UNIVERSITÄT DUISBURG ESSEN

Offen im Denken

Theorie-Kolloquium SS 2026
Fr 22.05.2026, 14:00-15:30
MC 351 & online (URL in E-Mail)

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Spontaneous Universal Irreversibility:

Resolving the problem of quantum measurements and quantum thermalization via a stochastic modification of quantum theory

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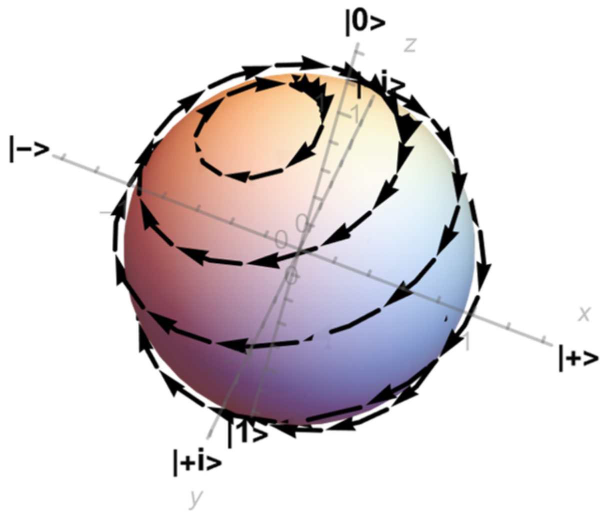

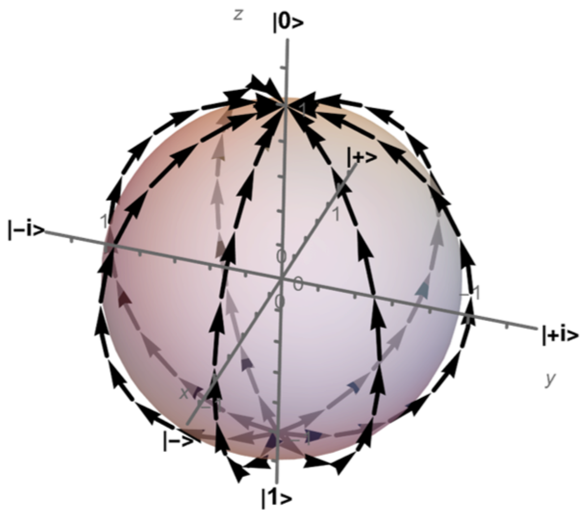

I argue that the deterministic and reversible, unitary evolution of quantum theory cannot objectively account for the irreversible or stochastic behaviour observed in nature. Thus, quantum theory cannot provide any observer independent, dynamical description of definite events, such as a pointer localizing during a measurement, a system achieving an equilibrium steady state or indeed, a system spontaneously breaking a symmetry. As an alternative perspective, I suggest that quantum theory is an effective theory requiring corrections to accurately describe systems in the thermodynamic limit or equivalently in the quantum-classical crossover regime, where such irreversible behaviour generically occurs.

A minimal stochastic modification of quantum theory is proposed, which gives rise to objective, irreversible dynamics in closed systems, resulting in emergent classicality, while being physically viable (with energy conservation, no super-luminal signalling, etc) as well as experimentally falsifiable. Born’s rule and microcanonical equilibrium statistics emerge from within the theory, guaranteed by a novel fluctuation dissipation relation and the total entropy adheres to a modified H-theorem, converging upon Boltzmann’s thermodynamic entropy. Thus, the so-called model of Spontaneous Universal Irreversibility self-consistently resolves both the quantum measurement and thermalization problems and provides a general mechanism for the objective emergence of localized, equilibrated classical states from their underlying quantum constituents.

[1] A. Mukherjee and J. van Wezel, Phys. Rev. A 109, 032214 (2024).

[2] A. Mukherjee and J. van Wezel, Proc. R. Soc. A 481, 20250254 (2025).

[3] A. Mukherjee, arXiv:2504.16197 (2025).

[4] A. Mukherjee, et. al., Phys. Rev. A 112, 062202 (2025).