Single helicity and quasi-single helicity states in RFPs

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We present a systematic study of single helicity (SH) states and quasi-single helicity (QSH) states in RFPs. We begin with cylindrical paramagnetic pinch equilibria with uniform resistivity, characterized by a single dimensionless parameter proportional to the toroidal electric field, or the RFP toroidal current parameter $\Theta$. For sufficiently high $\Theta$, there are several unstable $m = 1$ ideal MHD instabilities, typically one of which is nonresonant, with $1/n$ just above $q(r = 0)$. We evolve these modes nonlinearly to saturation for low Hartmann number $H$. We then obtain the $m = k = 0$ quasilinear profiles, which typically have toroidal field reversal, and study their stability. For typical cases, these profiles may remain unstable to tearing modes, but only for sufficiently high $H$. For lower $H$ these states are stable. We show results indicating the proximity of these thresholds to the thresholds between SH and QSH behavior.

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