FLUID PLASMA STABILITY IN STELLARATORS WITH ANISOTROPIC ENERGETIC SPECIES

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Abstract

The energetic ion content in typical high-β LHD discharges accounts for about 1/3 of the total β [1]. Furthermore, because the densities are relatively low ($n_e < 3 \times 10^{19} m^{-3}$), there is a measurable anisotropy in the plasma pressure [2]. Local and global fluid MHD stability in anisotropic pressure plasmas can be investigated with the Kruskal-Oberman energy principle [3] (ignoring the kinetic energy integral) and with the rigid hot particle energy principle of Johnson et al. [4]. These energy principles have been adapted in the TERPSICHORE code. A heliotron configuration that models LHD with finite parallel anisotropy driven by neutral beams with a total $\beta \simeq 3.9\%$ (unstable according to ideal MHD) shows that the Kruskal-Oberman based theory predicts stability when $\beta_b/\beta \geq 1/3$, where β_b corresponds to the beam ion β value. The rigid hot particle model requires $\beta_b/\beta \geq 1/4$ to obtain stability. Large perpendicular anisotropy driven by ICRH may lead to more interesting results because the MHD equilibrium properties become more highly distorted.

References

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