



	Experiment title: Cross over to strong phonon scattering in densified silica	Experiment number: HS-1300
Beamline: BL21-ID16	Date of experiment: from: 08/11/00 to: 17/11/00	Date of report: 28/02/01
Shifts: 24	Local contact(s): Giulio MONACO	<i>Received at ESRF:</i>
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Report:

The nature of vibrations in glasses at frequencies Ω near the end of acoustic branches is of considerable current interest. A central prediction is that at sufficiently high Ω acoustic phonons enter a Ioffe-Regel regime where they become strongly scattered by the intrinsic inhomogeneities of the glass [1]. We measured on ID16 the inelastic structure factor $S(Q, \omega)$ in the frequency region of the crossover for a large range of Q in densified silica glass, d -SiO₂. We selected that particular glass because it is the only one we know to have a Ioffe-Regel crossover for the longitudinal acoustic (LA) branch which is well accessible to measurements on ID16 ($\Omega_{co} \simeq 9$ meV).

Fig.1 shows a few typical spectra obtained in ~ 12 hours in d -SiO₂ at 565 K for Q -values ranging from 1.75 nm⁻¹ to 27 nm⁻¹. The electronic instrument background is subtracted from all these spectra. In Fig. 1-a, the dotted lines are the instrumental functions matched to the elastic peak. In Fig. 1-b the corresponding elastic central peak is subtracted to emphasize the inelastic contribution. These new data are very well in line with our previous results [2]. *All* features described in [2] are in fact confirmed, with a much better S/N ratio. The solid lines in Fig. 1-b are calculated with all parameters as in [2] except for the free intensity prefactor. We note that the instrumental function for analyser 2 ($Q = 1.75$ and 2.5 nm⁻¹) unfortunately contains this time the contribution of a Darwin reflection. This emphasizes the importance of a systematic instrument calibration at low- T for each new instrument line-up.

In addition to the results around $Q_{c0} \simeq 2.2 \text{ nm}^{-1}$, we had time to explore higher Q -values. There is a definite gap for intermediate Q 's, as illustrated by the spectrum at 12 nm^{-1} , and the boson peak at Ω_{BP} is recovered at higher Q -values, as shown by the strong feature at 27 nm^{-1} . It is very interesting that Ω_{c0} and Ω_{BP} practically coincide.

References :

- [1] E. Courtens *et al.*, Solid State Comm. **117** (2000) 187.
- [2] E. Rat *et al.*, Phys. Rev. Lett. **83** (1999) 1355.

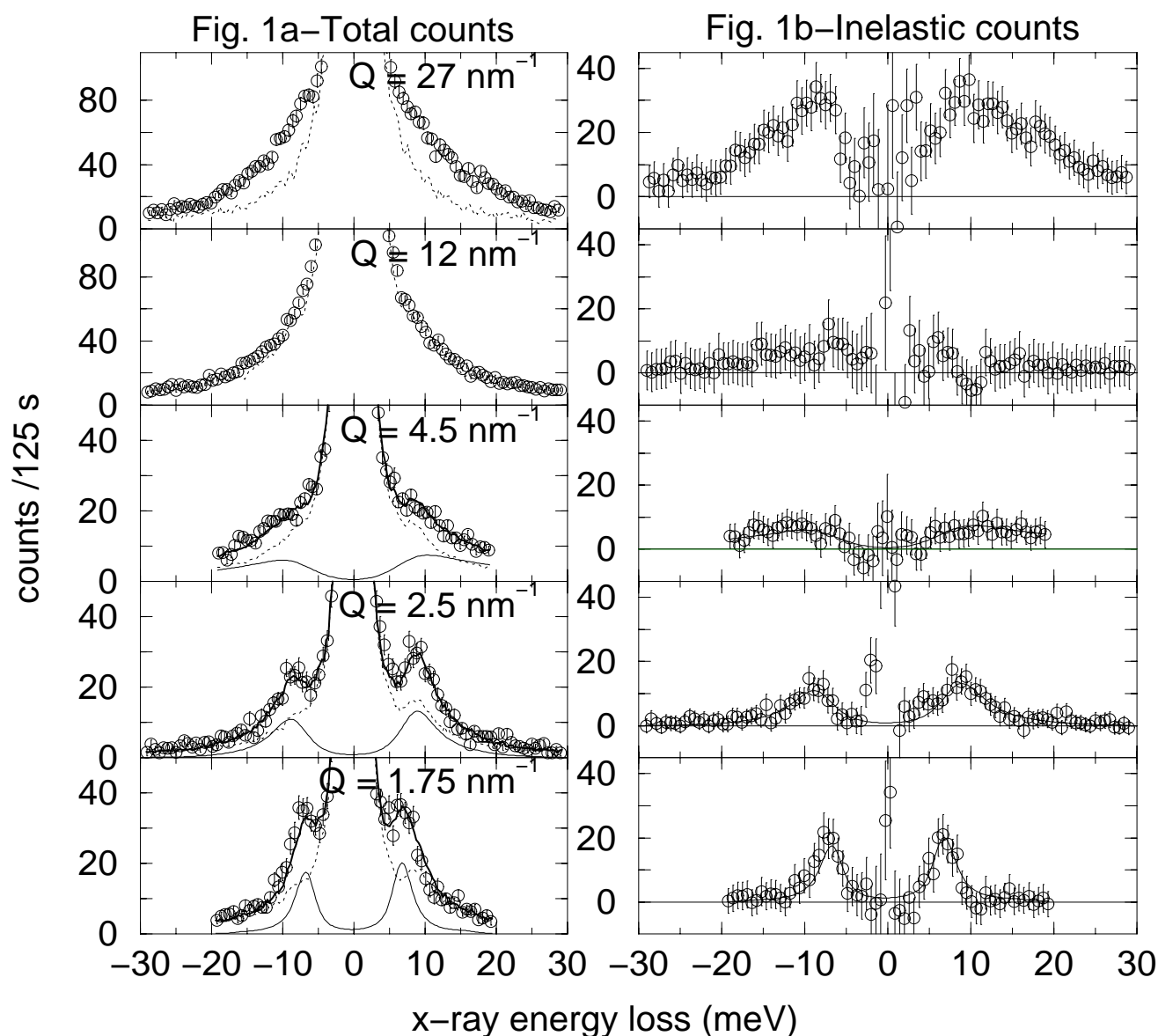


Figure 1. A few typical spectra on $d\text{-SiO}_2$ at 565 K.