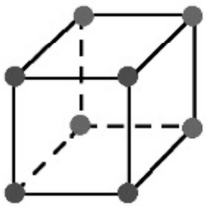
3D crystal systems (7)

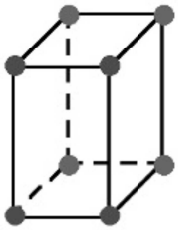
= axis systems of the crystal
= metrics of the unit cell

cubic



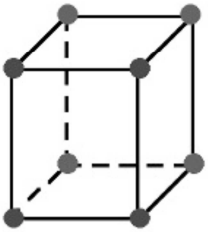
a

tetragonal



a, *c*

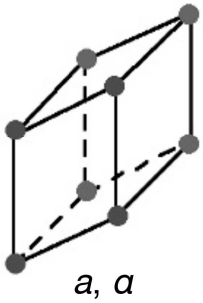
orthorhombic



a, *b*, *c*

$\alpha = \beta = \gamma = 90°$

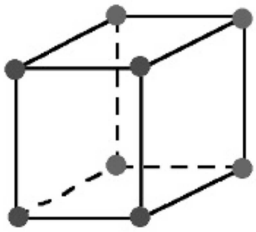
rhombohedral



a, *α*

$\alpha = \beta = \gamma$

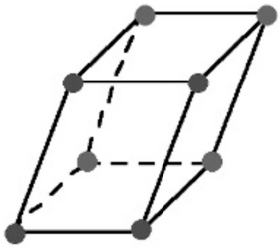
hexagonal



a, *c*

$\alpha = \beta = 90°, \gamma = 120°$

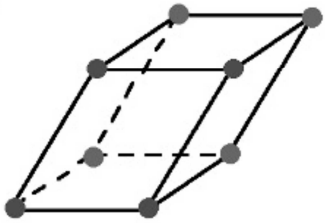
monoclinic



a, *b*, *c*, *β*

$\alpha = \gamma = 90°$

triclinic



a, *b*, *c*, *α*, *β*, *γ*

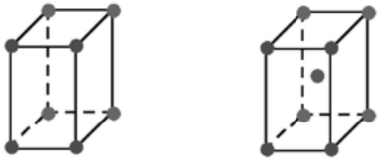
cnx.org

3D Bravais lattices (14)

cubic

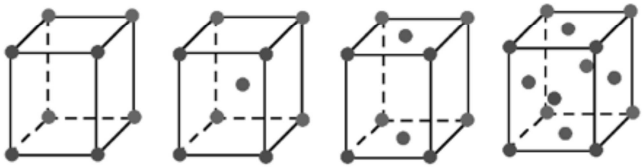
primitive | body-centered | face-centered

