SXPS288 Module guide

This item contains selected online content. It is for use alongside, not as a replacement for the module website, which is the primary study format and contains activities and resources that cannot be replicated in the printed versions.

Contents

1 Structure of the module

Introduction

SXPS288 is a practical science module with three main projects that address astronomy, physics and planetary science. It builds on your previous study, adding a vital element of experimental work. The experimental investigations in these projects cover aspects as diverse as quantum mechanics; properties of electrons; planetary atmospheres and surface processes; and the structure and contents of the Milky Way. You'll use remote equipment ranging from an X-ray spectrometer to a radio telescope (ARROW) in Milton Keynes or an optical telescope (PIRATE) in Tenerife. Before the module begins, you should select which of these two astronomy options (ARROW or PIRATE) you wish to do. You'll build your experience and expertise in practical investigation, including observation, hypothesising and reporting skills. An exciting project develops team-working skills critical to collaborative scientific enquiry.

Practical scientific enquiry, whether in the field or in the laboratory, proceeds through objective observation and experimentation: good experimental design starts with a clearly defined and testable hypothesis or research question and proceeds by assembling the necessary equipment and techniques to carry out investigations to test that hypothesis. Skilled practical scientists report effectively and critically evaluate their findings. In the course of studying SXPS288, you will develop skills such as calibration, data analysis and data interpretation that are essential for practical work in physics, astronomy and planetary science. You will study under the general guidance of your group tutor, with Project Specialists providing more specific advice.

Whilst on SXPS288, you will be developing a number of new skills as you work through your experimental investigations. Skills weeks at strategic points in the module will cover skills such as scientific communication, experimental design and technique and Python programming. It is important to record these as you progress, to help you remember what you have done, evaluate what you have learnt and enable you to come back to it when you want to, at a later time. To help you with this, we have provided a tool, the *learning log* which we will be signposting you to, throughout the module at strategic points. It is a useful way of remembering how your learning has progressed and you will be asked to provide extracts as part of your TMAs.

Project 1 – Astronomy: exploring the Milky Way

In this project you'll use either a radio telescope (ARROW) or an optical telescope (PIRATE) to investigate the structure and content of our own Galaxy, the Milky Way.

The observations at radio wavelengths are of emissions from interstellar hydrogen. From this, you'll map out the spiral arms and determine the structure of the Galaxy.

The optical observations concern photometry of open and globular clusters of stars in different wavebands. From this, you'll compile a colour-magnitude diagram to estimate properties such as the age and distance of the clusters.

The two techniques complement each other. Whichever instrument you use, you'll be contributing to an investigation into the structure and content of the Galaxy. You'll typically

work in a group with four other students, supported by experts in either radio or optical astronomy.

You must choose one of the two options (ARROW or PIRATE) at the start of the module. We'll provide full descriptions of both projects, together with a discussion forum, to help you choose. Places on each telescope option are limited, so register your preference early to maximise your chances of getting an observing session on your preferred activity.

Project 2 – Physics: electron–photon interactions

This project, about charged particles and radiation, is in two parts.

In the first part of this project, you'll use interactive screen experiments (ISEs) in a classic experiment to measure a fundamental property of the electron – its charge-to-mass ratio.

The second investigation is a live experiment in which you will control an X-ray source and detector. You'll investigate the process of Compton scattering – the interaction of X-ray photons with individual electrons. During your investigations into the Compton effect, you'll be recreating a Nobel prize-winning experiment and confirming a fundamental result in quantum mechanics.

This project will develop your skills in conducting practical investigations including calibration of equipment, handling of experimental errors and the presentation and interpretation of results.

Project 3 – Planetary science: atmosphere and surface of Mars

This project is centred on an imagined space mission to Mars. In the first phase you'll carry out a live experimental investigation using infrared spectroscopy to determine properties of planetary atmospheres. You'll be making use of technology designed by researchers at the OU and flown on actual space missions.

The second part of the investigation concerns planetary surface processes. Using genuine Mars data, you'll learn how to process and extract information from public domain datasets. You'll use this to model processes such as the production and evolution of the atmosphere and surface features of another planet.

