Reply to the comment by G Coddens

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Reply to the comment by G Coddens

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We have read the comment on our paper with some surprise. The comment is not relevant to the contents of the paper and, to use the same words at its author, 'it contains several ambiguous statements and lacks precision' but it also contains many speculations. We feel it would serve no useful purpose in going into a lengthy discussion and we will, therefore, just discuss a few points.

We do not question the excellent work done on phason dynamics in quasicrystals. We have not measured the quasielastic neutron scattering from a quasicrystal and the aim of our work has not been to show that these results are wrong. This is obviously a fact which has passed by the author of the comment. We have performed measurements on an Al-based ternary alloy not having a B2 structure, as the author of the comment claims, but a B2-based structure, designated as a τ-phase. The fact that we quoted two papers ([13] and [14] in the article referred to as [1] in the comment) which deal with the ordering of vacant sites in τ-phases makes this point obvious. In particular, it is not possible to compare the atomic jump processes in a binary system with an ideal B2 structure (for example Ni_3Sb) with the corresponding processes taking place in a ternary system not having exactly a B2 structure. The reason why we have compared our results with the corresponding ones in quasicrystals is that the system we investigated is ternary and is also Al-based.

It is an indisputable fact that in both quasicrystals and the AlCuNi alloy atoms jump at a large and similar rate. There are several different jump processes taking place in the AlCuNi alloy. The quasielastic peak corresponding to the fastest of these has a width of about 1 meV which is even larger than has been found in quasicrystals. What the jump processes should be called is irrelevant. It must in this connection be remembered that phasons are not restricted to quasicrystals, but result in a straightforward way from a cut of a high-dimensional space, close to the edges of atomic surfaces. Accordingly, it is no surprise that phason jumps are experimentally observed in both the AlCuFe icosahedral crystal and its rhombohedral approximant. A solid that shows this kind of fast atomic motion is most presumably a solid whose structure fits with high-dimensional crystallography, first invented for genuine quasicrystals. The so-called τ-phases also correspond to this picture, as was demonstrated with no ambiguity by Steurer [1].

We have not measured the temperature dependence of the atomic hopping process so we do not speculate about it.

We have, from intensity considerations, concluded that the relative number of hopping atoms is of the order of a few per cent. If the quasielastic signal is small and narrow the elastic signal is influenced to a non-detectable extent. We have also shown from the Q variation of the total, the elastic and the quasielastic intensities that several different phenomena build up the measured spectra. This depends entirely on the energy resolution and on the Q range which phenomena a particular measurement reveals. The signal, both the elastic and the quasielastic, is thus partly resulting from static short-range order and partly from coupled static and dynamic disorders of different kinds. We have used a simple formalism to interpret our data, especially the elastic diffuse scattering. The performed analysis nevertheless gives, together with the diffraction results, important information about the rate and the geometry of the atomic jump processes taking place in the sample.

Reference

[1] Steurer W 2000 *Z. Kristallogr.* **215** 323