



	Experiment title: Harmonic relaxation in glasses?	Experiment number: HS-1653
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Shifts: 21	Local contact(s): Dr. M. Lorenzen	<i>Received at ESRF:</i>
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Report:

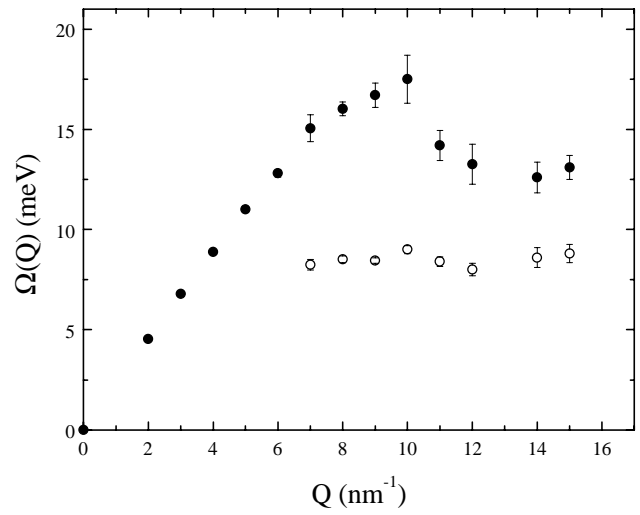
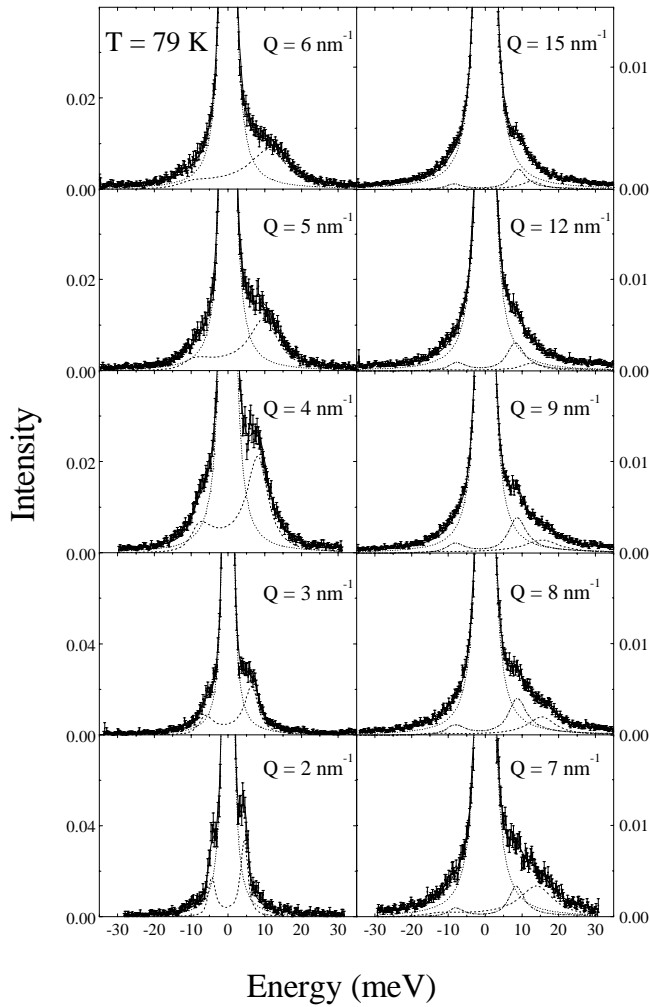
The purpose of this experiment was the search, in a prototypical glass former as glassy glycerol, for a positive dispersion, namely a speed up of the velocity of the longitudinal acoustic mode whose existence had been already previously reported in simple fluids and molecular liquids. Although no evidence of this phenomenon had been observed we found, thanks to the increased performances of the IXS experimental setup, the intriguing evidence of the presence of a secondary excitation, beyond the longitudinal one, in the Dynamical Structure Factor ($S(Q, \omega)$) of this system. This phenomenon, already predicted by Molecular Dynamics and Normal Modes Analysis Simulations in different systems [4,5], had still missed to the experimental observation in a glassy sample.

Our main findings are reported in figure 1 and 2 which respectively show some spectra at different Q values and the related dispersion curves. The data have been fitted by the convolution of the experimental resolution function with a model function, weighted by the detailed balance, composed by: 1) a delta-function to account for the central line, 2) a Damped Harmonic Oscillator (DHO) for the longitudinal mode, and 3) a lorentzian for the secondary peak.

The results of our observation can be summarized as follows:

- i) We find the normal longitudinal excitation dispersing just up $Q = 15 \text{ nm}^{-1}$; for the lower Q values we find the expected sound velocity, then we observe the expected bending of the dispersion curve just around Q values close to the half of the first peak position (around 15 nm^{-1}) in the Static Structure Factor ($S(Q)$) (see the spectra in fig.1 and the full circles in fig.2).
- ii) For Q larger than 7 nm^{-1} a secondary excitation appears in the spectra showing a weakly Q -dispersing behavior (fig. 2-open circles) and a Q -increasing intensity compared to the longitudinal one (fig. 1).

This behaviour is consistent with the results of numerical simulations, which show a secondary excitation clearly appearing at Q values close to the half of the first $S(Q)$ maximum position, almost not dispersing and increasing intensity with increasing Q .



Dispersion curve as deduced from the spectra of Fig. 1. Above $Q=7$ nm^{-1} a secondary excitation appears.

Dynamic structure factor of glassy glycerol @ $T=80$ K for several values of exchanged momentum Q .