

The Bristol Scientific Club Programme of Meetings for 2022 -2023

(1) Saturday, 22 October 2022

Speaker: James Annett: "Surprises and Modern Developments in Superconductivity"

Science fiction author and futurologist Arthur C Clark once said that *"Any sufficiently advanced technology is indistinguishable from magic"*. The phenomenon of superconductivity ultimately comes from quantum physics, not magic, but it certainly feels and looks like magic even to those who work research it. It seems inconceivable that a high speed train could levitate a few centimetres above a MAGLEV track, or that the intense magnetic fields needed to bend the energetic proton beams in the LHC in CERN can all be the result of the usually weak and ephemeral forces of quantum physics. The fundamental theory of superconductivity was first understood in the 1950s, by Bardeen Cooper and Schrieffer, who won the Nobel prize in 1972 (Bardeen's second trip to Stockholm, previously having invented the semiconductor transistor). This seemed to bring the field to maturity and interest declined. In the UK the distinguished Cambridge Professor Sir Brian Pippard even declared that *"the cat got the cream"* and the field was declared effectively dead. But nevertheless a few unsolved problems persisted, especially the hunt for new materials and room temperature superconductivity. A breakthrough in the 1980's led to the discovery of 'high temperature superconductivity' albeit still only at liquid nitrogen temperatures. Since then several whole new families of new materials have been discovered all with unique and surprising properties. Remarkably room temperature superconductivity (15C) was finally reported in 2020. These amazing results seem to confirm a long held theoretical prediction that high pressure phases of metallic hydrogen could exhibit room temperature superconductivity, but the huge pressures required (270GPa) are like those found in the cores of planets like Jupiter, so this is still far from a practical technology. But other novel technological applications of superconductivity are also emerging which may impact our lives more directly, such as the developments of the world's first *"quantum computers"*, based on the unique quantum properties of superconductors.

James Annett is Professor of Physics at the University of Bristol. He studied theoretical physics in Cambridge, earning his BA in 1982 and PhD in 1995. After a research fellowship at Emmanuel College, in 1987 he moved to the University of Illinois at Urbana Champaign, where the Bardeen Cooper Scheieffer theory of superconductivity had first been developed. This was the remarkable year marked by the discovery of high temperature superconductors, with the exciting American Physical Society meeting in New York that year (which JA attended) dubbed "the Woodstock of Physics". James Annett stayed in the USA as Assistant Professor of Physics, at Pennsylvania State University, before deciding to return to the UK becoming lecturer at the University of Bristol in 1994. Professor Annett has stayed in Bristol ever since then, serving as Head of School of physics from 2014-18.

(2) Friday, 25 November 2022

Speaker: Iain Watt: "Britons Ancient and Modern."

The islands that we call home today have been the goal of numerous population migrations over the millennia. This talk will look at several individuals of interest, dating from the earliest, largely intact, skeleton from 30,000 years ago, when we were not an island at all, to the late Iron Age/early Roman era. These people can tell us about themselves, their way of life and their places of origin. Further, since all we left behind us in prehistory were our skeletons, we gain insight into aspects of their cultures, diet and things thought important in the form of grave goods found associated with them. Studies of stable isotopes enlighten our understanding of their diet in childhood and later adult life (the last 7 years to be exact). Ancient DNA (aDNA) is revealing many more clues about the nature of these prehistoric migrations telling us where we ourselves came from, and how long ago, as well as mutations beneficial to our survival and the

infectious diseases we have suffered. The question arises – do our ancient predecessors have impact on our genome today? The answer is a guarded ‘yes.’ This evening’s discussion cannot be exhaustive but, hopefully, an entertaining overview of these current research topics. We will conclude with the intriguing question as to whether the placement of clotted cream on or under strawberry jam is a cultural or genetically driven feature in Southwest England!

Iain Watt MSc (Hons), FRCP, FRCR is presently an honorary professor in the Department of Bioarchaeology, University of Exeter and Honorary Research Associate, Oxford Archaeology. He qualified in medicine at the Royal London Hospital and, having initially pursued a career in internal medicine, studied clinical (diagnostic) radiology, serving 32 years in the Bristol Royal Infirmary and then six in the University Hospital of Leiden, The Netherlands. Granted the explosion in available imaging techniques during his career, subspecialisation became necessary, and Iain chose bone and joint imaging as his field of work and research interest publishing more than two hundred full papers and a similar number of abstracts in the literature. It was inevitable that an interest in living bones should lead to involvement with archaeological skeletal material working, as he did, with the early pioneers in human bioarchaeology, notably the late Dr Juliet Rogers here in Bristol.

