N=0 Compressional Instability Driven by Neutral Beam Ions in DIII-D

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Studies on DIII-D reveal that the direction of neutral beam injection is a critical factor in the excitation of Alfvén eigenmodes. For deuterium neutral beams injected in the direction of the plasma current (co beam injection) the usual reverse shear Alfven eigenmodes – or Cascade modes - are observed. However, for neutral beams injected counter to the direction of the plasma current, a new axisymmetric mode is observed in reverse magnetic shear plasmas. These modes have a much higher ratio of local density to temperature fluctuations than RSAEs, possess a clear n=0 magnetic signature at the plasma edge and have a frequency well below the Geodesic Acoustic Mode (GAM) frequency. The absence of temperature fluctuations suggests that there is no significant displacement perpendicular to the magnetic field lines, such as with compressional modes. For compressional low frequency Alfven waves, the absence of electron temperature fluctuations can be accounted for by the rapid electron thermal conduction along the magnetic field lines on the time scale of the mode period. Beam Emission Spectroscopy (BES) measurements of the electron density reveals a low poloidal wave number ($k_\theta \approx 0.06$ cm^{-1}) consistent with an m=2 density component measured on magnetic probes. The BES measurement of a long poloidal wavelength rules out the possibility that the poloidal resolution of the ECE diagnostic can account for the lack of observed electron temperature fluctuations. A surprising result is that the neutron emission and confined fast ion population (using the recently commissioned Fast Ion Dα diagnostic on DIII-D) is a factor of 4-5 lower than for a comparable plasma with co-beam injection and without the n=0 mode. Analysis is continuing in order to quantify the role of the mode in affecting the fast ion confinement in these plasmas.

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