

Prize Talk

PV IV Mon 13:30 HSZ 01

Brownian motion and thermodynamics in special relativity

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The generalization of Brownian motion and thermodynamics within Einstein's theory of relativity poses a number of interesting conceptual challenges. In the first part of the talk, we will consider the question of how to construct Langevin models of Markovian diffusion processes in special relativity [1]. The second half will be dedicated to the unification of relativity and thermodynamics, a topic that has stirred considerable debate over the last 100 years. Part of the difficulty

with relativistic thermodynamics lies in the fact that thermodynamic variables are nonlocal quantities that single out a preferred class of hyperplanes in spacetime. Moreover, there exist different, seemingly equally plausible ways of defining heat and work in relativistic systems. These ambiguities led, for example, to the various competing proposals for the Lorentz transformation law of temperature. From a more general perspective, however, traditional isochronous formulations of relativistic thermodynamics seem neither theoretically satisfactory nor experimentally feasible. We will discuss how these deficiencies can be resolved by defining thermodynamic quantities with respect to the backward-lightcone of an observer [2].

[1] J. Dunkel and P. Hänggi, Phys. Rep. 471(1): 1, 2009

[2] J. Dunkel, P. Hänggi and S. Hilbert, Nature Physics 5: 741, 2009