

Daniel Bartolomeo and Ariel Caticha

[back to namelist](#)

Daniel Bartolomeo and Ariel Caticha
University at Albany , USA

Uncertainty relations in the Entropic Dynamics approach to Quantum Theory

In the Entropic Dynamics (ED) approach to quantum theory the probability distribution codifies the uncertainty of particles' positions. Its evolution is prescribed jointly by a Fokker-Planck and a Hamilton-Jacobi equation [1]. The resulting dynamics is a non-dissipative diffusion in which the underlying particle dynamics is dominated by isotropic fluctuations superposed on a slow drift.

In an earlier version of ED [2], it was shown that it is this diffusive or osmotic behavior that leads to the Heisenberg Uncertainty Principle [3]. However recently we have shown that quantum mechanics exhibits a new symmetry: different microscopic models at the sub-quantum level lead to the same macroscopic behavior at the quantum level. The symmetry consists in being able to change the size of the microscopic fluctuations relative to the drift while still leading to the same macroscopic Schrödinger equation. In the extreme case one can essentially eliminate the fluctuations so that the particles follow Bohmian trajectories. Our goal here is to verify that the Heisenberg uncertainty relations survive unscathed. We show that even in the Bohmian limit the osmotic effects are not completely eliminated; they lead to effects such as the Heisenberg uncertainty relations and tunneling. Finally, we show that in the ED approach the position-momentum Heisenberg uncertainty relation is equivalent to the Cramer-Rao bound for position uncertainty.

REFERENCES

- [1] Ariel Caticha, Daniel Bartolomeo, and Marcel Reginatto. Entropic dynamics: From entropy and information geometry to Hamiltonians and quantum mechanics. AIP Conference Proceedings, 1641:155–164, 2015.
- [2] Ariel Caticha. Entropic dynamics, time and quantum theory. Journal of Physics A: Mathematical and Theoretical, 44(22):225303, 2011.
- [3] Shahid Nawaz and Ariel Caticha. Momentum and uncertainty relations in the entropic approach to quantum theory. AIP Conference Proceedings, 1443(1):112–119, 2012.

[Download abstract pdf](#)

