REPORT FOR EXPERIMENT HC2548

STATIC MEASUREMENTS

We had large intensities (but low coherence!). Results from circular averages of the measured intensity around the (1/2 1/2 1/2) superstructure peak were used to estimate Tc and to observe the critical scattering. These averages were fitted in the usual manner: a lorentzian-squared behaviour for the smaller q-values and a near-lorentzian shape for diffuse scattering:

$$I(q)=A/(1+(q/q_0)^2)^2+S(0)/(1+(q\xi)^{1.967})$$

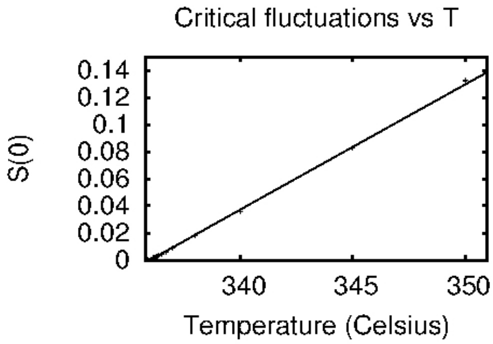

Fig 1: Fit of $S(0)^{-0.806}$ 12:00 Monday. The linear fit yields Tc=336.016(18)°C

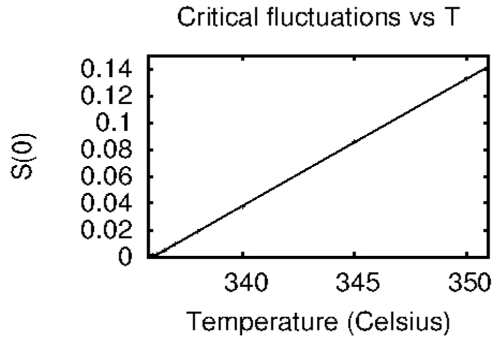

Fig 2: Fit of $S(0)^{-.806}$ around 6:00 Thuesday: the linear fit yields 336.017(5)°C

Data used provides very precise estimates of the transition temperatures and comparing the results obtained show a very high sample stability in a 24 hours period. S(0) corresponds to the susceptibilty. As S(0)α(|T-Tc|/Tc)^-1.241, $S(0)^{-.806}$ is linear in temperature (see Fig.1 and 2 showing stability of the results)

The high stability of the results ensures that no significant change in local sample composition occurs and that the Zn evaporation is negligible.

THE DYNAMICS OBSERVED

For each temperature, we have time series, usually 40,000 frames, and the period was either 0.05 s or 0.02s. The Yuryi's (ID10) python program was used, with three different sets of q-vectors.

I conclude here:

-For very small angles, there is usually a large pretransitional peak, which is strongly temperature dependent. Though the stability was of the order of a few mK, this peak is not fully stable and its variations for t>20-30s makes impossible to distinguish a fluctuation time from temperature instabilities. No reliable result is thus obtained for q<0.0005 $Å^{-1}$ (it is a ~5pixels radius).

-For larger angles, no fluctations are observed for q>0.00515 $Å^{-1}$(too fast for the minimum 0.02 s measuring time). It was checked for large time series and a large number of pixels that the correlation function was essentially 1. Shorter measuring times are necessary.

-We have reliable measurements in a one order of magnitude range of q (From 0.0005 to 0.005$Å^{-1}$). The correlations, after averaging on time and on pixels and after normalization are written:

$$\alpha(q,t)=1+\varepsilon+\beta*\exp(-t/\tau(q))$$

Only for larger angles the prepeak contribution is small, and it is in this region that we obtain the low value β~0.015-0.02, ε~0.1-0.2 is due to anisotropic parasitic scattering. In Figure 3 are shown the correlation functions observed at 336.025°C for the largest angles. The fluctuation time τ is well estimated, and we also check the remarquable stability of the beamline.

