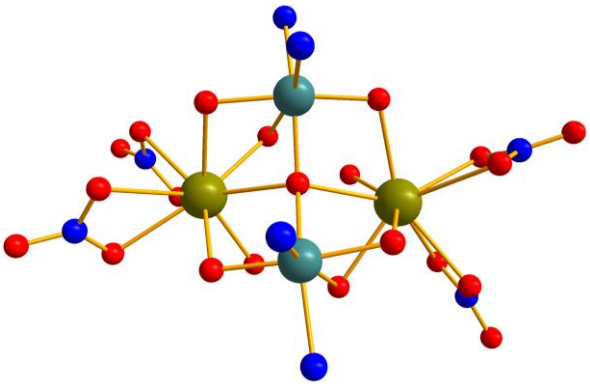
Master/Bachelor Thesis Project

Using Concepts of Machine Learning for Analysing Magnetization Data of Molecular Nanomagnets



Molecular nanomagnets provide us with a fantastic playground to experimentally test the quantum mechanics and quantum statistics of well-defined collections of interacting quantum objects. Despite their small size, and their in principle known Hamiltonian, molecular nanomagnets display a great variety of non-trivial collective quantum behavior. To quote P.W. Anderson: “More is different”.

A particular sub class of molecular nanomagnets is that of the so called Single Molecule Magnets (SMMs), which provide us with the opportunity to realize data storage and quantum bits at the molecular scale, and which are thus of interest from a fundamental scientific point of view as well as for potential applications. The best SMMs contain Lanthanide metal ions such as Dysprosium or Terbium, with partially filled 4f atomic shells. Using Lanthanide ions however presents us with a fundamental challenge, which researchers are tackling for decades without a satisfying solution yet: The analysis of the experimental magnetization data involves dozen of parameters in the Hamiltonian, those effect on the magnetization is largely not understood however.

Modern tools of machine learning, and the Convoluted Neural Networks (CNNs) used in deep learning in particular, have emerged as highly efficient tools for detecting trends in large data sets. Concepts of machine learning are currently entering also the physics science arena. The aim of this thesis is to explore the capabilities of CNNs for detecting trends in large sets of artificially generated magnetization data of prototypical Lanthanide-based SMMs, in order to guide experimentalists in identifying the relevant parameters in the model Hamiltonian.

Interested?

Then don't hesitate to come for a coffee on the second floor of the Physik Hochhaus!

Contact:

Prof. Oliver Waldmann, Room 202, Physik Hochhaus, oliver.waldmann@physik.uni-freiburg.de