Using Field-Particle Correlations to Diagnose Particle Energization by Electromagnetic Waves in Space and Laboratory Plasmas

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In weakly collisional plasmas, such as the Earth's magnetosphere or terrestrial laboratory experiments, kinetic plasma theory dictates that the energy of turbulent fluctuations of the electromagnetic fields and plasma flows is removed collisionlessly through interactions between the electromagnetic fields and the individual motions of the charged particles that make up the plasma. I will present the fundamentals of the recently developed field-particle correlation technique, and show examples from nonlinear kinetic numerical simulations of how it can be used with single-point measurements to distinguish and characterize different collisionless particle energization mechanisms. This fundamental approach can use either *in situ* spacecraft measurements or laboratory measurements to quantitatively determine the energization of particles by electromagnetic fluctuations, a major goal of space physics and plasma physics.