ESRF	**Experiment title:** Sound attenuation in fragile glasses	**Experiment number**: HD350
Beamline:	**Date of experiment**: from: 29/04/2009 to: 06/05/2009	**Date of report**: 09/12/2013
Shifts:	**Local contact(s)**: V. Giordano	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Dr. Ruta Beatrice*
Dr. G. Baldi*
European Synchrotron Radiation Facility, 6 rue Jules Horowitz, 38043 Grenoble, France.

Report:

The experiment results of this experiment have been published in:

B. Ruta, G. Baldi, V. M. Giordano, F. Scarponi, D. Fioretto and G. Monaco. "Acoustic exicitations in glassy sorbitol and their relation with the fragility and the boson peak", J. Chem. Phys. 137, 214502 (2012).

and

B. Ruta, G. Baldi, V. M. Giordano, L. Orsingher, F. Scarponi, S. Rols and G. Monaco.
"Communication: High-frequency acoustic properties and boson peak in glasses: a study of their temperature dependence", J. Chem. Phys. 113, 041101 (2010).

Abstract:

We have performed a detailed investigation of the vibrational properties of a fragile glass of sorbitol by means of IXS. The high frequency acoustic excitations can be described to a good approximation in a quasi-harmonic approach, thus with a sound velocity whose temperature dependence is completely governed by the transformation of the corresponding continuum medium and with an acoustic attenuation mechanism clearly non dynamic in its origin. Moreover, we find that the well-known excess in the vibrational density of states (VDOS) over the Debye, elastic continuum prediction (boson peak, BP) is clearly related to anomalies observed in the acoustic dispersion curve in the mesoscopic wavenumber range of few nm^{-1}. These elastic anomalies appear as a softening of the high frequency sound velocity and a corresponding strong, thus

Rayleigh like, damping mechanism for excitations energies close to that of the boson peak maximum. The study of the temperature dependence of these properties shows that the connection with the BP is kept under temperature changes. These results then lead to a natural frame for justifying and understanding the observed scaling of the boson peak with the parameters of the elastic medium. The link between BP and acoustic modes is moreover strengthen by the possibility to quantitatively reproduce its shape using the Q-dependence of the high frequency collective excitations.

The detailed analysis of the vibrational properties of sorbitol gave us the possibility to check the validity in this system of a proposed correlation between the fast dynamics in the glassy state and the corresponding relaxation dynamics in the liquid phase. We find that even taking into account the presence of anharmonic or relaxation mechanisms present at low frequencies, the proposed relation is not fulfilled opening many doubts on the concrete possibility to find universal relations.