Experimental Physics Seminar

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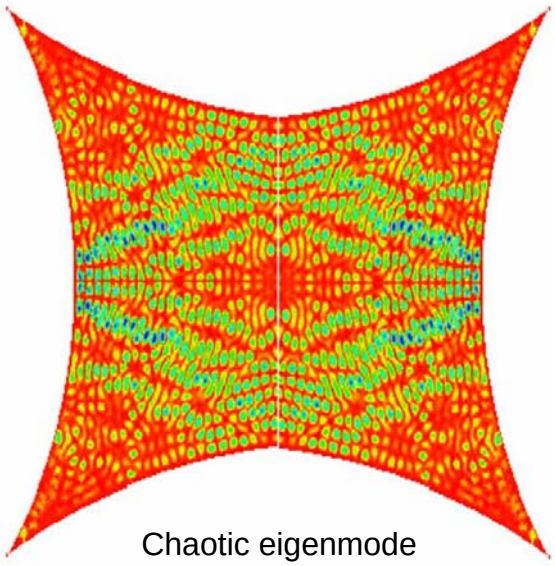
Wednesday 10/4/2006, 4:30pm
Willet Science Center 101

Universal Fluctuations in Quantum-Chaotic Systems

Ours is a chaotic world even without the hustle and bustle of everyday life. Be it the seemingly mundane dripping of water droplets from a loose faucet, to the much more complex gravitational dance of the sun, moon and the earth – chaotic systems seem to manifest themselves in almost every facet of physics and engineering, at scales ranging from the classical to the quantum mechanical. Though the mathematical formalism and experimental validation of classically chaotic systems have been around for over a century; but the field of Quantum Chaos is still in its infancy. These are quantum mechanical systems whose classical analog exhibits chaos. The question then arises-"What effect does classical chaos have on quantum dynamics"?



Chaotic eigenmode
at 12.57 GHz

Significant theoretical effort in mathematics and physics has identified the existence of universal fluctuations in the scattering properties of quantum-chaotic systems, which are conjectured to be explained through Random Matrix Theory (RMT). However, a major difficulty faced by experimentalists has been the recovery of these universal scattering fluctuations from the non-universal, system specific properties introduced by the act of measurement itself. In my talk, I will present a novel approach to overcome this difficulty. I use a simple normalization technique [1] that decouples the measurement apparatus from the underlying universal scattering aspects of these quantum systems. I will present experimental results on the scattering fluctuations of one such quantum-chaotic system in the form of a chaotic microwave resonator, and show their agreement with corresponding RMT predictions. These results are not restricted to microwave experiments but also apply to other allied fields, such as quantum-optics, acoustics, mesoscopic transport physics and electromagnetic compatibility.

[1] S. Hemmady, et.al., Phys. Rev. Lett. 94, 014102 (2005).

Please join us for light refreshments at 4:15pm outside WSC 109.