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Broad range single-shot electron energy spectrometer for THz driven booster accelerator using an in-vacuum tunable dipole magnet

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In the first prototype of the AXSIS light source, electrons sourced from a 55 keV DC gun are first compressed by a THz-powered buncher, then accelerated in a THz-driven "booster"to 430 keV kinetic energy and finally accelerated to 20 MeV in a THz-powered LINAC. Guided by simulations, a booster prototype was developed employing three layer segmented structures and requires 400-μJ single-cycle THz pulses with center frequency 300 GHz. Since THz-driven accelerators provide electrons over a broad energy range and/or with large momentum spread, a broadband single-shot electron spectrometer with large momentum acceptance and sufficient resolution has been developed for the THz-driven booster accelerator. This energy spectrometer uses a compact in-vacuum tunable dipole magnet, and the special design of the pole shoes is such that electron bunches within 20-430 keV are focused onto a 4cm long image plane where the scintillator is directly mounted to increase energy resolution. We present the design of the magnetic spectrometer, along with the calibrations carried out and expected performance such that the energy distribution of accelerated electrons can be measured.

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Footnotes

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