Study of the AE/MHD stability of LHD, TJ-II, DIII-D and ITER plasma

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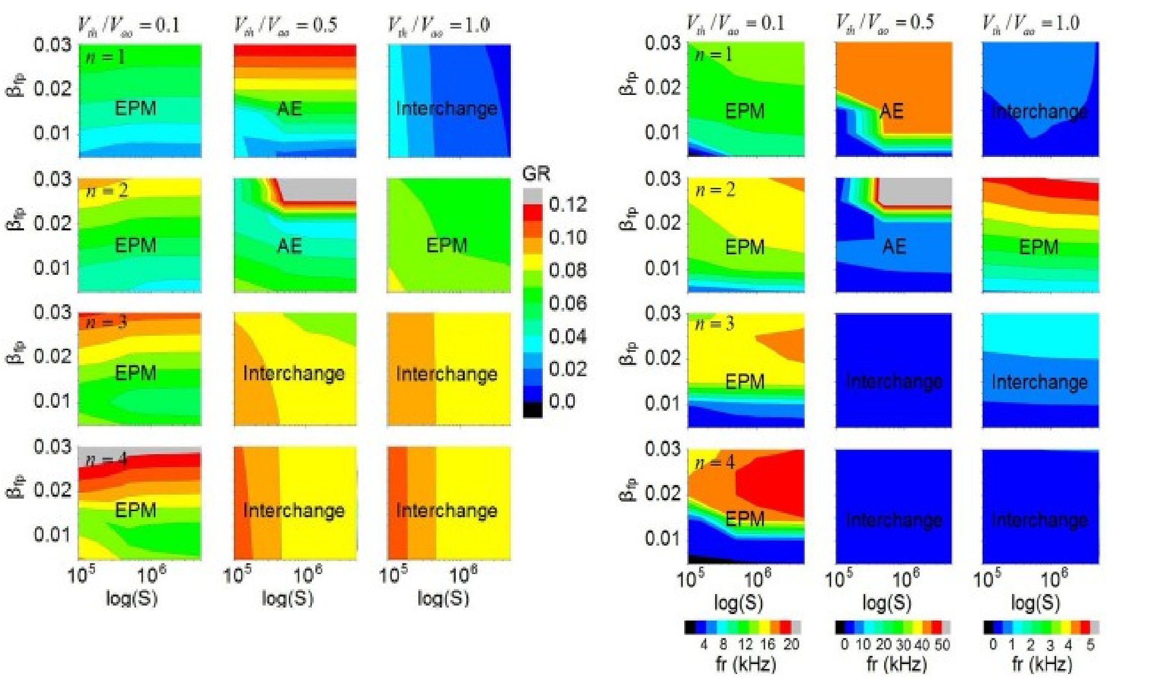
ABSTRACT

The aim of present study was to perform a theoretical analysis of the magnetohydrodynamic (MHD) stability and energetic particles effects on a LHD, TJ-II, DIII-D and ITER plasma. We use the reduced MHD equations to describe the linear evolution of the poloidal flux and the toroidal component of the vorticity in a full 3D system, coupled with equations of density and parallel velocity moments for the energetic particles species, including the effect of the acoustic modes, multiple EP species, helical couplings, helically trapped particles and Finite Larmor Radius damping effects. We add the Landau damping and resonant destabilization effects using a closure relation. We simulated the Toroidal Alfven Eigenmodes (TAE) and trapped energetic ion driven modes (EIC) in LHD, Helical Alfven Eigenmodes (HAE) in TJ-II, Reverse shear Alfven Eigenmodes (RSAE) in DIII-D and alpha particles driven AE in ITER. The analysis identified optimization trends of the AE stability regarding the magnetic field topology, thermal plasma parameters and neutran beam injector (NBI) operational regime.



Instability growth rate and frequency of the toroidal modes $n = 1$ to 4 for different values of EP β, EP thermalized velocity and plasma resistivities in LHD discharge with low magnetic field and thermal plasma density