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Rogue decoherence in the formation of a macroscopic atom-molecule superposition MATT MACKIE, Temple University, OLAVI DANNENBERG, Helsinki Institute of Physics — We theoretically examine two-color photoassociation of a Bose-Einstein condensate, focusing on the role of rogue decoherence in the formation of macroscopic atom-molecule superpositions. Rogue dissociation occurs when two zero-momentum condensate atoms are photoassociated into a molecule, which then dissociates into a pair of atoms of equal-and-opposite momentum, instead of dissociating back to the zero-momentum condensate. As a source of decoherence that may damp quantum correlations in the condensates, rogue dissociation is an obstacle to the formation of a macroscopic atom-molecule superposition. We study rogue decoherence in a setup which, without decoherence, would yield a macroscopic atom-molecule superposition, and find that the most favorable conditions for said superpositions are a density $\rho \sim 10^{12}\,\mathrm{cm}^{-3}$ and temperature $T \sim 0.1$ nK.

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