Ariel Caticha and Daniel Bartolomeo

back to namelist

Ariel Caticha and Daniel Bartolomeo
University at Albany, USA

Trading drift and fluctuations in entropic dynamics: a new symmetry for quantum mechanics

Entropic Dynamics (ED) is a framework that allows the formulation of dynamical theories as an application of entropic methods of inference. In the generic application of ED to derive the Schrödinger equation for N particles the dynamics is a non-dissipative diffusion in which the system follows a “Brownian” trajectory with fluctuations superposed on a smooth drift. The physical input is introduced through constraints that separately control the fluctuations and the drift.
There is a set of N constraints that controls the fluctuations. The central role played by the corresponding Lagrange multipliers with (one for each particle) is well understood: they serve to regulate the flow of time, and the differences among the are associated to differences in the mass of the particles.
There is another constraint involving a “drift” potential that correlates the motions of different particles. The drift potential contributes to the phase of the wave function and it is ultimately responsible for such quantum effects as interference and entanglement. The corresponding multiplier controls the strength of the drift motion relative to the fluctuations. The single-valuedness of the quantum wave function requires that must take integer values.
In this work we explore a new symmetry of quantum mechanics: we show that different “microscopic” models at the sub-quantum level lead to the same “macroscopic” behavior at the quantum level. More specifically, models with different values of can lead to the same Schrödinger equation.
The limit is of particular interest: the drift prevails over the fluctuations and the system evolves along the smooth lines of probability flow. Thus ED includes the causal or Bohmian form of quantum mechanics as a special limiting case. We further show that the Heisenberg uncertainty relations are an osmotic or diffusive effect even in the no-fluctuation Bohmian limit. Finally, we note that ED allows the construction of a theory – a non-dissipative dynamics with fluctuations but no quantum potential – that is neither classical nor quantum. In the limit this hybrid theory is fully equivalent to classical mechanics.

Watch presentation video

Download presentation pdf

Download abstract pdf