Contribution ID: **82** Type: **Contributed Oral**

Highly spin-polarized multi-GeV sub-femtosecond electron beams generated from single-species plasma photocathodes

Monday, 7 November 2022 15:30 (18 minutes)

High-gradient and high-efficiency acceleration in plasma-based accelerators has been demonstrated, showing its potential as the building block for a future collider operating at the energy frontier of particle physics. However, generating and accelerating the required spin-polarized beams in such a collider using plasma-based accelerators has been a long-standing challenge. Here we show that the passage of a highly relativistic, high-current electron beam through a single-species (ytterbium) vapor excites a nonlinear plasma wake by primarily ionizing the two outer 6s electrons [1, 2]. Further photoionization of the resultant Yb2+ ions by a circularly polarized laser injects the 4f14 electrons into this wake generating a highly spin-polarized beam. Combining time-dependent Schrodinger equation simulations with particle-in-cell simulations, we show that a sub-femtosecond, high-current (4 kA) electron beam with up to 56% net spin polarization can be generated and accelerated to 15 GeV in just 41 cm. This relatively simple scheme solves the perplexing problem of producing spin-polarized relativistic electrons in plasma-based accelerators.

References:
[1] Z. Nie, et. al., Phys. Rev. Lett. 126, 054801 (2021).
[2] Z. Nie, et. al., Phys. Rev. Res. 4, 033015 (2022).

Acknowledgments

DOE Award No. DESC0010064

Primary authors: NIE, Zan (UCLA); LI, Fei (UCLA); MORALES, Felipe (Max Born Institute); PATCHKOVSKII, Serguei (Max Born Institute); SMIRNOVA, Olga (Max Born Institute); AN, Weiming (Beijing Normal University); ZHANG, Chaojie (UCLA); WU, Yipeng (UCLA); NAMBU, Noa (UCLA); MATTEO, Daniel (UCLA); MARSH, Kenneth (UCLA); TSUNG, Frank (UCLA); MORI, Warren (UCLA); JOSHI, Chan (UCLA)

Presenter: NIE, Zan (UCLA)

Session Classification: WGs 4+5 Joint Session

Track Classification: Working Group Parallel Sessions: WG4 Oral: Beam-Driven Acceleration