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Simulation studies towards HEP applications of plasma accelerators

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Plasma accelerators sustain large field gradients and could enable future x-ray sources and compact linear colliders. The development of performant open-source simulation methods allows for the investigation of open challenges towards these applications, including the acceleration of beams with high quality to high energies. This presentation will discuss recent studies on these topics.

First, we will discuss the possibility to use a laser-plasma accelerator as an injector for the next-generation storage ring Petra IV at DESY. This requires several nanocoulombs of 6-GeV electrons per second with a sub-percent energy acceptance, and an energy compression beamline was developed to fulfil these requirements. A Conceptual Design Report will be published soon.

Second, to achieve the required high luminosity, linear colliders rely on flat beams to avoid potentially deleterious beamstrahlung effects. We show that flat beams in plasma accelerators can be subject to beam quality degradation due to emittance mixing caused by transverse coupling in the wakefields. Depending on the mechanism causing the resonance, the use of laser drivers, flat particle beam drivers, or hollow plasma channels can avoid the resonance and mitigate the emittance deterioration.

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