Asymmetry-Induced Transport with Azimuthal Perturbations at the Trapping Separatrix

A.A. KABANTSEV, UCSD, YU.A. TSIDULKO, Budker Inst., C.F. DRISCOFF, UCSD — Our experiments show that weak multipolar perturbations added to a trapping separatrix have large effects on asymmetry-induced transport and plasma wave damping, as suggested by recent theoretical models. Here, the pure electron plasma columns have a controlled trapping separatrix created by an applied \( \theta \)-symmetric wall “squeeze” voltage, and a controlled overall asymmetry such as magnetic tilt. Breaking the \( \theta \)-symmetry of the separatrix by adding multipolar potential perturbations \( \phi_m \) causes large and easily characterized effects for a variety of asymmetry-induced dissipative processes. For example, the measured bulk expansion rate \( \nu_P \) is a function of the angle \( \Delta \theta \) between the magnetic tilt and the multipolar separatrix perturbation. This function is the sum of phase-constant (c) and phase-variable (\( \theta \)) parts, i.e., \( \nu_P = \nu_c + \nu_\theta \cos(2\Delta \theta) \). For dipole or quadrupole (\( m = 1, 2 \)) perturbations \( \nu_c \approx \nu_\theta \), so \( \nu_P \approx 2\nu_\theta \cos^2(\Delta \theta) \); and for higher (\( m = 3, 4, ... \)) perturbations one finds \( \nu_\theta \equiv 0 \), so the \( \nu_P \) enhancement is phase-independent. Moreover, the two parts scale differently with magnetic field \( B \), possibly explaining the puzzling \( B^{-1.4} \) scalings observed experimentally.

1Supported by NSF PHY-0354979.
2D.H.E. Dubin and Yu.A. Tsidulko, adjacent poster