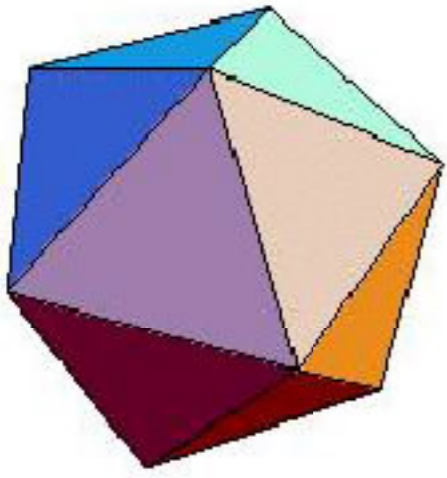
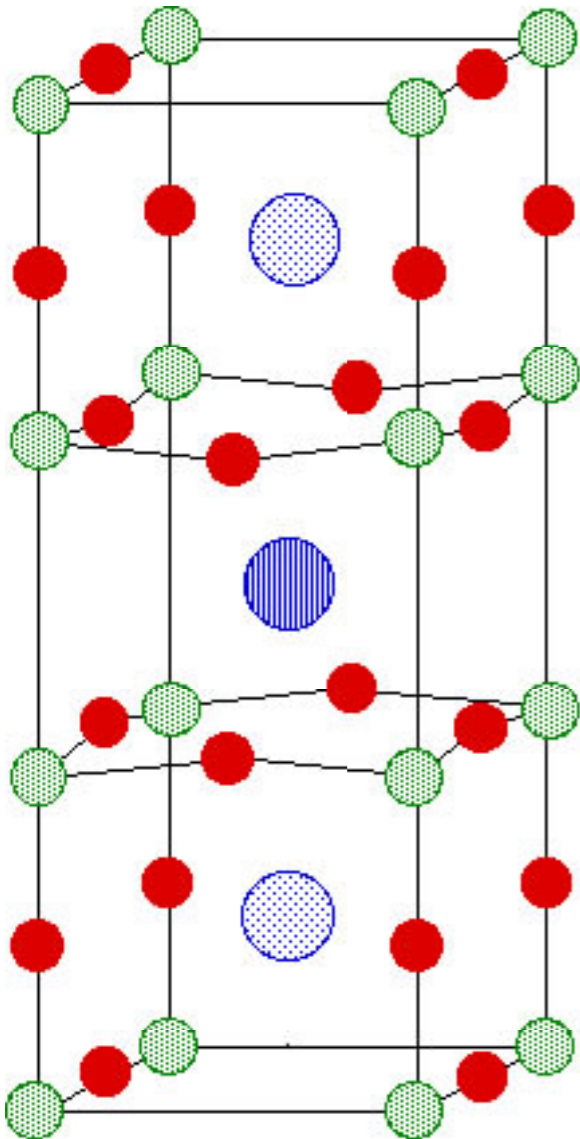






2) Symmetrie und Struktur



Hochtemperatur - Supraleiter



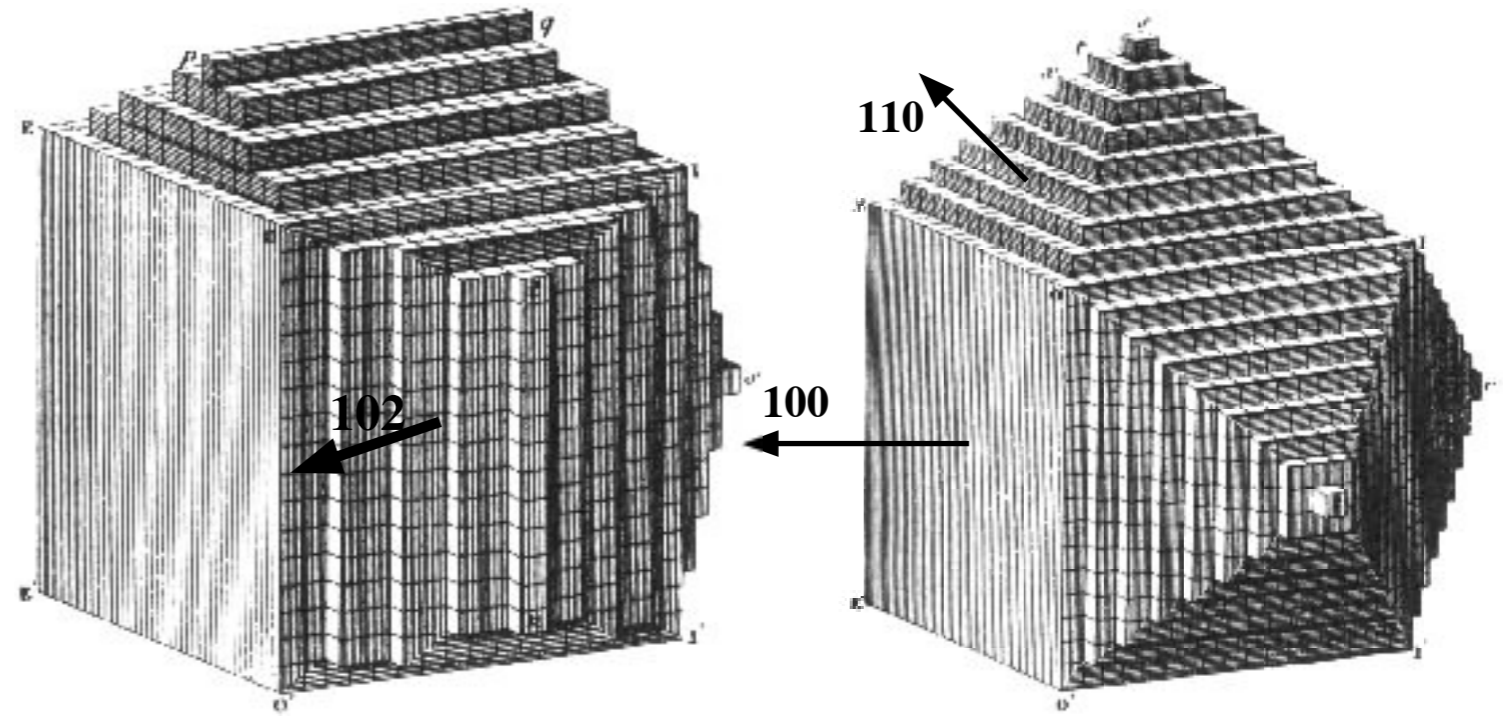
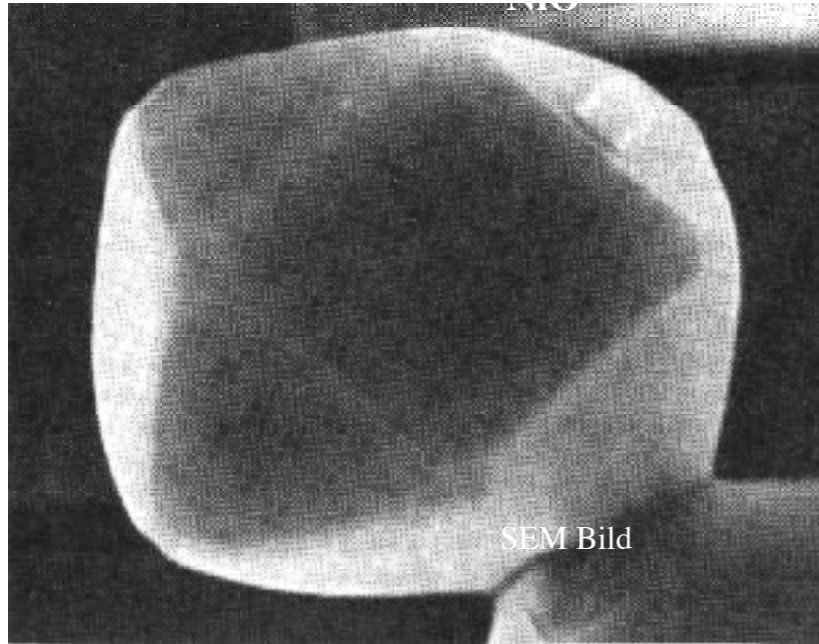
-  Barium
-  Yttrium
-  Copper
-  Oxygen

