Contribution ID: **23** Type: **Poster**

Validation of the Imaging Neutral Particle Analyzer via Pitch Angle Scattering of Injected Beam Ions*

Wednesday, 4 September 2019 14:15 (15 minutes)

The pitch angle scattering rates of deuterium beam ions in low density, nearly MHD-quiescent plasmas are measured using an imaging neutral particle analyzer (INPA) in DIII-D. The INPA is a scintillator-based diagnostic that provides energy and radially resolved measurements of confined fast ions [1]. The main purpose of this study is to validate this novel diagnostic system during classical fast ion behavior. The pitch angle scattering rate is manipulated by varying the electron temperature using electron cyclotron heating (ECH) and by changing Zeff through neon gas puffing. To compare with the experimental data, a series of synthetic INPA images are simulated through the following steps: (1) the time evolution of the fast ion distribution is obtained by the NUBEAM module of the TRANSP code; (2) the neutral flux towards the INPA is estimated by the FIDASIM code; (3) the INPASIM code simulates the neutral-foil interaction and traces the ions to the strike position of the INPA phosphor [2]. Preliminary results show agreement within 25% error in signals produced by the probing beam. In addition, a sensitivity study on the INPA phase space was performed by artificially varying the pitch angle scattering rate (through Zeff) to observed the change in signal detected. It was found that in general, the signal levels decreased as the pitch angle scattering rates increased and vice versa.
Signals produced by sources other than the fast ion interaction with beam neutrals are also investigated. The charge exchange process between confined fast ions and edge cold neutrals is modelled and compared to the measurement. The result can partially account for the image deficit. A separate set of signals that are unaccounted for in the simulation are distinctly observed and are thought to be asymmetric signals produced by newly born fast ions on the first few orbits for three reasons: (1) the energy of the particle corresponding to the signal matched the energy of a single neutral beam; (2) the temporal appearance of the signal is strongly correlated with the timing of the specific beam; (3) the signal does not appear to change in magnitude with different pitch angle scattering rates. To investigate this further, simulated fast ion orbits are followed in reverse and evaluated on whether they passed through the beam footprint and have the correct velocity space requirements. Preliminary statistical results show that this is a reasonable possibility.

*Work supported by US DOE under DE-FC02-04ER54698

[1] X.D. Du et al Nucl. Fusion 58 082006 (2018)
[2] X.D. Du et al Nucl. Fusion (2019) in preparation

Country or International Organization

United States

Primary author: LIN, Daniel (University of California, Irvine)

Co-authors: DU, Xiaodi (General Atomics); HEIDBRINK, William W. (University of California Irvine); VAN ZEELAND, Michael (General Atomics)

Presenter: LIN, Daniel (University of California, Irvine)

Session Classification: Poster

Track Classification: Diagnostics for Energetic Particles