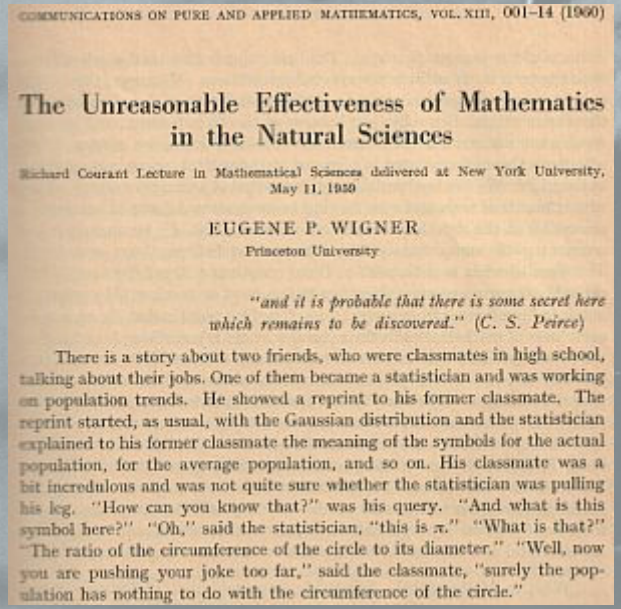
Mathematical World

Stage ‘Tor Vergata’ 13-17 June

"The Unreasonable Effectiveness of Mathematics in the Natural Sciences"



COMMUNICATIONS ON PURE AND APPLIED MATHEMATICS, VOL. XIII, 001–14 (1960)

The Unreasonable Effectiveness of Mathematics in the Natural Sciences

Richard Courant Lecture in Mathematical Sciences delivered at New York University, May 11, 1959

EUGENE P. WIGNER
Princeton University

"and it is probable that there is some secret here which remains to be discovered." (*C. S. Peirce*)

There is a story about two friends, who were classmates in high school, talking about their jobs. One of them became a statistician and was working on population trends. He showed a reprint to his former classmate. The reprint started, as usual, with the Gaussian distribution and the statistician explained to his former classmate the meaning of the symbols for the actual population, for the average population, and so on. His classmate was a bit incredulous and was not quite sure whether the statistician was pulling his leg. "How can you know that?" was his query. "And what is this symbol here?" "Oh," said the statistician, "this is π." "What is that?" "The ratio of the circumference of the circle to its diameter." "Well, now you are pushing your joke too far," said the classmate, "surely the population has nothing to do with the circumference of the circle."

