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New generation attosecond light sources[1]

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Millijoule level, few-cycle, carrier-envelope phase (CEP) stable Ti:Sapphire lasers centered at 800 nm have been the workhorse for the first generation attosecond light sources in the last 16 years. The spectral range of isolated attosecond pulses with sufficient photon flux for time-resolved pump-probe experiments has been limited to extreme ultraviolet (10 to 150 eV). The shortest pulses achieved are 67 as. It was demonstrated in 2001 that the cutoff photon energy of the high harmonic spectrum could be extended by increasing the center wavelength of the driving lasers. In recent years, mJ level, two-cycle, carrier-envelope phase stabilized lasers at 1.6 to 2.1 micron have been developed by implementing Optical Parametric Chirped Pulse Amplification (OPCPA) techniques. Recently, when long wavelength driving was combined with polarization gating, isolated soft x-rays in the water window (280-530 eV) were generated in our laboratory. The number of x-ray photons in the 120–400 eV range is comparable to that generated with Ti:Sapphire lasers in the 50 to 150 eV range. The ultrabroadband isolated x-ray pulses with 53 as duration were characterized by attosecond streaking measurements. The new generation attosecond soft X-ray sources open the door for studying electron dynamics with element specificity through core to valence transitions.

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