

First test of a 10 m discharge plasma source with a proton beam in the AWAKE experiment

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Scalable plasma sources R&D for the AWAKE experiment at CERN focus on two technologies as alternatives to the existing laser-ionised rubidium vapor plasma source: the Helicon Plasma Source (HPS) and the Discharge Plasma Source (DPS). As a proof of principle of such alternative sources, a 10 m long DPS has been designed, built and tested with a 400 GeV proton beam over a 3 weeks run in the AWAKE tunnel. The main objective of this unique test was to measure the self-modulation instability (SMI) of the proton beam. Thanks to the flexibility of the DPS setup (adjustable plasma length, density and gas type), several other features have been explored: observation of current filamentation instability at high plasma densities, investigation of ion motion as a function of the mass of the discharge gas (He, Ar and Xe), time and space resolved imaging of the plasma light to observe the wakefield dynamics.

This presentation will describe the DPS setup, its implementation, commissioning and operation in the AWAKE tunnel and will give an overview of its performance during the run. Finally the next milestones of the plasma sources R&D program will be shown.

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