Classical delocalization vs. quantum localization for non-compact cusped billiards

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We show examples of billiard systems on non-compact tables whose classical and quantum dynamics behave, at least for some aspects, in radically different ways. In particular, classical ergodicity entails that the material point delocalizes for long times, but the quantum eigenstates are (and remain at any time) strongly localized; and this while the Schnirelman Theorem—often referred to as quantum ergodicity—holds. We use these examples to discuss the scope of the definition of quantum ergodicity named after Schnirelman.