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Studies of magnetic islands in the TJ-II Heliac and the related transport

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In the first part we study the magnetic equilibrium of TJ-II using the VMEC code together SIESTA MHD code. The pressure profiles determine island geometry. For each island width we obtain the associated MHD energy in order to find a correlation between them and identify an island width that has better stability properties.
A dynamical analysis of magnetic islands is aimed at explaining the phenomenology in TJ-II showing a correlation between MHD activity and transport barriers. The nonlinear island growth is studied in presence of a plasma flow associated width the transport barrier. In previous works it has been found that the presence of a sheared flow reduces the growth rate of the island and is thus stabilizing. As mentioned before,
the presence of flows near the island separatrix produces a polarization current which
alters the dynamical properties related to diamagnetic effects. Based on these results we propose a model in which the polarization current, due to the oscillatory part of the parallel current,
stabilizes an initial island. This coincides with the time after the MHD bursts are observed. As
the current grows the associated sheared flow builds up a transport barrier. When the island size gets very small the effect of the transport barrier becomes more effective. Then the temperature around
the island increases, which reduces collisional effects, and the boundary layer that shields the island from external flows gets reduced producing the island to get locked, i.e. the polarization current is ineffective in keeping the island stable and starts growing through magnetic reconnection. At this time there is particle acceleration and the MHD activity starts manifesting. The cause for the modification of the island state is that the magnetic torque acts on the island as the collisionality decreases.
At some point the island size becomes large enough to drive a polarization current, since large ripples outside the separatrix produce larger oscillations of the parallel current.
This whole process is modeled using the Astra transport code in which we include a turbulence model based on the resistive ballooning mode. Three impurity species of Carbon are also included in order to obtain the emitted radiation that is measured in the experiments by bolometers. In this way we can have a relatively good correlation with the experimental sequences.

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