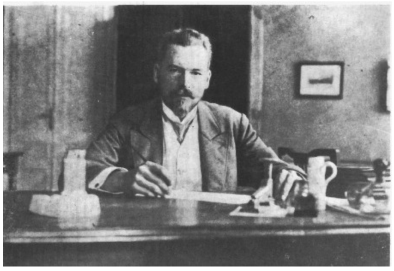

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# Entropic stabilization of quasicrystals

*Wednesday, 27 September 2023 09:00 (40 minutes)*

Among the soft matter systems one finds crystalline and liquid crystalline structures, but in the meantime also quasicrystalline. These can have fivefold or more than sixfold symmetries, which are not compatible with translational symmetry. Model structures are tesselations with more than one tile subdued to matching rules, or projections from higher dimensional periodic crystals. The higher dimension stands for the number of those reciprocal wave vectors in the spectrum, which are linearly independent over the integers. As a consequence quasicrystals possess in addition to the standard phonon (strain) degree of freedom also a phason (strain) degree of freedom. In the tiling picture the latter shows up as flips of the tile vertices. The random tiling hypothesis assumes, that the flips enlarge the configurational space, giving rise to a large entropy and making quasicrystals high temperature phases. I shall deal with the two-dimensional decagonal Tübingen triangle tiling. It can be represented as a tiling with two golden triangles or alternatively with five different polygons. There is a confusing large number of vertex environments in quasicrystals, but also an efficient book keeping tool, denoted polar calculus. It allows to determine the number of arbitrary vertex environments. We have extended it to count the number of all possible vertex flips. With vertex energies from a molecular dynamics simulation and the vertex and flips statistics from the polar calculus we could determine the phason dependent free energy and the phason elastic constants, describing the flips by an Ising and a ten states Potts model. Stability is attained by a soft phason transition only at a higher temperature, proving the random tiling hypothesis.

**Primary author:** Prof. TREBIN, Hans-Rainer (Universität Stuttgart)

**Presenter:** Prof. TREBIN, Hans-Rainer (Universität Stuttgart)

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