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14.8 Fast computation of 3D distribution of neutral density from neutral beam injection in toroidal plasmas

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A diagnostic neutral beam or heating neutral beam provides a population of high energy neutrals for active beam plasma diagnostics in fusion plasmas such as charge exchange recombination spectroscopy. Accurate modeling of the local density of beam neutrals is needed for interpretation of diagnostic data. A simple and fast model has been developed to calculate 3D density distribution of beam neutrals from neutral beam injection. The model takes into account beam parameters, i.e. beam ion source and aperture geometry, beam divergence and focus. The simple model saves significant computing time by calculating beam attenuation in 1D flux coordinates and mapping back onto 3D Cartesian grids that are built around the neutral beam centerline. The main assumption of the model is that plasma rotation does not significantly affect beam attenuation, which is generally true for neutral beam injections in fusion plasmas. The calculated 3D beam neutral density profile and magnitude are in excellent agreement with more sophisticated codes such as NUBEAM and FIDASIM, but the computing time is more than one order faster. Further optimizations and parallelization of the code should further decrease the calculation time, which may make the model suitable for real-time applications.

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