Experimental report

09/09/2023

Proposal: CRG-2926 **Council:** 10/2022

Title: Quasi-static elastic domains in the quantum paraelectric phase of SrTiO$_3$

Research area: Physics

This proposal is a new proposal

Main proposer: Benoit FAUQUE

Experimental team: Benoit FAUQUE
Philippe BOURGES

Local contacts: Stephane RAYMOND

Samples: SrTiO3
SrTiO3 O18

Instrument	Requested days	Allocated days	From	To
ORIENTEXPRESS	1	1	28/06/2023	29/06/2023
IN12	7	7	28/06/2023	05/07/2023

Abstract:

The abstract is in the scientific case pdf file.

Report on the experience 7-01-572: Quasi-static elastic domains in the quantum paraelectric phase of $SrTiO_3$

During one week of experiment on IN12 we have extended the study of the stable TA branch that we found in pure STO [1]. Measurements have done first in pure STO (three days) and then in Ca-doped STO (four days). Adding a tiny concentration of Ca in STO stabilizes the ferroelectric order (see Fig.1 a-b) like it does in the case of $SrTiO^{16}{}_{1-x}O^{18}{}_x$. The advantage of Ca-doped sample is that single crystals have a larger volume (by a factor 4) compare to the isotopic O substitute samples.

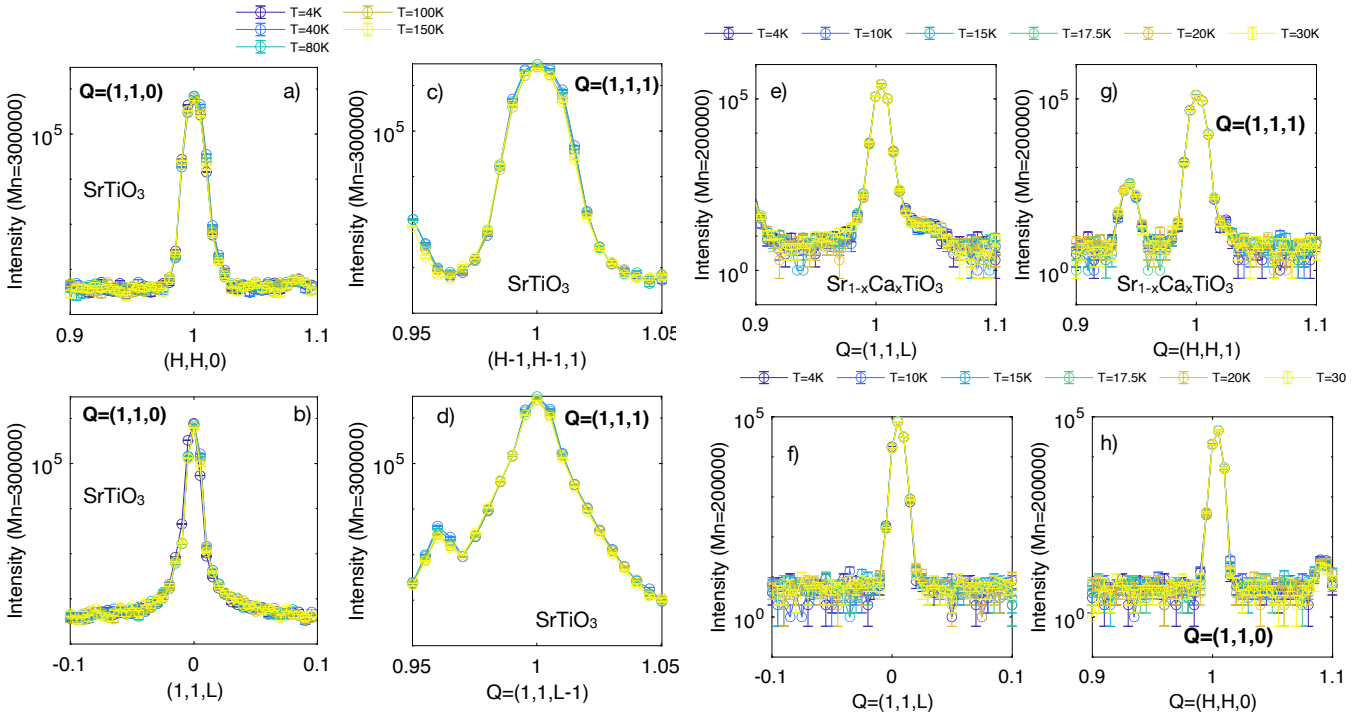

Figure 1: **Absence of quasi-elastic signal in $Sr_{1-x}Ca_xTiO_3$** : Q-scans along the (H,H,0) and (0,0,L) directions for the Bragg peaks Q=(1,1,0) and Q=(1,1,1) for x=0 a-d) and x=0.8% for e-h) for different temperatures. For both compounds we did not detect any quasi-elastic signal in the tail of the Bragg spots at low temperature.

We first study the T-dependence of the TO mode as well as it dispersion. We then focus on the quasi-elastic signal around the Bragg spots : Q = (002), (110) and (111). Fig 1 shows typical scans done around the two Bragg spots (110) and (111) at different temperatures and in the two samples : $x = 0$ and $x = 0.8$ %. No quasi-elastic signal is found at low temperature. In particular close to the Q-point where the TA softening has been found the largest Q=(0.017,0.017,2) [1]. These results are further support with our complementary study on THALES where we found that the softening of the TA branch is not complete.

References

[1] Fauqué, B., Bourges, P., Subedi, A., Behnia, K., Baptiste, B., Roessli, B., Fennell, T., Raymond, S., and Steffens, P. (Oct, 2022) Mesoscopic fluctuating domains in strontium titanate. *Phys. Rev. B*, **106**, L140301.