

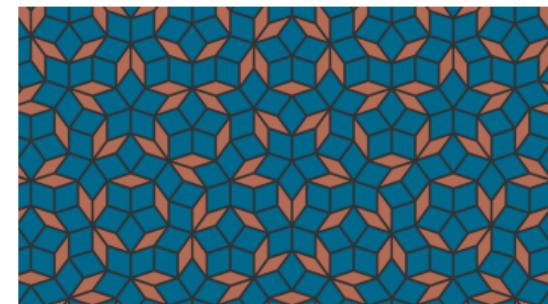
Exact results on electronic wavefunctions of 2D quasicrystals

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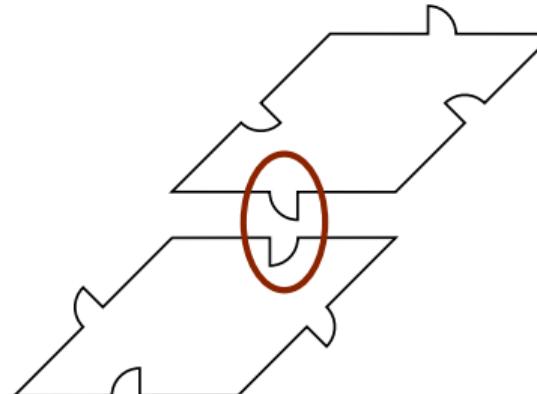
June 20, 2017



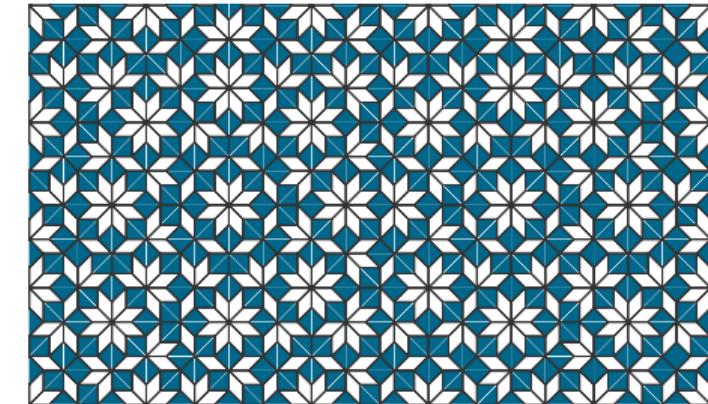
A QUASIPERIODIC PUZZLE [BÉDARIDE ET AL. 12]



Pay the squares, get the rhombuses for free!

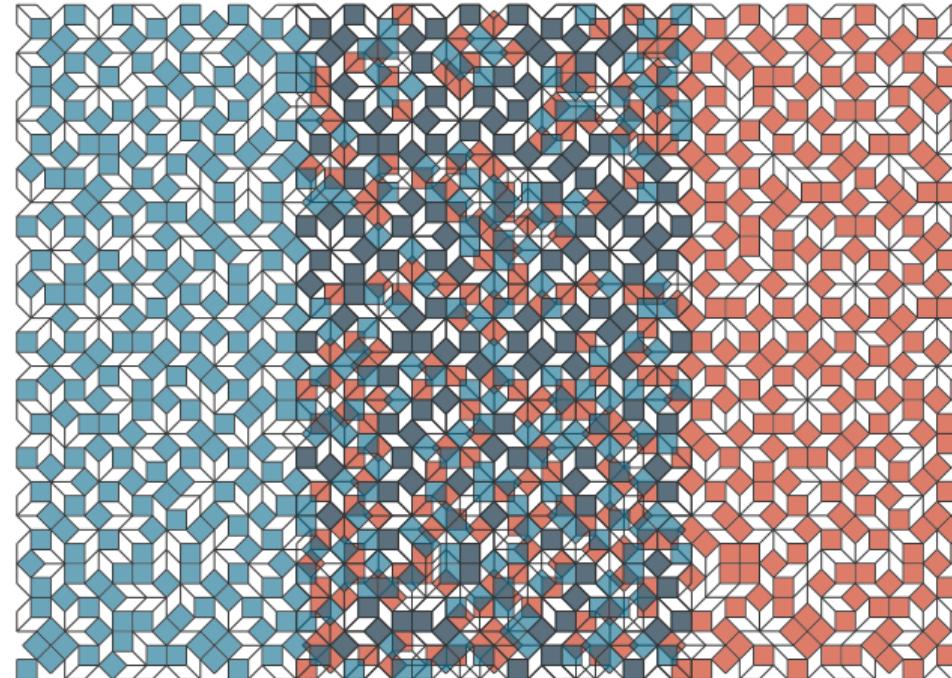


Forbidden configuration.



