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Demonstration of proton bunch self-modulation in a discharge plasma source (student)

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

The AWAKE experiment at CERN explores accelerating electrons using proton-driven plasma wakefields. A crucial challenge is creating long (10-100 meters), highly uniform plasmas with electron densities in the range of 1 to 10 x 10^{14} cm^{-3}. This presentation describes the first experimental test of a 10-meter discharge plasma source (DPS) in the AWAKE experiment.
The DPS uses a double-pulse direct-current discharge in noble gases (He, Ar, Xe) and its shot-to-shot reproducibility was investigated across a wide range of pressures (8-45 Pa) and currents (300-600 A). The plasma density was characterized using longitudinal interferometry over hundreds of shots.
The DPS's applicability and readiness were assessed in the AWAKE experiment by propagating the 400 GeV proton bunch through the plasma and observing the development of the self-modulation instability (SMI). The measured SMI frequency corroborated the plasma density values obtained through interferometry. These results demonstrate the DPS's potential for use in AWAKE and pave the way for future studies on achieving the critical 0.25% longitudinal density uniformity needed for electron acceleration.

Working group

WG3 : Beam-driven plasma acceleration

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