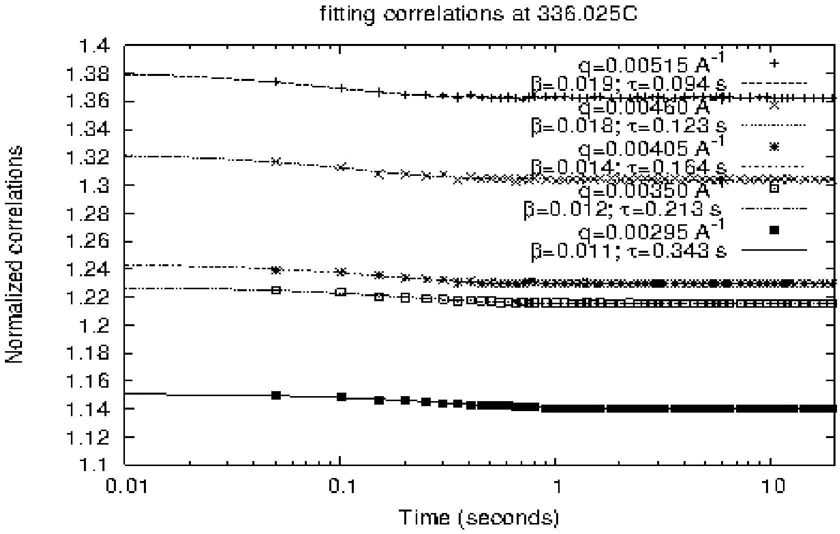

Fig. 3 Observed correlations at 336.025°C for five larger q-values

We have 13 temperatures, and we obtain a set of τ(q,T). The results are gathered in Figure 4. In the same figure, the result of fits with the equation: $\tau(q,T)=\tau_0(T)/(1+(q/q_0)^2)$ are plotted

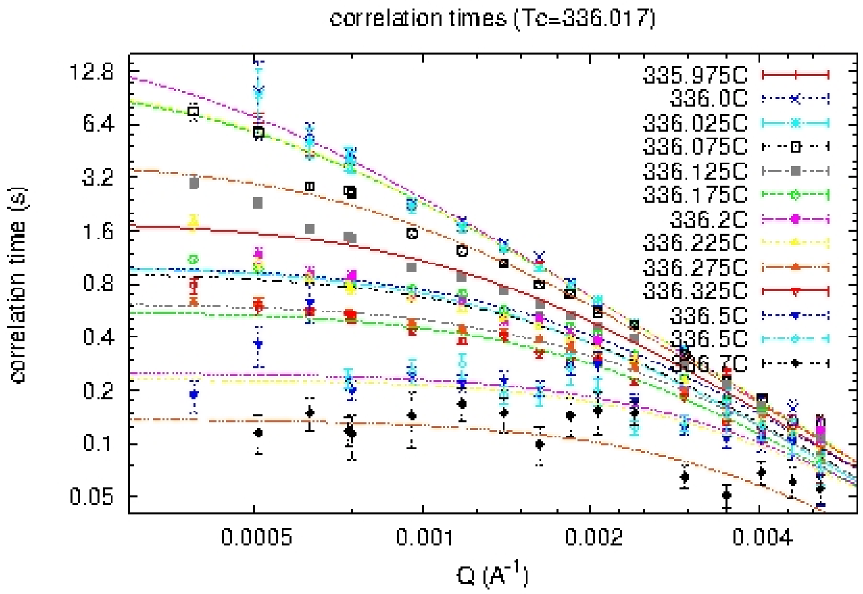

Fig. 4- The fluctuation times vs q at various temperatures (notice the logarithmic axes)

This equation provides an estimate of $\tau_0(T)$ for the various temperatures. In Figure 5, $\tau_0(T)$ is plotted versus T-Tc. The errors are clearly overestimated, but fitting yields the exponent zν=1.253(84).

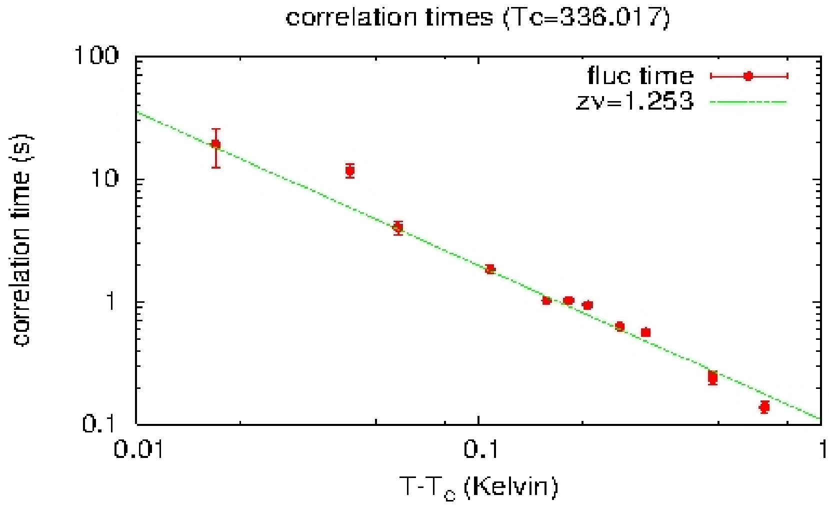

Fig. 5- The temperature variations of $\tau_0(T)$ vs T-T_c. The fit corresponds to $z\nu$=1.253

This estimate of $z\nu$ yields (ν=0.631) z=1.99(13), which agrees with the theoretical value (z~2.03), with a poor precision.

-We can have a better coherence, and reduce the noise from pre-peaks by closing slits horizontally.

-We can have a better management of the prepeak intensity (dependent on the BM2 experiment)

-We have to better the exploration of the reciprocal lattice in the vicinity of the Bragg position by slightly moving the detector apart: with a small misorientation, some q-values have a larger set of pixels.