LPAW 2023
Laser and Plasma Accelerators Workshop 2023
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Laser-induced acceleration of Helions from a high-density polarized gas-jet target

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Polarized Helion beams are of great importance for basic research. Experimental efforts to generate them by plasma acceleration may also pave the way towards applications like polarized fusion, where one tries to enhance the yield of fusion reactors by aligning the nuclear spins.

Our approach for plasma acceleration of polarized particle beams is to use a pre-polarized gas-jet target, assuming that nuclear polarization is not affected by the rapidly changing magnetic fields inherently present in laser-generated plasmas or during the double-ionization process which occurs within a picosecond or less. The laser pulse produces an intense electron current along the plasma channel which generates a vortex magnetic field around it. According to particle-in-cell simulations the polarization of Helions is mostly conserved in such a scenario.

A first polarization measurement has been carried out in summer 2021 at the PHELIX laser facility, employing a complete experimental setup with a high-density polarized ^{3}He gas-jet target [1] and a ^{3}He polarimeter optimized for the short ion bunches from plasma acceleration [2]. The target comprises holding magnetic fields to conserve the nuclear polarization of hyperpolarized ^{3}He gas, a compressor to deliver the required ^{3}He backing pressure of about 30 bar, as well as a non-magnetic valve and a titanium nozzle for jet formation. The polarimeter is based on secondary nuclear reaction in a deuterated foil which converts the ^{3}He polarization information into a measurable angular asymmetry. The results of these beam polarization measurements are presented in this talk.

Acknowledgments

We gratefully acknowledge the strong support by the staff of PHELIX laser during the beam time at GSI Darmstadt.

References

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