Proteine

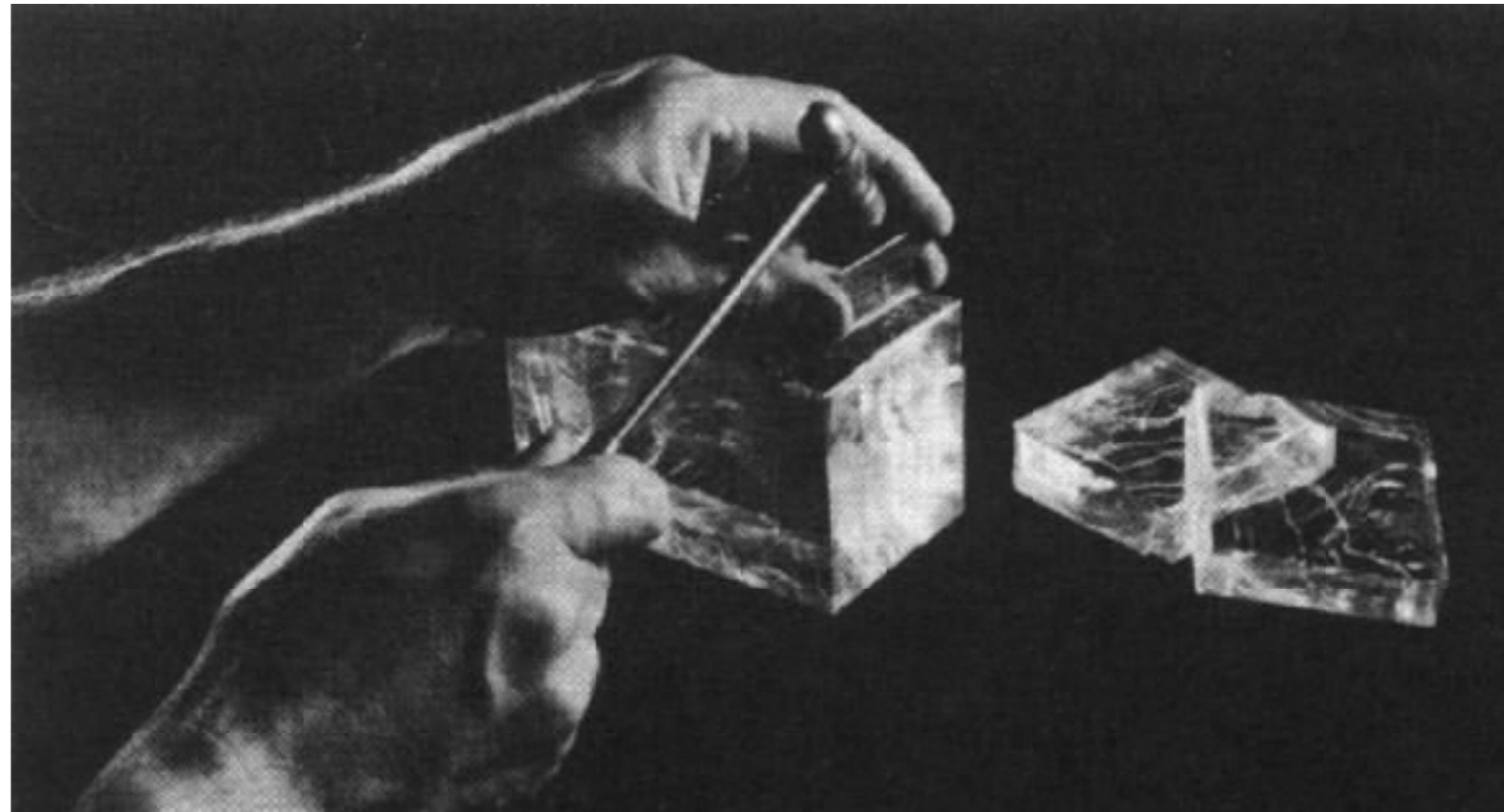


Morphologie von Kristallen

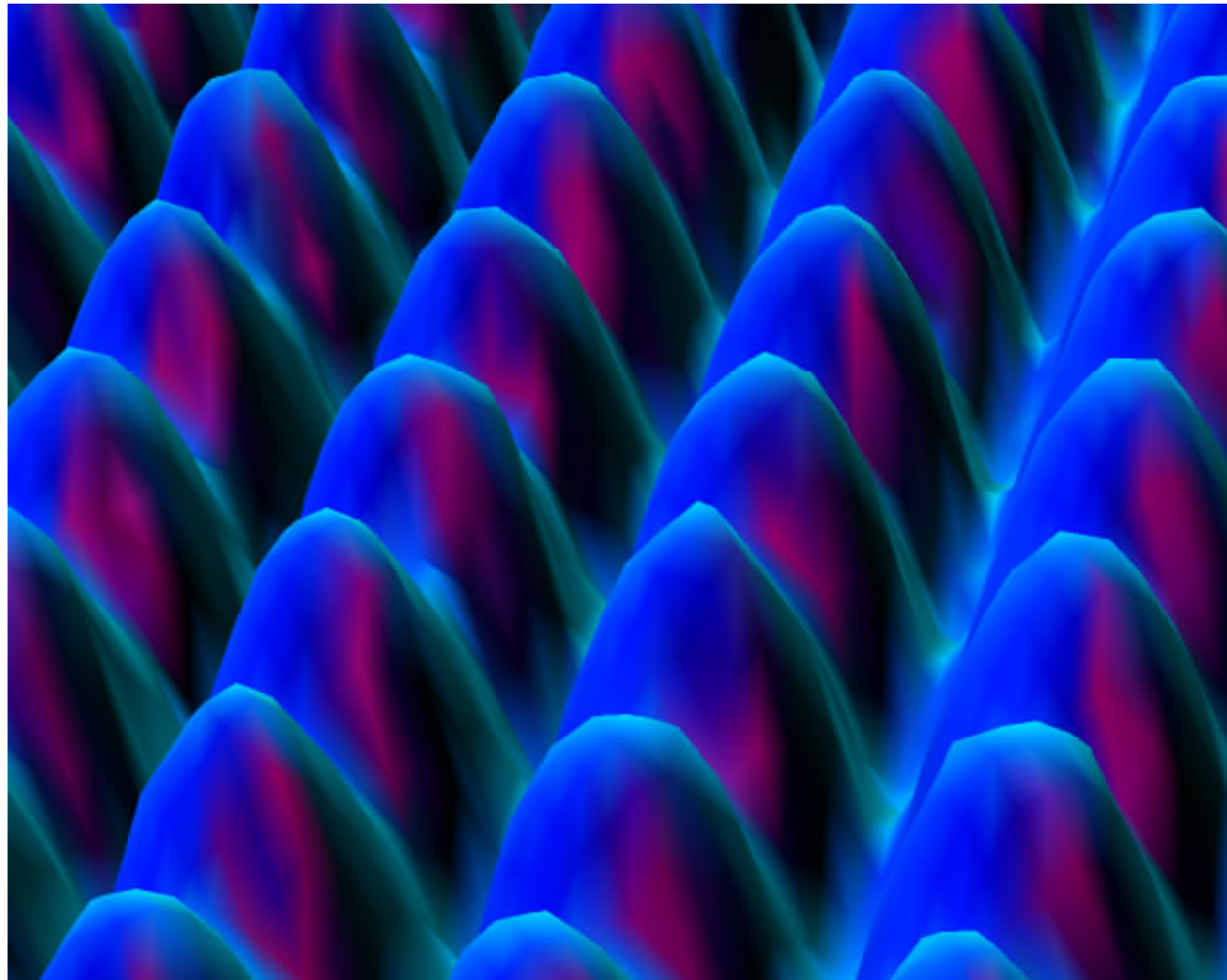
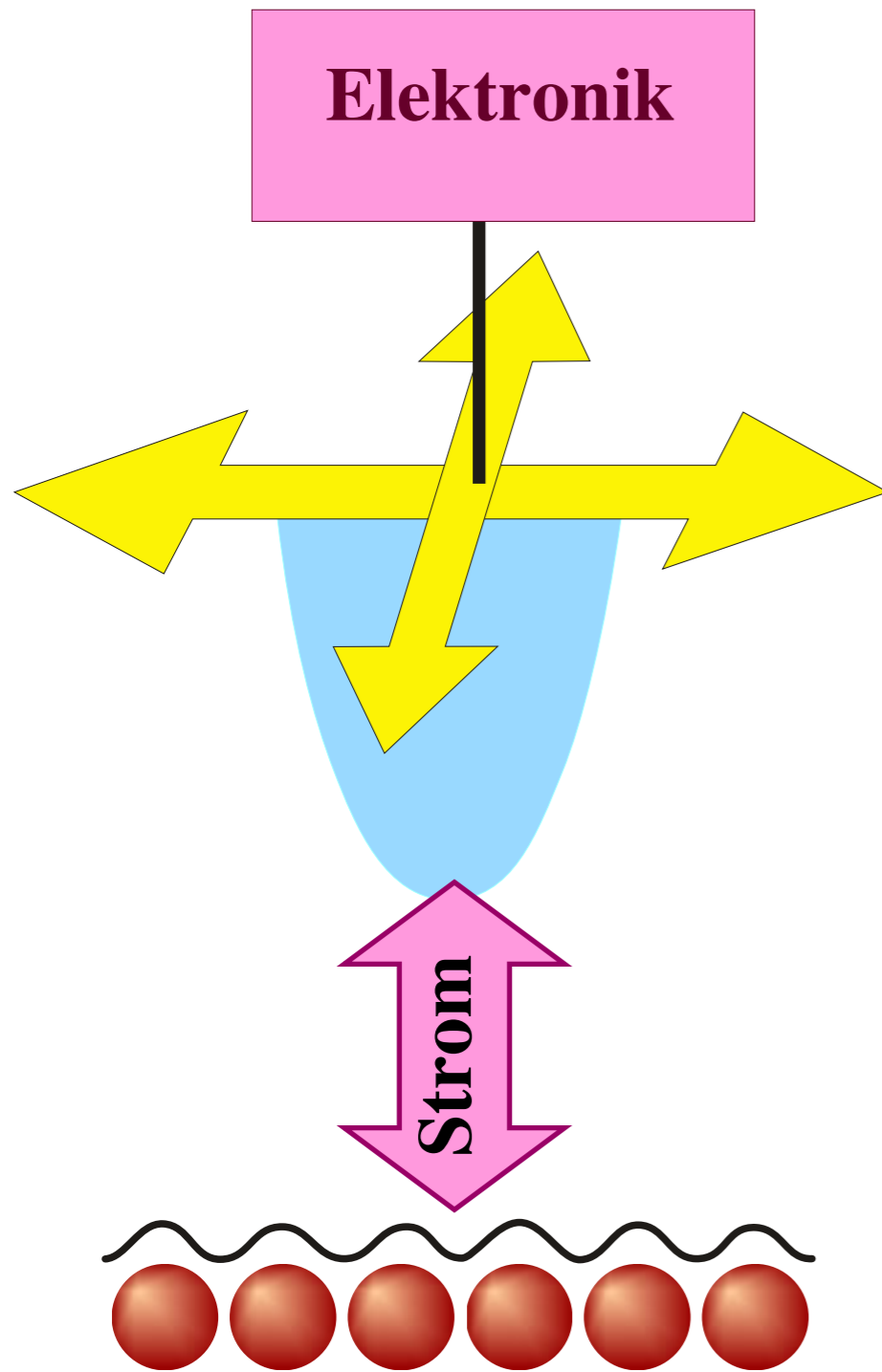
Wachstums-ebenen



