EUROPEAN SYNCHROTRON RADIATION FACILITY

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ESRF

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office via the User Portal:

https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Reports supporting requests for additional beam time

Reports can be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** **Critical lattice dynamic in lead zirconate titanate with low concentration of Ti**	**Experiment number**: HC 1692
Beamline: ID28	**Date of experiment**: from: 22.10.14 to: 27.10.14	**Date of report**: 26.02.15
Shifts: 18	**Local contact(s)**: Roman Burkovskiy	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

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Report:

Inelastic x-ray scattering has been successfully studied in monocrystal lead zirconate titanate ($PbZr_{1-x}Ti_xO_3$) with Ti concentration x = 0.007. The phonon spectrum has been collected at different points of the Brillouine zone and various temperatures. The main attention has been paid to direction [110] (Σ-direction). Here we have focused on M-point q = (½ ½ 0) and center of Brillouine zone near Bragg peak Q = (2 0 0). The measurements have been carried out for 4 temperatures in paraelectric phase and 1 temperature in intermediate phase.

The example of collected spectra is shown in figure 1. Two strong phonon resonances are observed at this spectrum. Low-energy peaks correspond to the transverse acoustic (TA) phonons with polarization vector e = (1 -1 0) ("*in-plane*" phonon). High-energy peaks correspond to the transverse optic (TO) phonon.

As the result of the fit by the sum of 4 phonon resonances TA and TO phonons dispersions have been obtained. The temperature evolution of TA phonon dispersion is shown in figure 2. While temperature decreases approaching the phase transition temperature the energy of TA phonon branch goes down. After transition to intermediate phase the TA phonon energy raises.

Temperature evolution of spectrum in M-point has been traced (figure 3). The interesting behavior of central peak has been obtained. The central peak intensity at M-

point of the Brillouine zone demonstrates critical growth on approaching the phase transition.

This behavior indicates that there are some special processes of M-superstructure formation. The further analysis will be carried out to establish intermediate phase origin in lead zirconate titanate.

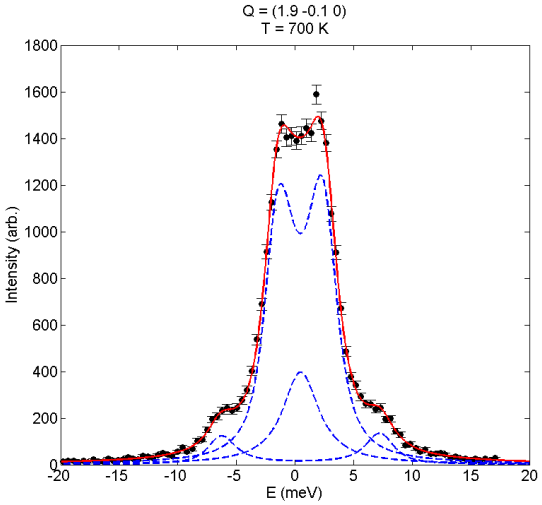

Figure 1 – Inelastic X-ray spectrum for $PbZr_{1-x}Ti_xO_3$ with Ti concentration x=0.007 at Q = (1.9 -0.1 0) and T = 700K: points-experimental result, lines – fitting result.

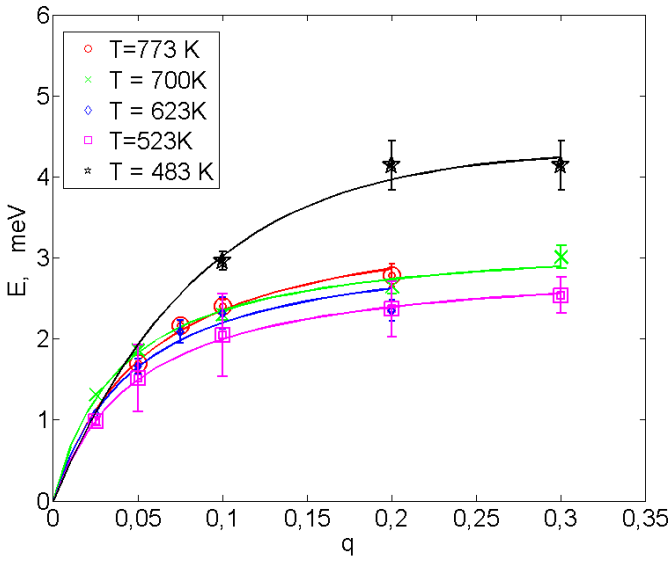

Figure 2 – TA in plane phonon dispersions along Σ-direction for different temperatures in $PbZr_{1-x}Ti_xO_3$, x=0.007.

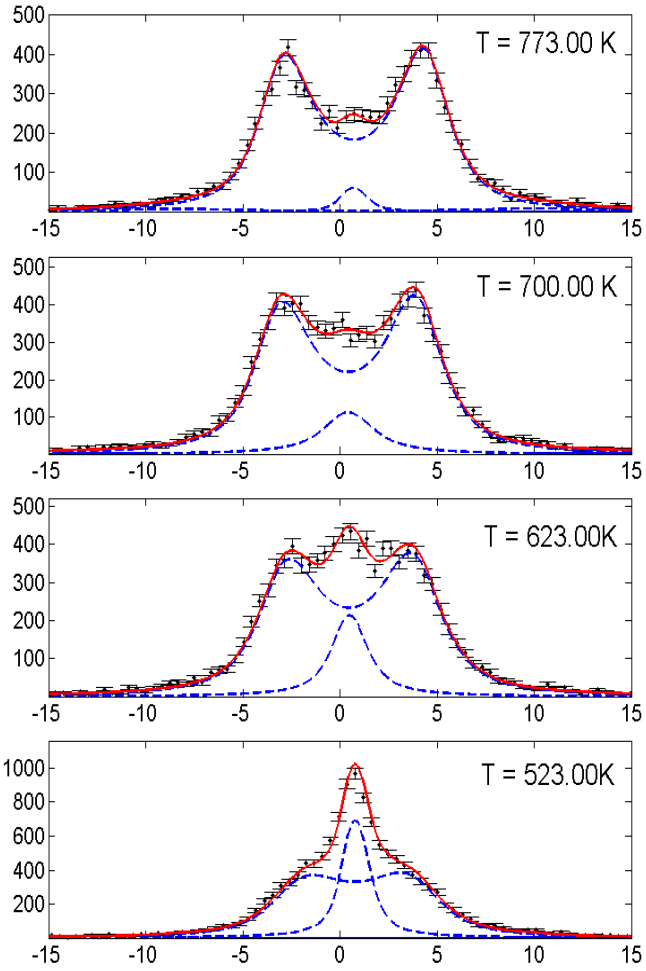

Figure 3 - Temperature evolution of spectrum in M-point Q = (1.5 -0.5 0) in $PbZr_{1-x}Ti_xO_3$, x=0.007.