Towards the end of the module, you'll complete a short team-based project involving analysis of experimental data relating to your Mars investigations. This activity will guide you through the manipulation and interpretation of observational data on planetary atmospheres and surfaces. You'll work collaboratively with your team using a variety of communication methods, including scheduled online forums.

Project 3 is an extended project where during the second half you will work in a group to produce a report for your EMA.

2 What to do before you start

Before starting SXPS288 make sure that you do the following.

- Before the module starts you must choose your preferred astronomy option (radio or optical telescope) via the Choosing your Astronomy project activity in the 'Before the module begins' section of the Study planner. It is important to do this as soon as possible so that you can be allocated to a tutor specialising in that project.

- Work through the Python getting started activity which will take you through installing and setting up the Python programming environment you will use throughout this module. There is also a reference document Python – What you need to know, which you may wish to start reading.

- Check that you know who your tutor is. You should receive an email with your tutor's contact details around the time your study is scheduled to start.

- Take some time to find your way around the SXPS288 module website and familiarise yourself with the contents. The tab bar at the top of the page and the links just below it will help you to move between sections of the website. For example, to return to the home page containing the Study planner, just select the leftmost tab labelled 'SXPS288 19J Home'.

- Check the *Study planner* and make a note of important dates in your other diaries or calendars where time-conflicts might arise.

You will use a variety of communication methods and online tools. For example, there is a forum that you will use for posting messages and for discussing ideas and issues with fellow students in your tutor group. In addition, your tutor will lead real-time discussions in online rooms (see Section 5.2).

SXPS288 is an intensive online module where all the materials needed for study are made available from a single module website. Consequently, it is important to check that you have:

- the computing equipment ready to start the module (Section 3)
- an appreciation of the time commitment needed (Section 5.3)
- an understanding of what to find and where to find it on the module website (Sections 5.1 and 5.3).

You should also be aware of the need to be actively engaged in, and contribute to, the Team Project which takes place from April to early June (Section 5.3).

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3 What do I need to provide?

To study SXPS288 you need to provide the following:

1. A suitable computer with an internet connection for engagement with:
   - the module website
   - interactive study materials
   - forums and wikis
   - online tutorials
   - interactive assessments (iCMAs)
   - tutor-marked assignments (TMAs)
   - Team Project work (part of the end-of-module assessment or EMA)
2. Headphones and a microphone for taking part in online tutorials. (Be sure to test this equipment well before your first online tutorial.)
3. One or more notebooks for planning your practical work and recording your observations and conclusions.

To check the suitability of your computing equipment consult the OU Personal Computing requirements for the module.

In this module you be will carrying out online practical science activities via The OpenScience Laboratory (OSL). The OSL makes it possible for you to take part in interactive practical science anywhere and anytime the internet is available. The laboratory features investigations using on-screen instruments, remote access experiments and virtual scenarios using real data.

The OSL has been developed to make best use of the HTML5 capabilities of web browsers. As a result, in order to carry out the practical science activities in this module, you will need to have the latest version of Chrome or Firefox, or another HTML5-compliant browser, such as Edge or Safari installed on your PC.

It is also important that you follow the links to OSL activities that are given in your module materials rather than launch the activity from the main OSL website. This is because, in some cases, the OSL contains different versions of each experiment for use on other modules.

4 Learning outcomes

Learning outcomes tell you what you should have achieved on completing your study. They are grouped into four different categories (listed below) to help you see what kinds of knowledge and skills are involved. You will gradually progress towards achieving these outcomes, building evidence of progress in a *learning log* as your individual record of achievement.

Knowledge and understanding

Demonstrate knowledge and understanding of:

KU1   Understand the factors involved in good experimental design in astronomy, physics and planetary science.

KU2   Understand the benefits, constraints and design considerations of remotely operated experiments.

KU3   Understand how different regions of the electromagnetic spectrum can be employed to investigate processes, structures and phenomena in a variety of situations and across differing distance scales

KU4   Understand the context and background science of the environment or system being investigated and how this influences experimental design.

Cognitive skills

C1   Propose scientific questions that can be tested by observation and measurement.

C2   Critically evaluate scientific reports and publications.

Key skills

KS1   Use knowledge of experimental design and experimental technique to plan and carry out experimental investigations in physical sciences considering health, safety and risk assessment.

