Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

The effect of particle to fluid density ratio on the clustering of inertial particles in turbulence ANIRBAN BHATTACHARJEE, MAHDI ESMAILY, Cornell University — Inertial particles show negligible clustering in turbulence when the Stokes number (St) is either large or small but show substantial clustering at St = O(1). This non-monotonic trend has been analytically proven and numerically verified in the past with the assumption that the particle to fluid density ratio is infinitely large. In this work, we investigate the more physically realistic case of particle clustering in flows where the particle to fluid density ratio is finite. The Lyapunov exponent which characterizes the amount of clustering (negative values) or dispersion (positive values) has been analytically derived as a function of Stokes number and particle to fluid density ratio. At infinite density ratio, it has been shown that much of the behavior of particles in 3D turbulence can be explained using a 1D canonical flow that oscillates at a single frequency. We employ this canonical flow to show that a decrease in particle to fluid density ratio leads to less clustering and more dispersion when the flow is hyperbolic, whereas in elliptical flows, there is no clustering and the dispersion decreases with a decrease in density ratio.

Anirban Bhattacharjee
Cornell University

Date submitted: 02 Aug 2020 Electronic form version 1.4