argentina (2), Guatemala (1), Bolivia (1) and Colombia (3). Eight students were undergraduates, 23 postgraduates and four postdoc; one was a bachelor's student and one a senior researcher.

Figure 2. Workshop photo with all participants.

18 students identified themselves as female, 17 as male, and 2 as non-binary. Most of the students had no previous knowledge of interferometry. Despite the workshop's being in person, all the lectures were broadcast in real time via Teams and about 10 additional students joined the workshop lectures online.

Programme

The first week of the workshop was dedicated to lectures introducing the students to the basics of optical and infrared interferometry, the VLTI instruments, and the many tools commonly used for VLTI observation preparation and data reduction. Additionally, various scientific lectures were given covering different research areas where optical and infrared interferometry has made significant contributions, such as exoplanets, active galactic nuclei, massive young stellar objects, protoplanetary discs, stellar evolution, evolved massive stars and fundamental stellar parameters. The lectures were organised in two parts: first a general introduction to the scientific topic understandable by everyone, and then specific lectures presenting VLTI results on the given scientific topic. Several professors from Latin America were invited to give the general introductions, while the VLTI lectures were given by expert interferometrists in the respective fields. In this way, the knowledge was also spread to more senior colleagues, and collaborations were fostered. The setup was very successful as some of the professors decided to stay on during the second week and join the practical sessions themselves. This enabled them to help the students with the scientific interpretation of the data.

The second week was dedicated to practical hands-on sessions. The students were divided into groups according to their scientific interests. Each team had a VLTI expert available to work with them as tutor during the entire week. On Monday, the students were assigned a scientific target observed with a specific VLTI instrument; they were shown how to browse the archive and how to download their data set, how to obtain and install the respective data reduction pipeline, and how to reduce the data. On Tuesday, they used the tools presented during the first week for model-fitting. Wednesday was dedicated to image reconstruction; the students attended a tutorial and then received a special data set suitable for image reconstruction. At the end of the day each group made a five-minute presentation of their results. On Thursday they continued working on their initial data set, finished any pending tasks, and prepared their final presentation which was given on Friday in front of the whole school. Students, lecturers and ESO colleagues joined to listen to the various presentations.

The programme was organised to leave enough time for networking and for in-person interactions between students and lecturers during coffee breaks, lunches, and other activities: a welcome reception on the first day, a barbecue on the first Friday, an excursion on Saturday, and a wine and cheese reception on Wednesday of the second week. Several short talks during the first week were dedicated to soft-skills development such as unconscious bias, scientific writing, job hunting, career development, job applications and interviews, among others. Since the workshop was held at the ESO offices in Santiago and the telescopes were too far away to visit, a live connection with Paranal was hosted on Thursday of the second week. The students were shown the control room and could observe in real time during twilight. Calibrator observations were prepared by some students, and some volunteers reduced the data in real time. Moreover, during the second week the last hour of the day was dedicated to presenting various scientific profiles working at an observatory: the operator, the engineer working on the instruments, the astronomer. Special attention was paid to selecting the speakers so as to maintain the gender balance and also include women from Latin America to act as role models for the students.

The lecturers and tutors were highly impressed by the professionalism and commitment of the students. When polled after the workshop, the students were very satisfied with the quality of the lectures and the practice sessions. The hardest part for them was the data reduction, which also suffered from some hiccups with the network and the computer setups. But these issues were overcome and as a benefit many students returned with the relevant software packages and pipelines installed on their own hardware, ready to use for their own science after returning to their institutes.

The lecture presentations are being archived on the Zenodo open-access repository[4]. The I-HOW initiative will keep in touch with participants over the years, forming a network of I-HOW alumni, to track their careers and offer possible follow-up activities. In conclusion, we are confident that the workshop reached its goal of providing the students with the skills and tools needed to explore and use archival VLTI data for their science. At the same time, the workshop has successfully contributed to the growth of the participants as scientists and provided room for networking, thus paving the way for (future) collaborations.

Acknowledgements

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References

Garcia, P. 2009, The Messenger, 135, 50
Millour, F. et al. 2021, The Messenger, 185, 28

Links

[1] VLTI-HOW website: https://www.eso.org/sci/meetings/2022/VLTI-How.html
[2] IAU Hands-On Workshops: https://www.iau.org/training/iau-hands-on-workshops/
[3] Gordon and Betty Moore Foundation: https://www.moore.org/
[4] Presentations on Zenodo: https://zenodo.org/communities/vltihow2022/
[5] Jean-Marie Mariotti Centre: https://www.jmmc.fr/

ESO/A. Ghizzi Panizza (www.albertoghizzipanizza.com)

This picture shows a beautiful meeting between the Swedish–ESO Submillimetre Telescope (SEST) and the Milky Way, apparently almost touching each other. This shot was taken at ESO's La Silla Observatory, located on the outskirts of the Chilean Atacama Desert, at an altitude of 2400 metres.