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Observational astrophysics: from proposals to publication

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Abstract. The education of early career researchers in astronomy is growing in importance, as new and complex instruments are being commissioned to pioneer new hot topics in astrophysical research. Young researchers usually do not have the opportunities to gain hands-on experience with instrumentation and the telescope time application process in their early careers. To help provide such opportunities, ERASMUS+ and OPTICON joined forces and organised two summer schools in one event held at Stará Lesná in Slovakia between 17 and 27 July in 2019. Here, we describe the school and results of student group work which offered a high quality scientific output obtained in a short time.

Key words: Astronomical instrumentation, methods and techniques – Methods: data analysis

1. Introduction

Education of early career researchers is more and more demanding with the development of new instruments and with operations of new and modern observatories producing large amounts of data. Students usually have only limited opportunities to gain experience with these new instruments and novel methods. A natural way to improve the careers of young researchers is their participation in various summer schools, where the data reduction skills, new observing techniques and instrumentation development are presented. This is very well illustrated in a recent Astro2020 White Paper on the importance of telescope training for young astronomers (Whelan et al., 2019).

2. Early career education programmes in astronomy

The traditional organiser of such summer/winter schools is OPTICON (Optical Infrared Coordination Network for Astronomy) with a series of NEON Observing Schools and other schools in observational astrophysics. OPTICON is a

large EU-funded Research and Innovation project that has been running since the EU funding period FP6. It consists of three main areas: joint research activities, trans-national access, and networking activities. OPTICON has 16 work packages and WP12 *Enhancing community skills, Integrating communities* is a networking activity that is dedicated to organising schools in different aspects of observational astrophysics.

The key goals for the OPTICON WP12 are: 1) training of early career researchers in optical and infra-red observing techniques and data reduction procedures, 2) advancing the knowledge of astronomical instrumentation at all career stages, and 3) enabling equal participation of all EU member states in new large scale facilities. These goals are reached by organising 2–3 schools and workshops every year. The events include NEON Observing schools providing hands-on observing experience at professional telescopes, instrumentation schools, and Hot Topics conferences[1].

ERASMUS+ is an EU funded programme which promotes mobility of students, teachers and researchers and it is divided into Key Actions. Astronomical institute of Czech Academy of Sciences obtained an ERASMUS+ KA2 grant 2017-1-CZ01-KA203-035562 titled: "Per Aspera ad Astra Simul" with international partners from Instituto de Astrofisica de Canarias (IAC), Spain, Masaryk University, Czech Republic, Comenius University, Slovakia, Astronomical Institute of Slovak Academy of Sciences and with an associated partner Gran Telescopio de Canarias, Spain. Our project consists of two parts, firstly it enables a short term mobility of experienced researchers between partner institutes and secondly, it allows for long term mobility (up to 12 months) of early career researchers who can spend their time enhancing their careers at partner institutes.

One of the goals of our ERASMUS+ project is to disseminate the results of new educational and scientific approaches developed during the exchanges. As a dissemination event, a summer school on Observing techniques and data reduction of astrophysical data was organised. In order to make for a more complete experience, the data reduction school was joined with proposal writing school organised by OPTICON. The two schools strongly and logically connected, covering the needs of students to gain experience with modern data and instrumentation but also with proposal writing and the telescope time allocation process, with the latter becoming more and more competitive.

3. Joint ERASMUS+ and OPTICON summer schools

These two different EU funded programmes were united in the school "Observational Astrophysics: from proposals to publication" which was held at AI SAV at Stará Lesná in Slovakia between 17 and 27 July in 2019. In total, 28 students from 12 EU countries and associated states as well as one student from Ethiopia

[1]You can find more information on the OPTICON organised schools at https://opticon-schools.nbi.ku.dk/

participated. Unfortunately, two students from Morocco could not obtain visa in time, even if though their applications were made one month before the school.

The different aspects of the school will be introduced in detail in the following sections, while the results from students' projects will be presented in form of conference proceedings.

4. Data reduction part of the school

The first part was dedicated to lectures introducing various observatories and also OPTICON and ERASMUS+ programmes. Besides lectures (taking place mostly on 18 June), about 30 hours of group work was planned for students. After the talk about European Southern Observatory, the first hands-on session dealing with photometric data reduction was presented by H. M. J. Boffin (ESO) and prepared by D. Jones (IAC). The 28 students were then divided into groups led by experienced tutors from partner institutes. These groups consisted of 4–5 students working on a particular hot topic in modern astronomy such as quasars, exoplanets, Solar system bodies and AGNs. The group work comprised reading up on the topic proposed by the tutor and to then reduce and analyse a selected data set. Furthermore, the results of the students' analyses later presented on Sunday 24 June during a closing mini-conference. Each group had 15 minutes for their talk and 5 minutes for questions. The whole process very precisely simulated a real scientific conference and thus young participants also has the opportunity to improve their presenting skills. Each project and its results will be presented as an article of this proceedings.