KS2   Use computer programming and scripting to organise and process experimental data and to present results.

KS3   Use library and other online services to find scientific information, papers and data.

KS4   Make experimental observations and measurements and assess the accuracy of results.

Practical and/or professional skills

P1   Work effectively as a member of a team using verbal and written communication.

P2   Communicate information and conclusions effectively to specialist and nonspecialist audiences.

These outcomes are assessed in each of the projects as follows:

Astronomy: exploring the Milky Way: KU1, KU2, KU3, C2, KS2, KS3, P1, P2

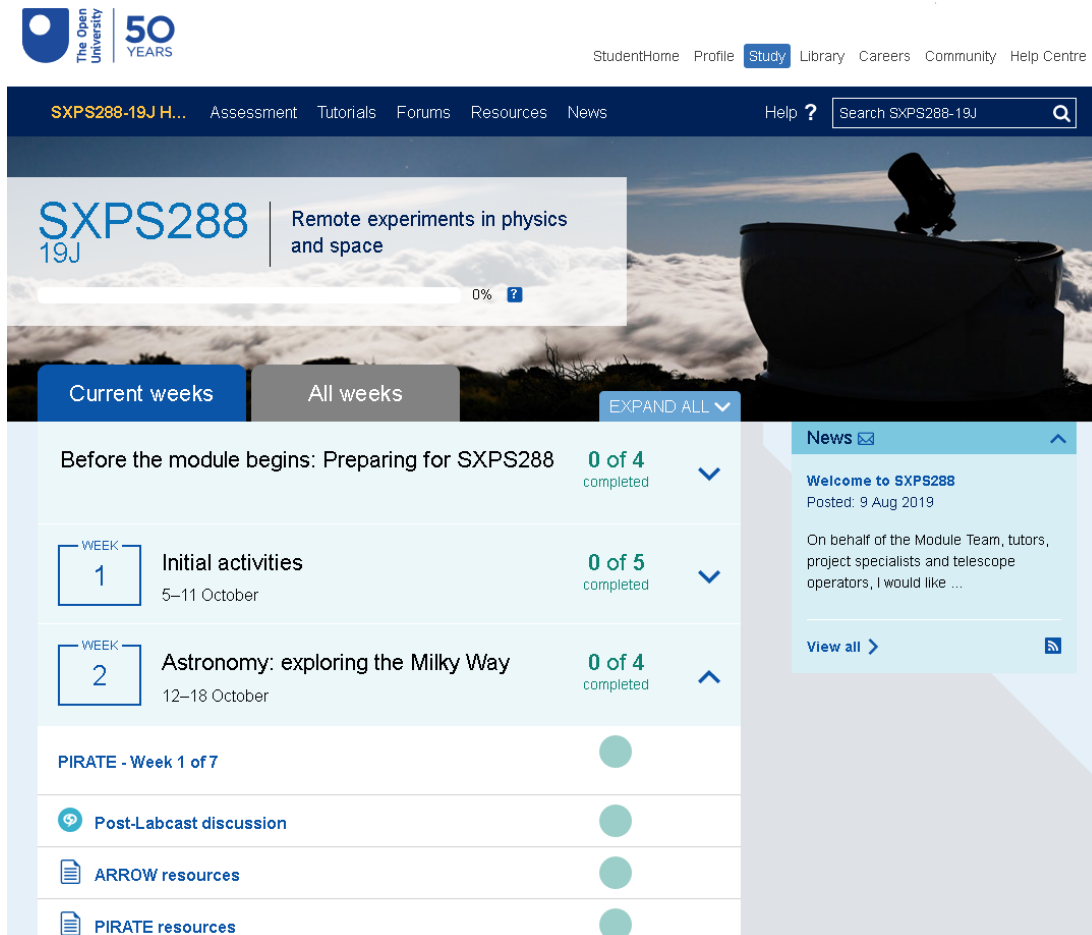Physics: electron–photon interactions: KU1, KU2, KU4, C2, KS2, KS4, P1, P2

Planetary science: Mars atmosphere: KU1, KU2, KU3, KU4, C1, C2, KS1, KS2, KS4, P1, P2

Additionally, all of these may be assessed as part of the final EMA Project, Planetary science: Mars surface.

