Trapping and binding by dephasing

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Abstract

The binding and trapping of particles usually rely on conservative forces, described by unitary quantum dynamics. We will demonstrate how both can also arise solely from spatially dependent dephasing, the simplest type of decoherence. This can be based on continuous weak position measurements in only selected regions of space, for which we propose a practical realisation. For a single particle, we demonstrate a quantum particle-in-a-box based on dephasing. For two particles, we demonstrate their binding despite repulsive interactions, if their molecular states are dephased at large separations only. Both mechanisms are experimentally accessible, as we show for an example with Rydberg atoms in a cold gas background.

References

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Figures

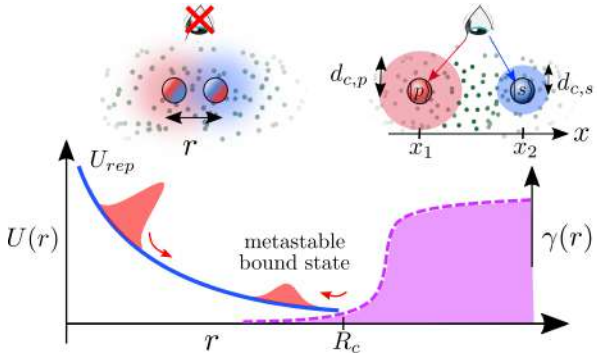

Figure 1: Formation of metastable bound states of repulsively interacting Rydberg dimer using selective relative distance measurements via Electromagnetically Induced Transparency (EIT).

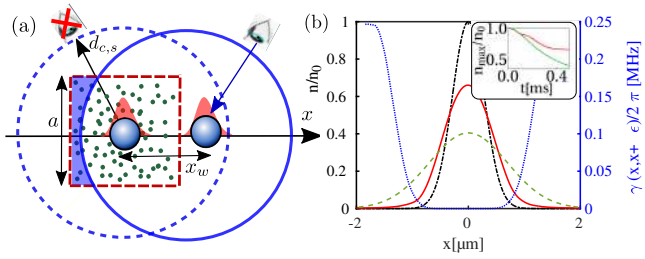

Figure 2: Trapping a single particle through dephasing. (a) Sketch of an atom trapped in a dephasing well resulting from position measurements, (b) Probability density of trapped particle at various times.