Recent progresses in building a femtosecond extreme-ultraviolet (XUV) comb at WIPM

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Optical frequency comb in the XUV region has attracted a great deal of attention since its first demonstration in 2005 [1-2]. On one hand, it provides laser in the XUV region with narrow band width for the first time. This advance pave the way for measuring important transitions in the XUV region. For example, the 1S-2S transition of He, He^+, and Li^+ at 120 nm, 61 nm, and 40.7 nm, respectively. On the other hand, ultrafast processes on the attosecond/femtosecond time scale are evolved during high order harmonics generation when the laser intensity inside an enhancement cavity reaches ~10^{13} W/cm^2. Thus, ultrafast science can be revealed with high harmonic spectrum, coherence measurements, etc., with the benefit of high repetition rate. In a word, XUV comb leads to another joint frontier of precision spectroscopy and ultrafast science [2].

In this work, we report on the recent progress in building an XUV comb at Wuhan Institute of Physics and Mathematics (WIPM). High harmonic generation in an enhancement cavity is adopted to realize the short wavelength in the XUV region. The driving IR comb has a repetition rate of 100 MHz, a pulse duration of ~100 fs and a maximum output power of 100 W. After mode matching, this IR comb is coupled into a 3-meter long travel wave enhancement cavity. The enhancement cavity is designed to have a buildup of ~200 and a beam diameter of ~20 μm at the focus. With the PDH method, we were able to lock the length of the enhancement cavity to the repetition rate of the driving laser. Up to now, we have achieved an average power of 3.6 kW in the enhancement cavity and intra-cavity high harmonic generation is on the way.

[1] R. J. Jones *et al*., Phys.Rev.Lett., **94** (2005) 193201.
[2] C. Gohle *et al*., Nature, **436** (2005) 234.