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The Law of Temperature Transformation

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时间：11月09日（星期四）15:00—16:30
地点：北京大学物理楼中212大教室

报告人简介 (About speaker) : Prof. Ye received his Ph.D. from Yale University. Currently, he is a chair professor at the newly found Great Bay university in Dongguan, Guangdong, China. He is a condensed matter theorist working on the interdisciplinary field of condensed matter, quantum optics, cold atoms, non-relativistic quantum field theory, Turbulence and conformal field theory. Recently, he has been particularly interested to explore possible deep connections among quantum/topological phases, Sachdev-Ye-Kitaev models and quantum black holes from material's point of views.

摘要（Abstract）: Despite the special theory of relativity was discovered 120 years ago, how does the temperature transform in the theory remains unknown. This historical outstanding problem was initiated from the phenomenological thermodynamics point of view by the late giants such as Planck, Einstein, Pauli and Laue and also followed intensively by many other people. Here we resolve this outstanding problem by using a completely different approach: writing a partition function in terms of path integral in the imaginary time at a finite temperature, then perform Lorentz transformation directly on the partition function. The most disruptive change from zero to finite temperature is the existence of a reservoir which sets up the temperature and also plays the role of ether. It is the relative motion between the system and the reservoir which dictates the Law of Temperature Transformation, while it is still the relative motion between the system and the observer which determines the transformations of all the other physical quantities just like at zero temperature. We classify different experimental set-ups, especially stress the dramatic differences among the three ensembles: micro-canonical, canonical and grand-canonical in a moving sample. Impacts on the thermodynamic zeroth to the third laws are discussed. Contrast to the Doppler effect for an inertial observer, the Unruh effect for an accelerating observer and several other effects are made. Possible implications on the temperature of a quantum black hole are hinted through the AdS/CFT correspondence. Feasible experimental detections of these new effects in the condensed matter systems are analyzed.

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