Spaltebenen

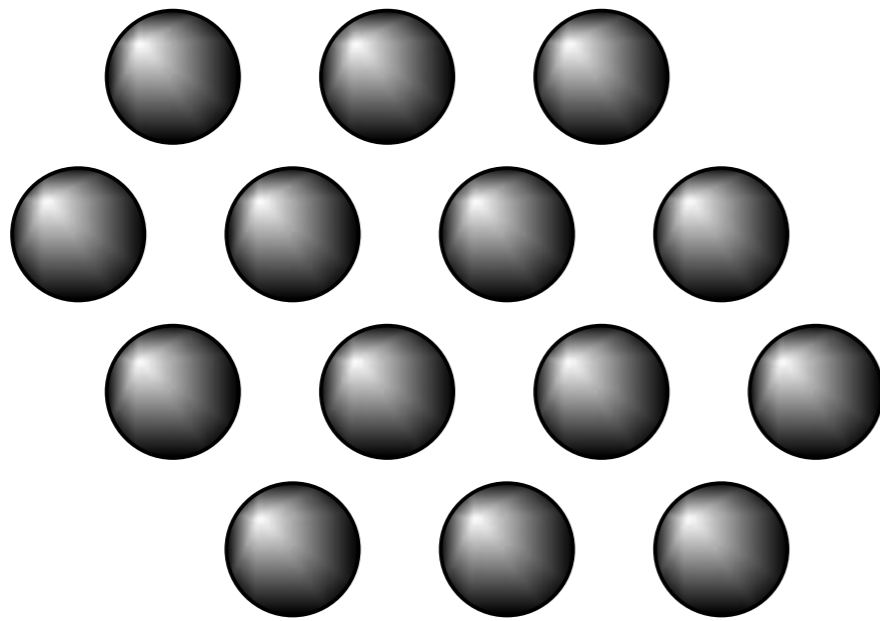


Raster-Tunnel Mikroskopie

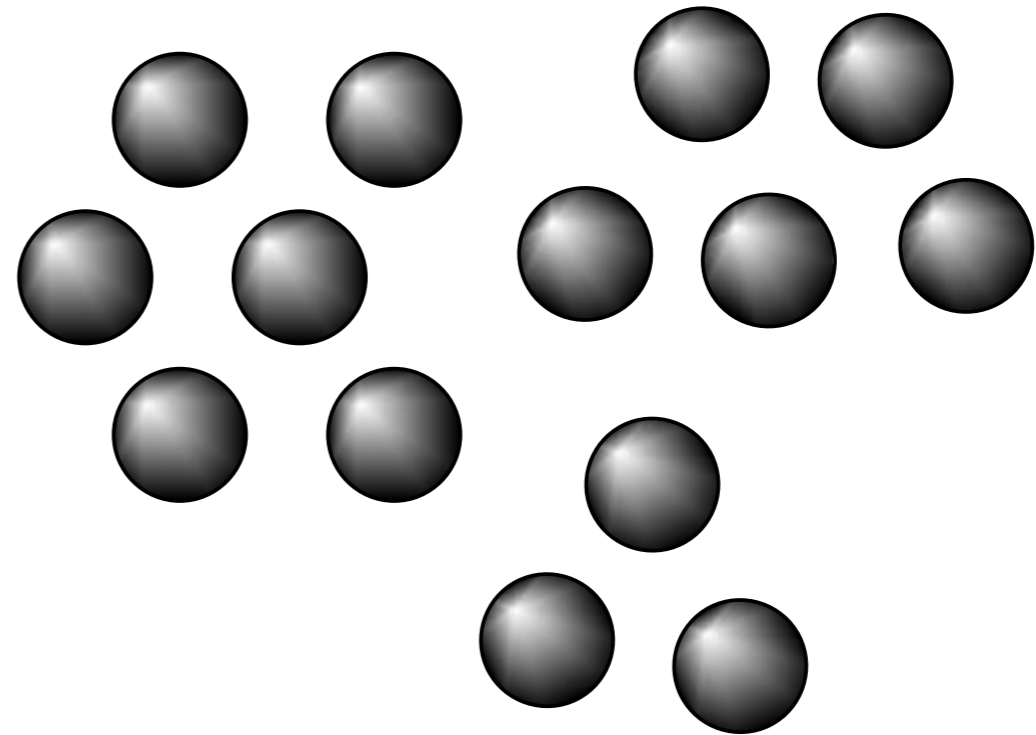


Ordnung in Festkörpern

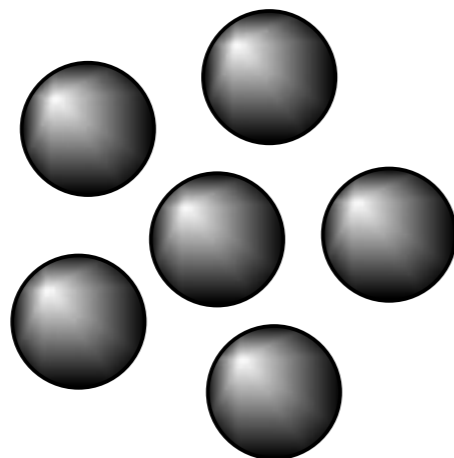
kristallin



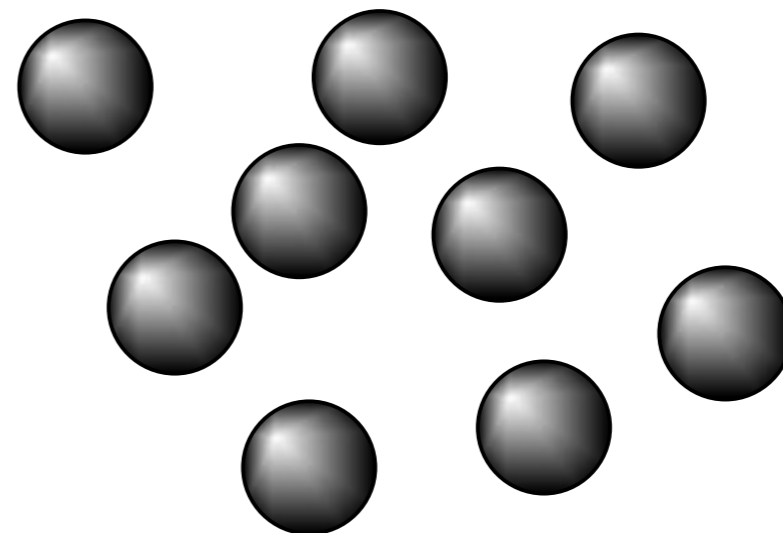
polykristallin



quasikristallin

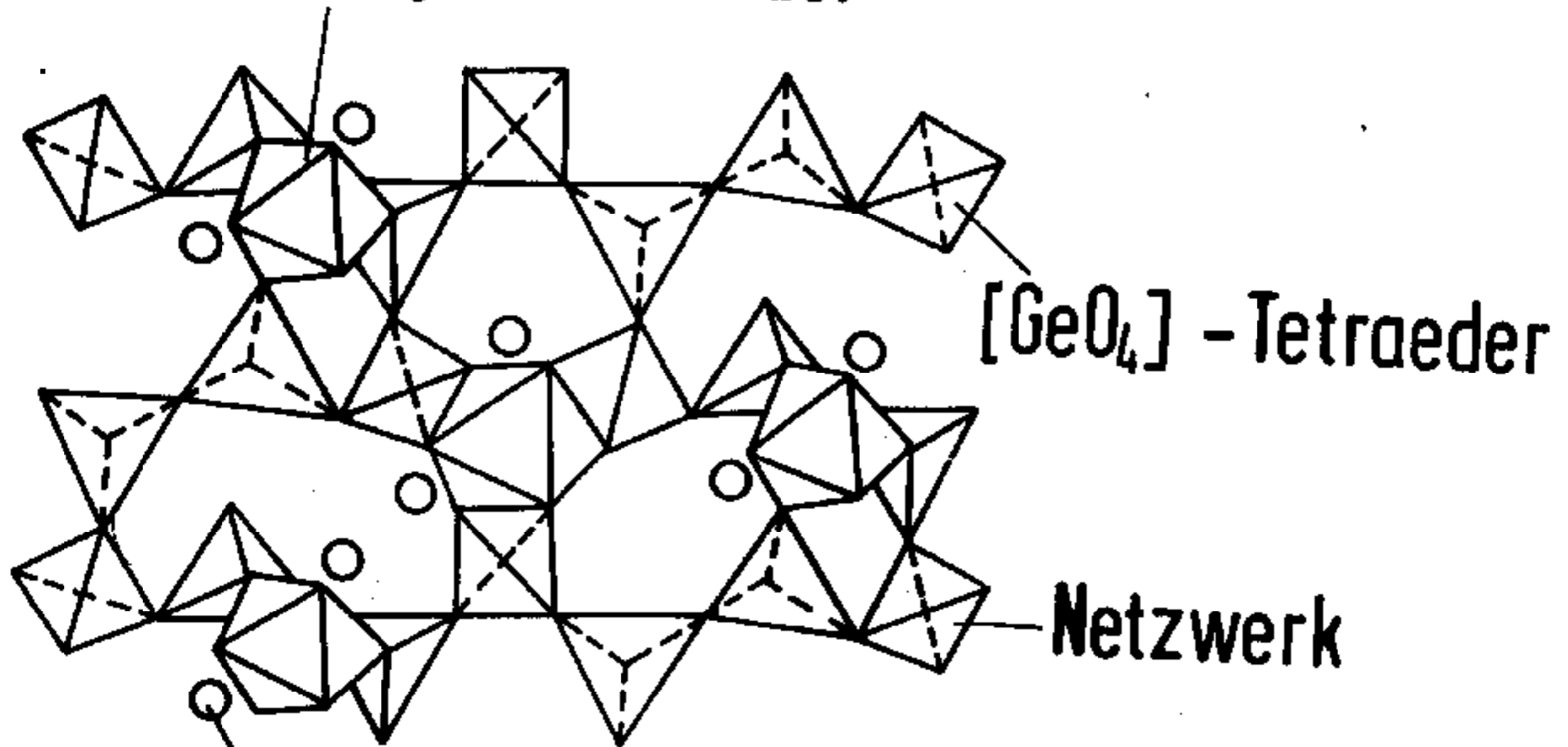


