S N BOSE NATIONAL CENTRE
FOR BASIC SCIENCES
Block JD, Sector III, Salt Lake, Kolkata 700 106

DEPARTMENTAL SEMINAR

Physics of Complex Systems

11th August, 2022 **4.00 PM** **ONLINE / FERMION**

SPEAKER

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TITLE OF THE TALK

Initial conditions and single-file diffusion: compressibility, hyperuniformity and everlasting memory

ABSTRACT

Single-file diffusion, where an assembly of diffusive particles move in quasi-one-dimensional channels without passing each other, has been a benchmark problem for anomalous transport in interacting systems for the last sixty years. The reason for this is two-fold : the simple set-up allows for a great deal of analytical tractability in a wide class of interacting systems; and the advent of our capabilities to experimentally observe and manipulate transport at the micro- and nano scales, for example, in zeolites, carbon nanotubes, membranes or bio-medical devices. Extensive theoretical studies over the last decade have investigated an intriguing feature of single-file diffusion : the amplitude of anomalous transport (here, the sub-diffusion coefficient) can have an ever-lasting dependence on the choice of initial conditions - i.e., whether the system starts from an equilibrium-like fluctuating initial state (annealed) or from a fixed initial configuration (quenched). In this work we show that the long-term memory of initial conditions in single-file diffusion is in fact mediated by a single static quantity: the Fano factor - a generalized compressibility that quantifies the density fluctuations of the initial state. We thereby identify a universality class of hyperuniform initial states whose dynamical variances coincide with the `quenched' cases studied previously; we also describe a continuous family of other classes among which equilibrated (or `annealed') initial conditions are but one member. The Fano factor of the initial condition is a store of long-time memory, which controls sub-diffusion for arbitrarily long times.

Reference: Tirthankar Banerjee, Robert L. Jack and Michael E. Cates, arxiv:2206.08739 (2022) https://arxiv.org/abs/2206.08739.

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