DOI: 10.18727/0722-6691/5101

Report on the ESO–European Interferometry Initiative School

The 9th Very Large Telescope Interferometer School

held at University of Lisbon, Portugal, 9–14 July 2018

Paulo J. V. Garcia[1,2]
Mercedes Filho[1,2]
António Amorim[1,3]
Antoine Mérand[4]

[1] CENTRA, Instituto Superior Técnico (IST), Lisbon, Portugal
[2] Faculdade de Engenharia da Universidade do Porto (FEUP), Portugal
[3] Faculdade de Ciências da Universidade de Lisboa (FCUL), Portugal
[4] ESO

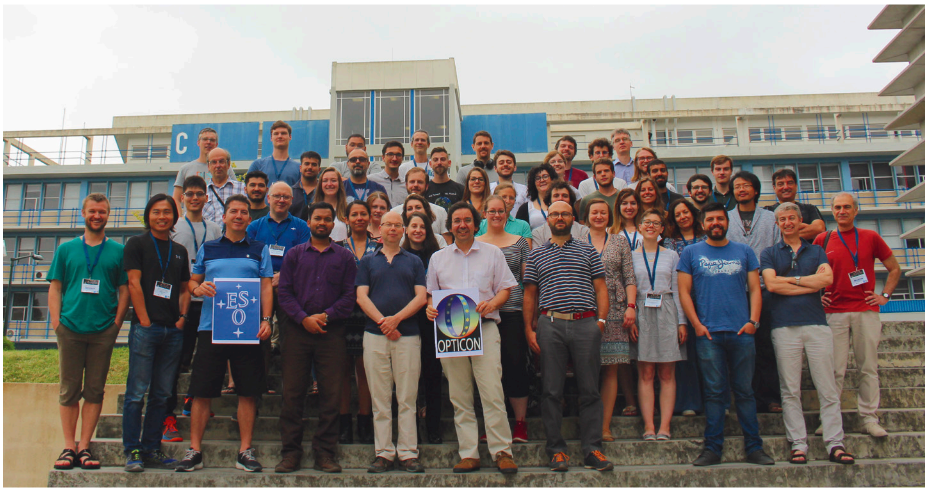

Figure 1. Group photo of the participants and lecturers of the 9th VLTI School at the Physics Department of the Faculty of Sciences, University of Lisbon.

The 9th Very Large Telescope Interferometer (VLTI) school guided participants through the process of acquiring and analysing VLTI observations from end to end, encompassing a range of steps, from scientific programme design to data reduction and exploration. This school was jointly funded by OPTICON (through the European Interferometry Initiative [EII]) and ESO. In total, 37 students participated and 15 lecturers were involved, ensuring broad coverage of topics. Continuous feedback was gathered throughout the school and the lecturers worked hard to fine-tune the programme using input from the students.

Long baseline interferometry in the optical-to-infrared is in its infancy when compared with interferometry in the radio and (sub-)millimetre wavelengths. At the much higher frequencies of the optical-to-infrared, atmospheric turbulence dominates and this precludes detecting the oscillating electric field with an individual telescope. After several successful experiments worldwide, ESO's VLTI achieved first light in 2001, combining two telescopes. Closure phase, combining three telescopes, was obtained in 2004. The VLTI is unique as it is a common-user facility serving a very broad community and also allows the simultaneous combination of four 8-metre-class telescopes. Very early in its history, it was recognised that training on using the VLTI was essential — particularly as expertise in long baseline optical interferometry had been confined to only a few groups in France and Germany, and in the early years the UK was not yet an ESO member state. The first VLTI school took place in 2002 at Les Houches in France, and VLTI schools have since been held in several countries including France, Germany, Hungary, Poland and Portugal.

In July 2018, the Portuguese VLTI Expertise Centre organised the 9th VLTI Summer School[1], which was aimed at postgraduate students and postdocs wishing to learn the theory and practicalities of infrared interferometry. The school had 37 students, 28 of whom were MSc or PhD students originating from 15 different countries: Brasil, Bulgaria, China, Denmark, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Norway, Poland, the Netherlands, the UK as well as ESO. Roughly half of them were from France, Germany and the UK. The interferometric expertise of the students was varied, which allowed them to learn from each other as well. The gender balance among the participants was 38% female and 62% male.

The school was designed to be practical, introducing students to many tools that are commonly used to prepare VLTI observations and to facilitate data reduction. A computer room with more than 20 computers was made available to run the requisite software. An open source virtual machine[2] with all the required software was installed. Students also brought their own laptops, and could run the virtual machine on these computers. The main focus of the school was on the new adaptive-optics assisted, two-object multiple beam combiner, GRAVITY (Gravity Collaboration, 2017), but there were plenty of references to the other VLTI instruments including the Multi AperTure mid-Infrared SpectroScopic Experiment (MATISSE; Lopez et al., 2014).

The school started on Sunday evening with a welcome dinner, registration and practical briefings. Classes started on Monday morning with a theoretical introduction by David Busher (Cambridge University, UK). Then Astronomical Software to PRepare Observations (ASPRO), from the Jean-Marie Mariotti Centre (JMMC) in France, was introduced in a practical session. Initially it was used to plot the visibilities using simple models and the *uv*-coverage of several array configurations. This same software was used to test for the observability of astronomical targets using the VLTI. These activities were guided by Gilles Duvert, Guillaume Mella and Laurent Bourgès (from the Institut de Planétologie et d'Astrophysique de Grenoble [IPAG], France).

