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Tunable All-Optical Quasimonochromatic Thomson X-Ray Source in the Nonlinear Regime

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We present an all-laser-driven, energy-tunable, and quasimonochromatic x-ray source based on Thomson scattering from laser-wakefield-accelerated electrons. One part of the 40TW laser beam was used to drive a few-fs bunch of quasimonoenergetic electrons, produced using the shock-front injection scheme, while the remainder was backscattered off the bunch at a weakly relativistic intensity(a0=0.9). When the electron energy was tuned from 17–50 MeV, narrow x-ray spectra peaking at 5–42 keV were recorded with high resolution. These measurements reveal nonlinear features including spectral red-shift and onset of higher harmonics, which we present along with the corresponding calculations. We show large statistics demonstrating the stability and practicality of this source concept as well as suitability of the shock-front injection for the collision experiments. Finally we discuss the further prospects of this technology and the application-oriented future developments.

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