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Edinburgh Winter Lecture Programme – 2018 / 19

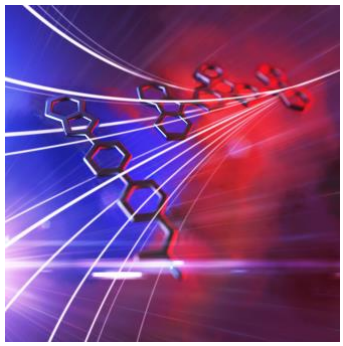
All talks start at 7.30pm in the Royal Society of Edinburgh, 22 - 26 George Street, with refreshments from 7.00 pm

Download the talk abstracts at: http://home.eps.hw.ac.uk/~phyrrt/IOP_Edinburgh_2018_19

Tuesday 6th November 2018

Dr Erik Gauger
(Heriot Watt University)

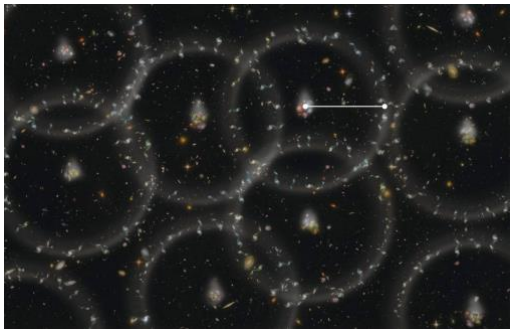
Learning from Nature: bio-inspired quantum technologies?



Tuesday 4th December 2018

Dr Rita Tojeiro
(University of St Andrews)

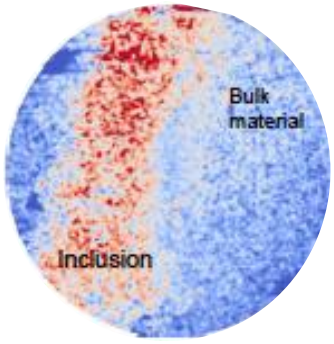
Mapping the Universe



Tuesday 19th February 2019

Prof. David D. Sampson
(University of Surrey / University of Western Australia)

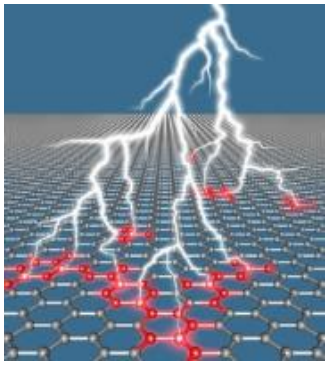
Label-free micro-imaging in medicine and biology with optical coherence tomography



Tuesday 12th March 2019

Dr Emma Springate
(STFC Central Laser Facility, Rutherford Appleton Lab)

Ultrafast science and lensless imaging with extreme ultraviolet pulses



We sincerely thank Renishaw for sponsorship

Free and open to non-members.
For more information contact Robert Thomson (R.R.Thomson@hw.ac.uk)

Edinburgh IOP Winter Lecture Programme – 2018 / 19

Tuesday 6th November 2018 – Dr Erik Gauger (Heriot Watt University)
Lecture Title: Learning from Nature: bio-inspired quantum technologies?

Abstract: One of the stranger aspects of quantum mechanics is the superposition principle: it allows particles to exist in more than one place (or state) simultaneously - in stark contrast to the world of our everyday experience. Quantum superpositions are not only puzzling, they could also be key to super-charging new technologies, such as quantum computers, quantum-enhanced sensing, and secure communication. However, in man-made systems, superposition states prove fragile and typically decay rapidly unless carefully protected in a very special environment. Could life have evolved to exploit such delicate phenomena? Recent experimental evidence suggests the answer is yes: for instance, Schrödinger cat states appear to play to a role in the photosynthetic process of bacteria and algae, and the directional sense of migratory birds is widely believed to be powered by superpositions states of electron spins inside a molecular compass structure. In this lecture, I will cover these intriguing examples of where Nature appears to have found ways of creating biological instances of "quantum technology" and discuss prospects for artificial quantum-enhanced light-harvesting and sensing technologies.

Tuesday 4th December 2018 - Dr Rita Tojeiro (University of St Andrews)
Lecture Title: Mapping the Universe

Abstract: The structure of the Universe on the largest scales tells us a great deal about its composition, geometry, expansion and ultimate fate. I will review our progress on mapping the large-scale structure of the Universe over the last few decades, show some of the most complete and largest maps we have ever made, and discuss the mysterious cosmological model that these maps have revealed.

Tuesday 19th February 2019 - Prof. David D. Sampson (University of Surrey / University of Western Australia)
Lecture Title: Label-free micro-imaging in medicine and biology with optical coherence tomography

Abstract: New and better tools to image biological tissue in vivo are important for biological and biomedical research based on animal models, and also important for next-generation diagnosis and surgical guidance in the medical setting. Whilst optical microscopy continues to advance on the cellular and sub-cellular scale, and medical imaging tools, such as positron emission tomography and magnetic resonance imaging, are well established on the scale of the whole organ, imaging the tissue environment in situ on the micro-scale, between that of cells and whole tissues, is currently challenging.

My research has been exploring the potential of optical coherence tomography for label-free imaging of tissues, on the resolution scale of 2-20 μm and over fields of view in the range 1-50 mm per dimension. We have been developing the capacity to perform such imaging using hand-held probes and from within hypodermic needles, which can be delivered to locations deep in tissues not normally accessible to optical imaging. We have been exploring extensions of this method that improve contrast and allow us to perform angiography and lymphangiography. In this talk, I will draw on various example applications, including breast cancer tumour margin assessment, skin burn scar longitudinal monitoring, and airway smooth muscle assessment for asthma.

Tuesday 12th March 2019 - Dr Emma Springate (STFC Central Laser Facility, Rutherford Appleton Lab)
Lecture Title: Ultrafast science and lensless imaging with extreme ultraviolet pulses

Abstract: The Nobel-prize-winning technique of Chirped Pulse Amplification has enabled us to build high power laser systems producing ultrashort, femtosecond laser pulses at high repetition rates. These can be used as a strobe, to take freeze-frame snapshots of ultrafast processes, such as molecules breaking during chemical reactions, and then sequence them into high-speed movies.

In my lab, we use femtosecond lasers to produce coherent pulses in the extreme ultraviolet region (XUV) of the spectrum (100-10 nm wavelength, 10-100 eV photon energy) using a technique called high harmonic generation. This produces XUV pulses that are spatially and temporally coherent, emitted in a pencil beam, and tightly synchronized to the generating laser pulses.

The high photon energy of XUV allows us to remove even tightly bound electrons from samples, using the photoelectric effect. By measuring the energies of the ejected electrons, we build up a map of changes in electronic structure of samples on ultrafast timescales. We have been able to apply this to observe what happens to electrons 2D materials such as graphene when they are illuminated, which could help us understand processes in photovoltaics, for example.

The short wavelength of XUV can also be used exploited for high-resolution imaging. As it is difficult to make lenses for these wavelengths, we use a lensless imaging technique where we measure the scatter from the sample directly and then use algorithms in place of a lens to reconstruct the image. We have been able to apply these to image mouse neurons at high resolution over a wide area, without staining or fluorescently tagging the sample.