Experimental Report

11/01/2014

Proposal:	**5-41-709**	**Council:**	4/2012	

Title: Magnetism in Sr2FeO4 and study of charge stripe ordering in Sr2-xLaxFeO4

This proposal is a new proposal

Research Area: Physics

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Samples: Sr2FeO4 , Sr1.85La.015FeO4

Instrument	Req. Days	All. Days	From	To
D10	0	4	27/11/2012	01/12/2012

Abstract:

Few is known about the magnetism in the negative charge transfer compound Sr2FeO4. Powder neutron diffraction studies report the absense of any magnetic reflections. However, the magnetic susceptibility in the same studies exhibits antiferromagnetic properties of this material. We managed to grow sizeable single crystals of Sr2FeO4. Therefore, the magnetism can be studied much more precisely by means of single crystal neutron scattering now. Next, charge disproportionation has been reproted for other Fe4+ Ruddlesden-Popper-members. Hence, we can also search for signatures of charge disproportionation and ordering within the same measurement. Furthermore, we are also interested in studying the effect of electron doping in Sr2FeO4 with regard to charge stripe instabilities that might also play an important role in the isostructural HTSC cuprates. Due to our phase diagram of the La1-xSr1+xFeO4 system, we expect a break-down of the commensurate magnetism of the type found in LaSrFeO4 somewhere around 40%-80% of doping x. The Sr1.85La0.15FeO4 sample should be clearly above the commensurate ordered regime. Hence, we propose also to search for charge stripe ordering in Sr1.85La0.15FeO4

Magnetism in Sr_2FeO_4 and study of charge stripe ordering in $Sr_{2-x}La_xFeO_4$

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Single crystals of Sr_2FeO_4 and $La_{0.15}Sr_{1.85}FeO_4$ were grown under pressurised oxygen atmosphere. Using a Laue Camera, these crystals were oriented and checked to consist of a single domain. During characterisation it became apparent that the sample is highly air and/or moisture sensitive. Therefore, we sealed the oriented crystals in argon atmosphere for transportation. However, additional to the time needed to glue the sample and mount it in the cryostat the sample was exposed to air/moisture because of totally unexpected problems when evacuating that particular cryostat that was available. Therefore, larger parts of the sample decomposed which leads to powder lines emerging from the Bragg reflections in our whole experiment.

In this single crystal neutron diffraction experiment on the remaining sample pieces we observed (1 0 0) and (0 1 0) reflections (with respect to the I4/mmm unit cell), see Fig. 1. Besides these probably structural reflections we were additionally able to detect incommensurate magnetic reflections. Also our (decomposed) $La_{0.15}Sr_{1.85}FeO_4$ sample exhibits similar incommensurate magnetism at low temperatures. The corresponding magnetic reflections can be found at (0.19 0.81 0) and (0.81 0.19 0) in Figure 1a and 1b, where Figure 1b shows a map of the entire HK0 plane with 0 < H,K <1. Surprisingly we found Bragg intensities also in the L=0.5 plane, e.g. at (1 0 0.5) (1 1 0.5) and (0 1 0.5). This suggests that the unit cell is doubled along the c direction (which could

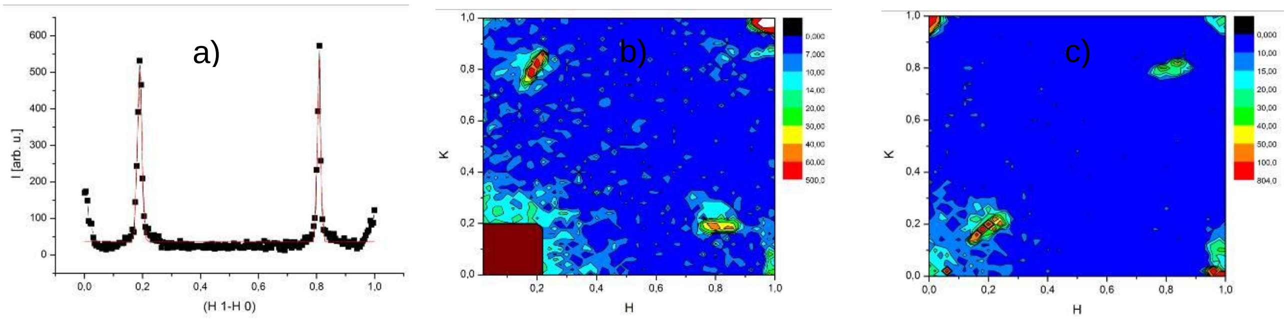

Figure 1: (10K data) a) Scan from (0 1 0) to (0 1 0), b) and c) H K L Maps with L = 0 and L = 0.5