E.Wigner scientific article

I. Tiling

II. Cristallography

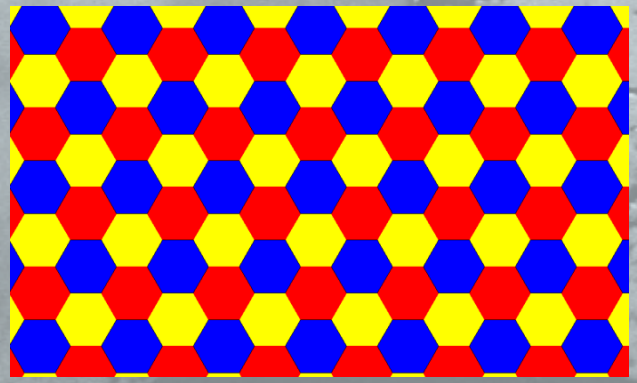
III. Quasi-Crystals

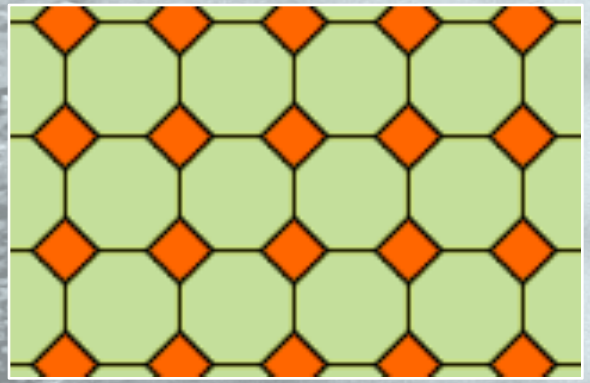
TILINGS

SIMPLE

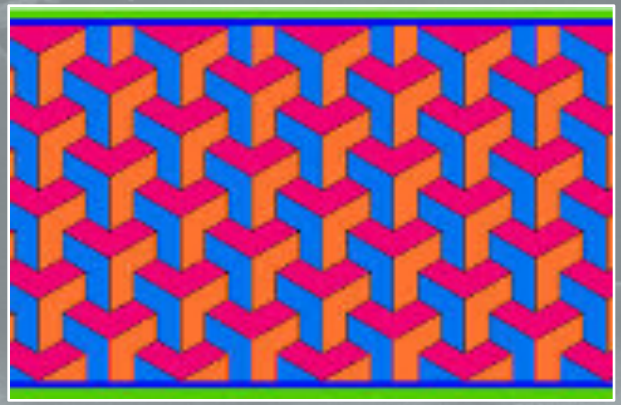
COMPOSITE

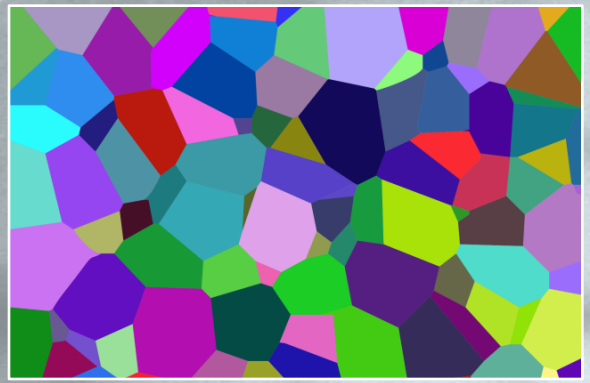
REGULAR





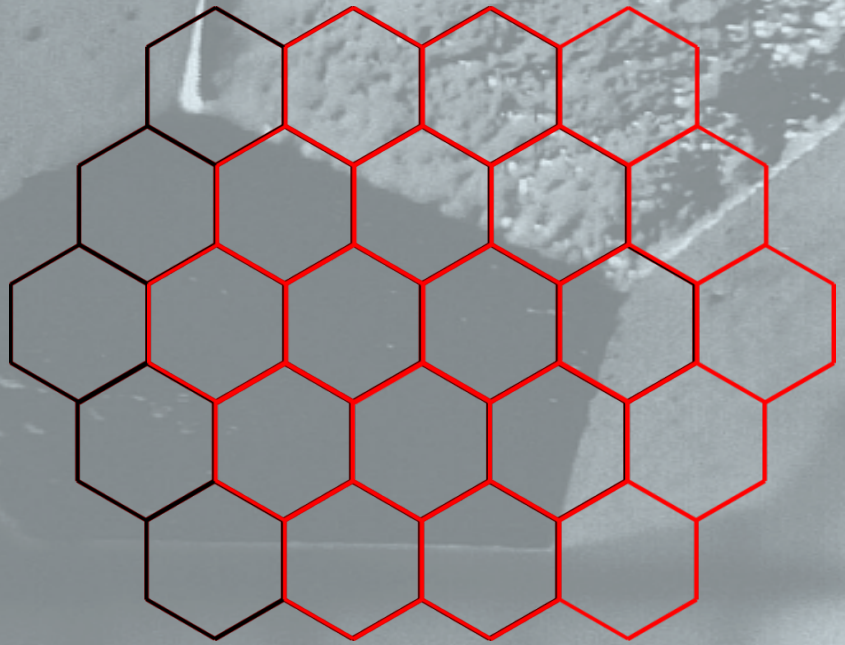
NON REGULAR





SYMMETRIES

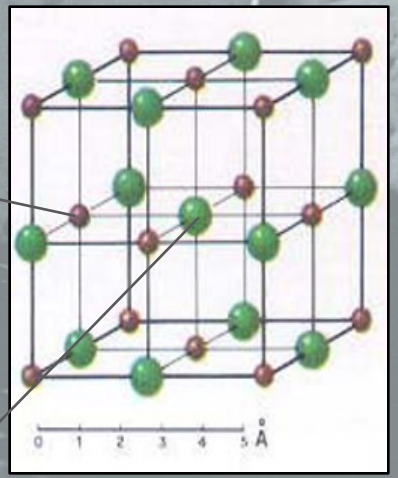
"Invariance with respect to a transformation"



