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Breakup of colloidal aggregates in turbulent channel flow[1] ALFREDO SOLDATI, CRISTIAN MARCHIOLI, University of Udine — Breakup of small aggregates in turbulence is of high relevance to industrial applications (from processing of colloids and nanomaterials to flocculation) and environmental processes (marine snow formation). In spite of their importance, breakup phenomena are poorly understood from a fundamental viewpoint and a basic description of breakup dynamics is still lacking. In this work we examine the complex role of turbulence and the way it generates fluctuating hydrodynamic stresses to which an aggregate is exposed. We use pseudo-spectral DNS and Lagrangian tracking to determine the breakup rate of sub-Kolmogorov colloidal massless aggregates in non-homogeneous anisotropic turbulence, considering both instantaneous and ductile breakup. Instantaneous breakup occurs when the stress generated by the surrounding fluid exceeds the critical value required to break that aggregate: $\sigma > \sigma_{cr}$. Ductile breakup is consequence of a non-instantaneous process activated when $\sigma > \sigma_{cr}$ and occurs when the energy dissipated by the surrounding fluid, $E = \int \epsilon(\tau|\sigma > \sigma_{cr})\mathrm{d}\tau$ with ϵ the fluid kinetic energy dissipation rate and τ time, exceeds the critical breakup value. Effects on breakup rates due to aggregate inertia will also be discussed.

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