ESRF	**Experiment title:** High frequency and high momentum transfer study on liquid and glassy polybutadiene.	**Experiment number**: HS - 847
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Report:

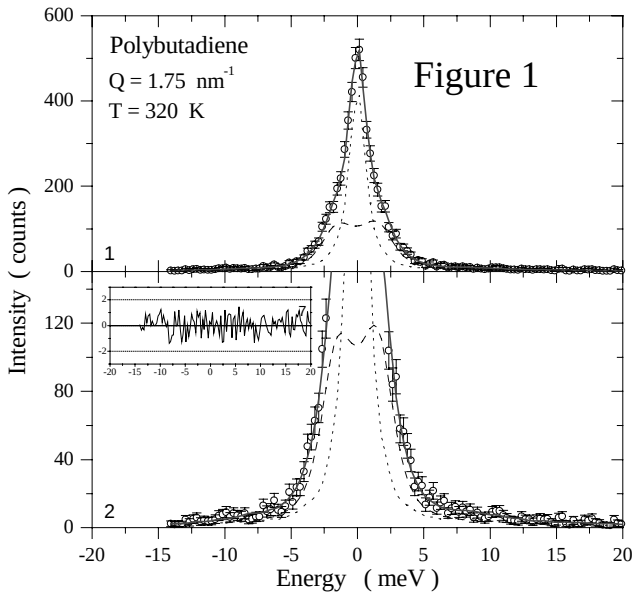
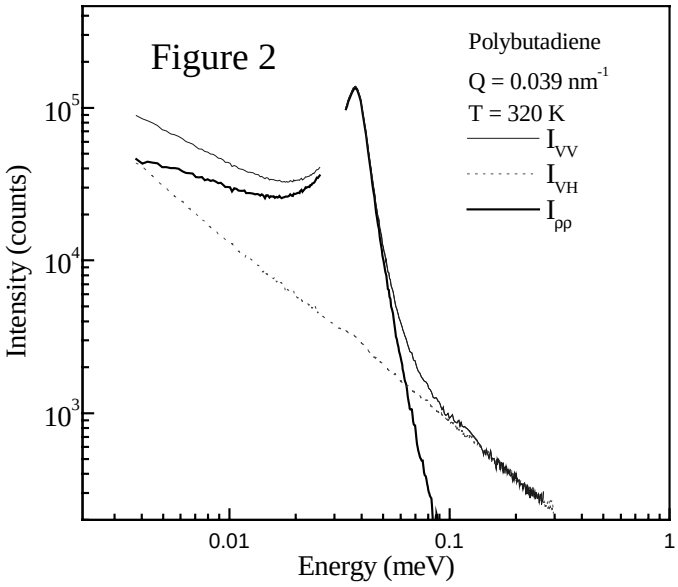
Inelastic X-ray scattering (IXS) measurements of polybutadiene were performed at 4 different temperatures, i.e. 294 K, 308 K, 320 K, 335 K. At each temperature, different Q values have been tipically detected, i.e. at T=294 K, Q=1 , 1.25 , 1.75, 2, 4, 4.25, 7, 7.25, 10, 10.25 nm^{-1} ; at T=308 K, Q=1, 1.5, 2, 3, 4, 4.5, 6, 7, 7.5, 9, 10, 10.5, 12, 15 nm^{-1} ; at T=320 K, Q=1.25, 1.5, 1.75, 3, 4.25, 4.5, 6, 7.25, 7.5, 9, 10.25, 10.5, 12, 15 nm^{-1} ; at T= 335 K, Q=1, 1.25, 1.5, 1.75, 2, 3, 4, 4.25, 4.5, 6, 7, 7.25, 7.5, 9, 10, 10.25, 10.5, 12, 15.

In order to extract the relevant spectroscopic features of the spectra, such as the frequency position Ω and the width Γ of the inelastic peaks, and the intensity of both elastic and inelastic peaks, a fitting procedure was used. It was based on the convolution of the experimentally determined resolution function with a model function. The central line was represented by a Lorentzian and the inelastic peaks by a DHO (damped harmonic oscillator). Fig.1 shows a typical spectrum taken at T=320K, Q=1.75 nm^{-1} . At each measured temperature, a linear behavior of Ω vs. Q has been found for Q < 5 indicating the

propagating acoustic nature of the mode responsible for the inelastic scattering, consistent with the results obtained in a previous experimental investigation of deuterated PB [1].

The good statistics of the spectra and the number of temperature and Q values now available in polybutadiene will allow a quantitative comparison with the theoretical predictions of different models of the glass transition. To this respect, a Brillouin light scattering (BLS) investigation has been also performed on the same system at the same temperatures, giving information on the low Q value Q=0.039nm^{-1}. A typical spectrum is reported in Figure 2. A preliminary contemporary analysis of IXS and BLS spectra shows that an istantaneous term and a single stretched exponential relaxation (structural relaxation) with the same relaxation time and stretching parameter can account for the shape of both IXS and BLS spectra, at least at low Q values. On these basis a possible interpretation of the quasielastic signal observed by coherent inelastic neutron scattering (INS) on the same system [2] can be foreseen in terms of structural relaxation entering the neutron scattering energy window.

These results strongly encourages a deeper comparison between IXS and INS. It would be of great interest to complete this research looking for Umklapp scattering by IXS in a broad Q range and to compare them with previous INS data with the specific aim to collect information on the microscopic dynamics involved in the vibrational modes of fragile glasses.

[1] D.Fioretto, U.Buchenau, L.Comez, A.Sokolov, C.Masciovecchio, A.Mermet, G.Ruocco, F.Sette, B.Frick, D.Richter, L.Verdini, Phys. Rev. E **59**, 4470 (1999).

[2] A.P.Sokolov, U.Buchenau, D.Richter, C.Masciovecchio, F.Sette, A.Mermet, D.Fioretto, G.Ruocco, L.Willner, B.Frick, Phys. Rev. E **60**, R2464 (1999).