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Drift-Wave Eigenmodes and Spectral Gaps in Tandem Mirrors
J. PRATT, H.L. BERK, W. HORTON, UT Austin, IFS — The GAMMA-10 tandem mirror system has achieved long energy confinement times ($70 - 90$ ms) with radial losses occurring faster than the electrostatically-plugged end-loss time (100 ms). This high confinement regime establishes a proof of principle that the combination of electrostatic and mirror confinement can successfully insulate electrons from thermal end losses. Scaling laws derived by Pratt and Horton [J. Pratt and W. Horton, Phys. Plasmas (13), 2006] provide a key prediction that drift wave motion in the tandem mirror geometry is qualitatively different from toroidal systems. With a discrete eigenmode solver, a shooting method, and by evaluating reflection coefficients, we calculate drift-wave frequencies in three model tandem mirror machines: the GAMMA-10, the kinetically stabilized tandem mirror (KSTM), and the LAPD machine where the magnetic field has been modulated to look like a tandem mirror. We examine the nature of the spectral gaps in these machines and their relation to instabilities. We validate the results of these calculations by comparing precisely with the Mathieu equation as well as with magnetic probe signals recorded in the LAPD as a function of axial position and of frequency of the antenna. We present 3D visualizations of the energetic ion orbits in each of these devices using a highly-parallel particle transport code. Work supported by DOE Grant No. DE-FG02-04ER54742.

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