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Building 222, room 013

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From the extreme ultraviolet to the mid-infrared with fiber frequency combs

Immediately after their introduction in 1999, fs-laser frequency combs revolutionized the field of optical frequency metrology. Nowadays, frequency combs are indispensable tools for comparing today's most accurate clocks and are key elements in many emerging novel applications in fundamental and applied science. A frequency comb is based on a train of fs-pulses leading to an equidistant structure of narrow longitudinal modes. Its elegance lies in the fact that the complete frequency comb containing thousands of individual modes is determined by only two radio frequencies: the repetition rate defining the separation between adjacent modes and the carrier-envelope-offset frequency determining the absolute position of the comb structure. The latter is related to the pulse-to-pulse phase slip of the electric carrier field underneath the pulse envelope. Stabilizing these two RF-frequencies via phase-locked loops fixes the overall comb structure and gives full control over the pulse train in the time and frequency domain.

Fiber laser based frequency combs allow ease-of-use, rugged, compact set-ups and reliable long-term operation. The introduction of Yb: fiber technology led to a dramatic improvement in fiber comb performance in various aspects, such as high bandwidth phase-locking, sub-Hz optical linewidths, GHz comb spacings and average powers approaching the 100 W-level. These improvements not only closed the gap to Ti:sapphire technology, but opened new perspectives especially for frequency conversion schemes. Yb: fiber lasers now serve as a basis for frequency combs at literally any wavelength between the XUV and the mid-IR spectral region. Beside a discussion of the performance of Yb: fiber frequency combs, this seminar will focus on frequency conversion schemes, such as cavity-enhanced high-harmonic generation for XUV and difference frequency generation for mid-IR frequency combs. Due to the robust performance of these systems, they constitute ideal tools for precision spectroscopy between 40 nm and 10 μm .

Host: Franz X. Kärtner, CFEL UX Seminar