amorph



Nah- und Fernordnung in Glas

$[\text{GeO}_6]^{2-}$ - Oktaeder



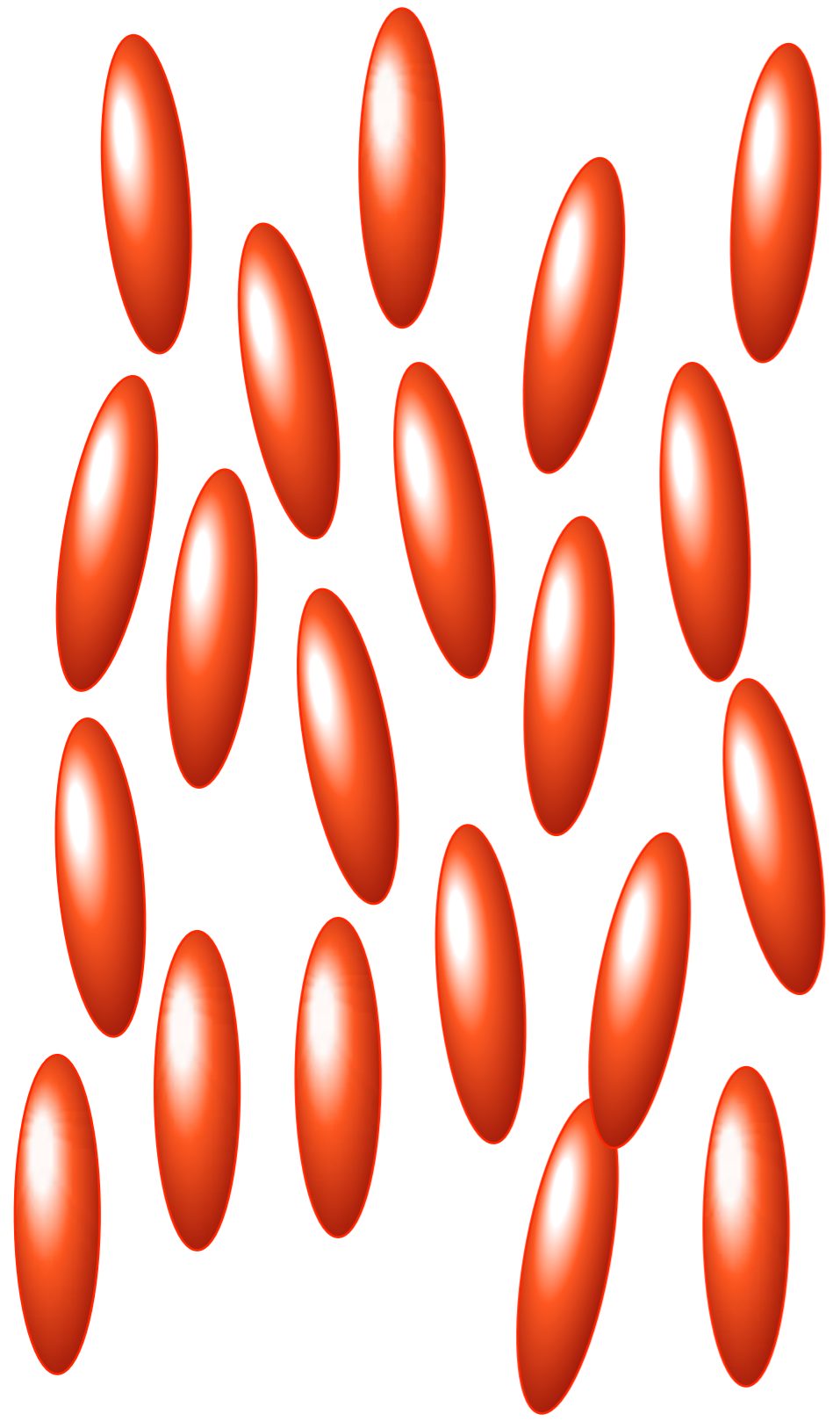
$[\text{GeO}_4]$ - Tetraeder

Netzwerk

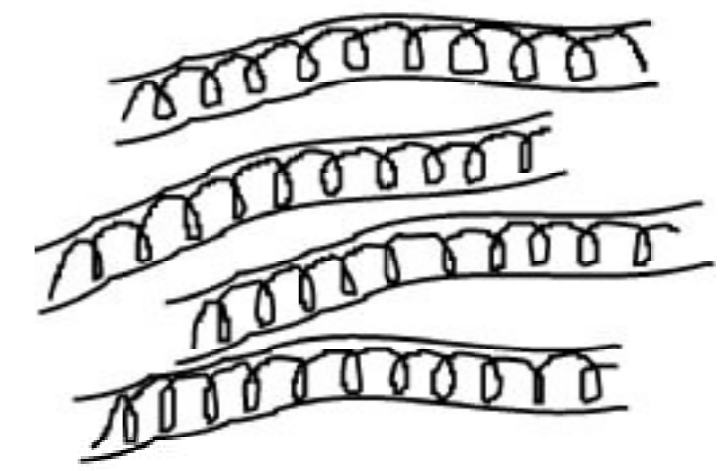
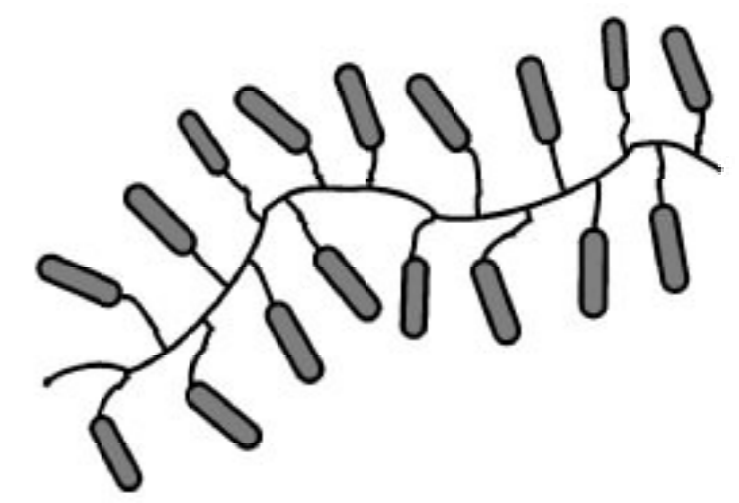
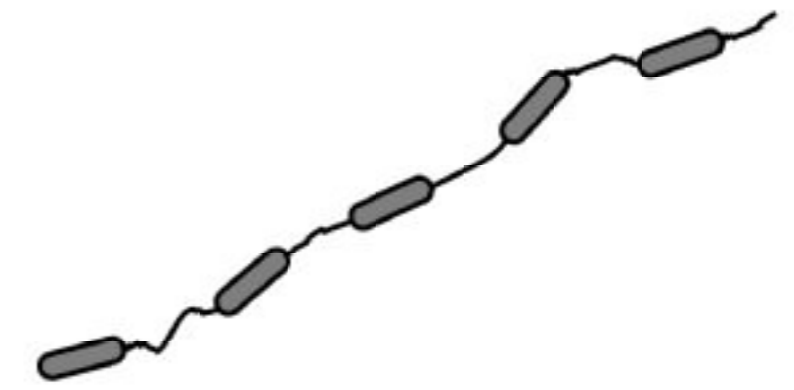
Li^+ (Netzwerk-Modifizier)

