Chaos and 1/f noise in nuclear spectra

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Many complex systems in nature and in human society exhibit time fluctuations characterized by a power spectrum which is a power function of the frequency f. We show that the energy spectrum fluctuations of quantum systems can be formally considered as a discrete time series. The power spectrum behavior of such a signal for paradigmatic quantum systems suggests the following conjecture: The energy spectra of chaotic quantum systems are characterized by $1/f$ noise. Moreover, we show that the spectra of integrable quantum systems exhibit $1/f^2$ noise. Although an exact proof of this conjecture is not available yet, random matrix theory can be used to derive theoretical expressions that reproduce to a good approximation the power laws of type $1/f$ ($1/f^2$) characteristic of chaotic (integrable) systems.

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