Measurement Of Alfvén Modes And Their Impact On Fusion Plasmas

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Abstract. In fusion plasmas and tokamaks in particular there exists a large variety of Alfvénic instabilities. These instabilities may impact the success of ITER and other burning plasma experiments since they can resonate with fast ions and be driven unstable causing enhanced transport of the energetic particles necessary for heating. Present tokamak experiments with Alfvénic instabilities show flattening of neutral beam fast ion profiles and loss of injected beam ions during periods of strong Alfvénic activity. This type of redistribution or loss of fusion born alpha particles in a burning plasma experiment could reduce the performance of these devices and potentially damage the first wall.

Recent advances in core fluctuation diagnostics are enabling great progress in understanding fast ion driven Alfvén Eigenmode (AE) instabilities and the resulting transport of the fast ions. Unprecedented measurements are being made by observation of their perturbed density, electron temperature, and magnetic field as well as indirectly through their effects on fusion performance and fast ion confinement. Detailed measurements and modeling of these instabilities on existing devices show that for several classes of AEs, the mode structure is well predicted by ideal MHD codes such as NOVA. By extending this finding to ITER and other future fusion experiments one can simulate the expected diagnostic performance needed to adequately resolve Alfvénic activity. Ensuring appropriate measurements of AEs in burning plasma experiments will allow the validation of predictions of alpha driven instabilities in plasmas dominated by self heating from fusion produced alpha particles and provide the control capability for optimizing performance, reducing the alpha particle losses, and minimizing potential first wall damage. In addition, such measurements may provide key information on the bulk plasma through so-called Alfvén spectroscopy.

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