(3) Saturday, 18 February 2023

Speaker: Peter Simpson: “Sleep Well – a short history and explanation of anaesthesia.”

While almost everyone receives an anaesthetic on several occasions during their life, few realise that anaesthesia as we know it, has only been around for about 170 years and that Bristol has played a part in its development. The anaesthetic properties of gases and vapours were discovered largely by serendipity and their commercial development and manufacture these days is very different from when they were introduced. Techniques of administration and monitoring of the depth of anaesthesia have evolved out of all recognition, so that patient safety and comfort are now paramount. While new drugs and techniques mean that the administration of anaesthesia is now significantly different from 20 years ago, the basic underlying principles remain the same. New techniques make impossible surgery possible and allow patients to return home on the day of operation, pain free and comfortable. Almost anyone, however sick they are, can be anaesthetised appropriately. Whether we can improve still further is debateable though monitoring techniques of, for example, cerebral function are only in their infancy. How did we, how do we and how will we know that the patient is asleep in the future?

Dr Sir Peter Simpson MD FRCA FRCP FRCS (Hon) FCARCSI (Hon) trained in London and Oxford prior to being appointed Senior Lecturer in Anaesthetics, University of Bristol and Consultant Anaesthetist to Frenchay Hospital. His clinical interests included anaesthesia and intensive care for neuro- and thoracic surgery. He was Medical Director of Frenchay before and during the merger with Southmead, to form the North Bristol NHS Trust. He was President of the Royal College of Anaesthetists and the first elected President of the European Society of Anaesthesiology. With his interest in medical ethics he chaired the UK Donation Ethics Committee and the Academy of Medical Royal Colleges working party responsible for producing “A Code of Practice for the Diagnosis and Confirmation of Death”. Knighted in the Queen’s Birthday Honours in 2006 for services to the NHS, he is now retired and enjoys time with his children and grandchildren, walking, playing golf, gardening his allotment and is currently President of Clifton Down Probus Club.

(4) Friday, 31 March 2023

Speaker: Professor Belinda Wilkes: “Views of the Universe through the sharp X-ray eyes of NASA’s Chandra X-ray Observatory”.

NASA's Chandra X-ray Observatory was launched on 23 July 1999 by the Space Shuttle Columbia. Now in its 22nd year of operations, Chandra continues to be an indispensable tool for expanding the frontiers of knowledge throughout astrophysics. Chandra's uniquely high (subarcsec) spatial, and spectral resolution

have facilitated the deepest and sharpest images of the X-ray sky and the highest quality X-ray spectra to date. Its broad capabilities allow continuous expansion of its science based on new discoveries and facilities , e.g. the Event Horizon Telescope, NASA/ESA's JWST ("Webb", launched 25 Dec 2021). I will review Chandra's launch and unique capabilities, and take us on a tour of some of the most spectacular discoveries across the whole range of celestial sources. These include the birth and death of stars, super-massive black holes, active galaxies, clusters of galaxies, dark matter, merging neutron stars, and more.

Chandra website: chandra.si.edu

Professor Belinda Wilkes is a Royal Society Wolfson Visiting Fellow at the School of Physics, University of Bristol. She recently retired as a Senior Astrophysicist at the Center for Astrophysics | Harvard & Smithsonian (CfA) (Cambridge, MA, USA), where she served as Director of the Chandra X-ray Center, which operates NASA's Chandra X-ray Observatory, from 2014-2020.

Professor Wilkes received her BSc (Hons) in Astronomy and Physics from St. Andrews University, Scotland in 1978 and her PhD in Astronomy from Jesus College, University of Cambridge, England in 1982. She spent two years as a NATO postdoctoral fellow at the University of Arizona's Steward Observatory, and moved to CfA's High Energy Astrophysics Division in 1984. She is a Fellow of the Royal Astronomical Society, American Astronomical Society, American Physical Society, American Association for the Advancement of Science, and Cambridge Philosophical Society, and a member of the International Astronomical Union, and the European Astronomical Society. She has received numerous awards, including the NASA Outstanding Public Leadership Medal, 5 NASA Group Achievement Awards, and a NASA MSFC Director's Commendation, and many Smithsonian Institution Exceptional Accomplishment Awards. In 2018 she was elected an Honorary Fellow of Jesus College, Cambridge University.

Professor Wilkes' research involves X-ray and multi-wavelength studies of active galaxies: super-massive black holes in galaxy nuclei. She is author and co-author of over 490 science publications, including 170 refereed papers (>12,200 citations, H-index 60), two books, several book chapters, and multiple articles and interviews in the public media.