Charge and orbital order (COO) in manganites can melt under magnetic field, so that the material becomes metallic. Under application of very high magnetic fields the drop in resistance is colossal, however, smaller magnetic fields are sufficient to melt the less stable COO in manganites doped with Fe.

In the layered manganites RBaMn_{2}O_{5+y}, the large-size cations R^{3+} and Ba^{2+} form the separate layers alternating along c-axis with MnO_{1+y} layers. For the oxygen contents 5+y = 5, 5.5 or 6 all the MnO_{1+y} layers are identical to each other. Each layer accommodates the charge and orbital order between Mn^{2+} and Mn^{3+} (y=0), Mn^{3+} and Mn^{4+} (y=0.5) and Mn^{3+} and Mn^{4+} (y=1) shown in Fig.1.

When a small amount of manganese is substituted with iron we observe that all Fe ions take the valence Fe^{3+}. All the Fe^{3+} ions reside in the sites of Mn^{3+}. This is not surprising because the Mn^{3+} and Fe^{3+} ions are very similar in size. In contrast, the site of Mn^{4+} is too small for Fe^{3+} and the site of Mn^{2+} is too large for Fe^{3+}.

Unlike to similar size and charge, the orbital properties of the Mn^{3+} and Fe^{3+} ions are very different. The Jahn-Teller (JT) ion Mn^{3+} tends to sit in a low-symmetry environment. Symmetry degrades when only one of eg orbitals is half-filled. However, for Fe^{3+} ion both of the eg orbitals are half-filled, so that the semi-closed d-shell of Fe^{3+} is spherically symmetric. Unlike to the JT ions, such as Mn^{3+} or Cu^{2+}, the ion Fe^{3+} have no on-site electrons that would produce any electric field gradient (EFG) at the place of ^{57}Fe nuclei. Therefore, when Fe^{3+} is placed into the octahedral site of Mn^{3+} the observed quadrupole splitting reproduces faithfully the distortion of octahedral environment of Mn^{3+}.

In agreement with the number of the non-equivalent structural sites of Mn^{3+} we see the single-site Mössbauer spectra in oxygen-depleted (O_{5}) and oxygen-saturated (O_{6}) samples, but two doublets for the intermediate oxygen content (Fig. 2). In the latter case, the major doublet comes from the site with the in-plane orientation of the principal component of EFG. The minor subspectrum for y=0.5, as well as the spectra for y=0 and y=1 come from sites with out-of-plane orientation of the main component of EFG (V_{ZZ} \perp MnO_{1+y} planes).

The 5-fold and 6-fold coordinated Fe^{3+} ions are in pyramids for (a) and (b, minor doublet) and in octahedra for (b, major doublet) and (c). Basically, these polyhedra are the same for Mn^{3+} and Fe^{3+}. However, the difference of the orbital configurations of the Fe^{3+} and Mn^{3+} ions gives rise to some distinction between the FeO_{6} and MnO_{5} pyramids [1]. Exact locations of the dopant Fe^{3+} and host Mn^{3+} inside of the pyramid do not coincide. The isotropic dopant ion Fe^{3+} is shifted towards the apex to equalize the fifth out-of-plane Fe-O distance with the four in-plane distances. Indeed, without such a shift one must expect much larger quadrupole splitting than observed.

Asymmetry between the doublet line intensities arises mostly from platy habitus of layered crystals whose surface normal points along V_{ZZ}. The out-of-plane and in-plane 3d-orbitals are the half-filled orbitals of Mn^{3+} in the O_{5} and O_{6} cases, where V_{ZZ}>0 and V_{ZZ}<0, respectively. The opposite signs of V_{ZZ} results in opposite doublet asymmetries owing to preferred orientation in Fig.2 (a) and (c). Additional smaller asymmetry contribution is due to vibrational anisotropy. The total asymmetry is enhanced by this effect (Goldanskii-Karyagin) in the «O_{6}» spectra, but weakened in the «O_{5}» spectra [2,3].

The fact that only one Mn^{3+} site exists in Mössbauer spectra shows that the charge-ordered domains are configured under control of the frozen disorder of Fe.