tetragonal



primitive | body-centered

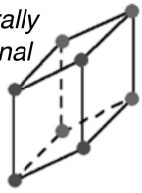
orthorhombic



primitive | body-centered | base-centered | face-centered

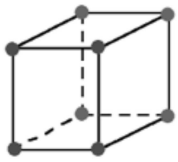
rhombohedral

also: rhombohedrally centered hexagonal



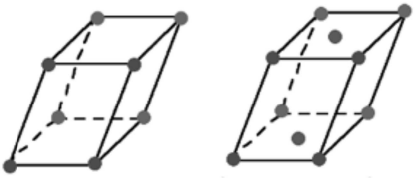
primitive

hexagonal



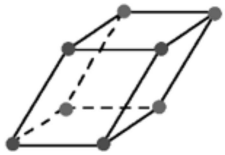
primitive

monoclinic



primitive | base-centered

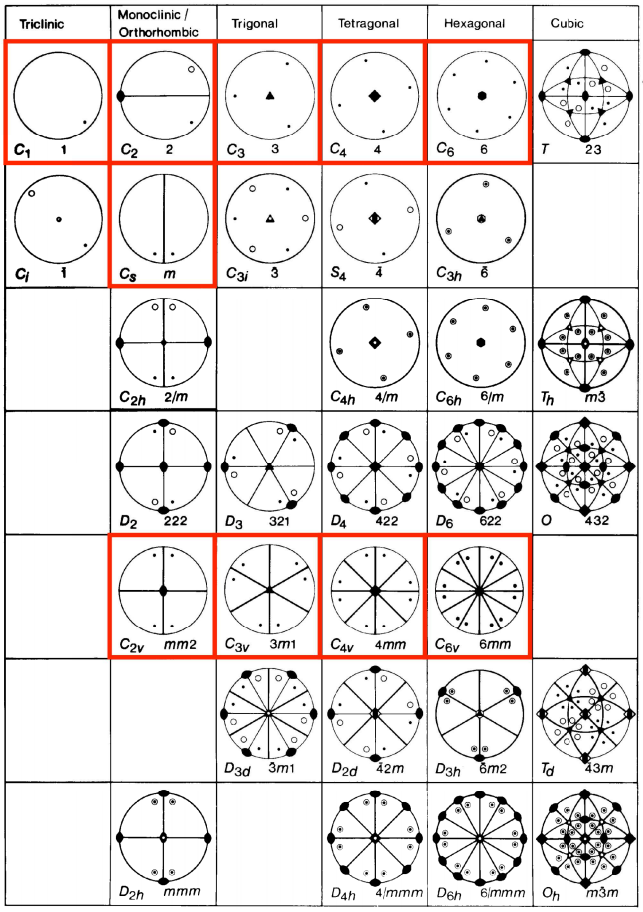
triclinic



primitive

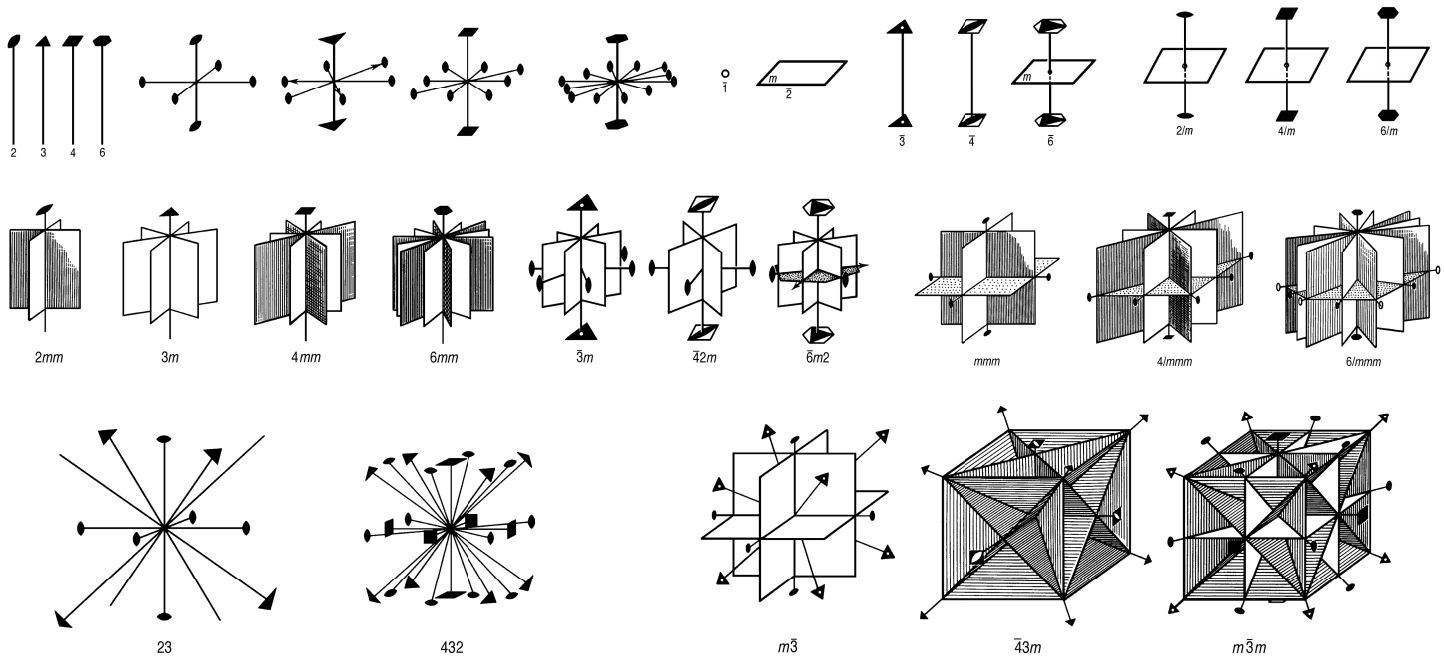
cnx.org

3D point groups (32)



"Elements of Symmetry in Periodic Lattices, Quasicrystals", in *"Materials Science and Technology"*, W. Steurer.

