

ANNEX 1: Trainees Opportunities at ESO

The Directorate for Science (DSC) houses the Offices for Science who are running a set of programmes, some aimed at training the next generation of astronomers, including the Studentship and Internship programmes. The DSC and its Offices also support the research work of the Astronomy Faculty who are routinely engaged in the supervision of junior scientists. The DSC thus welcome young astronomers with opportunities to work on front-line research work together with ESO science staff.

The Directorate of Engineering provides engineering resources and services to all ESO programmes as well as to the operations teams at the observatories and at ESO Headquarters. The Directorate employs engineers in all the disciplines: control engineering, software engineering, electronic engineering, optical engineering, system engineering, mechanical engineering. The DoE welcomes young engineers and trainees in all these disciplines.

The Directorate of Programmes houses the Project Management Department where there are also potential opportunities for trainees.

The Directorate of Operations is in charge of operating ESO's observatories in Chile (Paranal, La Silla, APEX, ALMA) and provides off-site support to the community from the headquarters in Garching. Training opportunities are primarily at the observatory sites within the maintenance, engineering and project support teams.

The sections below provide examples of tasks and the corresponding skills required. The list is not exhaustive.

1.1 Science Internships and Studentships

ESO takes an active role in training the next generation of users : as a leader in shaping the future of ground-based astronomy, ESO's studentship and internship programmes have a vital role in training the next generation of astronomers, providing students and interns with opportunities to engage in fruitful scientific interactions with more senior ESO astronomers who serve as role models. ESO success depends critically on having active and front-line researchers on staff : the active supervision and mentoring of junior scientists is thus an important component of the profile of Faculty and Fellow astronomers at ESO. Hosting science interns and students at ESO Santiago/Garching further contributes to a stimulating scientific atmosphere and to fostering scientific collaborations with the ESO community. The ESO DSC-Offices for Science (Chile/Germany) thus welcome astronomy interns to engage into specific research projects supervised by a Fellow or Faculty, as well as astronomy students to conduct part or all of their PhD work.

1.2 Software Engineering

There are two different types of projects and the software engineering departments are involved in the following:

- The development of software applications for the control of telescopes or instruments, including real-time control applications used for the operation of AO systems. Currently, and in the near future, software engineers develop control software for the ELT and its instruments as well as for Paranal instrumentation such as CRIFES, NAOMI, AOF and future instrument upgrades such as FORS2.
- The development of high-level applications which are used for the scientific operation of our observing facilities from the front-end applications used to prepare observations to the archiving software including data reduction systems used to process the data generated by our instruments. Currently, and in the near future, software engineers develop high-level applications for the VLT/VLTI and ALMA.

Skills/technologies used in software engineering

- C, C++, Java or Python
- SQL and/or noSQL databases
- Modern software development processes and methodologies such as agile development
- Multi-threaded programming and parallelisation techniques
- User interface development (web based or desktop)

1.3 Control Engineering

Control engineering has become a very important engineering discipline in the DoE. We welcome engineers with a knowledge of control theory and experience with modelling and simulations. As an example, the ELT is designed to have an M1 mirror composed of several hundred separate segments, each controlled by an [actuator](#). The shape of the entire mirror is constantly adjusted by a MIMO [active optics](#) control system, using input from multiple sensors to compensate for changes in the mirror shape due to thermal expansion, contraction and stresses as it is rotated. Motion Control is also a field widely used in our projects, for instance for precise telescope pointing. Finally, industrial automation is applied to ground-based astronomy specific problems like cryogenic and vacuum control and observatory interlock and safety systems.

1.4 Electronic Engineering

Electronic engineering is a very important discipline at ESO. Engineers and technicians of this discipline are responsible for the definition, design and manufacturing of control electronic and detector systems/subsystems for telescopes and instruments, as well for electrical compliance verification for

all ESO projects. The domain of expertise is quite extensive and covers instrument and telescope control electronics/automation to detector system design, production qualification and testing. Currently, and in the near future, our staff (and trainees) are involved in the development of control electronics for instruments such as NAOMI and CRIRES, prototype electronic systems for the ELT (e.g. electronic cabinets for the M1), and the implementation of the obsolescence management plan of the electronic systems at the La-Silla Paranal observatories. The development of detectors in the visible and IR is done in collaboration with industry.

Skills/technologies used in electronic engineering

- Siemens/Beckhoff PLC
- FPGA digital electronics
- Analog/Digital Circuits design, data acquisition
- Low-noise electronics operational at cryogenic temperatures
- Solid state physics, cryogenics, optics, radiometry and atmospheric spectroscopy

1.5 Mechanical Engineering

Mechanical engineers and technicians at ESO are responsible for the definition, design, analysis, procurement and initial assembly of mechanical, opto-mechanical, cryogenic and vacuum systems for advanced astronomical telescopes and instrumentation systems for all ESO observatories.

They are responsible for the mechanical design, drafting and construction of telescope subsystems and astronomical instrumentation operating at wavelengths from ultraviolet to the mid-infrared (LPO, ELT) and further to the radio band of ALMA. Their responsibilities also include cryogenic and vacuum systems, detector mechanics, precision mechanisms and structures for operating temperatures down to 3 Kelvin. Additional manpower in all these areas would be more than welcome.

The structural analysis group within the mechanical engineering department provides competencies which are extremely important for the ELT. Additional efforts in this area would also be more than welcome. Engineers perform analysis under mechanical design loads and predict structural response and performance. The group has been involved in the early feasibility phase of the ELT, by developing conceptual designs allowing trade-offs and defining the structural requirements for subsystem and system specifications. In the design phase, during prototyping and later during AIV, the group follows up the structural aspects in contracts.

Skills/technologies used in mechanical engineering

- FEA analysis, interest in system engineering of opto-mechanical systems, e.g large mirror deformation, earthquake analysis

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- Matlab, CodeV
- Mechanical engineering in the area of instrumentation and cryogenic systems
- Structural steelwork, handling, lifting and structural assembly

1.6 Optical Engineering

Trainees would be welcome to support the optical engineering department in the following areas:

- optical integration and optical metrology
- optical fibers, Laser frequency combs
- astrophotonics (technology watch)
- optical design and analysis
- wavefront and phasing sensors
- laser guide stars

1.7 Project Management

In general the management of projects at ESO, including the following of external contracts, requires people with experience. However, a trainee with the proper background (either in project management or an engineering discipline relevant to the work) can be a very effective assistant to an existing PM and learn a lot on the job (following up AIs, documents, agendas, etc).

1.8 Operations Engineering

The maintenance, support, and engineering departments at the observatories in Paranal (VLT), La Silla, and Sequitor (APEX) employ engineers of different disciplines including optics, mechanics, electronics, software, optical and radio frequency instrumentation, and system engineering. Trainees would be welcome to join these teams to support the day-to-day operation of the observatories e.g. in preventive and corrective maintenance activities and/or to support projects during their integration and commissioning phase at the observatory.