Area Seminar

Title	How and why does statistical mechanics work
Date and Time	31/03/2011 16:00:00
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Area	Theoretical Physics
Venue	Room No. 469

Abstract

As the title says we want to answer the question; how and why does statistical mechanics work? As we know from the most used prescription of Gibbs we calculate the phase space averages of dynamical quantities and we find that these phase averages agree very well with experiments. Clearly actual experiments are not done on a hypothetical ensemble they are done on the actual system in the laboratory and these experiments take a finite amount of time. Thus it is usually argued that actual measurements are time averages and they are equal to phase averages due to ergodicity. Aim of the present review is to show that ergodicity is not relevant for equilibrium statistical mechanics (with Tolman and Landau). We will see that the solution of the problem is in the very peculiar nature of the macroscopic observables and with the very large number of the degrees of freedom involved in macroscopic systems as first pointed out by Khinchin. Similar arguments are used by Landau based upon the approximate property of "Statistical Independence". We review these ideas in detail and in some cases present a critique. We review the role of chaos (classical and quantum) where it is important and where it is not important. We criticise the ideas of E. T. Jaynes who says that the ergodic problem is conceptual one and is related to the very concept of ensemble itself which is a by-product of frequency theory of probability, and the ergodic problem becomes irrelevant when the probabilities of various micro-states are interpreted with Laplace-Bernoulli theory of Probability (Bayesian viewpoint). In the end we critically review various quantum approaches to thefoundations of statistical mechanics. It is argued that the eigenstate thermalization hypothesis is a special case of von Neumann's quantumergodic theory, and analogies are seen in the Khinchin's classical approach and in the von Neumann's quantum approach.