ESRF	**Experiment title:** Critical fluctuations at the spin-Peierls transition in $CuGeO_3$	**Experiment number:** HE-73
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Results

We have performed for the first time detailed high resolution x-ray scattering studies on the line shape and the temperature dependence of the susceptibility and correlation length of structural fluctuations, near the spin-Peierls phase transition in $CuGeO_3$. This has been possible due to the careful choice of the experimental conditions. From this work we conclude that the structural fluctuations at this phase transition do not correspond to an order parameter critical fluctuations, and they match quite well the magnetic fluctuations. The phase transition is driven exclusively by antiferromagnetic frustration between nearest and next nearest neighbours along the chain axis.

The insertion device is a 48 mm period undulator, working at a gap of 25.8 mm, and the 25.2 keV (λ = 0.4921 Å) photons used in this experiment comes from the 7th harmonic. Vertical and horizontal divergences were 0.008 and 0.034 mrad., respectively. The beam was monochromatized by means of a double bounce Si(111) monochromator. Nominal flux at sample position is of the order of 2.5 10^{11} photons/s. Vertically focusing mirrors were not used in this experiment, and we did not find any contamination from higher order harmonics in our scans. In order to minimise defect induce diffuse scattering we performed the experiment in Laue geometry (or transmission), and hence the choice of a short wavelength. In this configuration optimum sample thickness is given by $d=1/\mu$, with

μ the linear absorption coefficient which at this energy μ = 79.3 cm-l. The sample was carefully cut avoiding as much as possible visible defect creation on the surface. The thickness was 0.14 mm and the measurement of the transmitted beam through the sample yielded an absorption factor of 3.1, which is close to the optimum value. Background was lowered down to 2-3 c/sec with a signal to noise ratio of 1.5 10^4, at 4K and at Q = (3.5 1 2.5)

Figure 1 shows the temperature dependence of the peak intensity of the scattering (full circles) and the critical scattering (open circles) in the neighbourhood of the phase transition temperature. Figure 2 shows the extracted hwhm along a* (full circles) and c* (open circles). Note that the correlation length of fluctuations does not diverge and remains finite at $T=T_{SP}$. There is in addition a second correlation length, shown as full squares in the figure, which has a different temperature dependence. This second length scale is thought to come from clamped order parameter fluctuations in the vicinity of defects.

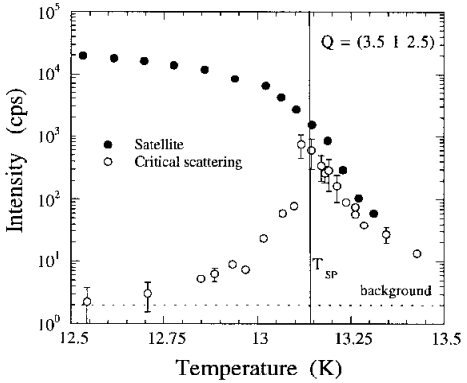

Figure 1.

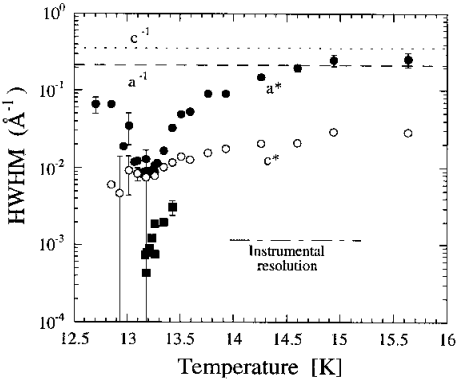

Figure 2.

Not shown in the figures is the anomalous type of line shapes of the critical fluctuations found along both directions. Whereas along a* scans have to be fitted with a generalised lorentzian, along c* the line shape is gaussian close to T_{SP}. The lack of divergence shown in figure 2 and the magnitude of the inverse correlation length along a* and c* make us think that the atomic displacements giving rise to the superstructure below T_{SP} are not the primary order parameter at the phase transition. The phase transition in this compound should be exclusively magnetic in origin, induced by competing antiferromagnetic interactions along the chain axis, c.