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Interpretation of Core Localized Alfven Eigenmodes in DIII-D and JET Reversed Magnetic Shear Plasmas[1]

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Newly developed core localized fluctuation diagnostics have revealed a surprisingly large multiplicity of high-n Alfven eigenmodes in reversed shear regimes in DIII-D [1], where toroidal mode numbers from n=8 to 40 are observed, and in JET [2] where mode numbers up to n=20 are observed. These modes, found near the zero shear surface, are reversed shear Alfven eigenmodes with interesting "twists". (a) Their range of frequency is affected by plasma compressibility [3]. (b) Plasma rotation, especially in DIII-D, leads to large Doppler shifts (up to 1.5 MHz is measured whereas Alfven Cascades oscillate locally at ∼100 kHz), leading to observed frequency down-chirps that are actually generated by frequency up-chirps in the rotating plasma frame at the zero shear surface. (c) The high-n property of the mode leads to the need for inclusion of ion diamagnetic drift terms for the frequency identification. At large n the instability drive comes from both injected neutral beams and thermal ions, particularly in high performance discharges. Addition of these new features was required in the NOVA end NOVA-K codes in order to account for the observed frequencies and instability drive. These observations, together with the recognition of the importance of the background plasma in driving Alfvenic instability, may lead to a significant re-evaluation of the role of internally generated Alfven waves in thermal transport and fast ion confinement in burning plasma experiments with reversed shear.

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[2] S.E. Sharapov, et al., Phys. Rev. Lett. **93**, 165001 (2005).
[3] M.S. Chu, et al., Phys. Fluids B **4**, 3713 (1992); H.L. Berk, et al., Proc. 20th IAEA Fusion Energy Conf. 2004, IAEA-TH/5-Ra.

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