DPP19-2019-000149

Abstract for an Invited Paper
for the DPP19 Meeting of
the American Physical Society

High-Frequency Energetic-Ion Modes in the DIII-D Tokamak[1]

KATHREEN E THOME, General Atomics

Experiments on DIII-D identify key phase-space dependencies of energetic-ion-driven waves in plasmas. Observation and understanding of the interaction of these modes with energetic ions could provide a measurement of the fast-ion population in a fusion reactor. Two such modes, Ion Cyclotron Emission (ICE) at the ion cyclotron frequency f_{ci} and its harmonics and the Doppler-shifted-cyclotron-resonant Compressional Alfvén Eigenmodes (CAEs) at $f \sim 0.6\ f_{ci}$, are driven unstable by the anisotropic fast neutral beam ions on the DIII-D tokamak. New measurements and analysis show that both centrally and edge resonant ICE are excited on DIII-D with central ICE detected in plasmas with low edge pressure and edge ICE primarily in H-mode plasmas. The spectral behavior of central ICE changes with the neutral beam injection angle with the highest emission levels destabilized by the counter-current beams. As the fast-ion loss boundary moves radially deeper into the plasma, creating sharp gradients in velocity space, the central ICE from the co-current beams increases but that from the counter-current beams does not. Modeling is underway to understand these differences in ICE behavior, underlying instabilities, and the relationship between ICE and phase space gradients. An example of the potential of central ICE as a reactor diagnostic is the observed modulation of its signal with sawteeth. Similar to ICE, new observations of CAEs show that CAE spectral behavior depends on beam injection angle. They are excited on DIII-D when the beam ions are near-Alfvénic and are found to exhibit a threshold behavior with beam density. This work pushes forward the understanding of the relationship between the fast-ion distribution and these two high-frequency energetic-ion modes, a step towards a passive burning plasma fast-ion diagnostic.

[1]Work supported by the US DOE under Award Number DE-FC02-04ER54698.