5 Studying SXPS288

5.1 The SXPS288 website

The website is central to your studies and provides access to all the online resources for the module. The website's home page is your *Study planner* (Figure 5.1), which provides a central point of navigation to most of the materials.

Figure 5.1 The Study planner

After the initial activities in Week 1, you will be ready to start your first project on Astronomy in Week 2.

In each week you will find a link to the relevant section of the project materials.

In addition, you will find resources specific to each project on the Resources tab of the SXPS288 website.

At the end of each project there is an assessment week with a link to the appropriate TMA, which can also be found in the Assessment section of the module website.

At the top of the SXPS288 website you will find the following tabs:

- **Assessment**: here you will find links to the TMAs and iCMAs and - in due course - everything you will need for your EMA project work.

- **Tutorials**: this contains links to online tutorial rooms. Some will take place in your own tutor group room and others in the module wide room. Check the Study planner for details of module wide events and Labcasts.
- **Forums**: this contains links to forums you will use through out the module, including your Tutor group forum and project specific forums – see also Section 5.2.
- **Resources**: this houses resources needed for each project. The page also contains a link to your learning log together with links to online rooms for use in your experimental work. There is also a link to the *Library resources* page, which provides useful links to websites that can assist in searching for information.
- **News**: please check the news feed regularly for updates on the module and also items of general interest.
- **Help**: this links to the section in the OU Computing Guide about using the module website.

5.2 Tutorials: online discussion forums and online rooms

There are two main types of forum on SXPS288: a tutor group forum and a project forum. Your tutor group forum will open on the first formal day of study (i.e. in Week 1). You will be able to interact with your tutor and the other students in your tutor group via this forum by asking and answering questions or sharing ideas and resources. Each of the three main practical projects will also have a single project forum which will be open for the duration of each project and for the week immediately following (the assessment week). Additionally there are forums for specific purposes such as choosing your astronomy project and Python support.

You should check your tutor group forum and the *News* page of the module website at least twice a week during your study, to make sure you have not missed any important communications from the module team.

The tutorial sessions can be set up and run by your tutor or by the project team. We recommend that you read the section on setting up and using online rooms in the OU Computing Guide well before your first tutorial, and ensure that your computer, headphones and microphone are set up correctly so that you can participate fully.

You should acquaint yourself with the online rooms software as soon as possible. You will be expected to take part in your tutor group sessions, or at least to follow them via the recorded playback option, if available. There is more guidance on the use of online rooms and recordings in the Help Centre: https://help.open.ac.uk/online-rooms.

Additional online rooms are provided for team communications during planning and while carrying out your experimental investigations. These are available under 'Online rooms' on the Resources section of the SXPS288 website and can be used without a tutor present for your own discussions. There is a booking wiki for the planning rooms – please use this to avoid any conflicts.

5.3 Pacing your study and release of online

materials

Throughout your studies you will be required to use a personal computer to access experiments and data, and to analyse and report results. You should be prepared to set aside several periods of up to half a day for completing some of the tasks. Therefore, to study this module successfully, you must be able to study regularly (for 8 to 10 hours per week) and have broadband access to the internet (for up to 4 hours per week) throughout the duration of the module.

You may wish to set aside a physical study-space and to block out some longer periods of time (preferably half-days) for your practical work. Your tutor will specify times for some of your online tutorials, but others will be scheduled during your study to suit the requirements of your tutor group.

When the website opens you will have access to the first project. At the official start of the module you will also have access to the project 2 material and the remaining materials will be available well in advance of the final project. Section 1 of this guide gives you an overview of all three projects.

The end-of-module assessment (EMA) involves a Team Project that will require online group-working from April to the start of June. If you are unavailable for study or do not have regular access to a broadband internet connection for more than seven consecutive days during this time, your ability to complete the module satisfactorily will be affected.

6 Learning support

6.1 Your tutor and the Project Specialists

Two distinct groups of OU staff will support your learning on this module: your own (group) tutor, and Project Specialists specific to each project of the module.

Your (group) tutor will support your learning, providing formal feedback through marked assignments. You are expected to take an active part in the tutor group forum, and your tutor may also give a number of group tutorials via online rooms. You can contact your tutor by posting a message on your tutor group forum, by direct email, or by telephone.

