Frustration effects in spinel-type compounds

Alois Loidl
Experimentalphysik V, Center for Electronic Correlations and Magnetism
Universität Augsburg, 86 135 Augsburg, Germany

Frustration characterizes the inability of a system to find a unique and ordered ground state despite the presence of strong interactions. Frustration is a fundamental concept in the physics of spin glasses. But frustration can also arise in stoichiometric solids solely from geometric constraints. Antiferromagnetically coupled Ising spins on a triangular lattice are a prototypical example of a fully frustrated magnet. Frustration in the spin sector is well known in triangular based materials, like Kagome lattices (2D) or pyrochlores (3D). In 3D systems, depending on the spin value, the magnetic interaction strength, the type of geometrical frustration and the magnetic anisotropy very different ground states can evolve: spin liquids, spin ice, spin clusters or resonating valence bonds have been identified.
Frustration in the orbital sector is much less investigated, but is expected to be also a generic property of the orbital degrees of freedom, even in simple cubic lattices. It seems clear that the tendency to form an orbital liquid is much higher in systems with additional geometric frustration. However, in this case the experimental situation is rather poor.
In the present contribution we will discuss spinel compounds, like LiV_2O_4, ZnV_2O_4, $FeCr_2S_4$, $FeSc_2S_4$ and $MnSc_2S_4$, revealing either frustrated magnetism, or frustrated orbital order, but also exhibiting spin-orbital liquids in some cases. The results of measurements of the magnetic susceptibility, magnetization and heat capacity, as well as NMR and ESR experiments are discussed and interpreted in the frame of the concept of frustration.