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Aggregation and fragmentation dynamics of inertial particles in chaotic flows

J. C. Zahnow (1), R. D. Vilela (2), T.Tél (3) and U. Feudel (1)

(1) Theoretical Physics/Comples Systems, ICBM, University of Oldenburg, 26129 Oldenburg, Germany, (2) Max Planck Institute for the Physics of Complex Systems, 01187 Dresden, Germany, (3) Institute for Theoretical Physics, Eötvös University, H-1518 Budapest, Hungary (Jens.C.Zahnow@uni-oldenburg.de)

Inertial particles advected in chaotic flows often accumulate in strange attractors. While moving on these fractal sets they usually approach each other and collide. We consider inertial particles in a simple, two-dimensional laminar flow aggregating due to collision. The new particles formed in this process are larger and follow the equation of motion with a different parameter. These particles can in turn fragment when shear forces in the flow become sufficiently large. We find that an asymptotic steady state of the particle size distribution sets in and that it is unique. Different possible mechanisms for the fragmentation are compared in their influence on this steady state size distribution. It is found that the shape of the distribution is relatively robust with respect to the number of fragments that are created during break-up (binary, ternary, quarternary fragmentation), but changes with different size distributions of the fragments (e.g. all fragments have the same size versus randomly distributed sizes of the fragments). In addition, a scaling relationship between the average particle size and the 'stickiness', i.e. the strength with which aggregates are bound together, is found.