

Statistical approach in cluster analysis of 2D quasicrystals

Aleksandra Dabrowska and Janusz Wolny,

*Faculty of Physics and Nuclear Techniques,
AGH University of Science and Technology, Poland*

Keywords: Quasicrystals; Clusters; Average Unit Cell

In quasicrystals, certain characteristic and occurring frequently groups of atoms called clusters can be found.

It is possible to cover the entire structure by some types of them. For instance for Penrose lattice it is the set of atoms lying within regular decagon and called Cartwheel Decagon which covers completely the whole structure. Because some atoms belong to different neighbouring clusters it is important to determine the ways of clusters' overlapping. For the Cartwheel Decagons matching rules were first introduced by Petra Gummelt [1].

In this paper we have calculated the probability distribution of clusters in an average unit cell approach [2]. This probability convoluted with a structure factor for particular cluster what leads to the structure factor for the studied quasicrystal. The analysis was conducted for some characteristic types of clusters' decoration (for example: for non-decorated Penrose lattice). For them we have calculated the formulas for structure factors which we used to obtain the so called enveloped functions connecting all the diffraction peaks. Finally we have discussed applications of the obtained formulas in determination of unknown quasicrystalline structure from measured diffraction pattern.

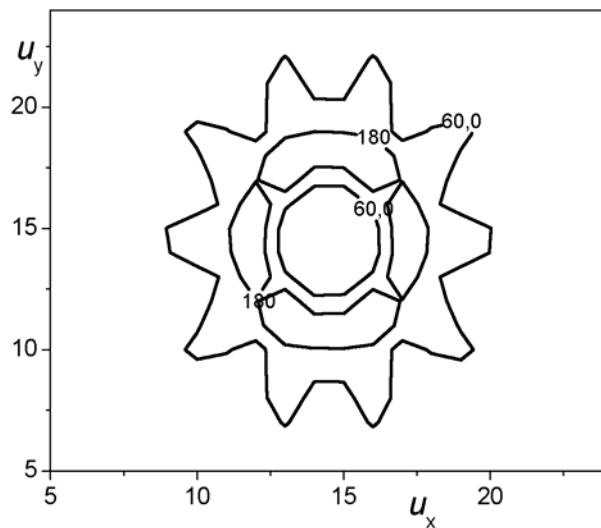


Fig.1. The probability distribution of clusters covering non-decorated Penrose lattice in an average unit cell.

[1] Gummelt P., Penrose tilings as coverings of congruent decagons, *Geometriae Dedicata* **62** (1), 1-17 (1996).

[2] Wolny, J., *Philos.Mag. A* **77**, 395-412, (1998).