Each of the three practical projects will also be supported by a Project Specialist, who will be available via the forum associated with each project.

Together, your tutor and the Project Specialists will support you through your studies. We hope you'll take advantage of this unique method of study support.

Learning support for the Team Project (EMA) will be provided by your group tutor in the role of a Project Consultant. The role of the Project Consultant is to set the pace of the teamwork and to provide advice and guidance on achieving the necessary degree of interaction between team members.

6.2 Online Library resources

As an OU student you have exclusive access to a world-class collection of online information resources via the OU Library website.

These include academic books and journals, newspapers, encyclopaedias and dictionaries that will help you with your assignments. If you are unsure where to start looking for information you can browse through the list of sources selected for your subject area on the Library Resources page of this website (within the Resources page).

You can access online library resources 24 hours a day, seven days a week through your module website or directly through the OU Library website. You will need your Open University Computer Username (OUCU) and password.

Improving your skills

If you are new to using online information resources and would like advice about where to start then you may find the *Getting started* section on the Library website useful.

There is a range of online training sessions available to help you make better use of Library resources in your studies. These include a session on how to find information for your assignments. The skills weeks in SXPS288 contain activities that will help you to find, evaluate and manage information. These will benefit your studies and help you to develop workplace skills values by employers.

Getting advice and guidance

The *Help and Support* section on the OU Library website includes a series of 'How do I?' guides about using online library resources. The Frequently Asked Questions (FAQs) provide clear answers to the most commonly asked questions.

Library staff are also available seven days a week to help you use the OU Library website and advise you on finding and using information for your studies. Full contact details for the Library Helpdesk are available on the OU Library website.

7 Assessment

7.1 Types of assessment

SXPS288 uses Single Component Assessment (SCA). Your TMAs and EMA will all contribute to your Overall Examinable Score (OES).

There are three types of formal assessment. All cut-off dates are indicated on the Study planner.

i.   Interactive computer-marked assessment (iCMA)

   For the first two projects there is one formative iCMA that will provide immediate feedback to demonstrate your progress. The scores from iCMAs do not count towards your overall mark and you may make repeated attempts. Both of these iCMAs can be found on the Assessment page. Instructions on how to use the iCMA and submit your answers are all explained in the initial information page within each iCMA.

ii. Tutor-marked assignment (TMA)

   A tutor marked assignment must be completed at the end of each practical project and these are labelled as TMA 01–03. They are submitted via the eTMA system. Your group tutor will mark this work. The TMA scores are weighted as follows.

TMA 01	15%
TMA 02	15%
TMA 03	20%

   Each of the TMAs counts towards your OES and each TMA can be found on the Assessment page. You have the opportunity to practise using the eTMA system by submitting a dummy TMA 00 to your tutor. TMA 00 and instructions on how to submit it can be found on StudentHome. One question in each of the three TMAs follows a similar format, comprising a report based on one or more of the project's investigations, as specified in the question. The other question or questions may ask you to present information from the project to different audiences, or to provide evidence for some of the skills (as opposed to the knowledge) that you have acquired during the project.

iii. End-of-module assessment (EMA)

   The end of module assessment (EMA) is the examinable component of SXPS288, and is weighted as 50% of your OES.

   In Question 1 of the EMA will work with several other members of your tutor group on a Team Project, each of you making a different contribution to the project according to your preference and expertise. The remaining questions on the EMA are to be completed by you working individually. In addition to achieving an overall pass mark on the OES there is a threshold of 30% on your individual contribution to the EMA. The EMA is submitted via the eTMA system as TMA 30.

There is no other examination.

7.2 Submitting your assignment

Using the on-line eTMA system, you can submit a word-processed document, or a scanned version of a handwritten one; advice on how to produce an eTMA is provided on the module website. Information about how to use the eTMA system can be found at the following link:

https://help.open.ac.uk/submitting-a-tma.

You will also find more information on the following page:

https://help.open.ac.uk/topic/assessments-and-exams/category/assignments.

This page has links to useful information on preparing assignments, writing in your own words and how to get help if you are falling behind or having difficulty with assignments.

Information on EMA submissions, including submission deadlines, can be found on the following page:

https://help.open.ac.uk/submitting-an-ema.