Flüssigkristalle

nematische Flüssigkristalle

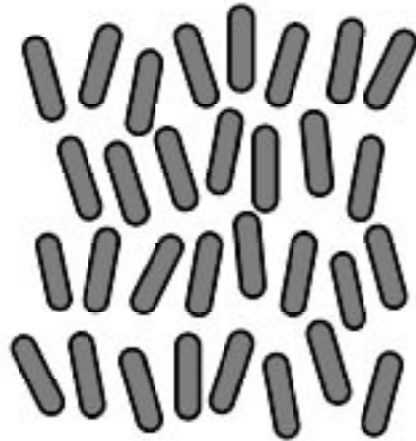


Flüssigkristall - Polymere

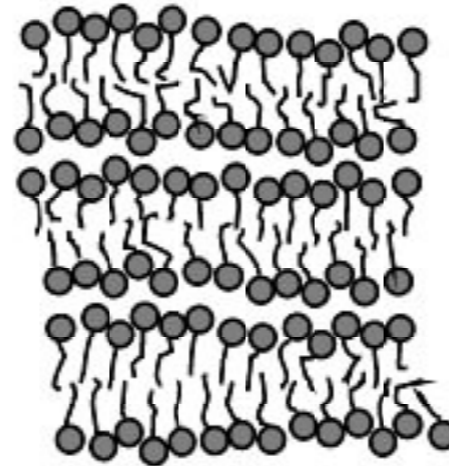


Partielle Fernordnung

eindimensionale Positionsfernordnung:

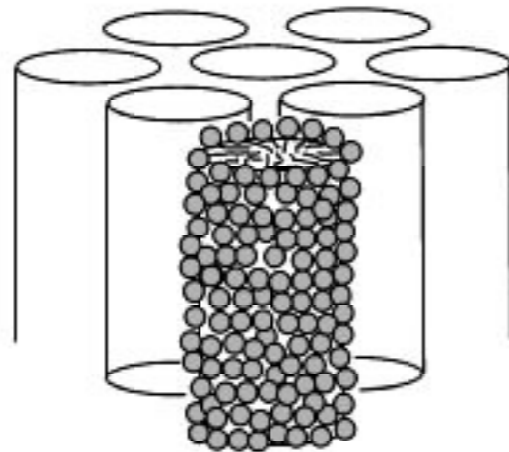


smektisch

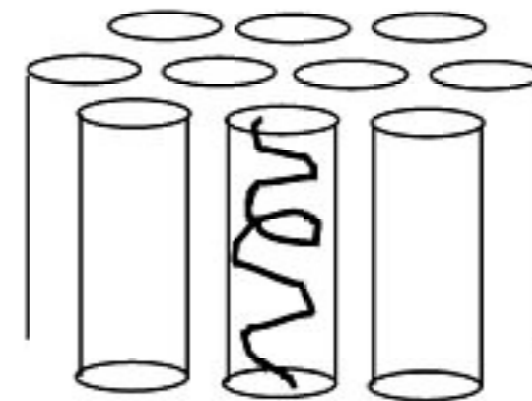


lamellar: Amphiphile, Amphiphilpolymere
und Blockcopolymere

zweidimensionale Positionsfernordnung:



hexagonal: Amphiphile, Amphiphilpolymere
und Blockcopolymere



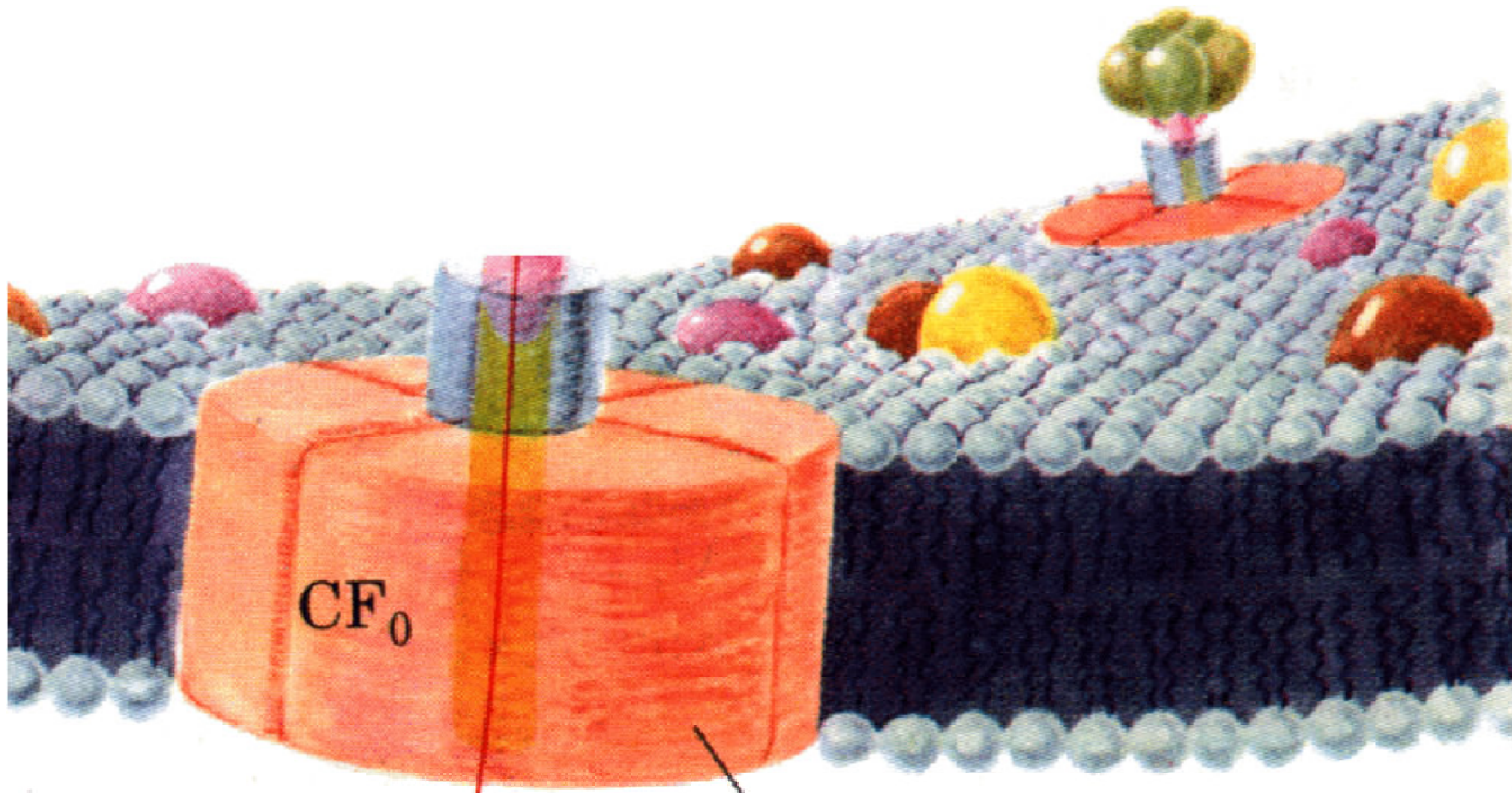
Condens

dreidimensionale Positionsfernordnung:

