Statistical Physics and Anomalous Dynamics of Foraging

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My talk will illustrate the application of fractional calculus and non-local operators to mathematically model the search for food by biological organisms, and problems by trying to do so.

A question that attracted a lot of attention in the past two decades is whether biologically relevant search strategies can be identified by statistical data analysis and mathematical modeling [1]. A famous paradigm in this field is the *Lévy Flight Hypothesis*. It states that under certain mathematical conditions Lévy dynamics, which defines a key concept in the theory of anomalous stochastic processes, leads to an optimal search strategy for foraging organisms. This hypothesis is discussed very controversially in the current literature [2]. After introducing the stochastic processes of Lévy flights and Lévy walks I will review examples and counterexamples of experimental data and their analyses confirming and refuting the Lévy flight hypothesis.

This debate motivated own work on deriving a fractional diffusion equation for an n-dimensional correlated Lévy walk [3], studying search reliability and search efficiency of combined Lévy-Brownian motion [4], and investigating stochastic first passage and first arrival problems [5].
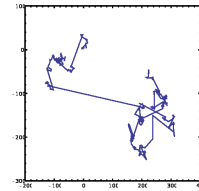
References

[1] see webpage by the *Advanced Study Group* corresponding to the title of this talk: www.mpipks-dresden.mpg.de/~asg_2015

[2] R.Klages, *Search for food of birds, fish and insects*, book chapter in: A.Bunde, J.Caro, J.Kaerger, G.Vogl (Eds.), *Diffusive Spreading in Nature, Technology and Society.* (Springer, Berlin, 2017).

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