Understanding and predicting how discrete particles move in turbulent flows is a topic of great importance to a broad range of problems, including plankton distribution in oceans, pollution in the atmosphere, combustion, seed dispersion over land and cloud formation. Of particular importance is how particles in turbulence move relative to each other, which can be addressed from the point of view of forward-in-time (FIT) and backward-in-time (BIT) dispersion. FIT dispersion is physically related to how groups of particles spread out in turbulence, whereas BIT dispersion is physically related to how particles mix together, and is also important for understanding particle collisions in turbulence. When FIT and BIT dispersion are different, it signifies irreversibility, and since FIT and BIT dispersion are related to different problems, understanding the irreversibility is of fundamental and practical importance. The FIT and BIT dispersion of

fluid particles has been considered in a number of studies, with the conclusion that in 3D turbulence, fluid particle-pairs separate faster BIT than FIT. The effect of particle inertia on the BIT dispersion was only recently addressed in, where it was found that inertia has a profound effect upon the dispersion irreversibility, with inertial particle dispersion being much more strongly irreversible than fluid particle dispersion, in general. The strong effect of inertia on the pair-separation irreversibility comes from the non-local in-time dynamics that it introduces to the system. However, the analysis in only considered the mean-square separation of the inertial particles. To fully understand and characterize the BIT dispersion and the dispersion irreversibility, the full Probability Distribution Functions (PDFs) of the particle-pair separations must be analyzed. This is precisely the purpose of the present work.