

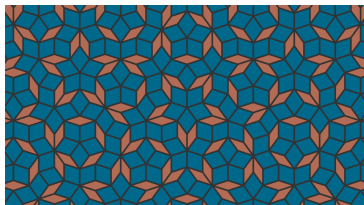
Exact results on electronic wavefunctions of 2D quasicrystals

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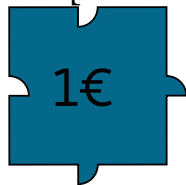
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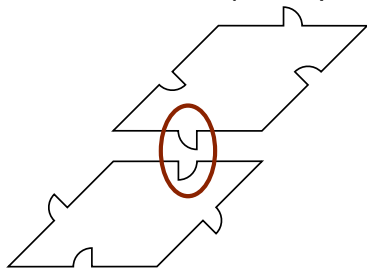
June 20, 2017



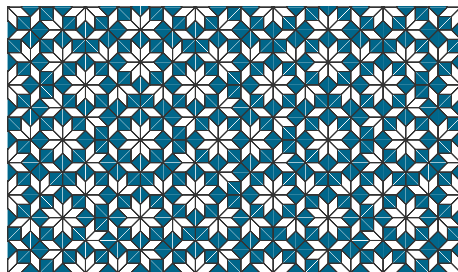
A QUASIPERIODIC PUZZLE [BÉDARIDE *ET AL.* 12]



Pay the squares, get the rhombuses for free!

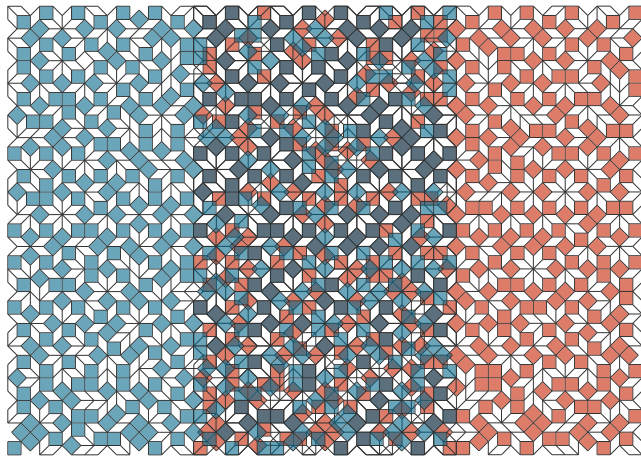


Forbidden configuration.



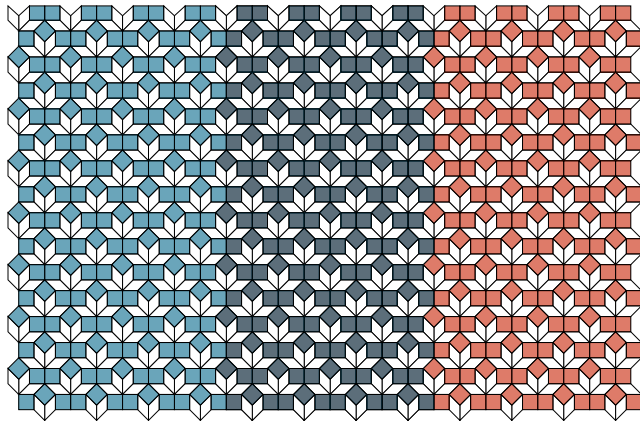
Patch of the Ammann-Beenker tiling.

