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Generation of Quasi-Monoenergetic Electron Pulses at POLARIS

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We present experimental results on laser-driven electron acceleration achieved with the POLARIS laser in Jena (Germany) delivering pulses of 2.4 J in 160-170 fs. Here, we observed the generation of quasi-monoenergetic electron pulses by self-modulated laser wakefield acceleration in a gas cell. We found a clear correlation between the accelerating length and the peak electron energies. Through a parabolic fit of the accelerating length vs. the peak electron energy the accelerating E-field, injection position and dephasing legth could be estimated. Furthermore, the aceleration process could be devided into three steps. First, the laser intensity increases most likely in the region of out-streaming gas in front of the gas cell. When the laser intensity is sufficiently high wavebreaking occurs. Afterwards, the electron energy grows with the acceleration length in the linearly decreasing E-field amplitude. Once the electron pulse approaches the decelerating electric field (E > 0) of the plasma wave, the electron energy reaches its maximum achievable value.

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