



Molecular nanomagnets have been proposed as prime quantum bit candidates. Quantum computing promises to enable calculations that will forever remain intractable with conventional computers. In principle, any two-level system will function as a qubit. One of the decisive quantities which determine the usefulness of a particular system is the ratio of the quantum coherence time and the time needed for a single quantum operation. The latter is given by electronics constraints, thus only the former can be optimized by chemical means. The quantum coherence time is the lifetime of an arbitrary superposition state, and corresponds to the time available for the quantum computation. The advantage of molecular systems is that their properties may be tuned continuously and almost without limitations by chemical synthetic means. This feature is especially useful, given the fact that quantum computing only becomes competitive if networks of hundreds of interacting qubits can be generated. In that respect, the fact that molecules have been shown the ability to form long-range ordered arrays on surfaces is also beneficial.

However, thus far, quantum coherence times have been mostly less than astounding, typically some microseconds at ca. 5 K. We have recently shown that single ion systems (i.e., mononuclear complexes) can display much longer coherence times. Thus, we have found coherence times of up to 68 μs at 7 K for $(\text{PPh}_4\text{-d}_{20})_2[\text{Cu}(\text{mnt})_2]$ and even at room temperature, the quantum coherence time is almost a microsecond.[1] Thus, the quantum coherence time exceeds that of prime competitors, such as diamond NV centres and phosphorus dopants in silicon in certain conditions. In this presentation, we will show published results,[1 – 4] as well as new results on single-qubit systems, two-qubit systems and on triangular qubits featuring antisymmetric exchange interactions. The last of these were predicted to be addressable by means of microwave electric fields, which would enable local control. Also we will discuss our recent work on the qualitative prediction of the quantum coherence time from the molecular structure.

[1] K. Bader, M. Winkler, **J. van Slageren**, *Chem. Commun.*, **52**, 3623 - 3626 (2016). [2] K. Bader, D. Dengler, S. Lenz, B. Endeward, S.D. Jiang, P. Neugebauer, **J. van Slageren**, *Nat. Commun.*, **5**, 5304 (2014); [3] P. Lutz, R. Marx, D. Dengler, A. Kromer, **J. van Slageren**, *Mol. Phys.*, **111**, 2897 – 2902 (2013); [4] C. Schlegel, **J. van Slageren**, G. Timco, R.E.P. Winpenny, M. Dressel, *Phys. Rev. B*, **83**, 134407 (2011); [5] C. Schlegel, **J. van Slageren**, M. Manoli, E.K. Brechin, M. Dressel, *Phys. Rev. Lett.*, **101**, 147203 (2008).