Carrier Envelope Phase Stabilized Sub-5fs Laser for Attosecond Pulse Generation.

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The generation of single attosecond laser pulses has opened up the new era for research the electron dynamics in attosecond time scale, in general, intense few-cycle optical pulses was used to drive the gas jet to generate high-order harmonic wave for attosecond laser, it has been well known that field reproducibility in each laser shot is predominant for isolated attosecond pulses generation. In this presentation, we report the carrier-envelope phase controlled 5fs laser at repetition rate of 1kHz through hollow-core capillary for spectral broadening, white-light continuum was first generated by injecting the 25 fs amplified pulses with pulse energy of 800 μJ into a hollow fiber filled with rare gas at high pressure. By dispersion compensation with a set of chirped mirrors, the shortest pulses are measured to be 4.6fs which is less than two optical cycles, and the pulse energy is up to 400 μJ. Following, we carry out carrier-envelope phase stabilization of the few-cycle optical pulses. The carrier-envelope offset frequency of the seed oscillator is fixed at a quarter of the repetition frequency of the oscillator, so every fourth pulse has the same carrier-envelope phase. The phase drift during the amplification stage is monitored by spectral interferometry between an octave spanning white-light continuum generated in a sapphire plate and its second harmonic. Carrier-envelope phase slip is extracted from the interference through Fourier transform and is stabilized by a phase lock loop. The jitter is found to be less than 53 mrad (root-mean-square, RMS). This laser system with carrier-envelope phase stabilized few-cycle pulses enables us to produce coherent soft X-ray emission and open the way to generate single attosecond pulses.