Eitan Tadmor

Talk 1: *Critical Thresholds in Eulerian Dynamics*

Abstract: We are concerned with the questions of global regularity vs. finite time breakdown in Eulerian dynamics, driven by different models of nonlinear forcing. To address these questions, we propose the notion Critical Threshold (CT), where a conditional finite time breakdown depends on whether the initial configuration crosses an intrinsic, O(1) critical threshold. Our approach is based on spectral dynamics, tracing the eigenvalues of the velocity gradient which determine the boundaries of CT surfaces in configuration space. We demonstrate the critical thresholds phenomena with several prototype models. We begin with global regularity of the 1D Euler-Poisson. We continue with the corresponding n-dimensional restricted Euler-Poisson equations. Here we identify a set of [n/2] spectral invariants which lead to a remarkable characterization of 2D sub-critical initial configurations with global smooth solutions. Finally, we revisit the 3D restricted Euler equations, and obtain a surprising global existence result for a large set of sub-critical initial data in the 4D case.

Talk 2: *Kinetic Formulations and Regularizing Effects in Quasi-Linear PDEs*

Abstract: We quantify the regularizing effects in a general family of quasi-linear scalar PDEs, using velocity averaging of their underlying kinetic formulations. The PDEs are first and second order equations which involve nonlinear transport and (possibly degenerate) diffusion. In particular, we improve previous regularity statements for multi-dimensional conservation laws, and we derive completely new regularity results for related convection-diffusion and elliptic equations driven by degenerate, non-isotropic diffusion. This is a joint work with T. Tao.