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<th><strong>PHY127</strong></th>
<th><strong>Observing the Night Sky</strong></th>
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<tr>
<td><strong>Academic Year</strong></td>
<td>10 Credits</td>
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<tr>
<td><strong>Staff contact</strong></td>
<td>Dr K Inskip - <a href="mailto:k.inskip@sheffield.ac.uk">k.inskip@sheffield.ac.uk</a></td>
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**Outline Description**

This module aims to equip the student with a grounding in the observational and computational data analysis skills they will need as part of an astronomy degree programme, and is an essential pre-requisite of the more advanced handling of astrophysical data that will be expected as part of Levels 2, 3 and 4. The module consists of a mixture of taught material, workshops, and practical activities in positional astronomy, optics, practical observing skills, basic python programming, and astrophysical data analysis.

**Restrictions/Core for Programmes**

Core: PHYU06, PHYU11, PHYU25  
Approved: PHYU01, PHYU02, PHYU23

**Prerequisites**

N/A

**Co requisites**

N/A

**Approx Time allocation (hours)**

6 Lectures, 36 Laboratory, 58 Independent Study

**Assessment (%)**

Online tests (Optics & Positional Astronomy) - 35%  
Observing Proposal - 10%  
Observing Report - 10%  
Data Analysis Notebooks - 35%  
Semester 2 report - 10%

**Aims**

This module aims to:

- provide students with the knowledge of positional astronomy and astronomical coordinate systems necessary to plan telescopic observations;
- teach students how to observe astronomical bodies using a telescope, and provide them with an opportunity to do so;
- provide students with a basic knowledge of optics in the context of telescope optics and the design of astronomical telescopes;
- develop students’ skills in Python programming as applied to astronomical data analysis;
- give students experience in analysing astronomical data, and communicating results appropriately.

**Outcomes**

By the end of the module, a student will (be able to):

- demonstrate competency in their understanding of positional astronomy through their ability to define, use and manipulate astronomical coordinate systems and plan astronomical observations;
- have gained experience in the successful use of astronomical instrumentation;
- understand the basics of geometric optics and be able to apply this understanding to astronomical instrumentation in the form of basic refracting and reflecting telescopes;
- be able to use simple python programming to carry out basic analysis of astrophysical data;
- have demonstrated effective written communication skills in the context of a technical observing proposal, observing report, online laboratory notebooks and written report.

**Teaching Methods**

Positional astronomy will be taught through three flipped teaching sessions followed each week by a 3hr computational workshop, during which students will work on formative and assessed MCQs to acquire and demonstrate competency in positional astronomy..
Telescope Optics and the use of the ROSA telescope will be covered by 3 lectures and laboratory workshops (3 hrs each) combining formative MCQs (optics tests and the ROSA ‘driving test’) with structured planning and production of a written observing proposal, to be completed either within the lab setting or as homework.

Following successful completion of the formative ROSA ‘driving test’ and submission of an observing proposal, students will gain practical experience of observing using ROSA. This will take place between reading week and the submission of their short observing report at the start of semester 2.

In semester 2, students will use online python laboratory notebooks to gain familiarity and develop skills in programming and data analysis within 3x4hr computer laboratory sessions. The results of one data analysis experiment will be written up in the form of a popular science article.

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<th>Recommended Books</th>
<th>To Measure the Sky: An Introduction to Observational Astronomy - Chromey</th>
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**Syllabus**

**Optics:** This topic covers the lensmaker’s equation, ray diagrams for both lenses and mirrors, and diffraction from an aperture. The first session will provide grounding in key concepts, followed by a workshop which will focus on reinforcing these concepts and giving students experience in applying/using them. By the end of the session, students are expected to understand the propagation of light in systems involving either mirrors or lenses, and predict image locations and magnification either through the use of equations or through construction of ray diagrams. The second session focuses on telescopes specifically, including a brief review of the key principles of interference and diffraction before looking at basic telescope optics/design, the importance of aperture/collecting area, and resolution. The workshop builds familiarity with these concepts and will give students practice in determining instrumental effectiveness based on collecting area, resolution, and consideration of aberrations.

**Positional Astronomy:** This aspect of the course is designed to equip you with the knowledge and skills needed to plan and carry out astronomical observations. To do this, you will need
- an understanding of how and why stars and the Sun appear to move in the night sky, and how this depends on your location on the Earth;
- a working knowledge of the definitions and use of the principal astronomical coordinate systems;
- an understanding of the principles of spherical trigonometry;
- a working knowledge of the definition and use of solar and sidereal time and their dependence on the location of the observer.

The positional astronomy aspect of the module is a workshop course, combining lectures with computer exercises, so that you both learn the material and develop skills in applying your new knowledge to solve problems. The computer packages used are fairly self-explanatory, and you do not need any prior experience or knowledge of computer programming. This part of the course culminates in a “driving test” qualifying you to use ROSA, the department’s remote-operated telescope. You will then put your skills into practice by planning and carrying out an observational practical exercise using ROSA.

**Astrophysical Data Analysis:** In semester 2, students will be introduced to virtual observatory software and develop their python programming skills to analyse astrophysical data related to topics encountered in other first year astronomy modules. This material is delivered via CoCalc online notebooks. Students will gain experience communicating their understanding of the subject effectively through the production of a short popular science article.

**Academic Notes**