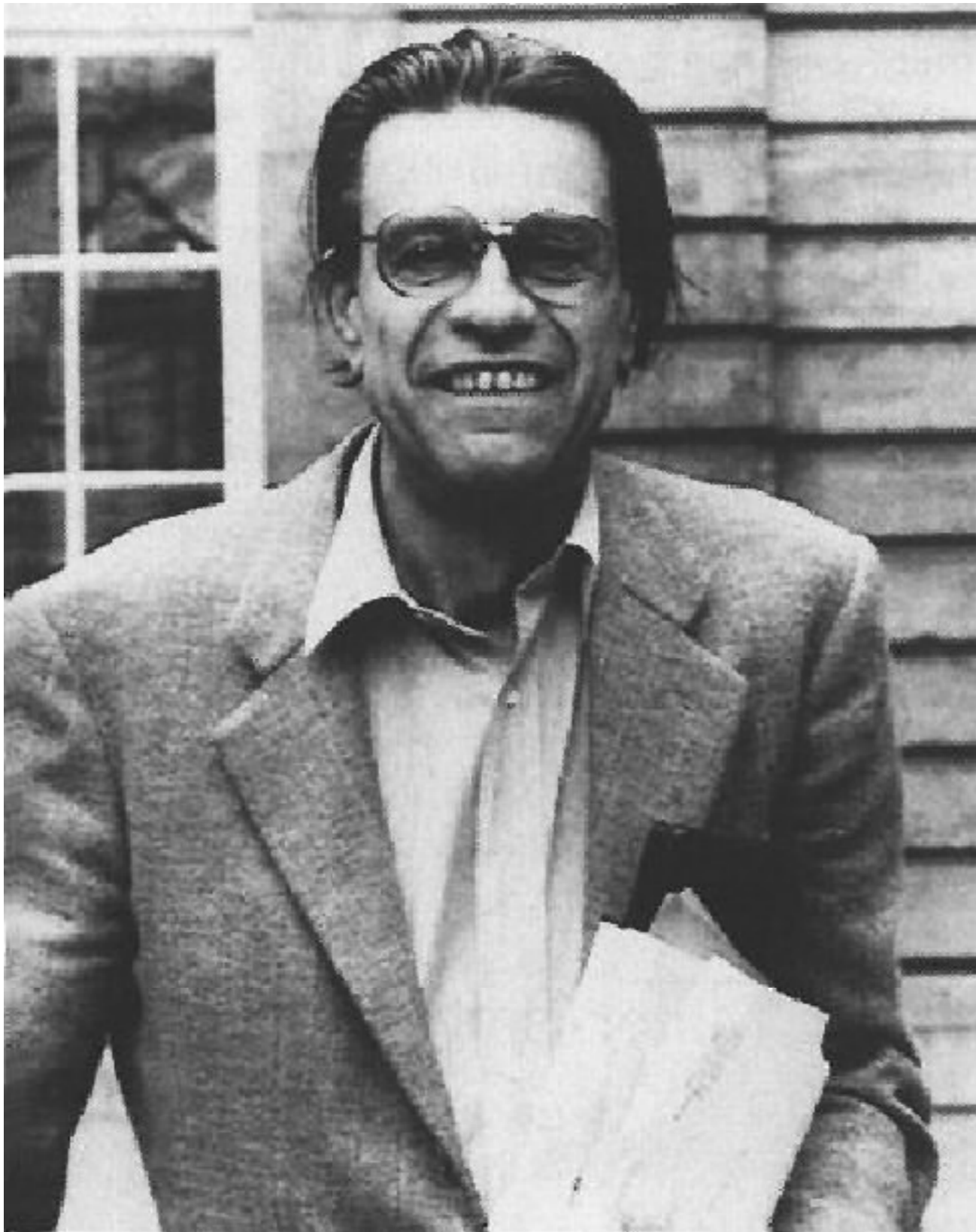
z. B. kubische Phasen

Biologische Flüssigkristalle

Membranen



Flüssigkristalle und Polymere



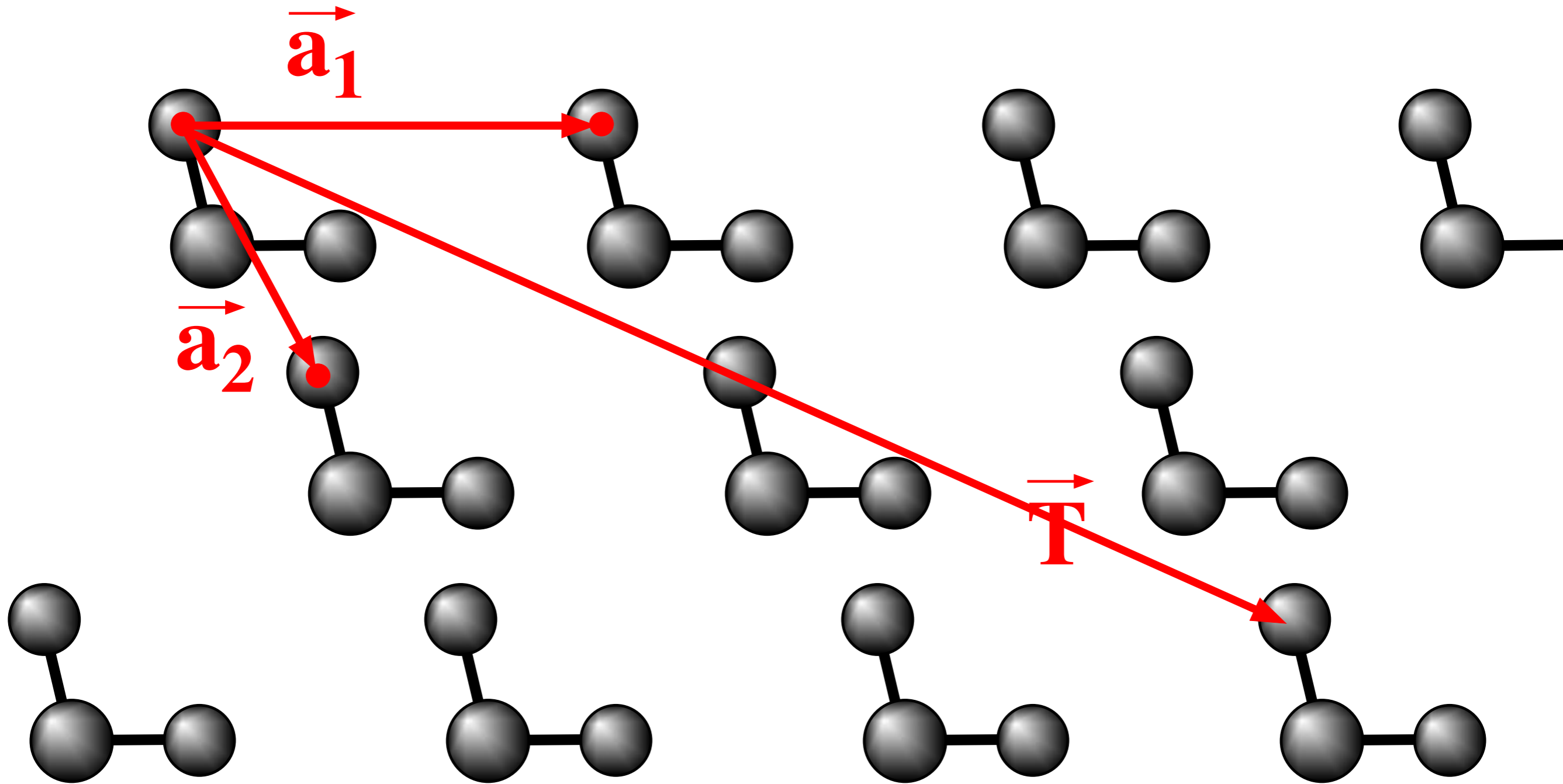
Pierre Gilles de Gennes



The Nobel Prize in Physics 1991

“For discovering that methodes developed for studying order phenomena in simple systems can be generalized to more complex forms of matter, in particular to liquid crystals and polymers”

Translationssymmetrie



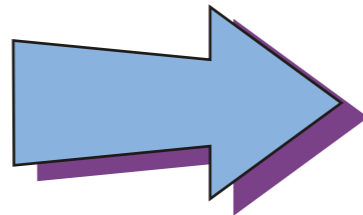
Weshalb Translationssymmetrie ?

