Ergodicity testing for anomalous diffusion. A practical guide for experimentalists

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An analysis of trajectories recorded in biological experiments often requires calculating time averages instead of ensemble averages [1]. According to the Boltzmann hypothesis they are equivalent only under the assumption of ergodicity. In this talk we present tools that allow to study ergodic properties [2]. This analysis is illustrated for two classes of anomalous diffusion processes: fractional Brownian motion and subordinated Ornstein-Uhlenbeck process. We show that only first of them is ergodic. We demonstrate this by applying rigorous statistical methods: mean square displacement, confidence intervals and dynamical functional test. Our methodology is universal and can be implemented for analysis of many experimental data not only if a large sample is available, but also when there are only few trajectories recorded.

[1] R. Metzler, J.-H. Jeon, A.G. Cherstvy, and E. Barkai, Phys. Chem. Chem. Phys. **16**, 24128 (2014).

[2] J. Janczura and A. Weron, J. Chem. Phys. **142**, 144103 (2015).