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A prequantization approach to quantum chaos

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Abstract

Prequantum dynamics has been introduced in the 70' by Kostant–Souriau–Kirillov as an intermediate between classical and quantum dynamics. In common with the classical dynamics, prequantum dynamics transports functions on phase space, but in addition incorporates some phases which are important in quantum interference effects. We consider the special model of the cat map which generates a chaotic dynamics on the torus. We define and calculate the Ruelle resonances of the prequantum transfer operator and show how they are related to the quantum eigenvalues. A remarkable consequence is that quantum dynamics emerges from long time behaviour of prequantum dynamics. We discuss perspectives of this approach in the non linear case, which could reveal its interest for quantum chaos, due to the fact that Gutzwiller and Van-Vleck semi-classical formula are exact for the prequantum transfer operator.