Pushing the X-ray Free Electron Laser to its limits

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Dr. Brian W.J. McNeil (CI, University of Strathclyde, Glasgow)

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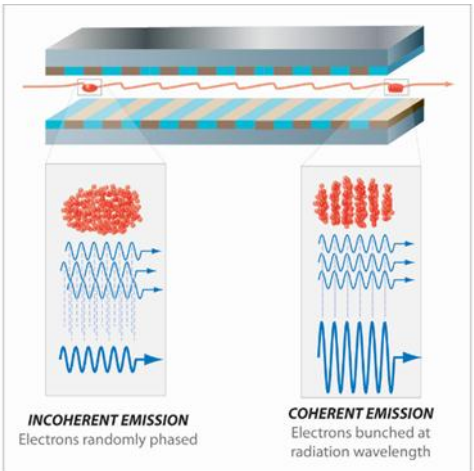

Abstract: New methods have been developed in the UK that can greatly improve the output from large scale X-ray Free Electron Laser facilities. Such facilities have a photon brightness that is 10^9-10^{10} times brighter than synchrotron X-ray sources like Diamond at RAL. Our research into shorter pulses, improved coherence, higher photon energies and multi-colour operation, allow for a greatly enhanced investigation of the natural world and have impact in a wide range of science and its applications from materials science to biological processes. These methods may be tested and developed at the UKRI-STFC CLARA FEL test-facility at Daresbury Laboratory and would inform the design of a future national UK X-ray FEL facility. Some aspects are already being investigated, tested and implemented at existing international X-ray user facilities. In this seminar, I will give an overview of basic X-ray FEL operation and then describe the methods that we have developed to greatly enhance their output.

Brian McNeil is a member of the Computational Nonlinear and Quantum Optics group in the Department of Physics at the University of Strathclyde, Glasgow. His main research interest is focused on collective effects in electron-light interactions as a source of coherent radiation and, in particular, X-ray Free Electron Lasers. He has worked on several UK FEL facility designs and is currently leader for the FEL Output Simulation and Optimisation work package for a UK-XFEL design. Recent FEL publication highlights, some of which are currently being implemented at international FEL facilities, include methods to reduce X-ray pulses into the few-cycle, sub-attosecond limit; increase their brightness by two orders of magnitude; wide bandwidth/multi-colour operation; the first 3D broad bandwidth FEL simulation code Puffin; a joint programme with Stanford investigating orbital angular momentum output; and a quantum description of the FEL for possible coherent gamma-ray output. He has contributed as a coordinator to the recent STFC 2017 Accelerator Strategic Review. His group have developed an FEL simulation software package which is now being adopted and used by designers at EU XFEL, LCLS-II and others.