Using rotating current ribbons to model MHD: the EHO

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From the earliest studies of MHD modes [1] it was assumed that field aligned current distributions might be responsible for the magnetic fluctuations observed, but now analysis is typically carried out in terms of mode numbers n (toroidal) and m (poloidal) of the measured magnetic field fluctuations, taking into account toroidicity [2,3] and plasma shape [4] as corrections on an effective poloidal angle.

Here we present a model of the MHD instability based on Mirnov's initial assumption, now taking into account the plasma shape. We assume there is ribbon of current parallel to the magnetic field at a rational surface in the plasma. We reconstruct the plasma equilibrium with kinetic constraints, trace candidate rational field lines with the TRIP3D code [5], and compute the field from a unit current along a field line spinning past each of the Mirnov probes, matching the frequency of the observed modes and their n number. The comparison of the amplitude and shape of the synthetic signals with measured dB/dt informs us of the accuracy of the reconstructed equilibrium, the width of the ribbon, and the applicability of this model to the mode observed. Mode frequency is matched against measurements of the main ion rotation profile, to obtain mode location and compare with the q profile. This procedure can be used to model solitary modes, such as the Outer Mode in JET [6], and possibly some EHOs in DIII-D [7]. The preliminary results obtained so far are promising when compared to [8].

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