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Quasilinear MHD model to determine beta and energy confinement time in a hardcore Z-pinch magnetic configuration ALEXEI KOUZNETSOV, JEFFREY FREIDBERG, JAY KESNER, MIT PSFC — The energy confinement time of plasma is a critical figure of merit for any magnetic configuration. In addition to the magnetic configuration itself, energy confinement depends on experimentally controlled parameters such as the edge conditions and the shape of the heating profile. This paper deals with the hardcore Z-pinch magnetic configuration, which can be considered to be an approximation to a large aspect ratio levitated dipole. We assume classical transport in the MHD stable region and carry out quasilinear diffusion analysis in the unstable region. Using quasilinear approximation, we analytically showed that a violation of the MHD stability condition results in enhanced particle and energy transport, which brings pressure profile back to marginal stability and forces particle density to be linearly proportional to $\oint \frac{d\ell}{B}$. Self-consistent numerical calculation of the density and pressure profiles allowed us to determine energy confinement time as the experimental parameters are varied. The resulting power law for beta and energy confinement time is discussed.

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