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Acceleration of spin-polarized ions from laser-plasma interaction

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High-energy, spin-polarized particles are of great interest for a variety of applications like deep-inelastic scattering for the investigation of the proton nuclear structure or fusion, where the use of polarized reactants can increase the fusion cross-section. Acceleration of such particles via laser-plasma interaction can prove to be difficult, as the target needs to be pre-polarized. This rules out solid-state based mechanisms. Further, strong laser fields can induce depolarization. Thus, novel acceleration schemes are required to ensure a significant degree of polarization.
In this talk, we will present an overview of the state-of-the-art for the acceleration of spin-polarized protons. Two acceleration mechanisms, Magnetic Vortex Acceleration [1] and Collisionless Shock Acceleration [2], will be investigated by means of particle-in-cell simulations. The two schemes prove to be feasible options for producing highly polarized ion beams even for parameters of near-future laser facilities.

[1] L. Reichwein et al., *Phys. Rev. Accel. Beams* **25**, 081001 (2022)
[2] L. Reichwein et al., *Plasma Phys. Control. Fusion* **66**, 055002 (2024)

Working group

WG2 : Laser-driven plasma acceleration of ions

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