SFB 608

Einladung zum Kolloquium

Ort: Universität zu Köln
II. Physikalisches Institut, Seminarraum 201

Zeit: Mittwoch, den 28. Januar 2004, 15 Uhr c.t.

Sprecher: Dr. P. Radaelli
ISIS, Rutherford Laboratory
Abingdon, UK

Thema: Self-organized patterns on the frustrated lattice of transition-metal spinels.

The interest in geometrically frustrated systems can be traced back to the work of Linus Pauling on the frozen disorder of crystalline ice. Frustration arises when geometrical constraints promote a locally degenerate ground state. In the case of ice, this corresponds to the many different ways of orienting the water molecules without changing the energy of the system. In a periodic system with this local geometry, there exists a manifold of degenerate ground states, which may freeze on cooling forming ice or remain liquid down to the lowest temperatures due to quantum effects. A third possibility is that of a phase transition that lowers the local symmetry and lifts the degeneracy. One of the classic examples of geometrical frustration is the so-called pyrochlore lattice, found in cubic ice, in cristobalite (SiO2), in the true pyrochlores (general formula A2B2X7) and in spinels (general formula AB2X4). Transition-metal spinels are regarded as model systems for ordering of charges, spins and orbitals on the pyrochlore lattice, giving raise to a diverse phenomenology, including that of spin liquids and ices and of charge ordering in mixed-valence systems. I will review some of the work done on these systems for the past few decades, including the 60 year-old quest for the ordering of charges in magnetite (Fe3O4), the oldest magnetic material known to mankind. One might in principle ask what would happen if the "entities" (spins, charges, etc.) at the nodes of the pyrochlore lattice had the tendency to form pairs. The answer is that frustration is lifted and the system orders, giving rise to an often complex dimerisation pattern, which may lead to the formation of nanometre-sized objects such as rings and helices. I will present examples of this behaviour in spinel oxides and chalcogenides.

Gez. Prof. M. Braden