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XUV frequency combs based on intracavity high harmonic generation

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Intracavity high harmonic generation utilizing femtosecond enhancement cavities (fsEC's) has been established as an efficient route for the generation of femtosecond frequency combs in the vacuum-ultraviolet (VUV) to the extreme-ultraviolet (XUV) spectral regions. Such VUV/XUV frequency combs enable precision spectroscopy of atomic and potentially molecular spectra in an otherwise difficult to access spectral region. An improved understanding of the intracavity ionization dynamics that currently limit pulse enhancement has enabled a new generation of XUV frequency comb sources with significantly higher powers, at the >10 microwatt level per harmonic order extending below 50nm. We have developed a novel time-resolved pump-probe measurement technique to monitor and characterize the intracavity ionization dynamics by utilizing the sensitive response of the fsEC resonance itself to plasma induced nonlinear phase shifts. In recent work, we have developed a high power dual-frequency comb system based on Yb-fiber laser technology. The two phase-coherent frequency combs can be up-converted to the VUV/XUV using the fsEC. Dual-comb spectroscopy has already been established as a powerful spectroscopic method in the infrared. It's extension to the VUV/XUV spectral region will enable robust and high precision direct frequency comb spectroscopy of complex atomic and molecular structure in this spectral region.