A historical perspective on the VLTI was given by Antoine Mérand (ESO), after which the second-generation VLTI instruments were introduced, including MATISSE (Alexis Matter, Observatoire de la Côte d'Azur [OCA]) and GRAVITY (Oliver Pfuhl, Max Planck Institute for Extraterrestrial Physics [MPE]). Finally, Andres Pino (ESO) explained the importance of considering VLTI operations when preparing observations.

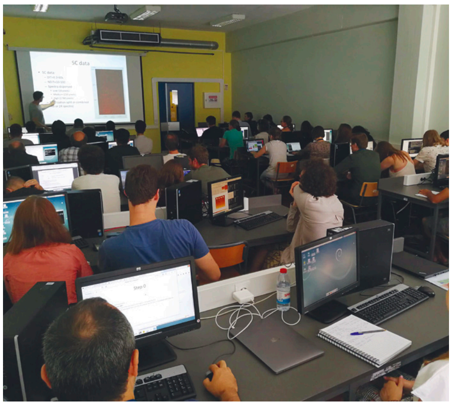

Figure 2. Oliver Pfuhl explains the GRAVITY pipeline to the students.

Figure 3. Joel Sanchez presents the solution to the image reconstruction exercise.

Figure 4. Eric Thiebaut explains the intricacies of image reconstruction to student Dominika Itrich, from Nicolaus Copernicus University in Torun, Poland.

An introduction to fitting models to interferometric data was carried out, followed by a practical session using the JMMC tool LitPro. These lectures and practical sessions were given by Michel Tallon and Eric Thiébaut (from the Centre de Recherche Astrophysique de Lyon [CRAL]). Eric Thiébaut, Joel Sanchez (ESO) and John Young (Cambridge) introduced image reconstruction theory and guided students through a practical application using several software packages, including BSMEM, MiRA and SQUEEZE. This allowed students to confirm that image reconstruction is possible and that results are consistent across different packages. Oliver Pfuhl and Gilles Duvert presented the GRAVITY pipeline and then led a practical activity illustrating its usage.

Finally, a lecture on the preparation of observations was given by Claudia Paladini (ESO); this very important lecture detailed how to submit a proposal to ESO, and afterwards the students created their own ESO proposal, submitting it to a mock Observing Programmes Committee (OPC). This exercise was carried out in groups over a specified amount of time. On the last day of the school (Saturday morning!) the groups presented their proposals orally and received feedback from the mock OPC, which consisted of Antoine Mérand, Claudia Paladini, Gilles Duvert, Oliver Pfuhl and Paulo Garcia. The proposals were considered to be of high quality, with subjects ranging from the Solar System to extragalactic science. In addition to the formal lectures and practical exercises, the programme also included time for students to give short talks on their own research.

Continuous feedback

The lecturers were very impressed with the professionalism shown by the students during this intensive school — the only social break was on Saturday afternoon!

Anonymous feedback from the students was collected daily. This allowed the collection of valuable information and enabled the lectures to be fine-tuned. The feedback was mostly very positive. One student stated, “Very good introduction lecture. I really appreciate that we start with hands-on exercises already on the first day.” The availability of several lecturers to answer questions was received positively by several students, with one remarking: “There were a lot of people around to answer questions during the practice session, it was very good.” Several students appreciated the practical aspects, which included fitting models and preparing observations — and in particular, the pause after each exercise to ensure everyone was on track. The lectures on GRAVITY also rated very highly amongst the students.

All students were housed in a large hostel, which maximised student interaction. On the first day, one student wrote that “The atmosphere” was the aspect that he most liked. Perhaps unsurprisingly, given that the school was held in Portugal, the organisers also received very positive comments on the food.

Several possibilities for future improvement were also identified over the course of this school. In their feedback, students requested, “more practice, fewer lectures” and “having slides before the lectures”. Some lectures could be improved further, in particular where “The tempo (...) was too fast or formulas weren’t explained enough.” “I know there were a lot of formulas and only a little time.” The organisers also plan to improve the gender balance of lecturers in future schools.

Acknowledgements

This school was one of deliverables of the OPTICON “VLTI Expertise Centres Network”, which included specific funding for its implementation; complementary funding was obtained via the Fizeau Exchange Programme and ESO. The total budget was around 37 000 euros; this covered full board for all participants, including lodging for 32 students and travel support for 17 students and for all of the lecturers. The VLTI school was organised by the Portuguese VLTI Expertise Centre and held at the Physics Department of the FCUL at the University of Lisbon. The organisers wish to express their gratitude to the Scientific Organising Committee, the Physics Department, and all administrative and support staff who made this school a reality.

References

Gravity Collaboration 2017, The Messenger, 170, 10
Lopez, B. et al. 2014, The Messenger, 157, 5

Links

[1] The school webpage: http://www.european-interferometry.eu/training/2018-school
[2] Virtual machine: http://www.virtualbox.org