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| | **Experiment title:**<br>High frequency sound attenuation in a glass of sulphur | **Experiment number**:<br>HD245 |
| **Beamline**: | **Date of experiment**:<br>from: 02/07/2008 to: 08/07/2008 | **Date of report**:<br>09/12/2013 |
| **Shifts:** | **Local contact(s)**:<br>V. Giordano | *Received at ESRF:* |

**Names and affiliations of applicants** (* indicates experimentalists):

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

## Report:

The experiment results of this experiment and the experiment HD88 (previous study) have been published in:

B. Ruta, G. Monaco, V. M. Giordano, F. Scarponi, D. Fioretto, G. Ruocco,K. S. Andrikopoulos and S. N. Yannopoulos. "Nonergodicity factor, fragility and elastic properties
of polymeric glassy sulfur", J. Phys. Chem. B 115, 14052 (2011).

## Abstract:

The vibrational properties in a partially polymeric glass of sulfur have been scrutinized in a wide frequency range in order to shed some light on different disputed topics concerning glass dynamics. Two main topics have been investigated: on one side, the elastic properties have been considered in relation to the excess in the vibrational density of states known as the boson peak; on the other side, the proposed correlation between elasticity of the glass and fragility of the corresponding supercooled liquid has been investigated.
The high frequency dynamics in sulfur does not show any signature of the elastic anomalies recently found in several glasses and which seem to be related to the boson peak. The dispersion curve for sulfur follows the typical sine-like behavior as observed in several other systems, while the acoustic attenuation exhibits an almost quadratic dependence on the excitation energy and is definitely non-dynamic in origin. Despite this apparent contradiction, we show that this finding is not in disagreement with the previous ones.
Some peculiarities are found in the IXS, high frequency sound velocity values with respect to the macroscopic limit explored with Brillouin Light Scattering that can be explained in terms of an anharmonic contribution which affects the acoustic properties in the GHz frequency range.

Finally, by considering the correct long wavelength limit of the density fluctuations in the glassy state, we estimate the continuum limit of the nonergodicity factor and we investigate recently proposed relations between the fast dynamics of glasses and the slow dynamics of the corresponding viscous melts.