CRYSTALLOGRAPHY

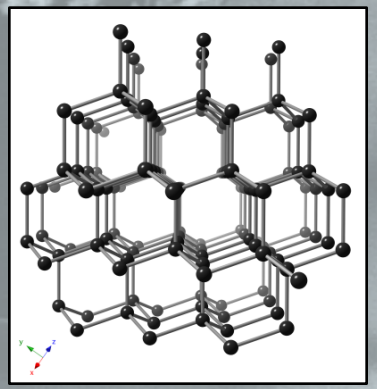
Study of crystalline structures

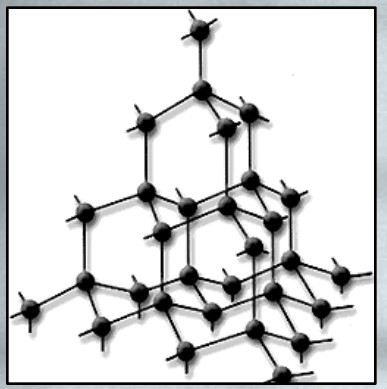
FCC (Face Center Cubic) LATTICE

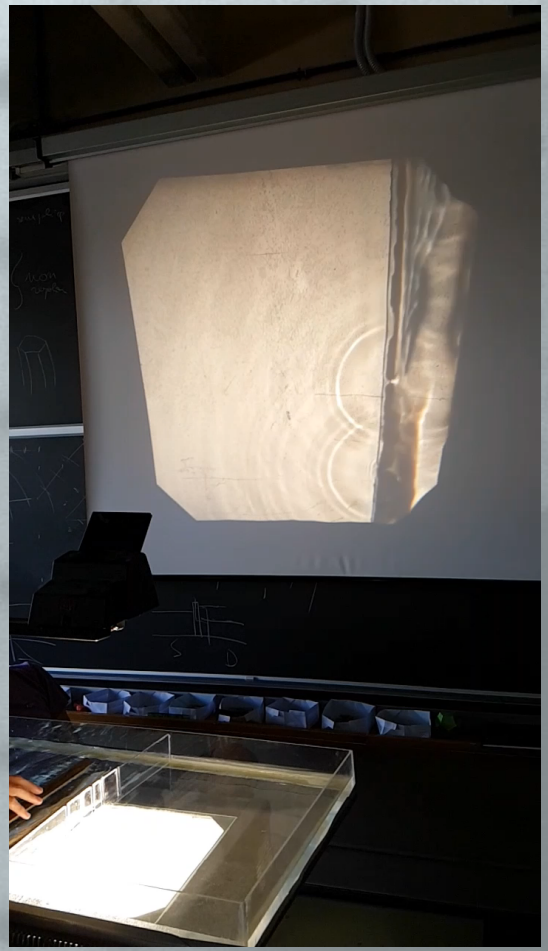


BCC (Body Center Cubic) LATTICE

Diffference between GRAPHITE and DIAMOND lattice.





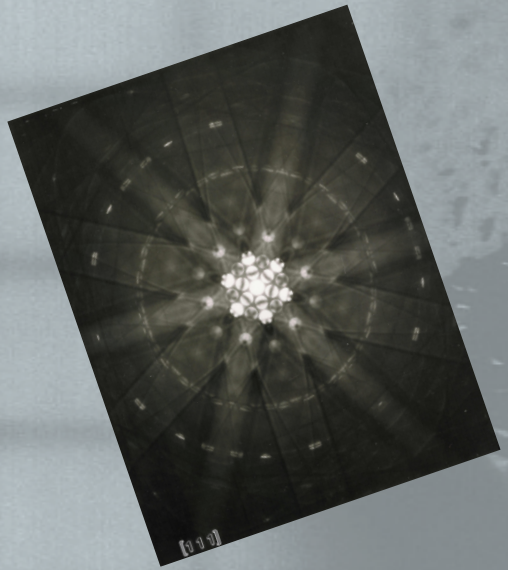


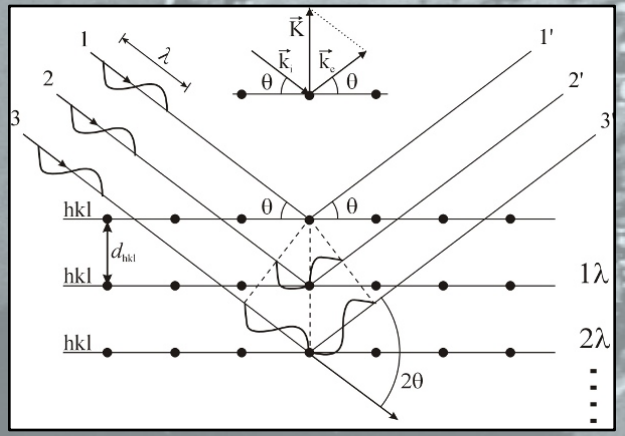
DIFFRACTION AND INTERFERENCE

"Diffraction is any deviation of waves from rectilinear direction"

