

# Preferential concentration of inertial particles and cluster dynamics in channel turbulence

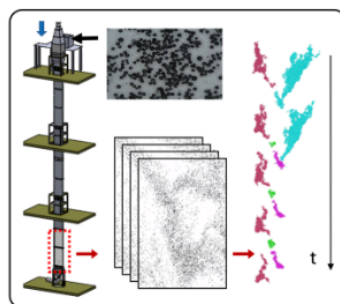
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Thursday, April 2nd (2026), 16:30 Paris Time  
[LMFL Fluid Mechanics Webinar Link](#)

## Abstract

Small heavy particles are known to preferentially concentrate when dispersed in turbulent flows because of their finite but larger than fluid inertia. The spatiotemporal characteristics of regions of high particle concentration, or clusters, can modulate the carrier flow and affect phenomena relying on local concentration or path integrated quantities, such as heat transfer between particle and fluid phases or transmission through the particle-laden flow. This talk will provide an overview of recent experimental work on a new four-stories-long particle-laden turbulent channel flow facility exploring particle and cluster dynamics in wall bounded flows. The focus is on denser than fluid particles smaller than the dissipative scales, with test conditions including independent variations of flow and particle parameters to analyze the role of the Stokes number - particle to flow time scales ratio - and the contribution of gravitational effects. High-speed planar imaging is used to track particles and cluster structures at the center of the channel. Particle data from fully developed duct flow simulations is also leveraged in this work to evaluate cluster dynamics. We will discuss preferential concentration and cluster time averaged and time-resolved statistics, as well as experimental and data analysis best practices. Our experiments corroborate that increasing the Stokes number by decreasing the dissipative time scales, increasing the Reynolds number in wall bounded flows, has a minimal impact when compared to that of varying the particle relaxation time. Overlapping power-law distributions of cluster size probabilities are observed in all cases despite large variations in local concentration within cluster regions, and thus, degree of clustering. The time clusters remain coherent also exhibits a power-law probability distribution, with cluster lifetimes in average positively correlated with cluster size, and independent of average concentration. The turnover time of eddies with equivalent volume to that of the clusters provides a robust scaling for the lifetime of clusters in the three-dimensional dataset, indicating that are the inertial scales those dominating the cluster dynamics. Turning attention to the rate of change of local concentration allows connecting the relative particle dynamics conditioned on local concentration. Wider distributions are observed for particles exhibiting stronger preferential concentration, for which steeper cluster coherence times are measured.



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