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Simulation of Laser Induced Fluorescence (LIF) Signals in a Plasma[1] F. CHU, F. SKIFF, Univ of Iowa — Velocity-space diffusion and electric mean fields play important roles in the transport phenomena in the turbulent plasma. One way to explore how they determine transport is through the optical test-particle diagnostics, which is based on using ionic electronic states as a means of tagging particles. It requires a means of changing and measuring the state densities by optical pumping and LIF. In order to interpret the LIF signals, which provide the information on particle orbits, we introduce a transfer function that specifies the probability of finding a particle at position x and velocity v at time t, given that the particle was at position x' and velocity v' at time t'. We model the signal at first without the presence of waves in the plasma, studying only the roles that optical pumping and velocity-space diffusion play in the resulting LIF signals. Then we consider how mean-field waves affect the distributions of metastable states. Finally we combine the two factors to construct the complete theory. We note that even "ordinary" LIF using a single laser and detection system can benefit from the test-particle approach under conditions where there is significant optical pumping or where the metastable lifetime is not long compared to a wave period.

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