



Weekend Courses 2023-24

The essentials of astronomy: a beginner's guide to the Universe

Start date: 16 August 2024

End date: 18 August 2024

Venue: Madingley Hall
Madingley
Cambridge
CB23 8AQ

Tutor: Dr Matthew Bothwell

Course Code: 2324NRX048

Tutor biography

Dr Matthew Bothwell is Public Astronomer at the Institute of Astronomy, University of Cambridge. He obtained his Master's degree at the University of Southampton, while carrying out research at the Harvard Center of Astrophysics. He then returned to the UK in 2007, completing his PhD at the University of Cambridge in 2011. After a year working as a researcher at the University of Arizona, he returned to Cambridge in 2012. Matt is a science communicator, who gives astronomy talks and lectures on almost any area of astronomy to a wide range of ages. When he is not doing outreach, Matt is an observational astronomer, who uses a range of state-of-the-art observing facilities to study the evolution of galaxies across cosmic time.

Course programme

Friday

Please plan to arrive between 16:30 and 18:30. You can meet other course members in the Terrace Bar which opens at 18:15. Tea and coffee making facilities are available in the study bedrooms.

19:00	Dinner
20:30 – 22:00	Introduction: the frontiers of astronomy
22:00	Terrace Bar open for informal discussion

Saturday

07:30	Breakfast (for residents only)
09:00 – 10:30	The history of radio astronomy
10:30	Coffee
11:00 – 12:30	What is in the radio sky?
13:00	Lunch
14:00 – 16:00	Free time
16:00	Tea
16:30 – 18:00	The invisible submillimetre universe
18:00 – 18:30	Free time
18:30	Dinner
20:00 – 21:30	Seeing heat: astronomy in the infrared
21:30	Terrace Bar open for informal discussion

Sunday

07:30	Breakfast (for residents only)
09:00 – 10:30	Optical astronomy
10:30	Coffee
11:00 – 12:30	Dark matter and dark energy
12:45	Lunch

The course will disperse after lunch

Course syllabus

Aims:

The course will allow you to:

- gain a deeper understanding of the methods of modern astronomy
- understand how and why astronomers use different regions of the spectrum
- gain an understanding of the types of astronomical objects we can see using different wavelengths

Summary of content:

Astronomy is the oldest science. For thousands of years, human beings have studied the lights in the night sky and tried to understand the workings of the cosmos. But for most of our history, our view has been limited. By observing the night sky with our eyes, we are only able to see the Universe in the wavelengths of light visible to our eyes. But visible light is only a small part of the entire electromagnetic spectrum.

Over the past century astronomy has become a 'multi-wavelength' science as astronomers have begun to study the sky using other regions of the electromagnetic spectrum. And the results have been astounding. Each new type of light, from radio waves to the infra-red, has provided a whole new window to the cosmos revealing a Universe more weird and wonderful than we had ever imagined.

In this course we will look at the science of modern multi-wavelength astronomy. We will begin with long wavelength radio waves, move on to submillimetre and then infrared light, and finally on to optical astronomy. Along the way we will encounter rapidly spinning neutron stars, hidden distant galaxies, stellar nurseries, violent supermassive black holes, and much more.

Presentation of the course:

The course will involve lectures and group discussions.

As a result of the course, within the constraints of the time available, you should be able to:

- develop a foundational understanding of the frontiers of astronomy
- gain knowledge of the key concepts and current advancements in various branches of astronomy
- explore the interdisciplinary nature of modern astronomical research and its implications for our understanding of the universe
- examine the historical evolution and significance of radio astronomy
- acquire a comprehensive overview of the historical milestones in the development of radio astronomy
- understand the pivotal role of radio telescopes in advancing our understanding of celestial objects and phenomena
- explore the hidden submillimeter universe and infrared astronomy
- gain insights into the significance of studying the submillimeter universe and the role of infrared astronomy in revealing hidden aspects of cosmic phenomena
- understand the technologies and observational techniques employed to study celestial objects in the submillimeter and infrared wavelengths
- explore the mysteries of dark matter and dark energy

- understand the concept of dark matter and its implications for the structure and evolution of the universe
- examine the role of dark energy in the expansion of the universe and its influence on the large-scale structure of cosmic matter

Reading and resources list

There are no compulsory readings for this course. However, you may find the below recommended reading list of interest to supplement your course.

General introductions to astronomy:

Bothwell, Matt, *The Invisible Universe* (Oneworld 2021)

Freedman, Roger and Kaufmann, William, *Universe* (W, H, Freeman & Co 2016)

Inglis, Michael, *Astrophysics is Easy!* (Springer, 2014)

Introduction to radio astronomy:

Woodruff T. Sullivan, III, *Cosmic Noise: A History of Early Radio Astronomy* (Cambridge University Press 2009)

Introduction to infrared astronomy:

Clements, David, L, *Infrared Astronomy – Seeing the Heat: from William Herschel to the Herschel Space Observatory* (CRC Press 2014)

Note: Institute of Continuing Education (ICE) students are entitled to 20% discount on books published by Cambridge University Press (CUP) which are purchased at the Press bookshop, 1 Trinity Street, Cambridge (Mon-Sat 9am – 5:30pm, Sun 11am – 5pm). A letter or email confirming acceptance on to a current ICE course should be taken as evidence of enrolment.

(Information correct as of 15 May 2023)