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Singular Currents Near Magnetic Islands in MHD Equilibria: Effects of Pressure Variation Within Flux Surfaces and of Symmetry[1] ALLAN REIMAN, Princeton Plasma Phys Lab — We present an analytic calculation of the MHD equilibrium current near a magnetic island that includes the effect of the pressure variation on the flux surfaces in that region. The current has logarithmic singularities at the X-lines of magnetic islands in non-stellarator-symmetric equilibria. The singular components vanish in stellarator-symmetric MHD equilibria. (Equilibria invariant under combined reflection in the poloidal and toroidal angles. Tokamaks with balanced double-null divertors are stellarator symmetric, but single-null tokamaks are not.) These equilibrium solutions are to be contrasted with equilibria having $\mathbf{B} \cdot \nabla p = 0$, where the singular components of the pressure-driven currents vanish regardless of the symmetry. They are also to be contrasted with 3D MHD equilibrium solutions that have simply nested flux surfaces, where the pressure-driven current goes like $1/x$ near rational surfaces, where x is the distance from the rational surface. (Except in the case of quasi-symmetric flux surfaces.) We work with a closed subset of the MHD equilibrium equations that involves only perpendicular force balance, and is decoupled from parallel force balance. It is not correct to use the parallel component of the conventional MHD force balance equation, $\mathbf{B} \cdot \nabla p = 0$, near magnetic islands.

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