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Recent Measurement and Interpretation of Stable and Unstable Alfvén Eigenmodes (AEs) in the Presence of Fast Ions in Alcator C-Mod[1]

J. SEARS, LANL, R.R. PARKER, A. BADER, T. GOLFINOPOULOS, MIT PSFC, T.P. INTRATOR, LANL, G.J. KRAMER, PPPL — Stable AEs of various toroidal mode number are excited by a wide-toroidal-spectrum antenna and detected by a fully resolved toroidal array of probes. Stable GAEs with $n = 0$ and damping rates around $\gamma/\omega_0 = 1\%$, and stable TAEs with $n = 1$ and damping rates around $\gamma/\omega_0 = 1.5\%$ are observed. In the same discharges, TAEs of higher toroidal mode numbers including $n = -4$ and $n = 6$ are more centrally localized and do not couple to the diagnostic until driven unstable by fast ions. Such non-linear behavior via mode-particle interaction is intrinsic to the complete picture of AE instability. A composite spectrum ($|n| = 0 - 10$) is rendered from the collection of stable and unstable mode observations, and from NOVA-K calculations; peak instability is reached around $|n| = 5$, in rough agreement with the theoretical scaling of fast ion drive. Within this broad spectrum, however, stability between adjacent modes is not smooth - it varies strongly with mode number and plasma shape. These local islands of stability could be exploited through subtle changes in equilibrium parameters to stabilize AEs in burning plasmas.

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