Energetic ions are often important sources of energy, momentum, current, and particles in magnetically confined plasmas. In ITER, neutral beams will drive current and alpha particles will be a primary source of heat. Accordingly, knowledge of the spatial profile of fast ions is critical.

The conventional wisdom is that, in the absence of long-wavelength MHD instabilities, fast-ion confinement is much better than thermal-ion confinement. Theoretically, the reason for this expectation is that the large orbits of fast ions phase average over electrostatic turbulence with decorrelation lengths on the scale of the thermal ion gyroradius. The effectiveness of this phase averaging increases with the ratio of fast-ion energy $E$ to plasma temperature $T$. An old compilation of fast-ion data in the regime $E \gg T$ found negligible levels of cross-field transport [1].

In recent experiments with smaller values of $E/T$ ($\lesssim 10$), cross-field diffusion of beam ions by microturbulence is observed in the DIII-D tokamak [2]. Fast ion $D_\alpha$, neutron, and motional Stark effect measurements diagnose the fast-ion distribution function. As expected for transport by plasma turbulence, anomalies relative to the classical prediction are greatest in high temperature plasmas, at low fast-ion energy, and at larger minor radius. Calculations of drift-wave stability and measurements of density fluctuations suggest that ion-temperature gradient (ITG) turbulence is responsible for the transport. Theoretical estimates of fast-ion diffusion are comparable to experimental levels.

To enable a more quantitative comparison with theory, new experiments were recently performed. Comparisons with three gyrokinetic codes (GYRO, GTC, and GENE) are underway. The implications for current drive, heat deposition, and alpha-ash removal in ITER will be presented.