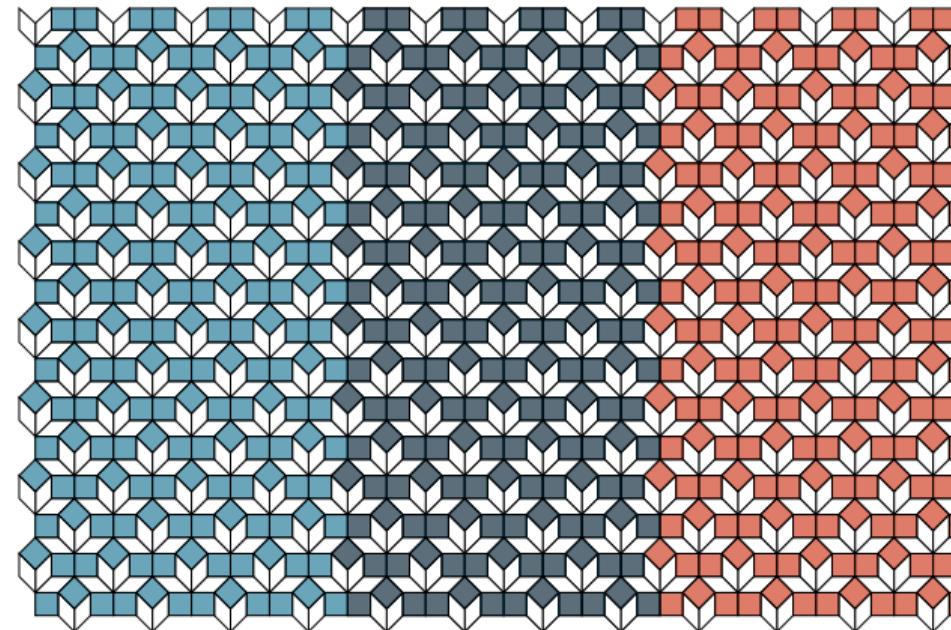
Patch of the Ammann-Beenker tiling.

PERIODIC, QUASIPERIODIC AND RANDOM



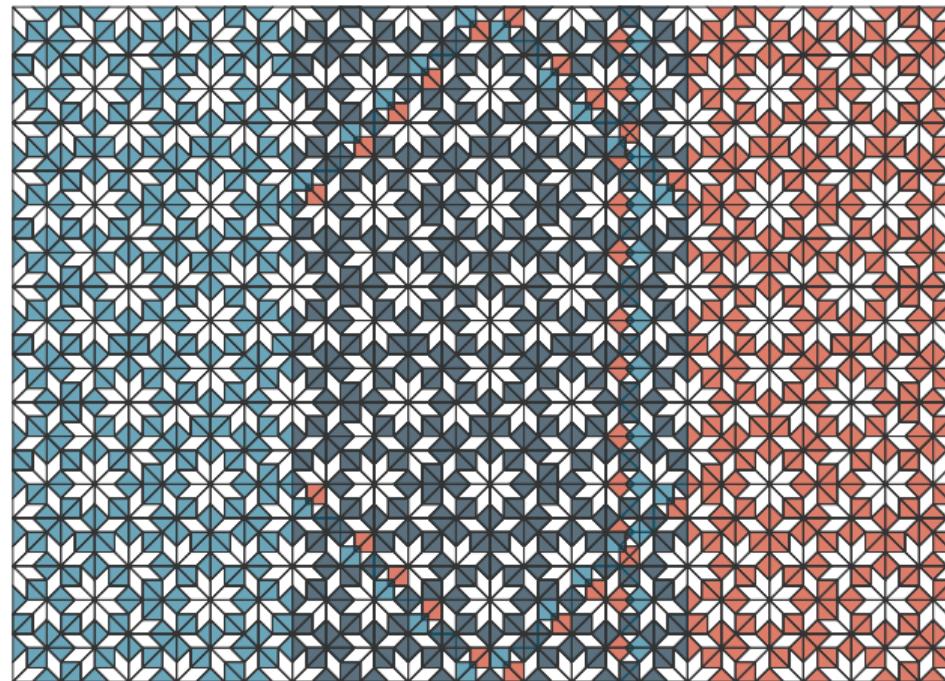
No long range order : random

PERIODIC, QUASIPERIODIC AND RANDOM



Perfect long range order : periodic

PERIODIC, QUASIPERIODIC AND RANDOM



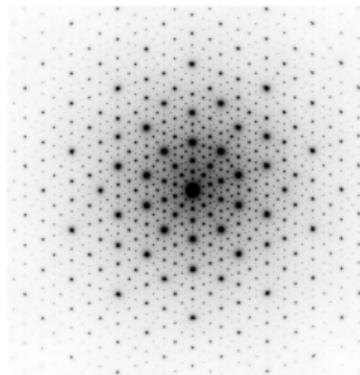
Long range order : quasiperiodic

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

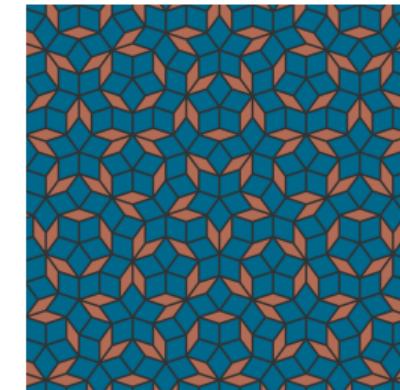
QUASICRYSTALS

Quasicrystal → quasiperiodically arranged atoms :

