

Modern physics for beginners

Date	21 May 2016	Time	10:00 - 16:45
Venue	Madingley Hall Madingley Cambridge		
Tutor:	Hardip Sanghera	Course code	1516NDX040

Director of Programmes Emma Jennings

For further information on this course, please contact Clare Kerr, Public Programmes Coordinator
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To book See: www.ice.cam.ac.uk or telephone 01223 746262

Tutor biography

Hardip Sanghera obtained his Ph.D. from Jodrell Bank, where he studied a class of radio loud active galaxies called Compact Steep Spectrum Radio Sources, where the radio jet is moving through the ISM, and yet may evolve into the typical larger classical radio source. Their study required high/ultra-high resolution observations using radio telescopes arrays e.g. VLA, MERLIN and VLBI, with follow-up observations using ground based optical telescopes, and the space based Hubble Telescope. Following his doctorate, he spent a number of years working at the Joint Institute for VLBI in Europe, in the Netherlands, before moving back to Cambridge, where he currently supporting the ESA space-based Planck observatory, which is mapping the CMB.

Day school content:

Classical physics at the end of the 19th century dealing with everyday things, on scales much larger than atoms and much slower than the speed of light, had done such an excellent job that in the view of some eminent scientists almost everything had now been discovered. However, as we shall see the remaining few unresolved minor niggles eventually led to the breakdown of classical physics at the turn of the 20th century and led to the awesome paradigm shift of quantum physics.

We will look at the structure and development of our astronomical universe, highlighting the features that appear inevitable from those that may be accidental. The emergence of the idea that our universe may be one amongst many in a 'multiverse' provokes us to think of our visible universe in a new way. Is it extremely likely or unlikely, or perhaps just typical? And what of the future? Do we live in a special period of cosmic history when it is possible to observe and understand the universe in ways that will be impossible in the far future?

We will consider the second of our paradigm shifts, from the early 20th century, that of the world of relativistic physics required for very fast motions or extraordinarily large masses. However, after discovering the ultimate speed limit of the cosmos to be that of the speed of light and its ensuing profound consequences, including that of mass-energy equivalence, Einstein was aware of the limitation of his special theory of relativity in that it only dealt with uniform motion. In the generalization of SR to include acceleration, which took a further 10 years, emerged his general theory of relativity. We will also consider this deeper theory of gravity, and if time permits how it can be used to both model our Universe and discover its possible fate.

Embarrassing as it maybe, we don't at present know what most of the rest of the Universe is composed of. We will look at the reasons why we consider dark matter must exist, consider the proposed candidates for the constituent of dark matter, and consider the various ongoing world-wide experiments to detect it. Then we shall consider the even deeper mystery of dark energy, first encountered in 1998, of why it was unexpected, and what could be the source of this anti-gravity effect.

Programme:

09:30	Terrace bar open for pre-course tea/ coffee
10:00 – 11:15	Session 1 Quantum Weirdness (Dr. Hardip Sanghera) The paradigm shift from classical to modern physics, in particular the world of quantum physics.
11:15	Coffee
11:45 – 13:00	Session 2 Expanding Universes (Prof. John Barrow) Modern cosmology from Einstein to inflation and the multiverse: the Universe from the beginning to the end of time.
13:00	Lunch
14:00 – 15:15	Session 3 Relativistic Weirdness (Dr. Hardip Sanghera) The paradigm shift of the special and general theories of relativity.
15:15	Tea
15:30 – 16:45	Session 4 Dark Matter and Dark Energy (Dr. Hardip Sanghera) Why the Universe requires, and is mostly composed of, dark matter and dark energy.
16:45	Day school ends

Additional information

Venue

Details of how to find Madingley Hall can be found on our website:

<http://www.ice.cam.ac.uk/who-we-are/how-to-find-the-institute>

Refreshments

Tea and coffee and a light lunch will be provided. If you have any specific dietary requirements or allergies and have not already advised us, please inform our Admissions Team on

ice.admissions@ice.cam.ac.uk or +44 (0)1223 746262.

Note Students of the Institute of Continuing Education 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 Institute course should be taken as evidence of enrolment.

Information correct as of: 25 April 2016