Single Helicity and Quasi−Single Helicity States in Reversed Field Pinches

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Abstract

Previous studies have shown that both single helicity[1] (SH) and quasi−single helicity[2] (QSH) states can emerge from 3−D RFP dynamics. However, both states have previously been observed to exist only at very low Hartmann number *H* and thus have been of limited relevance to present−day and future experimental devices. There is hysteresis between the QSH states and the multiple helicity state (MH) as *H* is changed. This hysteresis is deepened, in particular QSH states can exist for larger *H*, if there is an applied radial magnetic field on the wall (a field error). We have found that QSH states can also be achieved at high *H* if another form of external helical perturbation, of an electrostatic nature, is applied to the dominant helical mode. These perturbations are applied in a manner such that the radial magnetic field vanishes at the boundary so no flux surfaces intersect the wall.

Using this technique, QSH RFP states at higher *H* have been achieved when a toroidal loop voltage is applied. The observed QSH sidebands are ~ 4 toroidal mode numbers away from the dominant mode. The dominant mode appears to flattens the current profile local to the dominant resonance, which stabilizes the adjacent modes.

When the toroidal loop voltage is removed, preliminary studies indicate that it is possible for the plasma to go into a QSH state of quite narrow spectrum. These studies suggest that the applied helical electrostatic field can drive both net toroidal current and poloidal current, and a large region of good flux surfaces can exist, but toroidal field reversal is lost. Further studies of these states will be shown.

1. J. M. Finn, R. A. Nebel, C. G. Bathke, *Phys. Fluids B* **4**, 1262 (1992).

2. S. Cappello, D. F. Escande, *Physical Review Letters* **85**, 3838 (2000).

Poster presentation requested. Please schedule presentation on tuesday or wednesday.