Classical orbit correlations: the key for understanding universality in quantum chaotic systems

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A chaotic classical system is characterized by apparently random, ergodic phase space flow. However, a closer inspection shows that (periodic) orbits in chaotic systems are not independent but appear in bundles exhibiting strong classical correlations. While hidden in classical dynamics, these correlations are revealed through constructive interference in the corresponding quantum system.

I will introduce an advanced semiclassical path integral approach to demonstrate that such correlations are responsible for the universal behavior exhibited by quantum systems with a chaotic classical limit. Thereby I will provide a microscopic understanding of random matrix theory predictions for this universal behavior. This is relevant for spectral statistics but moreover in particular for chaotic scattering and for transport processes. I will address recent applications of this semiclassical theory to quantum transport of electrons on mesoscopic scales [1].

[1] J. Kuipers, D. Waltner, C. Petitjean, G. Berkolaiko and K. Richter, *Phys. Rev. Lett.* **104**, 027001 (2010).