Abstract for GR-TR Conference on Statistical Mechanics and Dynamical Systems

Talk Invited | Invited Talk

Quasi–Stationary Chaotic States in Multidimensional Hamiltonian Systems

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We study numerically statistical distributions of chaotic orbit coordinates, viewed as independent random variables, in weakly chaotic regimes of three multi–dimensional Hamiltonian systems: Two Fermi–Pasta–Ulam (FPU–β) oscillator chains with different boundary conditions and number of particles and a microplasma of identical ions confined in a Penning trap and repelled by mutual Coulomb interactions. For the FPU systems, we show that, when chaos is limited within "small size" phase space regions, statistical distributions are well approximated, for surprisingly long times (typically up to $t \approx 10^6$), by a q–Gaussian ($1 < q < 3$) distribution function and tend to a true Gaussian ($q = 1$) for longer times, as the orbits eventually enter into "large size" chaotic domains of phase space. In the case of the microplasma Hamiltonian, we make use of these q–Gaussian distributions to identify: (a) a low–energy range of "weak chaos", over which the system "melts" and the q–index of the distributions attains a maximum $q \approx 1.8$ returning quickly to the $q = 1$ (Gaussian) value and (b) a wide energy range, over which a "liquid to gas" transition occurs, where q rises again, reaching $q \approx 1.4$ at $E \approx 50$, before returning slowly back to $q = 1$, at higher energies $E > 200$.