Extreme depolarization for any spin

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We present a detailed study of the depolarization dynamics of an individual spin with an arbitrary spin quantum number j, or, equivalently, of a system of $N = 2j$ constituent spin-1/2 initially in a symmetric state undergoing collective depolarization. In particular, we identify the most superdecoherent states. In the case of isotropic depolarization, we show that a class of maximally entangled pure states distinct from GHZ and W states, a.k.a. spin anticoherent states [1,2], display the highest decoherence rate for any number of spins. Moreover, we find that these states become absolutely separable after a time which does not depend on the number of spins. We also prove that entanglement is a necessary and sufficient condition, both for pure and mixed states, for superdecoherence to take place [3]. Finally, for anisotropic depolarization, we identify not only the states with the highest initial decoherence rate, but also the states that lose their purity most rapidly over any finite time for a few spins.

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