Critical thresholds in Euler-Poisson-alignment systems

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The Euler-Poisson equations describe important physical phenomena in many applications such as semiconductor modeling and plasma physics. This paper is to advance our understanding of critical threshold phenomena in such systems in the presence of different forces. We identify critical thresholds in two damped Euler-Poisson systems, with and without alignment, both with attractive potential and spatially varying background state. For both systems, we give respective bounds for subcritical and supercritical regions in the space of initial configuration, thereby proving the existence of a critical threshold for each scenario. Key tools include comparison with auxiliary systems, phase space analysis of the transformed system.