

The Science motivating the UK's Fourth Generation Light Source Project

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4GLS is a suite of accelerator-based light sources planned to provide state-of-the-art radiation in the low energy photon regime [1]. Superconducting energy recovery linac (ERL) technology will be utilised in combination with a variety of free electron lasers (IR to XUV), undulators and bending magnets. The 4GLS undulators will generate spontaneous high flux, high brightness radiation, of variable polarisation from 3 - 800 eV, optimised in the lower harmonics up to about 200 eV. Viable radiation at energies up to several keV may be provided from multipole wiggler magnet radiation. The ERL technology of 4GLS will allow shorter bunches and higher peak photon fluxes than possible from storage ring sources. It will also give users the added bonuses of pulse structure flexibility and effectively an infinite beam lifetime. VUV and XUV FELs will be used to generate short pulses (in the fs regime) of extreme ultraviolet light that is broadly tuneable and more than a million times more intense than the equivalent spontaneous undulator radiation. A strong feature of the scientific programme planned for 4GLS is dynamics experiments in a wide range of fields. Pump probe experiments will allow the study of chemical reactions and short-lived intermediates on the timescale of bond breaking and bond making, even for very dilute species. The high intensity of the FEL radiation will allow very high resolution in imaging applications. The lower intensity, high repetition rate ERL SR radiation provides ideal sources for ultra-high energy resolution spectroscopy from solids. The science motivating the 4GLS project is discussed.

Funding for the first three years of the 4GLS project was announced by the UK Government in April 2003. This includes the research and development work necessary to produce a design study report, with the construction of an ERL-prototype. Additional funds have recently been awarded that will enable a study of the production of ultra-short pulsed X-rays from the ERL-prototype via Thomson scattering. It is anticipated that the full 4GLS facility will be available to users in 2011.

[1] W R Flavell, E A Seddon, P Weightman, M A Chesters, M W Poole, F M Quinn, D T Clarke, J A Clarke and M J Tobin, *J Phys: Condens Matter*, 16, S2405-S2412, (2004); <http://www.4gls.ac.uk>.