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Spectral gap and critical thresholds in two-dimensional hydrodynamic flocking

We discuss the question of global regularity for a general class of Eulerian dynamics driven by a forcing with a commutator structure. The study of such systems is motivated by the hydrodynamic description of agent-based models for flocking driven by alignment. For commutators involving bounded kernels, existence of strong solutions follows for sub-critical initial data so that the initial divergence is not too negative and the initial spectral gap is not too large. A similar role of the spectral gap is found in our study of two-dimensional pressure-less equations. Here, a bound on the spectral gap paves the way for a new BV framework for existence of weak dual solutions for the 2D pressure-less Euler equations as vanishing viscosity limits.