

CALCULATED BEAM PROFILES FOR THE DIII-D OFF-AXIS AND LONG PULSE NEUTRAL BEAM UPGRADE

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An analysis of the propagation of a neutral beam along the axis of injection was performed. An analytic solution was found using a population of Gaussian point sources uniformly distributed on a surface in Cartesian coordinates normal to the direction of beam travel. The solution was extended to examine the effects of multiple source surfaces, incorporating the canting of the source surfaces that enables focusing the neutral beam. The model was then used to analyze the current DIII-D neutral beam ion sources (with an initial beam size of 12 cm x 48 cm) to obtain the beam profiles and intensities at locations downstream of the source plane. The calculated intensity profiles along the axis of beam travel lead to estimates of the scrape-off beam power loss to the beam line internal components. These results were compared to previous water-flow-calorimetry measurements of beam power depositions on the beam line internal components to validate the model. The model was then employed to calculate the beam profiles and beam intensities for the smaller aperture ion sources (12 cm x 43 cm) planned for use on the off-axis beam line. The calculated data are used in the mechanical and thermal analyses for the design of the beam line internal components for the future off-axis beam line, with operation at 80 kV for pulse lengths up to 10 seconds. We present a description of the analysis methodology, the calculated and measured power deposition results, and a discussion of the implications and limitations of the analysis.

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