Statistical Physics and Anomalous Dynamics of Biological Search Processes

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A question that attracted much attention over the past two decades is whether biologically relevant search strategies can be identified by statistical data analysis and mathematical modeling [1]. An example is the migration of T cells in the brain for targeting pathogens [2], which illustrates a famous paradigm in this field, the *Lévy Flight Foraging Hypothesis*. This hypothesis 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 organisms searching for targets. This idea is discussed controversially in the current literature. I will review examples and counterexamples of experimental data and their analyses confirming and refuting it. Related to this debate is own work about biological cell migration [3] and the biophysical modeling of bumblebee flights under predation threat [4], both based on experimental data analysis.

[1] R.Klages, *Search for food of birds, fish and insects*, chapter in: A.Bunde et al. (Eds.), Diffusive Spreading in Nature, Technology and Society, p.49 (Springer, Berlin, 2018)

[2] T.H.Harris et al., Nature **486**, 545 (2012)

[3] P.Dieterich et al., PNAS **105**, 459 (2008)

[4] F.Lenz et al., Phys. Rev. Lett. **108**, 098103 (2012)