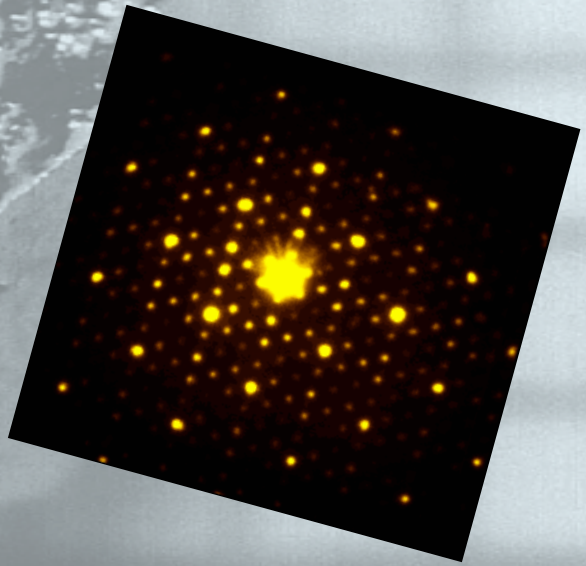
"Interference is the effect of superposition of two waves"

X-RAY DIFFRACTION ON CRYSTAL



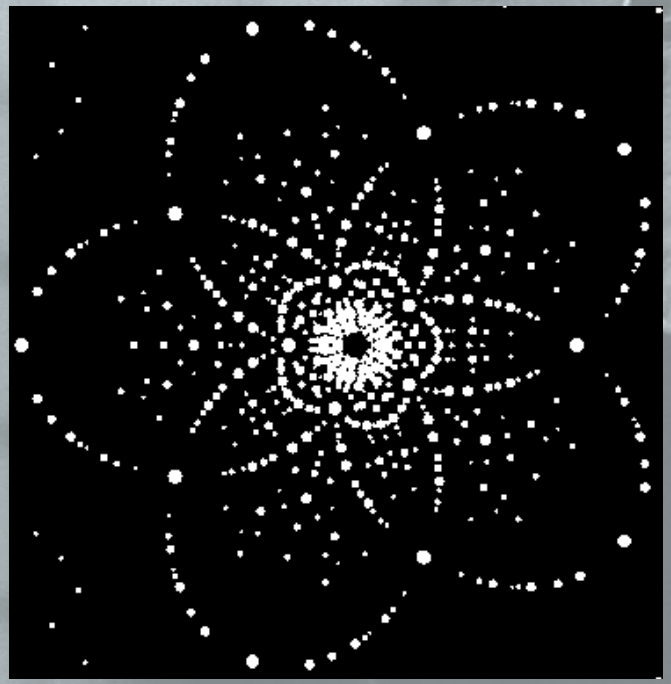


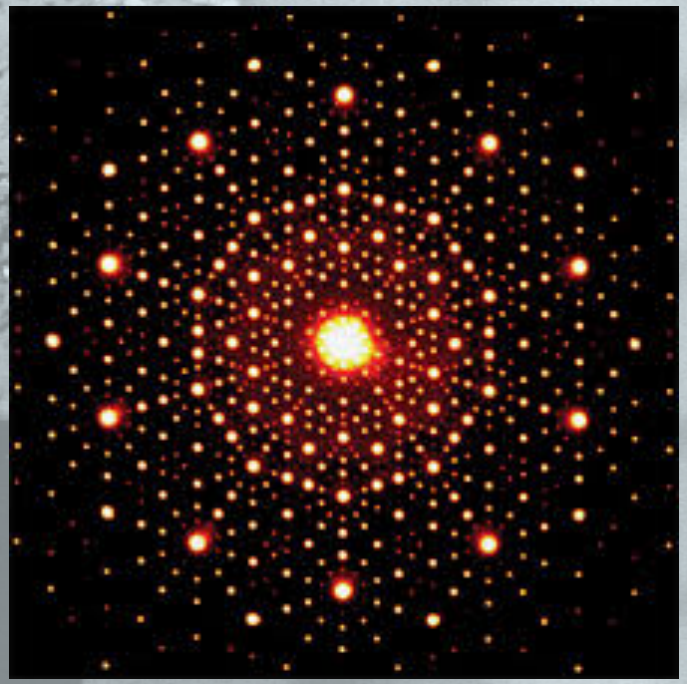
Planes of reflection in a crystal lattice



Nobel Prize 1915 – William Henry and Lawrence Bragg

WHY DO THEY EXIST?

