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XUV Frequency Combs via Femtosecond Enhancement Cavities

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We report on recent developments in tabletop extreme ultraviolet (XUV) sources based on high harmonic generation (HHG) in femtosecond enhancement cavities (fsEC). The XUV frequency comb is produced via HHG at the full repetition rate of the mode-locked oscillator (typically > 50 MHz), inside a passive enhancement cavity with an enhancement of a few hundred. Several technical challenges have recently been resolved, which have led to an increase in the generated photon flux in the XUV (10^{14} photons/sec), and a substantial improvement in the operating time of these sources. XUV sources based on fsECs are now able to perform direct frequency comb spectroscopy with MHz precision in atomic systems at wavelengths down to 60 nm. Ongoing research is aimed at determining the ultimate frequency stability of these new XUV frequency comb sources. XUV fsEC sources are also promising for some applications that are typically performed with XUV light at advanced light sources. These applications include electronic structure of quantum material systems, such as angle-resolved photoemission spectroscopy (ARPES), size metrology of nano-aerosol particles, and potentially velocity map imaging for studies of chemical physical problems. In this talk, we present a brief introduction to XUV frequency comb sources and the technical challenges that have been overcome to achieve the current performance levels. We will also discuss our progress on ARPES experiments with a fsEC XUV source and our efforts toward increasing the energy resolution of the produced harmonics. Finally, we describe ongoing efforts to further increase the maximum photon energy and photon flux generated, and subsequently delivered to an experiment by fsEC XUV sources.