4GLS

A Fourth Generation Light source Facility for the UK

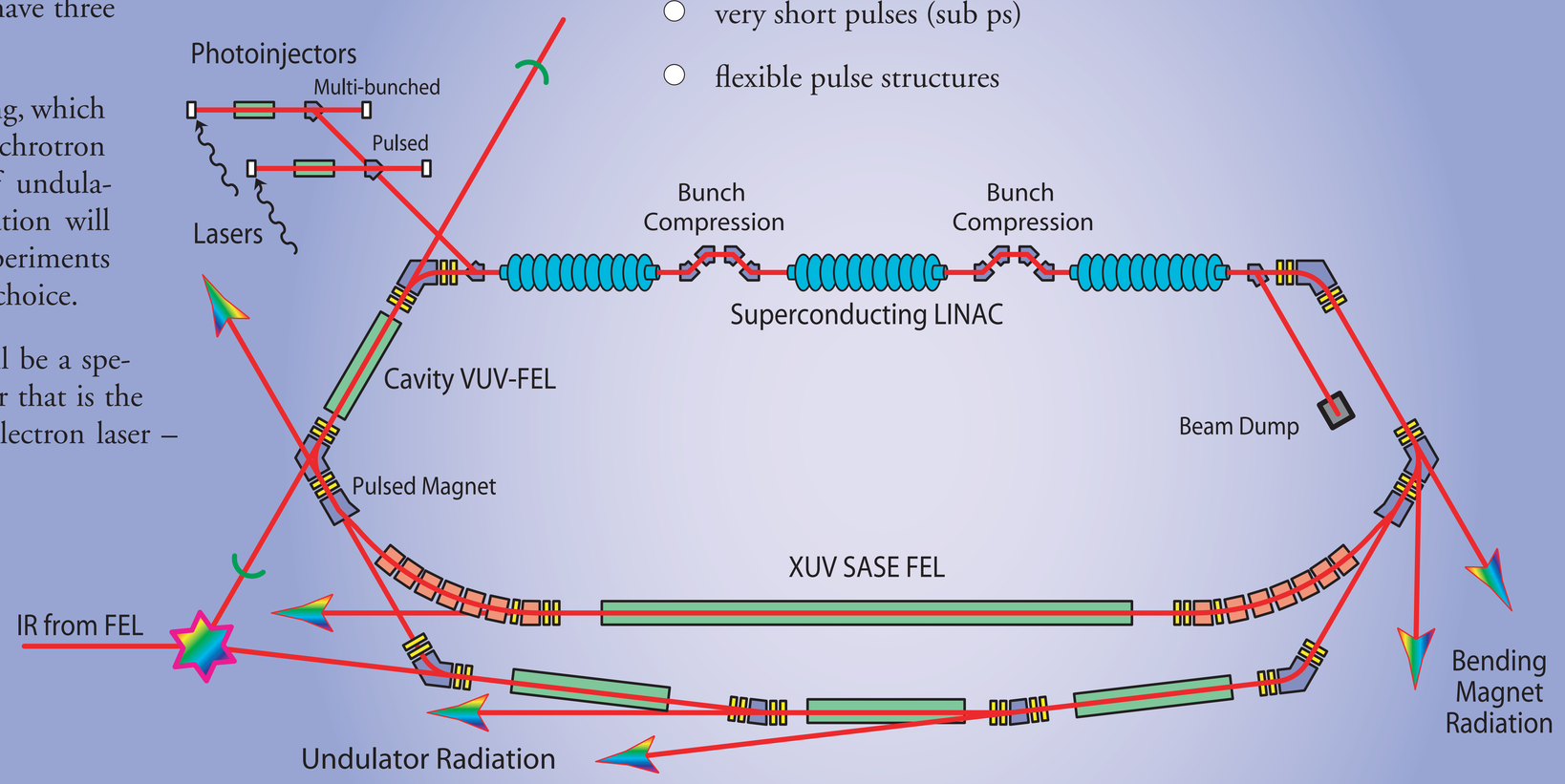
What is 4GLS?

4GLS is one of the major components of the Centre for Accelerator Science Imaging and Medicine – CASIM – which is to be based at Daresbury Laboratory in the U.K.

