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Intermediate asymptotics and aging phenomena in anomalous transport by flows.

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Anomalous transport in flows is often invoked in discussion of anomalous transport phenomena as described by continuous-time random walk (CTRW) or Levy walk (LW) schemes. The first model describes the particles' transport in eddy lattices, and the model of a Levy walk interrupted by rests describes the transport in flows which consist of eddies and jets. The models adequately describe the intermediate-time dynamics of the mean squared displacement (MSD) of the transported particles from their initial positions under initial conditions corresponding starting on the separatrix between two eddies or between an eddy and a jet, and the long-time dynamics for any initial condition, when the initial conditions are already forgotten.

Both random walk models lead to non-stationary dynamics on intermediate times, and exhibit aging phenomena. It is sometimes assumed that the corresponding models also can describe aging in flows. The aging phenomena in random walk schemes are connected with the walker's behavior during the very first step after the beginning of the observation, and assume that this dynamics is trivial (being at rest in CTRW, or either being at rest or moving along straight line in the interrupted LW) while the dynamics during the capturing periods in a flow is essentially quite complex and corresponds to rotations around elliptic points of eddies or oscillations in jets.

We concentrate on the MSD of the transported particles from their initial positions, and discuss in detail the aging dynamics of MSD in flows. We show that the time-evolution of the MSD depends strongly on initial conditions, that simple CTRW / LW-dynamics only describes the intermediate-time behavior of the initial conditions discussed above, and that several other regimes
(including superdiffusion or oscillations) are possible. Even in the case when simplified models correctly describe the intermediate time behavior of MSD when starting on the separatrix, they fail to describe the aging behavior of the MSD even in this case. We give the theoretical discussion of all theses issues, and illustrate our points by results of massive numerical simulations of the system.

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