Hauptgrund : Energie - Minimierung

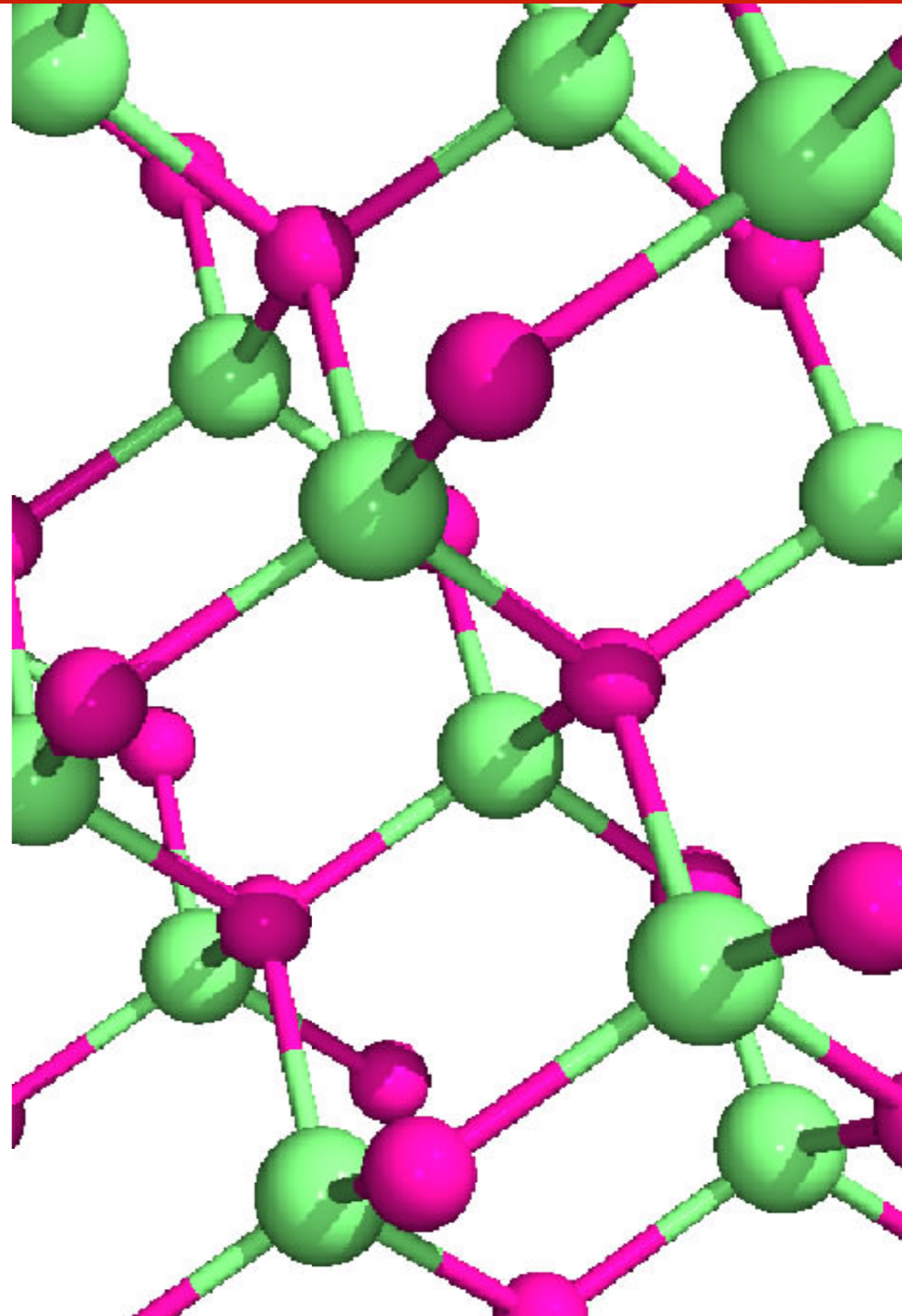
Bsp: GaAs



Ga bevorzugt tetraedrische Umgebung aus As



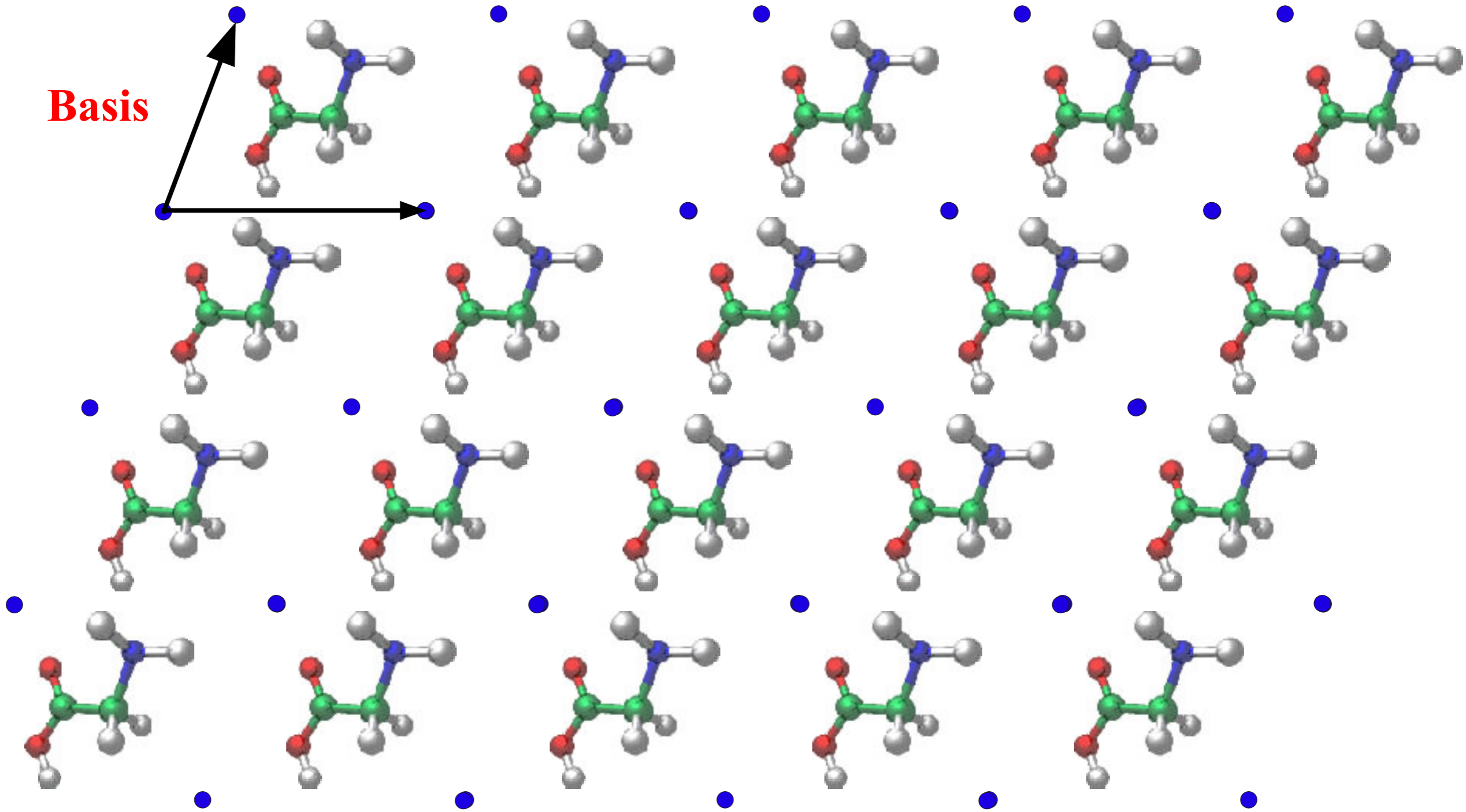
As bevorzugt tetraedrische Umgebung aus Ga



