Boltzmann-Gibbs statistics meets infinite ergodic theory

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Fermi pointed out that the Hydrogen atom in a thermal setting is unstable, as the canonical partition function of this simple system diverges. We show how a non-normalised Boltzmann Gibbs measure can still yield statistical averages and thermodynamic properties of physical observables, exploiting a model of Langevin dynamics of a Brownian particle in an asymptotically flat potential [1]. The ergodic theory of such systems is known in mathematics as infinite (non-normalisable) ergodic theory. We will then discuss these isssues in the context of 1/f noise, weak chaos, resetting, L´evy walks and a gas of laser cooled atoms [2].

References

[1] E. Aghion, D. A. Kessler, and E. Barkai From Non-normalizable BoltzmannGibbs statistics to infinite-ergodic theory Phys. Rev. Lett. 122, 010601 (2019).
[2] E. Barkai, G. Radons, and T. Akimoto Transitions in the ergodicity of subrecoillaser-cooled gases Phys. Rev. Lett. 127, 140605 (2021).