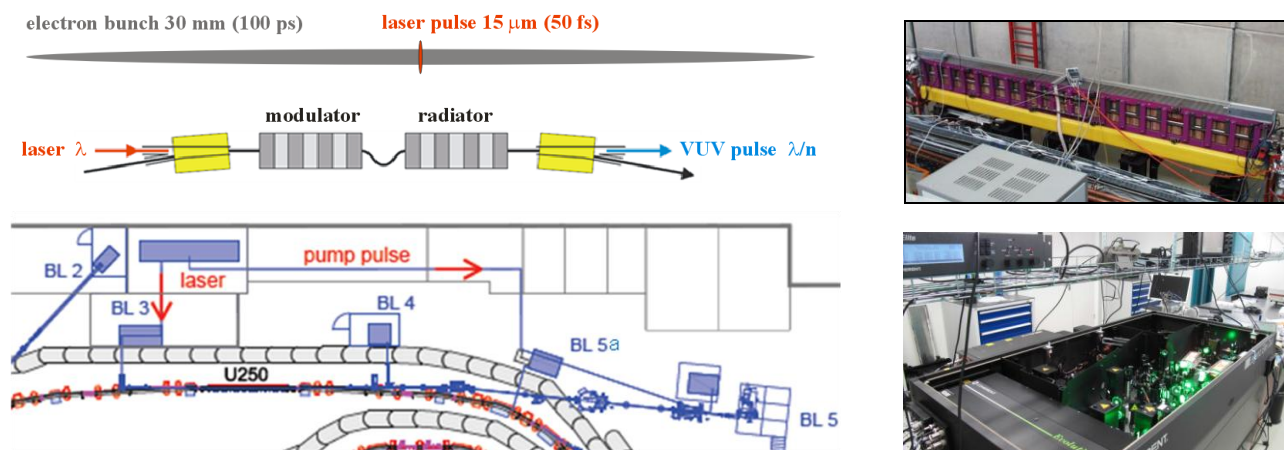


Accelerator Physics at DELTA (group of Prof. Khan)

DELTA is a synchrotron light source at the TU Dortmund comprising a 1.5-GeV electron storage ring. The following projects are currently pursued by the group of Prof. Shaukat Khan:

Coherent Harmonic Generation (CHG) and Terahertz Radiation

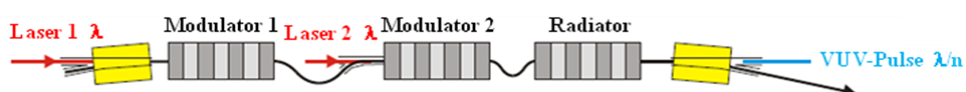
The electron bunches circulating in the DELTA storage ring are about 3 cm long, corresponding to a duration of 100 ps. Ultrashort laser pulses give rise to the emission of intense radiation in the vacuum ultraviolet regime from a 50 fs long “slice” within the bunches. These ultrashort light “flashes” may be used to illuminate fast atomic processes. DELTA is currently the only storage ring at which the so-called “coherent harmonic generation” method can be applied in routine operation.



In an undulator (a sequence of alternating dipole magnets), the so-called “modulator”, the energy of the electrons is modulated periodically by the laser field, causing an electron density modulation. This way, a sequence of micro-bunches with the periodicity of the laser wavelength is created within a 50-fs bunch slice. In a second undulator, the “radiator”, the density-modulated electrons emit ultrashort and intense pulses at harmonics of the laser wavelength. A few meter downstream along the storage ring, a gap in the temporal electron distribution is formed giving rise to the emission of intense and short pulses in the terahertz regime.

Echo-Enabled Harmonic Generation (EEHG)

In 2009, echo-enabled harmonic generation (EEHG) was proposed by G. Stupakov at SLAC/USA, a scheme leading to higher harmonics (shorter wavelengths) by using two modulators instead of one. EEHG is being tested at linear accelerators in the USA and in China. DELTA is presently the only storage ring, at which EEHG is planned. In addition to that, the group at DELTA participates in the investigation of “seeding” schemes at the free-electron laser FLASH at DESY in Hamburg.



Collective Phenomena

Collective phenomena arise when the dynamics of an electron in an accelerator not only depends on the surrounding fields, but also on the presence of other electrons. This is the case for beam instabilities as well as effects limiting the beam lifetime in a storage ring.