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Ion Source Characterization using Integrated Data Analysis

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TAE's current experimental device, C-2W, utilizes edge-biasing, neutral beam injection, and plasma control to create and sustain a field-reversed configuration (FRC) plasma imbedded in a mirror plasma. The eight positive ion-source neutral beams, four static energy (15 keV) and four tunable energy (15-40 keV), also stabilize, fuel, and heat the FRC. Injected beam power correlates non-linearly to plasma performance, and therefore, it is crucial to understand beam propagation from the ion source into the plasma. Ion sources are generally characterized by divergence, focal length, and perveance. Knowing the most probable values of these parameters assists in designing efficient beam lines and understanding the power injected into the confinement vessel. On short-pulsed, low-energy neutral beam systems, these quantities are diagnosed throughout the beam line by wire calorimeters and shinethrough detectors. A model has been developed to comprehensively utilize the measurements and associated uncertainties with an integrated data analysis technique, based on Bayesian probability theory, to estimate the beam divergences and focal length at optimum perveance.

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