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Lagrangian Intermittency in Colloid Transport Through Porous Media

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We present a study of the characteristic time scales and Lagrangian intermittency of colloidal suspensions moving in porous media. The phenomenology of intermittency constitutes long periods of slow particle motion interrupted by brief bursts of high velocity. For particles of finite size and mass, we conjecture that intermittency is associated with the inexact velocity thresholds that define when particles are mobile or immobilized. Traditionally, transport models based on Colloid Filtration Theory smooth out small-scale Lagrangian intermittency that is key to understand transport processes under *unfavorable* conditions, during which particles spend substantial time near the surface of the filter medium. Using the concepts of *flying* and *diving* residence times above and below a given velocity magnitude threshold we infer the Lagrangian time distributions for colloid deposition and detachment, respectively. The analysis is obtained from over 3×10⁴ trajectories recorded with three-dimensional particle tracking velocimetry in a refractive index matched porous medium. We propose a definition for deposition rate in terms of exit-time statistics from flying events along each particle path. A similar definition for detachment rate presented in terms of exit-time statistics from diving events. This amounts to measuring the time it takes for a particle to get into or out from a state of low mobility. More generally, our study brings new information to the manner in which deposition and detachment rates are quantified based on Lagrangian residence time distributions rather than average values. Considering the variability in reaction rates for colloidal suspensions could resolve discrepancies between observations and predictive models of colloid transport and filtration.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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