

Investigation of Novel Carrier-Envelope-Phase Stable Linearly and Circularly Polarized Attosecond Pulse Sources

¹Z. Tibai, ²Gy. Tóth, ¹Zs. Nagy-Csiha, ²J. A. Fülöp, ²Zs. Márton, ^{1,2}G. Almási, ^{1,2} J. Hebling

¹*Institute of Physics, University of Pécs, 7624 Pécs, Hungary*

²*MTA-PTE High Field Terahertz Research Group, 7624 Pécs, Hungary*

*hebling@fizika.ttk.pte.hu

Recently, we proposed a robust method for producing waveform-controlled attosecond pulses in the EUV spectral range [1]. In our scheme the relativistic electron beam, provided e.g. by a linac, is sent through a modulator undulator where a TW-power laser beam is superimposed on it in order to generate nanobunches. The nanobunched electron beam then passes through a single- or few-period radiator undulator. The simulated waveform of the generated attosecond pulse closely resembles the form of the magnetic field.

In the proposed scheme the electron bunch consist of many nanobunches separated by the modulation laser wavelength, hence a pulse sequence is generated. However, in case of a 1.5-cycle (or shorter) modulator pulse, isolated attosecond pulse generation is possible.

The dependence of the stability of the generated attosecond pulse energy on the modulator laser stability was investigated by varying the laser intensity in the range of $\pm 10\%$. The standard deviation of the attosecond pulse energy varied in the range of $\pm 20\%$.

For electron bunches with 1000 MeV energy, stable single-cycle 40-attosecond linearly polarized pulses with as high as 14 nJ energy can be generated. These attosecond pulse energies are high enough to use these pulses for example as pump pulses in pump-probe measurements. Pulses with the predicted exceptional parameters can enable time- and CEP-resolved measurements with sub-100-as resolution. Naturally, with this method attosecond pulses with linear or circular polarization can be generated in the VUV spectral range (10-200 nm). Depending on the generated wavelength, the energy of the pulses in case of linear polarization is 14÷280 nJ and in case of circular polarization is 27÷285 nJ.

References

[1] Z. Tibai et al., Phys. Rev. Lett. **113**, 104801 (2014).