A session on "How to write a good paper" was remotely presented by P. Woods, editor of Nature Astronomy. After the scientific paper writing session, a career session was opened by H. Korhonen who summarised the most important things for a successful career in astronomy (and science, in general). Subsequently, an extensive discussion about careers and paper writing opened. Students wanted to know how to deal with the referee reports as well as career aspects such as how to obtain a position or how a scientific career can be successfully combined with family life.

In general, the school allowed students to gain first-hand experience with modern data reduction processes for spectroscopic and photometric data. Furthermore, the importance of data archives and various routines for data analyses other than common IRAF [2] were also presented to the students. A relatively large number of hours (about 30) were dedicated to group work, allowing for detailed and careful analysis and ultimately for the preparation of high quality presentations.

[2]IRAF is distributed by the National Optical Astronomy Observatory, which is operated by the Association of Universities for Research in Astronomy (AURA) under a cooperative agreement with the National Science Foundation.

5. Proposal - time allocation committee exercise

The OPTICON part on proposal writing and evaluation started on Sunday 23 June. In the first part, an introductory lecture on the work of time allocation committee was presented by J. Fynbo. After the introductory lecture, logistical details for the exercise were explained however, the main idea of the exercise was very clear. Each group, with the same composition as for data reduction part, would act as a 'Telescope Time Allocation Committee'. They would all be given the same 10 proposals for discussion, and each panel would be chaired by the tutor from the data reduction part of the school. They would debate and rank the proposals, also attempting to provide useful feedback (just as would be expected from a real time allocation committee). All proposals were kindly provided by OPTICON with permission of their authors and they were anonymised. Furthermore, the real OPTICON time allocation committee rankings and feedback summaries were sent to the tutors on the last day, before the final discussion.

All in all, this meant that the participants had an opportunity to feel how a real time allocation panel works. In each group a responsible was assigned for each paper and this responsible was guiding the panel discussion with the guidance of the group tutor. The tutors were there to act as moderators, the main task of discussion about the proposals and preparation of the ranking was solely in hands of participants.

In the common session, all participants discussed each proposal. Each group provided their comments on the proposals and then presented their feedback to the others. After discussing each proposal, the summary of the OPTICON panel feedback was presented to participants for comparison. It was interesting to compare how each group's perception of the proposals differed. For some proposals, the opinion of various groups was very different, however, the clear conclusions of the session were:

- The best and the worst proposals were received by all groups in a similar way
- The best and the worst proposals had also very similar feedback from OPTICON time allocation committee to the feedback of our participants
- The "grey zone" in the middle often showed some fluctuations between groups, some of which might have been due to missing information about the proposers' team, and/or groups not reviewing proposals which would be a good match for their expertise
- In general, young researchers participating in summer school did a very good job consistent with the OPTICON time allocation committee (even though their individual experience with proposal writing and assessment was far more limited)

6. Closing and impact of the school

The school ended with a discussion after the proposal review exercise. In general, students and young researchers were very motivated and many of them had already some previous experience with e.g. IRAF and partly with proposal writing as they were involved in such tasks because of their supervisors. In the closing discussion, the organisational aspects such as ratio of lectures and group work were discussed. In general, participants prefer more group work over classical lectures - concluding that too many lectures would severely limit the time for project work.

As we would like to provide some guidance and inspiration for future summer school organisers, we decided to publish the results in the form of this proceedings. Furthermore, participants will acquire a feeling for the whole process from proposal writing to data reduction and subsequent publication as their project work which will be published here as well.

We would like to thank to local organizers led by J. Budaj and to all tutors and lecturers who contributed to the success of the school. As for ERASMUS+, the next school funded by the project will be held in summer 2020, while OPTICON plans three different schools for 2020. These types of schools have an important impact with many alumni going on to hold prestigious fellowships or posts in astronomy. Furthermore, many former participants later become tutors or organizers of these schools allowing for continuity and for education of young generation of astronomers. The high standard and impact of the schools is also demonstrated by the typical applications pressure factor which is usually around 2 and higher.

Finally, apart from the practical and scientific aspects of the school, there was also a great social dynamic among the participants (see group photo in Figure 1). On Tuesday 25 June, a hiking trip was organized to Skalnate Pleso Observatory and for those who wanted, a four hour hike to Hrebienok cottage. One group of eight students even made a detour to Tery cottage located quite high in the Tatra Mountains and with a gorgeous view. During the conference dinner (and the whole school, in general), young researchers interacted socially with tutors – an important experience for both sides ensuring the best possible working environment. We therefore believe that our school also had a strong social impact on students who could see that tutors and lecturers had their own similar difficulties, success stories or career steps. From the experience of organising this kind of school before, we also know that the connections forged in these schools will, in many cases, have a significant impact, leading to life-long friendships and collaborations.

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Figure 1. Group photo of summer school participants.

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