ESRF	**Experiment title:** **Phason fluctuations in i-AlPdRe and i-CdYb phases.**	**Experiment number**: D2-2-152
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Report:

We present a high resolution X-ray diffraction study on two single grain phases: the i-AlPdRe phase [1] which is supposed to be isostructural to the i-AlPdMn one and the new binary CdYb phase [2]. Both the Bragg peak width (sensitive to uniform phason strain distribution) and the diffuse scattering (sensitive to long wavelength phason fluctuations) have been studied.

The i-AlPdRe phase is particularly interesting because it is isostructural to the AlPdMn icosahedral phase. In the i-AlPdRe phase we find an anisotropic distribution of diffuse scattering intensity around the Bragg peaks. The fig.1 shows the diffuse scattering intensity measured around two Bragg peaks. Two illustrate the phason origin of the diffuse scattering it has been rescaled by a factor $Ibr.Qper^2$. As expected for the case of long-wavelength phason fluctuations the diffuse intensity is identical for both reflections [3]. A detailed quantitative study showed that the amount of diffuse scattering is similar to what was previously found in the AlPdMn phase [4], but with markedly different shape anisotropy. This indicates that the ratio of the phason elastic constants K2/K1 is different to the one measured in the i-AlPdMn phase.

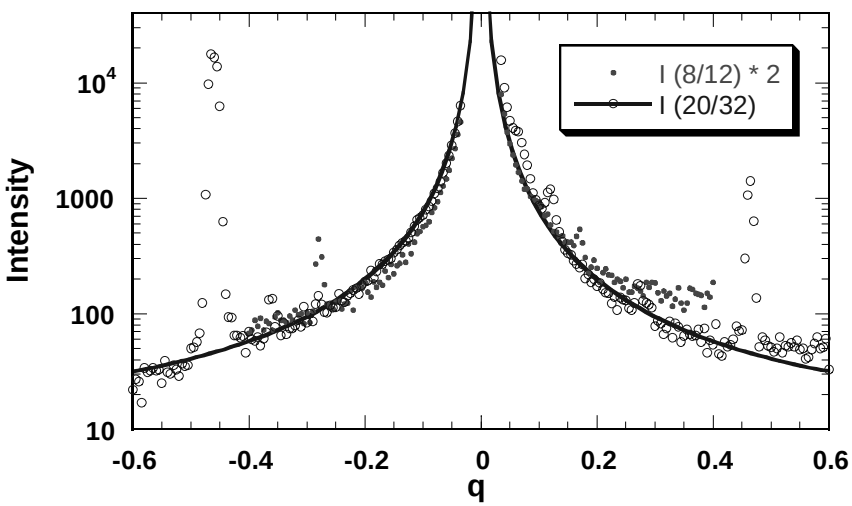

Fig1: Comparison of the diffuse scattering intensity measured around two different Bragg peak lying on a 2-fold axis. The diffuse intensity has been rescaled according to the IbQper2 factor. Open and closed circles are for the 20/32 and 8/12 reflections respectively. The solid line is a $1/q^2$ fit to the data.

The study of the i-CdYb phase shows that this phase presents a good structural quality. Its Bragg reflection shows an isotropic broadening which scales with Q_{per}, as a consequence of uniform phason strain distribution. The fig.2 shows the Bragg peak width as a function of Qper. As can be seen there is an almost linear correlation, with a proportionality factor equal to 0.004, a magnitude which is similar to what was found in the i-ZnMgRE phases [5].

There is also a clear anisotropic distribution of diffuse scattering intensity located around the Bragg peaks. It is related to long wavelength phason fluctuations with an anisotropy pointing toward a 3-fold type instability. The amount of diffuse scattering is of the same order of magnitude as the one found in the i-AlPdMn.

In conclusion this study shows that most icosahedral phases have a diffraction pattern with a significant amount of diffuse scattering located close to the Bragg reflections. This diffuse scattering is due to long wavelength phason fluctuations and might be a signature of low temperature instability.

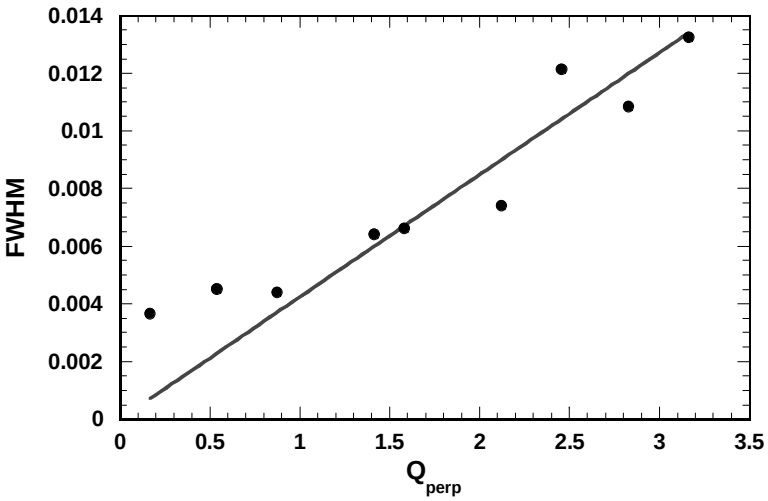

Fig 2: Bragg peak width as a function of Qper in the i-CdYb binary quasicrystal.

References:

[1] Guo, J.Q., Sato, T.J., Abe, E., Takakura, H., Tsai, A.P., 2000, Phil. Mag. Lett., 80, 495

[2] Tsai, A.P, Guo, J.Q., Abe, E., Takakura, H., Sato, T.J., 2000, Nature, 408, 537 and Guo J.Q., Abe, E., Tsai, A.P., 2000, Phys. Rev. B, 62, R14605

[3] de Boissieu, M., Boudard, M., Hennion, B., Bellissent, R., Kycia, S., Goldman, A. I., Janot, C. and Audier, M., 1995, *Phys. Rev. Lett.*, **75**, 89.

[4] Letoublon, A., de Boissieu M., Boudard, M., Mancini, L., Gastaldi, J., Hennion, B., Caudron, R., Bellissent R., 2001, Phil. Mag. Lett., 81, 273

[5] Letoublon, , A., Fisher, I.R., Sato, T.J., de Boissieu, M., Boudard, M., Agliozzo, S., Mancini, L., Gastaldi, J., Canfield, P.C., Goldman, A.I., Tsai, A.P., 2000, Mat. Science and Engineering, 294-296, 127.