Minimizing the magnetohydrodynamic potential energy for the current hole region in tokamaks

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Abstract. The current hole region in the tokamak has been observed to arise naturally during the development of internal transport barriers. The magnetohydrodynamic (MHD) potential energy in the current hole region is shown to be determined completely in terms of the displacements at the edge of the current hole. For modes with finite toroidal mode number $n \neq 0$, the minimized potential energy is the same as if the current hole region were a vacuum region. For modes with toroidal mode number $n = 0$, the displacement is a superposition of three types of independent displacements: a vertical displacement or displacements that compress only the plasma or the toroidal field uniformly. Thus for ideal MHD perturbations of plasma with a current hole, the plasma behaves as if it were bordered by an extra "internal vacuum region". The relevance of the present work to computer simulations of plasma with a current hole region is also discussed.

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