

Traveling-Wave Thomson-Scattering and optical FELs

Monday, 3 June 2013 18:00 (20 minutes)

We show that optical free electron lasers in the X-ray range can be realized using Traveling-Wave Thomson-scattering (TWTS). TWTS provides long interaction lengths in the centimeter to meter range with undulator periods in the micron range. These can be accomplished with existing petawatt class lasers as optical wigglers in a side scattering geometry by tilting the laser pulse front. TWTS circumvents both the nonlinear Thomson intensity threshold and the Rayleigh-length limit which in head-on Thomson-scattering prevents the SASE process to occur. Furthermore TWTS offers tuneability in the scattered wavelength via the incidence angle and flexibility in the optical undulator length.

In this talk we discuss the FEL dynamics of relativistic electrons in TWTS and quantify the influence of dispersion effects on the laser pulse properties and showing that they can be suppressed effectively. We present a self-consistent 1.5D FEL-theory which accounts for the oblique incident laser pulse and give scaling laws on the interaction geometry and FEL-amplification with respect to incidence angle and electron beam parameters. We finally present numbers on expected experimental performance for laser and electron beam parameters that will be available at HZDR.

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Session Classification: WG4 - Future accelerator concepts incl. gg, beam transport (applications)

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