Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Paths to caustic formation in turbulent aerosols[1] JAN MEIBOHM, Gothenburg University, Gothenburg, Sweden, VIKASH PANDEY, TIFR Centre for Interdisciplinary Sciences, Hyderabad, India, AKSHAY BHATNAGAR, NORDITA, Royal Institute of Technology and Stockholm University, Stockholm, Sweden, KRISTIAN GUSTAVSSON, Gothenburg University, Gothenburg, Sweden, DHRUBADITYA MITRA, NORDITA, Royal Institute of Technology and Stockholm University, Stockholm, Sweden, PRASAD PERLEKAR, TIFR Centre for Interdisciplinary Sciences, Hyderabad, India, BERNHARD MEHLIG, Gothenburg University, Gothenburg, Sweden — The dynamics of identical, small, and heavy particles in a turbulent flow has singularities, so-called caustics. At a caustic, local particle neighbourhoods collapse as the phase-space manifold folds over configuration space and particle-velocity gradients diverge. The formation of caustics has been studied in detail in the white-noise limit where caustic formation is essentially Kramers' escape. A different picture is that of the sling effect, where caustics form as the inertial particles are expelled from vortices in the turbulent flow. Here we reconcile these two distinct perspectives by computing an optimal escape path for the matrix of particle-velocity gradients in a persistent-flow model that accounts for persistent vortices in the flow. Whether caustics form by Kramers' escape or according to the sling effect depends on the degree of particle inertia. We compare our predictions with statistical-model simulations, and with results based on direct numerical simulations of two-dimensional turbulence.

[1]Knut and Alice Wallenberg Foundation, Dnr. KAW 2014.0048, Vetenskapsradet grant no. 2017-3865

Jan Meibohm
Gothenburg University

Date submitted: 03 Aug 2020 Electronic form version 1.4