Alfvén Eigenmode Structure During Off-Axis Neutral Beam Injection

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Abstract. The spatial structure of Alfvén eigenmodes on the DIII-D tokamak is compared for contrasting fast ion deposition profiles resulting from on and off-axis neutral beam injection (NBI). In both cases, poloidal mode rotation and eigenmode twist are correlated with the direction of normal ion diamagnetic flow and readily inverted with a reversal of toroidal magnetic field, B_T. While off-axis neutral beam injection results in weakly driven reversed shear induced Alfvén eigenmodes (RSAEs) due to reduced fast ion pressure gradient, $\nabla\beta_{fast}$, in the region of the mode, these marginally unstable modes exhibit a 2D phase structure that is indistinguishable from that observed during on-axis injection. This result is consistent with recent explorations using the non-perturbative codes Gyro and TAEFL that show a weak dependence of eigenmode structure on drive when fast ion density is uniformly reduced by a scalar multiplier. These codes also obtain unstable, counter-propagating modes with inverted 2D phase structure when B_T is held constant and diamagnetic flow direction is reversed by making $\nabla\beta_{fast}$ sufficiently positive for an isotropic population of fast ions. While measurements of the spatial profile of fast ion D-α light from the recently upgraded charge exchange recombination (CER) diagnostic on DIII-D suggest a strong modification of fast ion pressure toward this limit, no counter propagating modes have yet been observed in experiment.

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