Additional information can be found in the Assessment Handbook:

https://help.open.ac.uk/documents/policies/assessment-handbook.

You should download a copy of this handbook and refer to it as necessary.

File formats

TMAs and EMAs can be submitted in Word-compatible (.doc or .docx) format or as PDF (.pdf) files. Normally your TMA should be submitted as a single file.

You may be asked to include files in other formats such as Python notebooks, in which case these must be included together with your main TMA document as a single compressed (.zip) file. Consult the Computing Guide for advice on working with .zip files.

Submission deadlines

The submission deadline for all assignments is 12:00 noon in Milton Keynes on the date indicated on the Assessment tab of the module website. Cut-off dates for TMAs and for the EMA are also clearly indicated on the Study planner.

If, for any reason, you are unable to complete your assignment on time, you must contact your tutor before the cut-off date to discuss possible options. Under exceptional circumstances your tutor may allow an extension but you should not expect this to be longer than seven days. The procedure for late submission of assignments is given in your Assessment Handbook. You should not normally expect to receive more than one extension, and you should be aware that no extensions are possible on the EMA.

What to do when your marked TMA is returned

Your tutor will assess your work according to a set of guidelines provided by the Module Team and will give constructive comments on your answers. When you get your TMA back, it is worth spending some time studying these comments carefully.

All these comments are made specifically for your benefit; they should provide valuable feedback on your work, and you can use this feedback to improve what you do in the next TMA. So before you file your TMA away, it is important that you read carefully through all the comments and think about the implications that the advice has for your next TMA. You will find it useful to review these comments when you come to do your next TMA.

7.3 Writing in your own words

The purpose of assignments is to assess your understanding and this can only be done if it is your own work and you use your own words. For this reason, copying someone else's work without making reference to the author is regarded as cheating and is forbidden. The OU uses text-comparison software to detect potential cases of plagiarism in assessed work.

To help you understand and avoid plagiarism you can refer to the resources on the Developing good academic practices website.

7.4 Word limits

Communicating scientific topics clearly and concisely is an important learning outcome. Therefore, all the SXPS288 assignments include word length limits. Submissions exceeding these word counts will be marked only up to the corresponding limit: work beyond this point will not be marked.

Full details of the word limits for each question are given in the *Guidance and word limits* sections in the TMAs.

7.5 Your result

Your overall module result for SXPS288 will be determined by your scores on both the TMAs and the examinable component as shown in Table 7.1.

Table 7.1 The score requirements for each result grade in SXPS288

	OES
Pass 1 (distinction)	85
Pass 2	70
Pass 3	55
Pass 4	40

You must achieve an average score of at least 40% for OES to guarantee a pass result.

The TMAs count towards your OES score and are weighted as follows.

TMA 01	15%
TMA 02	15%
TMA 03	20%

The examinable component (EMA) contributes 50% of the total OES score. This is made up of 40% for your individual contributions and 10% for the joint report.

In addition, there is a module-specific threshold for SXPS288. You must score:

- at least 30% on the individual components of the EMA (TMA 30).

It is important that you submit all of the assessment components and you should do so even if you have not been able to fully complete them. Consult your tutor as soon as possible if you anticipate any difficulty in submitting these on time.

In summary, the following information is taken into account in the determination of your module result:

- your TMA scores
- your examinable component (EMA) score
- module-specific thresholds
- information about any special circumstances that have seriously affected your performance
- University policy on assessment and the determination of results including the assessment strategy for the module.

If you fail the module, you will have to have achieved an average OES score across the module of 30% and have submitted your EMA, to be eligible for a resubmission.

Further information on module results can be found in Section 4 of your Assessment Handbook, which can be found via the Help Centre on StudentHome.

8 Getting advice and guidance

In addition to the support of your individual tutor throughout the module, for each of the projects you will have access to a project forum with Project Specialists available to give advice and guidance specific to each experiment. The links to these forums can be found on the Forums tab of the module website and some will appear in the Study planner.

We have advisers who can help with a wide range of study support issues, from tutor timetable information to adapting material for studying with a particular disability. These advisers are based in the Science support team and you can find their contact details via the Contact us link in the Help Centre on StudentHome. They can also advise you on study choice, and help you make important decisions about your pace of study.