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COHERENCE EFFECTS IN MAGNETISM:SINGLE MOLECULAR MAGNET QUBITS AND SPIN-ORBIT QUBITS

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Rabi oscillations have been recently observed for the first time in two new species of magnetic materials: the Single Molecular Magnets (SMMs) and the Rare-Earth ions (REs).
The SMMs consist of *3d*-transition metal ion V_{15} clusters embedded in a self-organized non-magnetic environment ("SMM Qubits") whereas the RE ions, characterized by a strong spin-orbit coupling, are simple paramagnetic ions diluted in a non-magnetic matrix ("SO Qubits").
The coherence times are, in both cases, in the microsecond scale, despite strong spin-orbit coupling favoring spin-lattice decoherence (SO qubits) or large nanometer-size molecules with huge Hilbert space dimensions and embedded nuclear spins (SMM qubits).
Main decoherence mechanisms have been identified and studied in both cases and interpreted on the basis of their respective Hamiltonians with different degrees of complexity, including unavoidable weak (or strong) homogeneous or inhomogeneous disorder. Particular attention is paid to what we call "driven decoherence": the decoherence induced by the microwave field which induces the Rabi oscillations. Understanding this decoherence mechanism and investigating the ways to get rid of it, is of prime importance for the implementation of a quantum computer.