4GLS is essentially a suite of accelerator-based light sources designed to complement the ESRF and diamond by providing state-of-the-art radiation in the low energy photon regime – from the far-infrared to the extreme ultraviolet.

In the initial phase 4GLS will have three main components:

- At its heart is a low energy ring, which will provide optimised synchrotron radiation from a variety of undulators. Bending magnet radiation will also be available for those experiments for which it is the source of choice.
- Incorporated in the ring will be a special high precision undulator that is the core of a cavity VUV free electron laser – VUV-FEL.
- The third part of 4GLS is a stand alone infra-red free electron laser – the IR-FEL.



The 4GLS concept involves the use of an energy recovery linac (ERL) in a ring configuration. This is extremely flexible and will allow the easy incorporation of, for example, a single pass FEL (SASE FEL) that would allow the generation of coherent pulses of electron laser radiation up to 100eV.

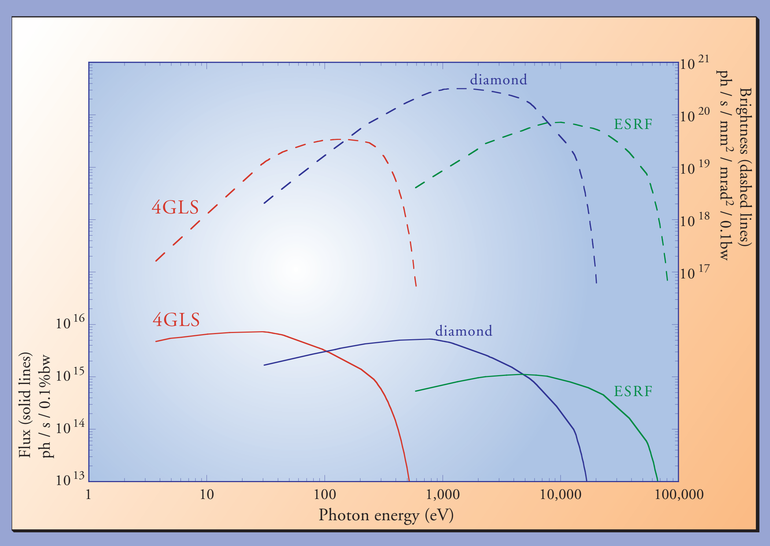
Other advantages of the 4GLS ERL ring are:

- effectively infinite electron beam lifetime
- very small emittance
- very short pulses (sub ps)
- flexible pulse structures

Undulators

The storage ring undulators will be optimised to generate high flux, high brightness radiation, of variable polarisation, in the photon energy range 4–50 eV. However, the undulators will also generate usable radiation (in the higher harmonics) up to several hundreds of eV.

The intensity and extremely broad tuneability of the vacuum-UV to soft X-ray radiation these undulators produce are two of their main attractions to synchrotron radiation users.



The undulators on low energy 4GLS complement the medium energy source, diamond, by reaching to lower photon energy and delivering an order of magnitude better brightness in the sub 100eV energy range. They will produce many orders of magnitude better brightness than the U100 undulator on beamline 5U.1 of the SRS.

Cavity VUV-FEL

The output from the VUV-FEL will be 5–6 orders of magnitude more intense than the standard undulator output and will therefore be of prime use in flux hungry experiments. For example, ultra-dilute experiments or where the detection technique is intrinsically inefficient. The impressive intensities possible in a cavity FEL are however achieved at the cost of operational range which is restricted to 3–10eV.

SASE-FEL

A SASE FEL in 4GLS would enable fast (sub ps) coherent pulses of light up to 100eV in energy. The calculated peak brightness of such a device is 10^{29} ph / (s mm^2 mrad^2 laser bandwidth).

IR-FEL

The IR-FEL will be based on a linac and will provide variable polarisation mid-IR and far-IR radiation. This will be pulsed with micropulses of between a few hundred fs and 20 ps (repetition rate of ~1GHz) grouped into macropulses of 5-10 microseconds duration.

The spontaneous radiation from the storage ring undulators and the stimulated emission from the FELs will enable very different experiments.

By grouping the components within a facility layout they can be used separately or in various combinations resulting in the creation of a world class facility that will enable experimentation at a level that will supersede anything existing or contemplated in the U.K. or Europe.

A component of CASIM

or more information visit the website at http://www.4gls.ac.uk
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