	Experiment title: Structural relaxation in PMN-type relaxors	**Experiment number**: HC2554
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Report:

The temperature dependence of the structural relaxation in a prototypical relaxor ferroelectrics $PbMg_{1/3}Nb_{2/3}O_3$ (PMN) was studied using XPCS technique. For this the sample, a single crystal of PMN, was made in a form of needle of 10 μm in diameter in order to use the horizontal scattering geometry in transmission mode. A coherent beam 10×10 μm in size of 8.1 keV radiation was used as a probe. The 2D diffuse scattering patterns were measured around 110 (2θ=26.36°) Bragg reflection by Andor CCD. By varying the crystal rotation θ we could cover 0.05-0.25 r.l.u. Q range to get the representative characterization of the dynamic behaviour of PMN . The sample's temperature was set and controled using Oxford CryoStream 700 Plus nitrogen blower in the temperature range 230-330 K i.e. in the region which is usually called "Dynamic relaxor region". This region is specially interesting, because the information on the Q-dependence of the relaxation parameters will provide the insight into the microscopic origin of the slow relaxation.

The series ot 2D scattering patters were analyzed to extract intensity-intensity time correlation function wich is described by the exponentialy decaying KWW expression $g^{(2)}(Q,t)=1+C\exp(-2(t/\tau)^{\beta})$, where C is the contrast, τ - characteristic relaxation time and β is the exponent describing the shape of the decay. The correlation functions for the scattering

wavevector Q=0.0072 1/Å at various temperatues are shown in Figure 1. All functions can be well described by the compressed exponential shape β>1. The obtained characteristic relaxation times τ are very long (τ>700 s) and show neither clear tempereture dependence nor Q dependence. This makes us think that the observed decay at long times could be due to experimental instability. Therefore the genuine structural relaxation is suspected to be faster than the speed of the camera used and was not detected during the experiment.

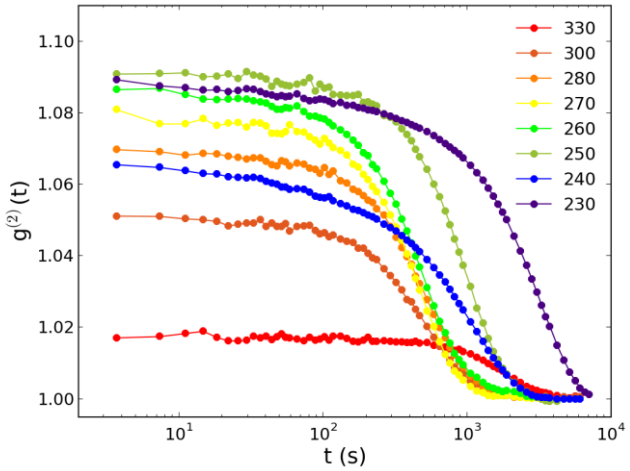

Fig. 1. *Intensity correlation functions measured in the proximity of 110 Bragg peak at Q=0.072 1/Å at various temperatures.*

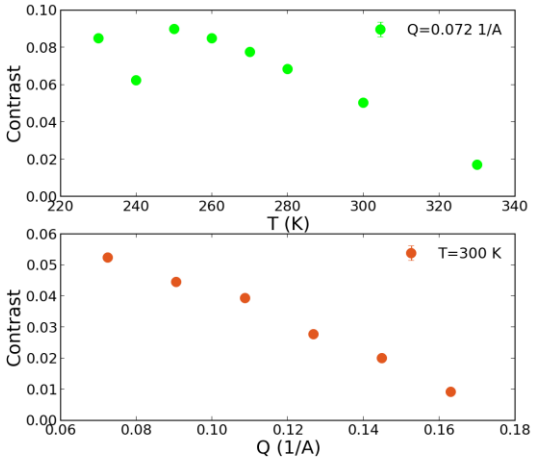

Fig. 2. *Contrast as a function of temperature T at Q=0.072 1/ Å and the wavevector Q at T=300 K.*

The presence of fast relaxations is supported by the observed behaviour of the contrast C of the correlation fucntions. The temperature and Q dependences of the contrast are shown in Figure 2. The value of the contrast decreases on increase of both Q and T. Such behavior was previously reported and rationalized by the presence of fast relaxation processes that fall out of the experimental time window[1,2] but manifest themselves by the contrast decrease due to the fast localized motions.

The preliminary analysis of the experimental data sugests that interesting dynamics in the relaxor ferroelectric PMN occur at time scales faster than 3 seconds. To accesse it a faster detector such as Maxipix that can take 300 frames per second allowing probing millisecond dynamics must be used. Our experiment, performed at 16 bunch filling mode, showed that the PMN is a strongly scattering object and there is just enough signal to probe millisecond dynamics in 200 mA filling mode.

References

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