be explained e.g. by oxygen deficiency ordering). An additional surprise is the shift of the H and K components of the incommensurate magnetic reflections to the positions (0.19 0.19 0.5) and (0.81 0.81 0.5) (Fig. 1c). The Sr_2FeO_4 sample shows a similar behaviour upon cooling. The incommensurate magnetic Bragg reflections in the L = 0 plane can be found at (0.15 0.85 0) and (0.85 0.15 0) (Fig. 2a). When the 300 K data is subtracted from the 2 K data it is possible to observe weak Intensities at the Bragg positions (0.15 0.15 0) and (0.85 0.85 0). In Map 2d) the L dependency of the Bragg intensities can be observed. The (0.15 0.15 L) magnetic signal appears for all integer L values while the broadness in L direction suggests that the weak intensities in our maps have their origin in the magnetic reflexions that are actually $\Delta L=1/2$ away.

Finally, we were able to detect interesting incommensurate magnetic peaks in both of our iron oxide samples. But further studies are needed in order to understand our observations properly.

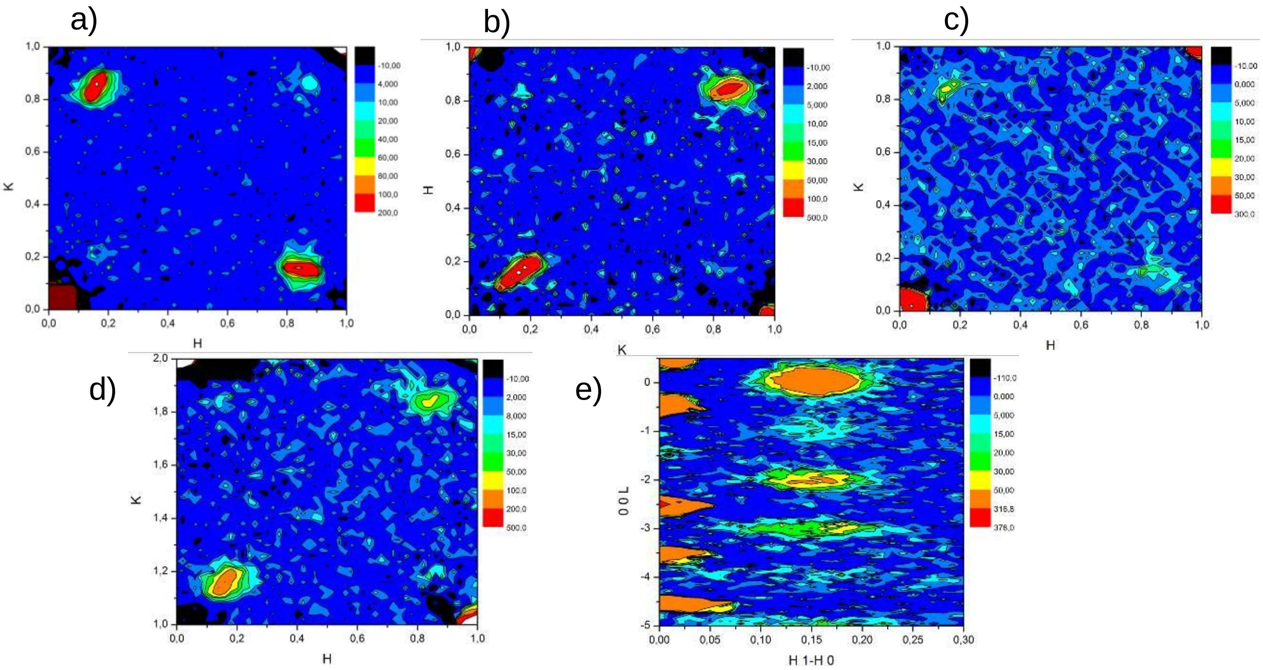

Figure 2: (subtracted data 2K-300K) a), b) and c) H K L Maps with L = 0 and L = 0.5 and L=1 d) Map around (0.5 1.5 0) e) HHL Map