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

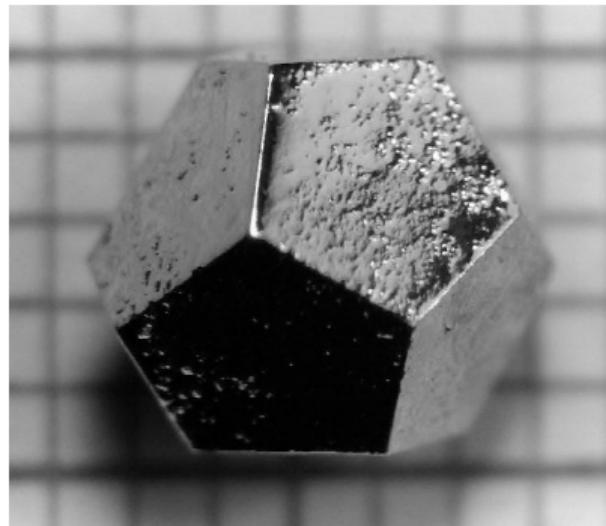


Diffraction pattern of a AlPdMn alloy
(Conradin Beeli group)

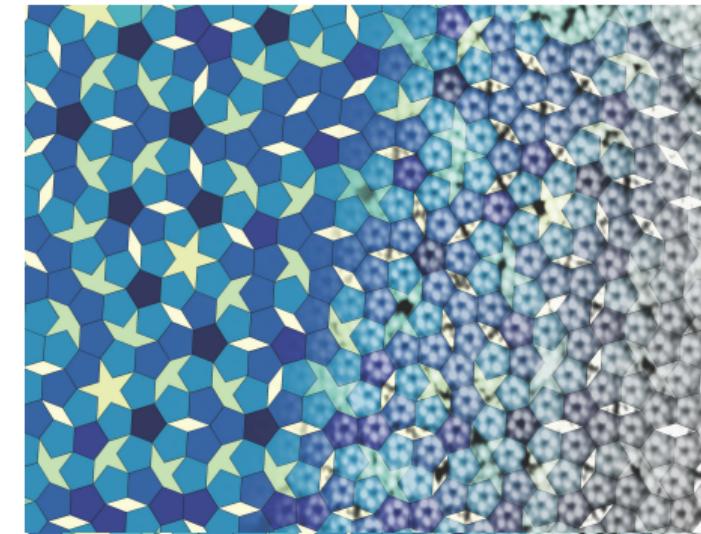


A patch of the quasiperiodic Penrose tiling,
used to model many quasicrystals.

EXAMPLES OF QUASICRYSTALS



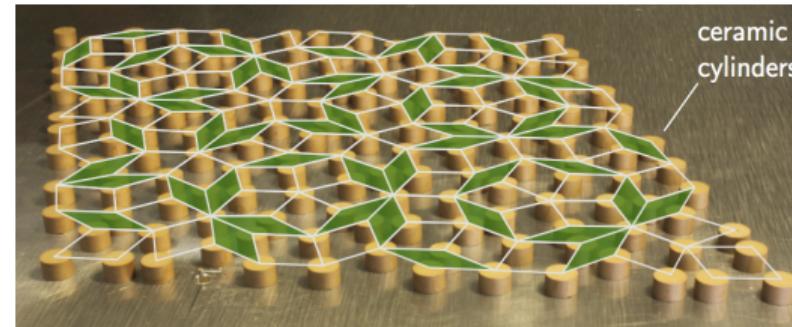
HoMgZn alloy in its icosahedral phase
(doi:10.1038/nmat1244)



A 2D molecular quasicrystal
(doi:10.1038/nature12993)

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

ENGINEERED QUASIPERIODIC STRUCTURES



A network of dielectric resonators [Vignolo *et al.* 14]

- Plasmons in semiconductor stacks [Merlin *et al.* 85]
- Microwaves in perforated metallic films [Matsui *et al.* 07]
- Microwaves in dielectric resonator networks [Vignolo *et al.* 14]
- Light solitons [Freedman *et al.* 07]
- Cold atoms in laser potentials [Guidoni *et al.* 97]
- Polaritons in wire cavities [Tanese *et al.* 14]

FRACTALS

