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Single-shot spectrometer with pointing angle correction for laser-driven electron beams featuring moderate pointing instability and transverse inhomogeneity

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Electron beams produced via Laser Wakefield Acceleration are notorious for their non-negligible pointing instability. This makes the retrieval of the energy spectrum via magnetic spectrometers particularly prone to energy miscalculations. As such, various spectrometer configurations have already been suggested to correct spectra for the pointing angle. Here, we experimentally demonstrate an improved scheme of a previously published concept employing two scintillating screens and a magnetic dipole in between. The first screen, providing the pointing angle, is placed at the exit of the vacuum chamber, and the second one behind the dipole. A collimator is coupled with the dipole, allowing a portion of the beam to be detected, resulting in an improved energy resolution. For the electrons entering the collimator, a numerical procedure is laid out to retrieve the exact pointing angle of each transverse beamlet on the dipole, which in turn allows a weighted sum procedure to be carried out to retrieve the final spectrum. We note that the first scintillator screen used in our setup causes significant electron scattering, effectively acting as an energy dependent attenuator. For this reason, we performed Monte Carlo simulations to measure this effect and back projected the observed spectrum to retrieve correct one.

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