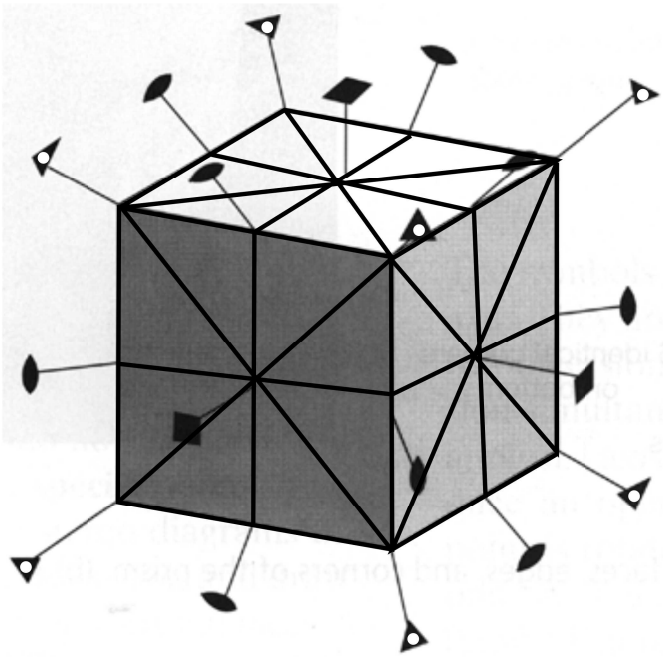
3D point groups (32)



"Fundamentals of Crystals", B. K. Vainshtein, 1994.

Point group of a cube

m*$\bar{3}$*m



rotational axes:
2, 3, 4
(×6, ×4, ×3)

mirror planes:
m
(×3)

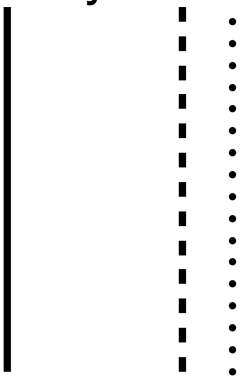
inversion center:
$\bar{1}$
&
rotoinversion:
$\bar{3}$
(×4)

en.wikipedia.org

All symmetry operations

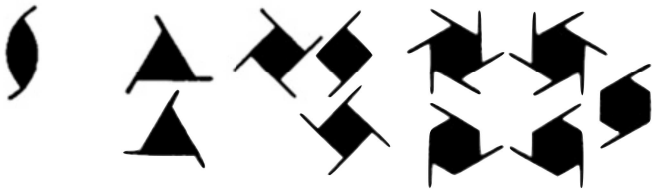
(incl. translational symmetry)

mirroring /
reflection
(on a line – 2D)
(on a plane – 3D)



reflection
+ translation

inversion
(+ rotation)

rotation
(*e.g.*, by 180°)

rotation
+ translation