state conversion. Ordering of the spin states is manifested in the corresponding superstructure reflections; these can be traced in a diffraction experiment as a function of external stimuli. By mapping the reciprocal space with an area detector and synchrotron light, we have studied the temperature dependence of the superstructure reflections for NdBaCoO$_3$ and TbBaCoO$_3$. We have found that above the metal-insulator transition there are two different Co ions in the asymmetric unit, one sitting in a pyramidal and one in an octahedral environment. Below the transition temperature there are four structurally different Co ions. This observation agrees with the “spin blockade” mechanism suggested for the metal-insulator transition in cobaltites. We also present results of structural analyzes illustrating how the corresponding powder diffraction measurements could easily overlook the correct structure. A symmetry analysis bracketing the observed phase transitions within the context of Landau theory is also given.

Keywords: cobaltites, spin transition, spin ordering

**P11.11.39**

**Acta Cryst. (2008). A64, C519**

**Investigation of the crystal symmetry of BiMnO$_3$: Electron diffraction study**

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BiMnO$_3$ has been considered as a multiferroic material due to the ferroelectric and ferromagnetic properties. The crystal symmetry is, however, controversial today. We investigated the crystal symmetry of BiMnO$_3$ by Convergent-Beam and Selected-Area Electron Diffraction (CBED and SAED, respectively). CBED, which was used in order to discriminate the crystal axes of BiMnO$_3$, showed that BiMnO$_3$ belongs to space group C2/c. In the [010] SAED pattern, however, the very weak but sharp h0l (l=2n+1) reflections were observed indicating the noncentrosymmetric long-range ordered structure (C2) [1]. This implies that the weak reflections had quite little influence on the CBED patterns [2]. The h0l (l=2n+1) reflections could not be detected in structurally related BiScO$_3$ and BiCrO$_3$ indicating centrosymmetric C2/c, respectively [1]. This strongly suggests that the noncentrosymmetric long-range ordered structure (C2) of BiMnO$_3$ is attributed not only to Bi$^{13+}$ ions with lone electron pair but also to Mn$^{4+}$ ions, that is, to correlation between Bi$^{13+}$ and Mn$^{4+}$ ions.

**Keywords**: magnetic structures, perovskite structures, neutron powder diffraction

**P11.11.41**

**Acta Cryst. (2008). A64, C519–C520**

**Coupling of Tb- and Mn-magnetic orders in multiferroic TbMnO$_3$**

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While ferroelectricity and magnetism are chemically incompatible, it has recently been shown that inversion and time-reversal symmetry can be broken simultaneously if magnetic spins order in a cycloidal arrangement as in RMnO$_3$. It has been also shown that although the magnetic ordering of Mn-spins drives multiferroicity, R-ions strongly modulate it and thus significantly influence multiferroic properties. Irrespective of the mechanism that drives multiferroic behavior, the magnetic coupling between R- and Mn-spins needs to be understood in order to arrive at a detailed and quantitative model of multiferroics. Here we report on diffraction measurements which demonstrate that the Tb- and Mn- magnetic ordering in multiferroic TbMnO$_3$ remain