Why collapse dynamics imply diffusion and how to use this to test collapse models

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Testing the limits of validity of the superposition principle is of crucial importance in the foundations of quantum mechanics and the development of quantum technologies. A way to quantify possible breakdowns of the superposition principle is given by collapse models. These models modify quantum mechanics by introducing a nonlinear interaction with a classical noise that induces collapse in space. The natural way of testing collapse models is through interferometric experiments of systems with large masses, which is challenging. For this reason, non-interferometric experiments were considered. These experiments exploit the fact that the noise responsible for the collapse induces a diffusion in momentum, in principle detectable even in localized systems by performing high precision position measurements. We first give a summary of the bounds on collapse models from non-interferometric experiments. Then we show how the diffusion in momentum is not just a property of collapse models but it is a universal feature of any dynamics inducing collapse in space. This implies that non-interferometric experiments test the quantum superposition principle in a stronger sense than one might suppose.