



Contribution ID: 53

Type: poster

A high-density plasma source for AWAKE

Monday, 14 September 2015 20:00 (30 minutes)

A prototype high density helicon discharge is under development, which aims to demonstrate its feasibility as a plasma cell for advanced accelerator schemes as AWAKE. The discharge mechanism relies on the non-resonant absorption of low-frequency plasma waves (with a frequency typically on the order of 10MHz), which are excited by antennas outside the vacuum chamber. The external wave excitation scheme allows for a distributed plasma generation without any obstacles within the beam path and thus, makes the plasma cell scalable to almost arbitrary lengths. In this paper results from the PROMETHEUS-A experiment are presented. The cell consists of a 1m long, 5cm diameter quartz vacuum tube embedded into a set of 4 water-cooled magnetic field coils, generating a homogenous magnetic field $B < 130\text{mT}$. Helicon waves are excited by 4 individual helical antennas wrapped around the tube, which are energized with a total peak rf power of 40kW at an rf frequency of 13.56 MHz. Unparalleled peak plasma densities compatible with AWAKE's nominal plasma density are achieved.

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Session Classification: Poster Session 1 (WG1-WG2-WG3-WG4) and Wine

Track Classification: WG4 - Application of compact and high-gradient accelerators/Advanced beam manipulation and control