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Nonlinear compression of long-wavelength-infrared free electron laser pulses in thick Germanium plate

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For enabling attosecond X-ray pulse generation via high harmonic generation in rare gases driven by free electron laser (FEL)[1], nonlinear compression of long-wavelength-infrared (LWIR) pulses from an oscillator-type FEL in a thick Germanium plate has been demonstrated[2]. LWIR-FEL pulses with the peak wavelength in 8.5 micro-m and the pulse duration of 146 fs in full width at half maximum (FWHM) generated from KU-FEL (Kyoto University FEL) were compressed down to 106 fs by inserting an antireflection-coated Ge plate with the thickness of 30 mm. At the same time, the spectral width of LWIR-FEL pulses was broadened in the Ge plate. The simultaneous occurrence of the spectral broadening and the pulse compression is called nonlinear compression. The achieved pulse duration (106 fs) was 86% of the expected pulse duration of the FEL pulse (123 fs) after the Ge plate with the assumption that no spectral broadening occurred in the Ge plate. By the nonlinear compression of the LWIR-FEL pulses, the peak power was increased to 1.4 times of the incident LWIR-FEL pulses. This work was supported by MEXT Q-LEAP (JPMXS0118070271).

Footnotes

[1] R. Hajima, 2019 IEEE Photonics Conference (2019) doi:10.1109/IPCon.2019.8908339.
[2] H. Zen et al., Opt. Express 31, pp.40928-40936 (2023).

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Primary authors: ZEN, Heishun (Kyoto University); OHGAKI, Hideaki (Kyoto University); HAJIMA, Ryoichi (National Institutes for Quantum Science and Technology)

Presenter: ZEN, Heishun (Kyoto University)

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