Abstract Submitted
for the DPP20 Meeting of
The American Physical Society

Variational Principles for Quasisymmetric MHD Equilibria[1]
AMITAVA BHATTACHARJEE, EDUARDO RODRIGUEZ, Princeton University/PPPL — The variational principle of Kruskal and Kulsrud (M. D. Kruskal and R. M. Kulsrud, Phys. Fluids 1, 265, 1958) has long provided the basis for the computation of solutions of 3D ideal magnetostatic equilibria with isotropic pressure. Recently, there has been progress in formulating rigorous conditions of quasisymmetry without relying on assumptions regarding the nature of MHD equilibria. We explore the interplay between quasisymmetry and the variational construction of Kruskal and Kulsrud. In the special case of axisymmetry, the formulation is shown to lead directly to the well-known Grad-Shafranov equation. However, in the more general case of quasi-symmetry, the question of existence of the global extrema of the energy functional with isotropic pressure remains open. Stimulated by recent analytical results (see Rodriguez and Bhattacharjee, this meeting) on MHD equilibria with anisotropic pressure, which avoids the problem of overdetermination in near-axis expansions of quasi-symmetric equilibria with isotropic pressure, we extend the variational principle of Kruskal and Kulsrud to include anisotropic pressure. We argue that a path to the construction of global quasisymmetric MHD equilibria for stellarator optimization might have to include the effects of anisotropic pressure.

[1]This work is supported by the DOE and the Simons Foundation.

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Date submitted: 29 Jun 2020 Electronic form version 1.4