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Energetic particle effects on n=1 MHD instabilities in a DIII-D hybrid discharge[1] D.P. BRENNAN, M.R. HALFMOON, University of Tulsa, C.C. KIM, University of Washington, R.J. LA HAYE, General Atomics — The δf kinetic-MHD model in the 3-D extended MHD code NIMROD is used to perform a simulation study of energetic particle effects on the $n = 1$ mode in a DIII-D hybrid discharge. The hybrid has low $q_{min} >\sim 1$ at high confinement, and is a candidate operational scenario for burning plasma experiments. However hybrid discharges are limited to moderate β_N by the $m/n = 2/1$ instability. Using realistic DIII-D equilibria, the stability of the $n = 1$ mode is computed over a (q_{min},β_N) space. Unstable modes are driven by energetic particles far into the MHD stable region in this space. The drive is associated with the fishbone mode or BAE mode, depending on q_{min}. The stability boundary is found near the experimental (q_{min},β_N), where the unstable mode has a $m/n = 1/1$ component localized near the axis. Experimentally, a $m/n = 1/1$ structure is observed in agreement with the computed mode in key physical respects. At higher q_{min} and β_N a mode with a broad $m/n = 2/1$ structure is unstable. This suggests that the $m/n = 2/1$ mode is triggered by energetic particles in these discharges, as β_N is increased. A group of several similar discharges shows strong agreement with this computational explanation of onset.

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