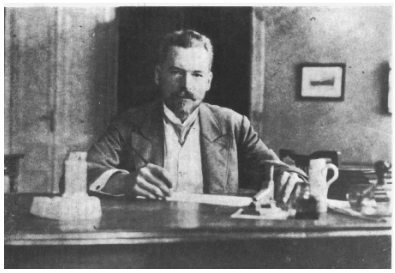

Contribution ID: **2** Type: **poster**

Weak Galilean invariance as a selection principle for stochastic coarse-grained diffusive models

Thursday, September 6, 2018 3:00 PM (3 hours)

Galilean invariance states that the equations of motion of closed systems do not change under Galilei transformations to different inertial frames. However, real world systems typically violate it, as they are described by coarse-grained models, that integrate complex microscopic interactions indistinguishably as friction and stochastic forces.
This leaves no alternative principle to assess a priori the physical consistency of a given stochastic model. In this talk, I use the Kac-Zwanzig Hamiltonian model of Brownian motion to clarify how Galilean invariance is broken during the coarse graining procedure to derive stochastic equations and derive a set of rules characterizing systems in different inertial frames, called "weak Galilean invariance". Several stochastic processes, generating both normal and anomalous diffusion, are shown to be invariant in these terms, except the continuous-time random walk, whose correct invariant description is discussed.
These results are particularly relevant for the modelling of biological systems, as they provide a theoretical principle to select stochastic models of complex dynamics prior to their validation against experimental data.

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Session Classification: Poster session