Abstract Submitted
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Numerical modeling of the breakup of cohesive particles by turbulence[1] YUAN YAO, JESSE CAPECELATRO, University of Michigan, Ann Arbor — Micron-sized particles in turbulent flows play important roles in many engineering and medical systems such as dust ingestion in gas-turbine engines and dry powder inhalers, where particles tend to form aggregates due to inter-particle cohesion. The dynamical evolution and morphology of these aggregates involve a complex interplay between turbulent stresses and inter-particle cohesive forces. Here we study the turbulence-induced breakup of a spherical particle 'clump' placed in homogeneous isotropic turbulence. Parameters are chosen relevant to powder suspended in air such that cohesion due to van der Waals is important. Eulerian-Lagrangian simulations are performed that models two-way coupling between phases and resolves particle-particle interactions. Aggregate breakup is investigated for different Adhesion numbers, Reynolds numbers and clump sizes. The intermittency of turbulence is found to play a key role on the early-stage breakup process. A scaling analysis shows that the time rate of breakup scales with a turbulent Adhesion number and an aggregate Reynolds number. A phenomenological model of the breakup process is proposed as a granular counter-part to the Taylor Analogy Breakup (TAB) model for droplet breakup, followed by a sensitivity analysis of the model parameters.

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