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High electron charge accelerated in the SM-LWFA regime with the LMJ-PETAL laser

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Energetic electron sources generated by ultra-intense lasers can serve for various applications in many research fields. In this presentation, we will report on recent numerical and experimental results on electron acceleration with the ~ 0.3 kJ, 0.7 ps, 5×10^18 W/cm^2 LMJ-PETAL laser system. Due to the long pulse duration, the interaction of the PETAL beam with a gas jet accelerates electrons in the self-modulated laser wakefield acceleration (SM-LWFA) regime. Energies up to 150 MeV have been experimentally obtained, with an exponentially decreasing spectrum and a large divergence (~100 mrad), as expected in the SM-LWFA regime. However, due to the high laser energy, a very high charge, close to the µC range, is measured, which open encouraging perspectives for new applications. Multidimensional particle-in-cell (PIC) simulations, run with the codes CALDER and Osiris, are able to reproduce these findings. The laser self-focusing and self-modulation is observed in the simulation, as well as electron acceleration in the wakefield. The simulation shows that direct laser acceleration (DLA) can also occur, but it doesn't seem to be the dominant mechanism in this setup.

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