Random walks, flocking, large deviations and Bose-Einstein transition

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Persistent random walks have been used to model self-propelled particles that are able to move with almost constant speed while randomly changing their direction of motion. Under the effect of interactions these self-propelled particles might exhibit self-organized motion where the majority of the particles move in the same direction, a behavior known as flocking.

In this talk I will first analyze a simple model of continuous-time persistent random walkers from the point of view of the large deviation theory, and I will show that it displays a phase transition that bears many similarities with the Bose-Einstein condensation. I will also present a mathematical model (taking ingredients from some well-known models of collective behavior in social systems) for self-propelled particles that under appropriate conditions are capable of collective motions.

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[1] D. Escaff, R. Toral, C. Van den Broeck, K. Lindenberg, A continuous-time persistent random walk model for flocking, Chaos **28**, 075507 (2018).

[2] K. Proesmans, R. Toral, C. Van den Broeck, Bose-Einstein phase transition in persistent and run-and-tumble walks, arXiv: 1808.09715.