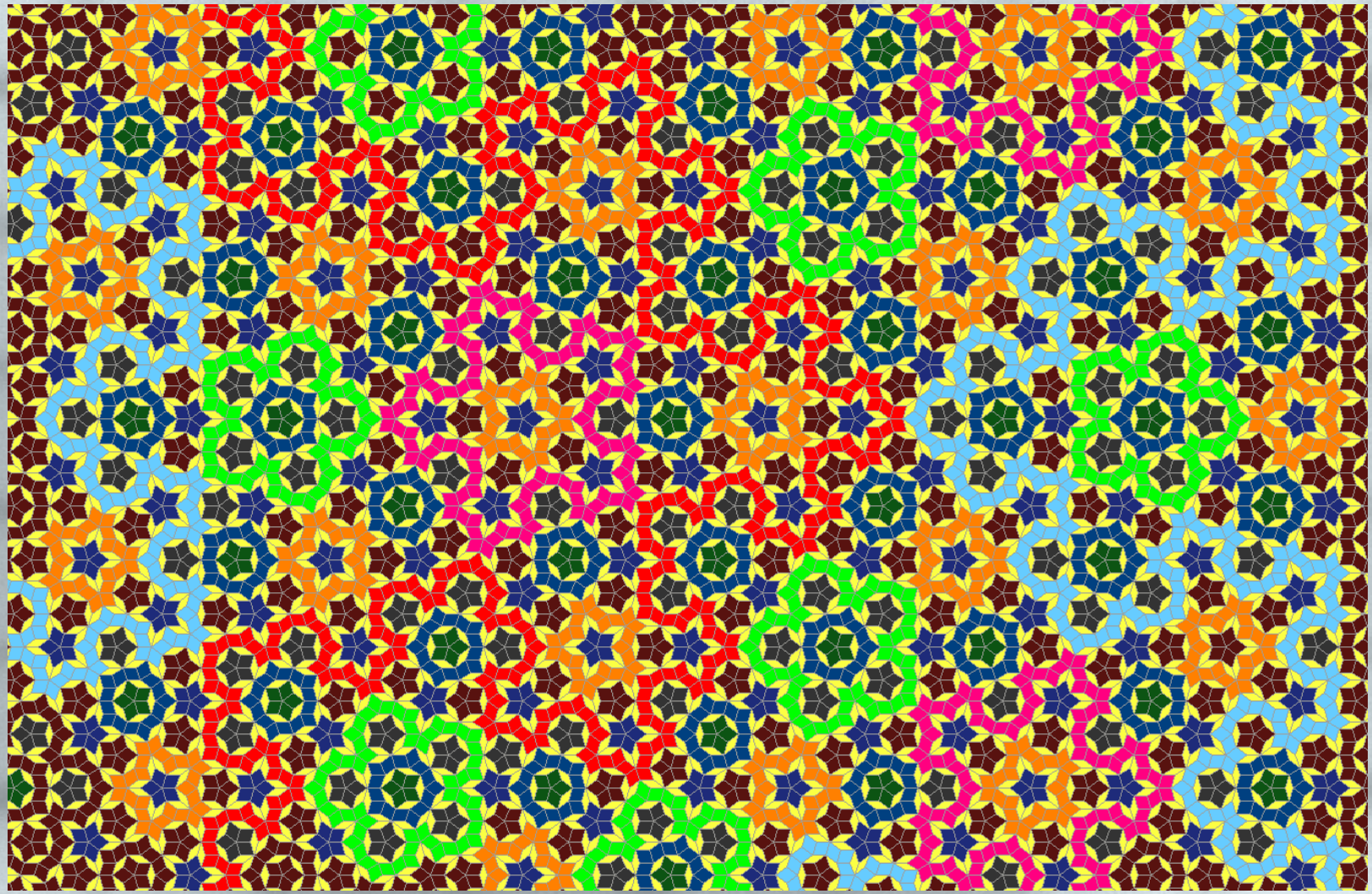




In 1982 diffraction patterns with 5-fold simmetry are observed.
These patterns violate the fundamental law of crystallography

THE FUNDAMENTAL FEATURE OF QUASICRYSTALS

A QUASICRYSTAL is an aperiodic crystalline structure which is the projection on a lower dimensional space of a regular crystal on a higher dimensional space.

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Francesco Astorre
Simone Tiberi


CLASSIFICATION
SYMMETRY
FUNDAMENTAL TH CRYS.
CLASSIFICATION
XRAY DIFFRACTION vs TUNNEL
RIPPLE TANK
PENTAGONAL SYMMETRY
APERIODICITY 5D → 2D
EXAMPLE 2D → 3D