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Study of Accelerating Channels for Copernicus Beams

TAE Technologies pursues an alternative approach to magnetically confined fusion with the advanced, beam-driven field-reversed configuration (FRC) [1]. Heating, current drive, and partial fueling from neutral beam injection are essential to sustainment of the FRC plasma [2]. The next generation device, Copernicus, aims to achieve the D-T reactor relevant plasma performance with a hydrogen plasma. This will require an increase in neutral beam power input from the NBI system on the present device. The beams will be based on positive ion sources with three-electrode ion optic systems (IOS) and operate at 60-80 keV. We will present an ongoing study of the ion optic system for these hydrogen neutral beams, highlighting simulations and experiments on several different extraction electrode geometries and accelerating voltages. First, with the use of IBSimu, simulations of the ion-optics, plasma extraction, and space charge dominated ion beam transport with a single aperture in the electrode are studied. These simulations are then experimentally verified on a test stand, complete with an ion source with a small number of apertures in the ion optic system, and a suite of diagnostics. These diagnostics examine the beam divergence, perveance, and the gas composition of the vacuum. The measured divergence is then compared to the simulated divergence from IBSimu.
[1] H. Gota et al., Nucl. Fusion 59, 112009 (2019)
[2] J. Titus et al., Review of Scientific Instruments 89, 10I123 (2018)

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