PERIODIC, QUASIPERIODIC AND RANDOM



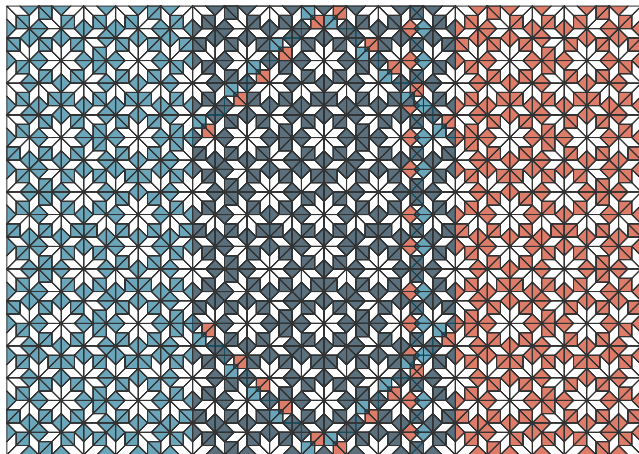
No long range order : random

PERIODIC, QUASIPERIODIC AND RANDOM



Perfect long range order : periodic

PERIODIC, QUASIPERIODIC AND RANDOM

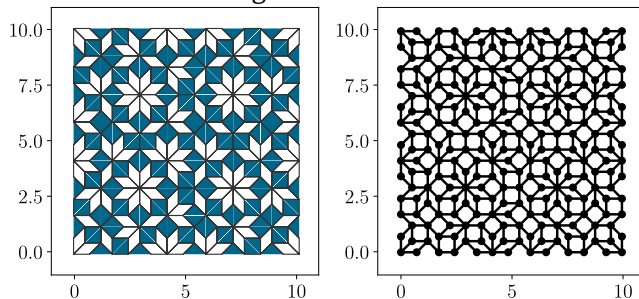


Long range order : quasiperiodic

(Math : **Meyer sets**, see Chap. 2 of [Grimm, Baake 13])

FROM TILES TO ATOMS

Place atoms at the vertices of the tiling :

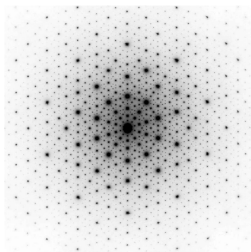


→ can atoms arrange in such a quasiperiodic fashion ?

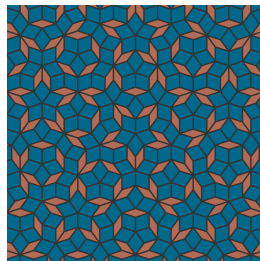
QUASICRYSTALS

In a quasicrystals, atoms are quasiperiodically arranged. Properties :

- **aperiodicity**
- **long range order** (diffraction pattern exhibits sharp peaks).

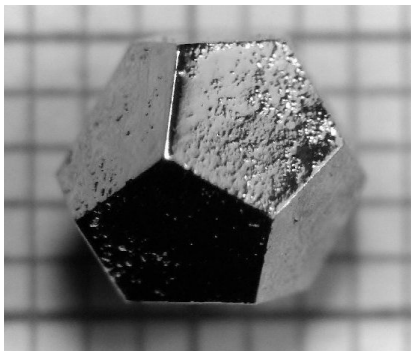


Diffraction pattern of a AlPdMn alloy
(Conradin Beeli group)

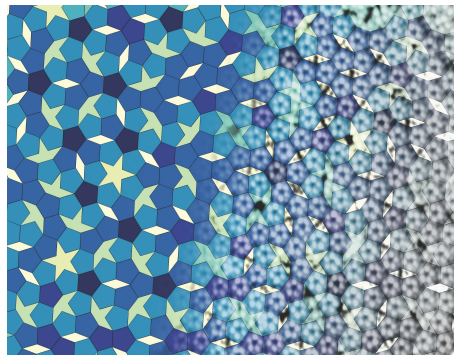


A patch of the quasiperiodic Penrose tiling,
used to model many quasicrystals.

EXAMPLES OF QUASICRYSTALS



HoMgZn alloy in its icosahedral phase
([doi:10.1038/nmat1244](https://doi.org/10.1038/nmat1244))



A 2D molecular quasicrystal
([doi:10.1038/nature12993](https://doi.org/10.1038/nature12993))

- many intermetallic alloys are quasiperiodic
- a single natural example : Khatyrka meteorite hosts quasicrystals
([doi:10.1126/science.1170827](https://doi.org/10.1126/science.1170827)).