Contribution ID: **141** Type: **oral**

Stochastic modeling of diffusion in dynamical systems: three examples

Tuesday, September 5, 2017 4:30 PM (30 minutes)

Consider equations of motion that generate dispersion of an ensemble of particles. For a given dynamical system an interesting problem is not only what type of diffusion is generated by its equations of motion but also whether the resulting diffusive dynamics can be reproduced by some known stochastic model. I will discuss three examples of dynamical systems generating different types of diffusive transport: The first model is fully deterministic but non-chaotic by displaying a whole range of normal and anomalous diffusion under variation of a single control parameter [1]. The second model is a dissipative version of the paradigmatic standard map. Weakly perturbing it by noise generates subdiffusion due to particles hopping between multiple attractors [2]. The third model randomly mixes in time chaotic dynamics generating normal diffusive spreading with non-chaotic motion where all particles localize. Varying a control parameter the mixed system exhibits a transition characterised by subdiffusion. In all three cases I will show successes, failures and pitfalls if one tries
to reproduce the resulting diffusive dynamics by using simple stochastic models.

Joint work with all authors on the references cited below.

[1] L. Salari, L. Rondoni, C. Giberti, R. Klages, Chaos 25, 073113 (2015)

[2] C.S. Rodrigues, A.V. Chechkin, A.P.S. de Moura, C. Grebogi and R. Klages,
Europhys. Lett. 108, 40002 (2014)

[3] Y.Sato, R.Klages, to be published.

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Session Classification: Session 7