

Report on experiment n° HC3976

X-Ray Photon Correlation spectroscopy (XPCS) for studying the critical dynamics in ordering AuAgZn₂

The aim of this experiment was to observe the dynamics of the speckles corresponding to critical fluctuations in a second-order transition system. The alloy AuAgZn₂ is a model system for the study of dynamics with non-conserved order parameter transition (« model A » of Hohenberg and Halperin). The exchange between two cubis sites occupied by Au or Ag atoms is equivalent to the flip of a spin in an Ising system. This needed to carry out experiments with a partially coherent x-ray beam at the ID10 beamline.

The sample was a single crystal and the ordering studied was of the « Heussler » type, i.e a SC to FCC transition with a lattice doubling, and the experiments were carried out in the vicinity of the (1/2 1/2 1/2) Bragg peak. A high temperature stability (+/-0.001K) was necessary and the medipix detector could provide measurements with a 0.02s time resolution. The transition temperature T_c was found at 609.162K (336.012°C) and time correlations were obtained in a narrow temperature domain of ~0.7K.

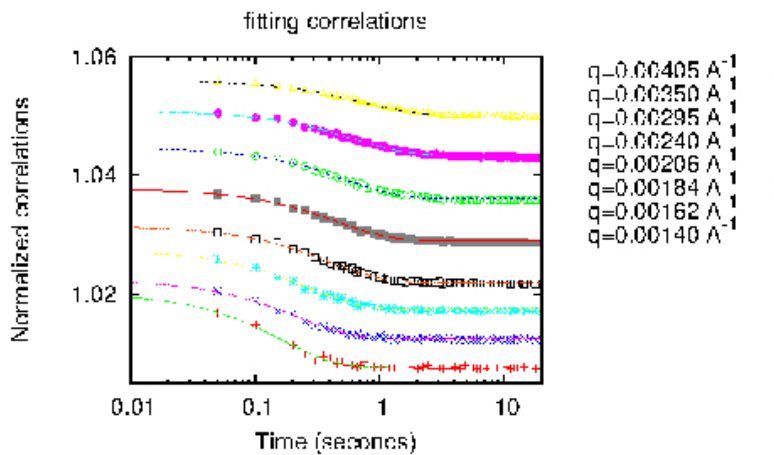


Fig 1 shows the correlations observed at T_c+0.113. One observes a low coherence contrast (~1%) and a fast process. This is connected to the atomic scale diffusion time (~40μs). Fluctuations are here a collective phenomena and we could observe the variations of the fluctuating time τ for various temperatures and diffusion vectors.

Fig. 1-The observed time correlations at T_c+0.113K

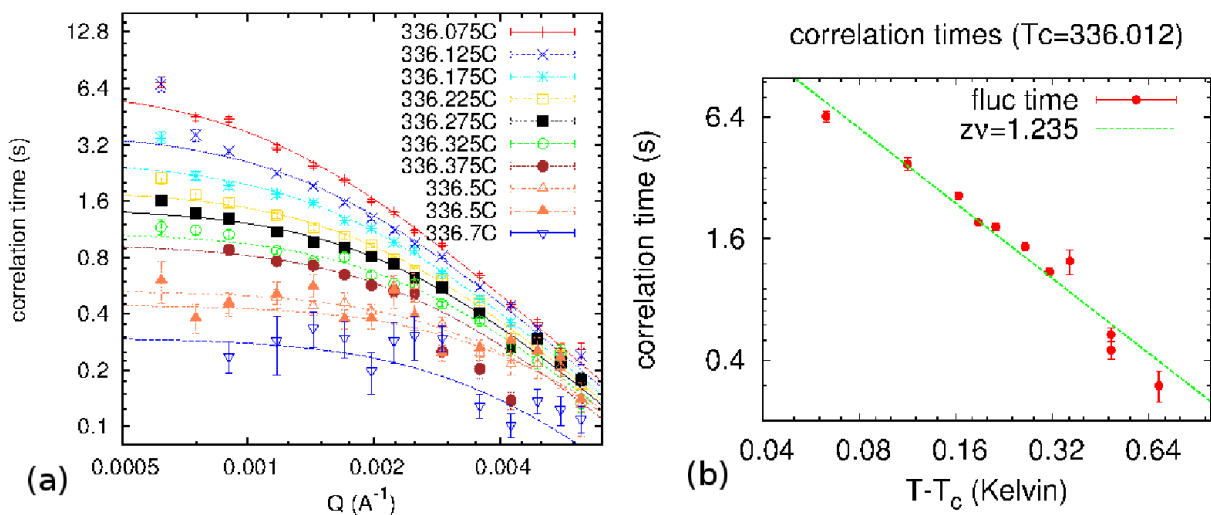


Fig. 2-The characteristic times measured for the fluctuations (left) and the temperature dependence showing a scaling behavior with $z \sim 2$

Results are summarized in Fig. 2. In Fig 2 (b) is given an estimate of the variations of $\tau(q=0)$ for temperatures in the neighbour of T_c . This scaling leads to a value $z=1.96(11)$ of the dynamic exponent. This result remains unprecise and it can be significantly improved with the higher ESRF brilliance

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References

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