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Anomalous dust transport in strongly coupled 2D complex plasmas

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Stochastic motion of dust grains in strongly coupled complex plasmas is affected not only by the neutral gas, but also by the interaction between the grains and between grains and the surrounding plasma. Under certain conditions these interactions create strongly ordered states with some disordered motion of the dust grains through the lattice. This motion can be tracked, and some of the statistical properties of the motion are known. However, the dynamical basis of these statistics is poorly understood. A straightforward technique is to produce the probability density functions (PDFs) of the particle displacements as a function of the time-lag. For relatively immobile states the PDF forms a stretched Gaussian whose variance expands faster with time than a normal diffusion process (superdiffusion) until the displacement approaches the mean interparticle distance d. There are good reasons to believe that this superdiffusion is associated with long-range memory effects in the particle dynamics. For greater times the PDF develops local humps at integer multiples of d, but the overall distribution is Gaussian and the diffusion is normal, i.e. memory is lost when particles escape from their cage in the lattice. In more mobile states superdiffusion on short time scales is still observed, but the humps due to caging are lost. On even longer time scales new humps develop on the PDFs due to trapping of particles in large vortices. At these longer time scales the transport is superdiffusive, and the memory effects are due to viscoelastic vortex flows covering a wide spectrum of temporal and spatial scales.

S. Ratynskaia, C. Knapek, K. Rypdal, S. Khrapak, G.E.Morfill, Phys. Plasmas 12, 022302 (2004)
S. Ratynskaia, K. Rypdal, C. Knapek, S. Khrapak, A. Milovanov, J. J. Rasmussen, G. E. Morfill, Phys. Rev. Let. 96 , 105010 (2006)