Contribution ID: **228** Type: **Poster**

Development and characterization of meter scale gas jets suitable for ≥10 GeV electron acceleration in HOFI plasma channels

Tuesday, 23 July 2024 18:00 (1h 30m)

Generating multi-GeV electron beams with Laser-Plasma Accelerators is accessible with PW class lasers [1] but requires an accelerator many Raleigh lengths long. A plasma waveguide is often used in LWFA experiments to combat drive laser beam diffraction and increase the electron energy gain. Hydrodynamic Optically Field Ionized (HOFI) plasma channels are particularly suitable for LWFA experiments since they support density gradients that guide the drive laser and are free-standing [2-4]. These channels rely on a gas jet to form an initial gas stream, which is then ionized and shaped by a channel forming pulse to create effective plasma waveguides. Recently, a 9 GeV electron beam at BELLA PW was created using a HOFI channel generated with a 30 cm long gas jet [5]. The characterization of the gas density profile of both short (~5cm) and long (~30cm) gas jets was essential to this result. This poster will discuss the impacts of various parameters on gas jet performance, highlighting key improvements that enhance the repetition rate and optimize the gas density profiles for HOFI channel LWFA experiments.

[1] A. Gonsalves Phys. Rev. Lett. 122, 084801 (2019)
[2] A. Picksley, Phys. Rev. Accel. Beams 23, 081303 (2020)
[3] L. Feder et al., Phys. Rev. Research 2, 043173 (2020)
[4] B. Miao et al., Phys. Rev. X 12, 031038 (2022)
[5] A. Picksley, in preparation

This work was supported by the U.S. Department of Energy (DOE), Office of Science, Offices of High Energy Physics, and DARPA under Contract No. DE-AC02-05CH11231.

Working group

WG1 : Laser-driven plasma wakefield acceleration

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Session Classification: Poster [Atrium]