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**Minimum energy states in the Hall MHD relaxation theory**[1] IVAN KHALZOV, DALTON SCHNACK, FATIMA EBRAHIMI, Center for Magnetic Self-Organization, University of Wisconsin, Madison — Many magnetized plasma systems exhibit the phenomenon of relaxation (or self-organization): they tend toward preferred configurations. According to Taylor's conjecture,[2] the relaxed state of such systems can be defined as a state with minimum energy subject to constraints imposed by slowly decaying invariants. In present study the relaxed states of a cylindrical plasma column are considered in the frame of incompressible Hall MHD. We perform a complete minimization of energy with constraints imposed by invariants inherent in the Hall MHD. Different classes of the relaxed states are analyzed including axisymmetric, single helicity and double helicity states. It is shown that the relaxed state and its energy are determined by only two parameters: magnetic helicity $K = \int \mathbf{A} \cdot \mathbf{B} \mathbf{d^3 r}$ and Hall parameter $\sigma = d_i/a$, where $d_i$ is ion skin depth and $a$ is a radius of plasma column. Our analytical results are compared with 3D numerical simulations of two-fluid plasma relaxation.

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[2]J.B.Taylor, Phys. Rev. Lett. **33**, 1139 (1974)

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