Study of Fast Ion Transport in Turbulent Waves in the Large Plasma Device (LAPD)

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Due to gyroradius averaging and drift-orbit averaging, the transport of fast ions by microturbulence in tokamaks often is smaller than experienced by thermal ions [1]. In this experiment, strong drift wave turbulence ($\delta n/n \sim 1$, $f \sim 5$-20 *kHz*) is observed in LAPD in gradient regions produced by obstacles. Energetic lithium ions ($E_{fast}/E_{thermal} \geq 300$, $\rho_{fast}/\rho_s \sim 10$) orbit through the turbulent region. Scans with a collimated analyzer and with probes give detailed profiles of the fast ion spatial distribution and of the fluctuating fields. The fast-ion transport decreases rapidly with increasing fast-ion gyroradius, which is explained well by gyro-averaging theory [2]. The characteristics of the fluctuations are modified by changing the plasma species from helium to neon, and by modifying the bias on the obstacle. A transition from non-diffusive to diffusive transport is observed when the fast ion time-of-flight in the waves exceeds its correlation time ($\tau_{corr} \sim 0.1$ *ms*) with the waves. Different spatial correlation lengths of the wave potential fields also alter the fast ion transport. A Monte Carlo trajectory-following code simulates the interaction of the fast ions with stationary two-dimensional electrostatic wave potential fields and with three-dimensional, time-dependent fields. Comparison between observation and modeling is presented.

[1] W. W. Heidbrink, M. Murakami, J. M. Park, et al., Plasma Phys. Controlled Fusion **51**, 125001 (2009)
[2] Shu Zhou, W. W. Heidbrink, H. Boehmer, et al., Phys. Plasmas, **17**, 092103 (2010)