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Analysis and Simulation of Plasma Wave Damping and Viscous Heating Due to the Generalized Ion Stress Tensor MICHAEL ADDAE-KAGYAH, ERIC HELD, Utah State University — Details of the analysis and simulation of two key effects of the generalized parallel ion stress tensor ($\Pi_{||}$), in magnetized plasmas is presented in this work. Kinetic-based derivation of the $\Pi_{||}$, employing a Chapman-Enskog-like (CEL) expansion of the particle distribution function [1], forms the theoretical basis of this study. The ultimate goal of this research is to incorporate adequate kinetic and non-collisional physics into the modeling of tenuous, high-temperature (fusion-grade) plasmas. Systematic application of hybrid fluid/kinetic models in the simulation of plasma systems gives accurate results. Sound wave propagation (parallel to the magnetic field), dissipation and the associated stress heating, are modeled as being generated by single scale-length flow perturbations. NIMROD simulation runs are , incorporating finite physical effects of the generalized $\Pi_{||}$, in slab geometry. These runs involve various scans of plasma parameters corresponding to various degrees of plasma collisionality. Results show that parallel viscosity, damping rate and viscous heating obtained with the generalized $\Pi_{||}$ agree with those based on Braginskii $\Pi_{||}$ (at high collisionality). Also, generalized $\Pi_{||}$ predicts more realistic values at low collisionality. Future research would focus on incorporating time-dependent effects, and also on using multiple scale-length flow perturbations.

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