Gitter und Basis

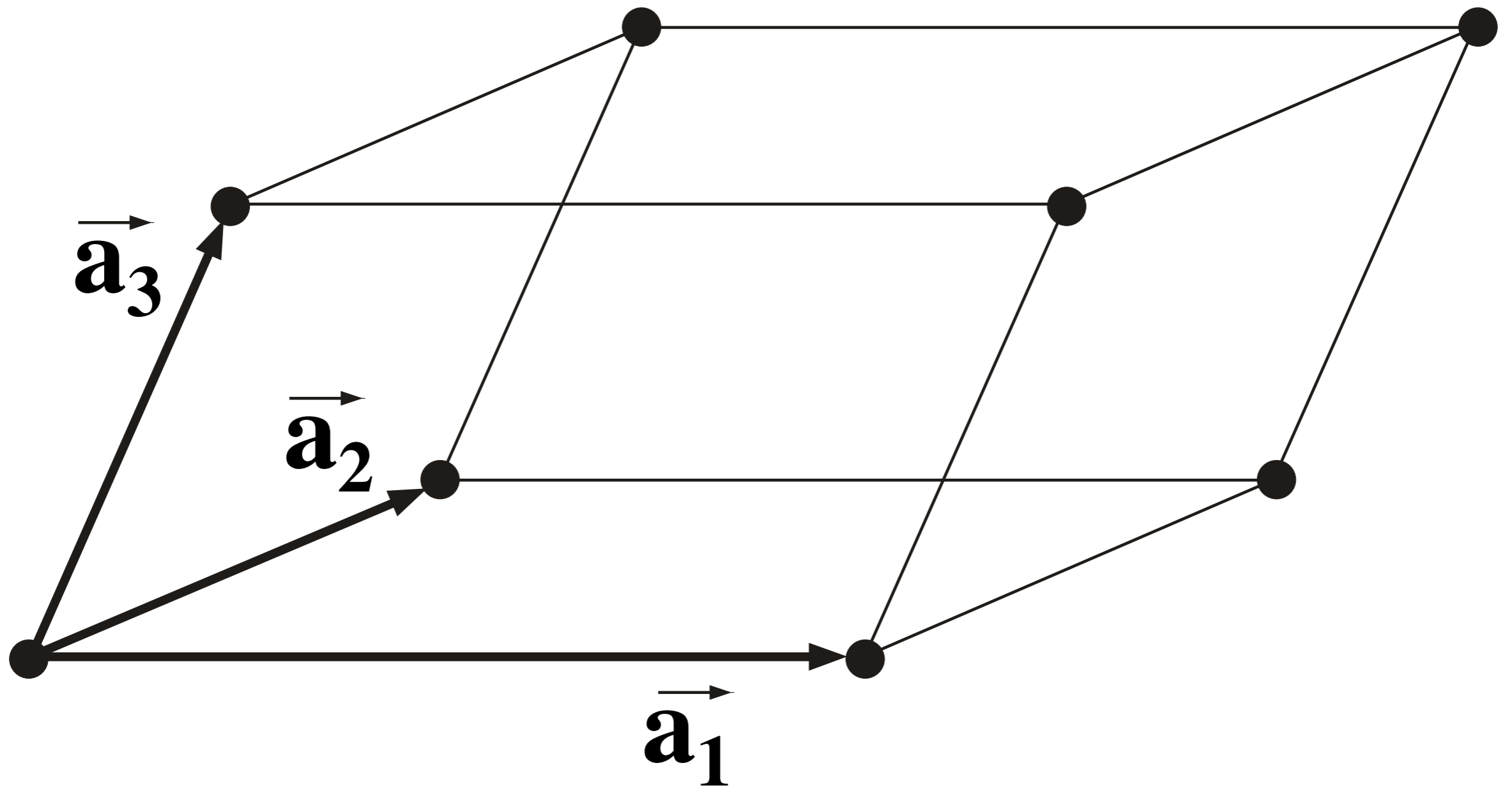
Gitter

Basis



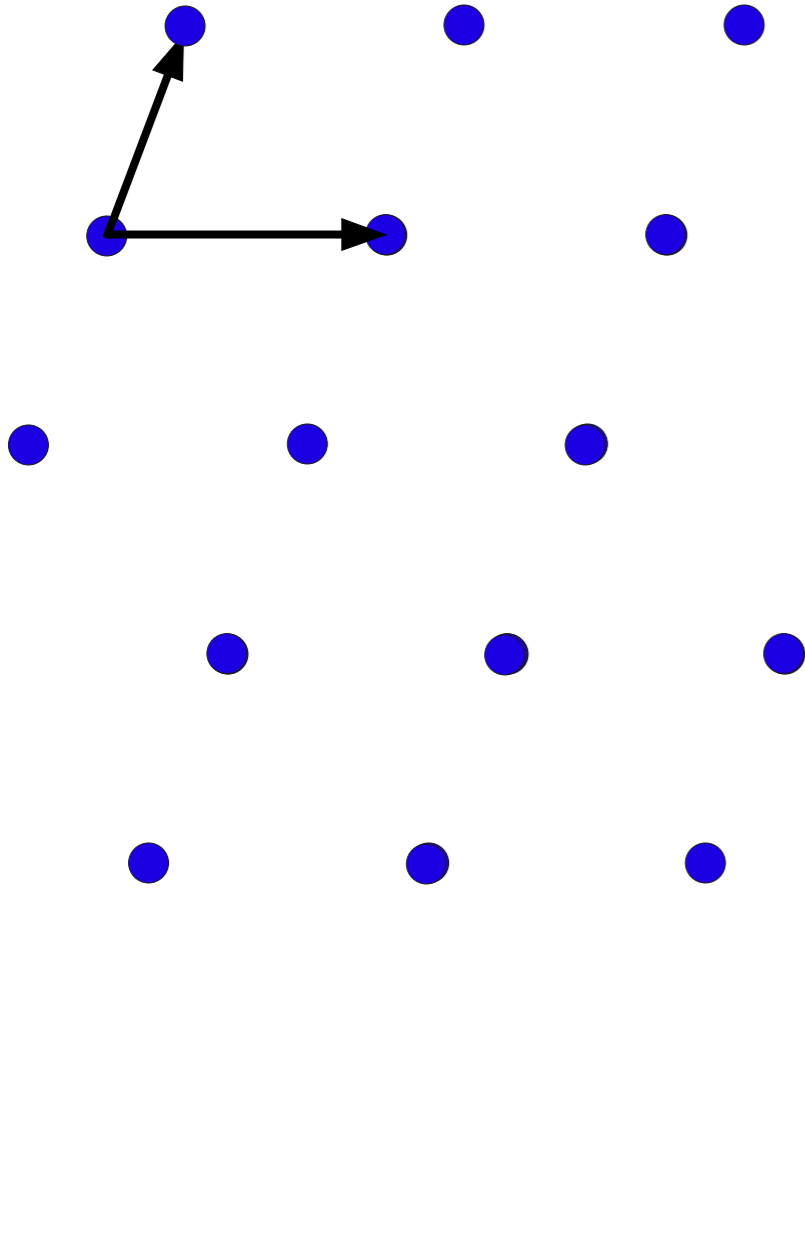
Translationsgitter

Einheitszelle und Basisvektoren des Translationsgitters

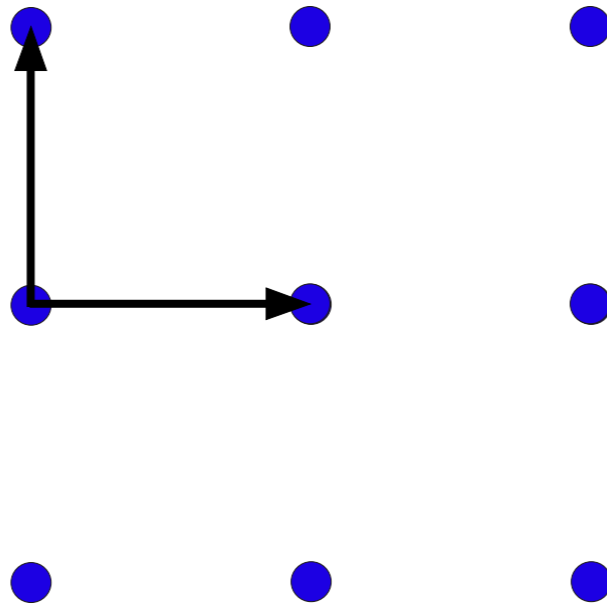


Unterschiedliche Gitter

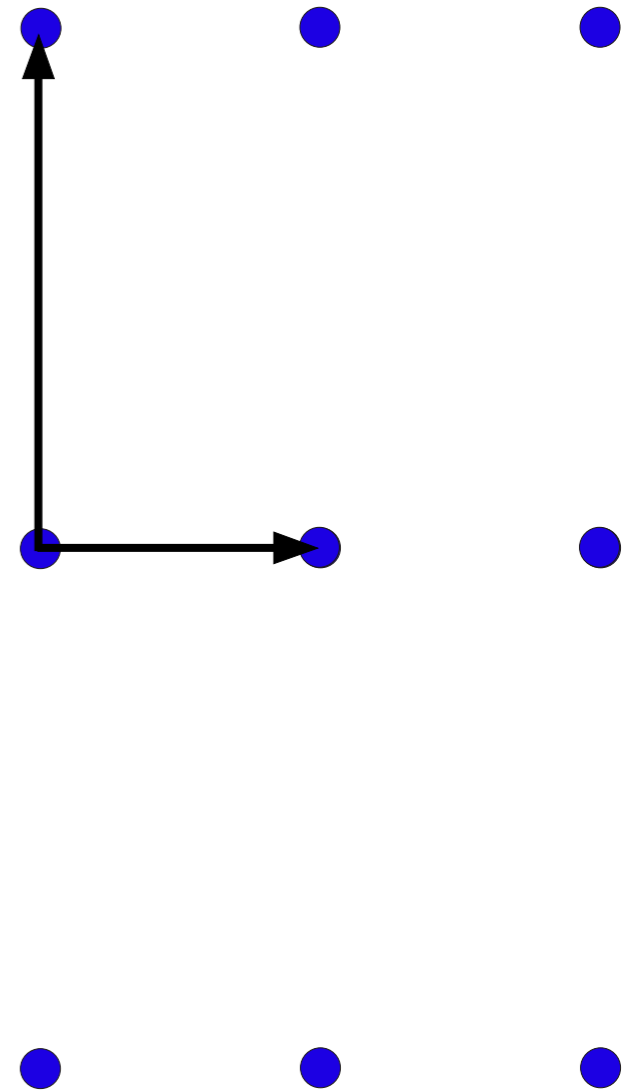
allgemein



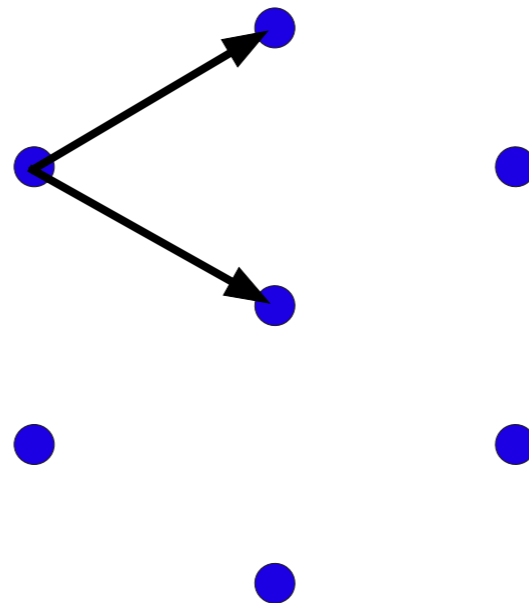
quadratisch



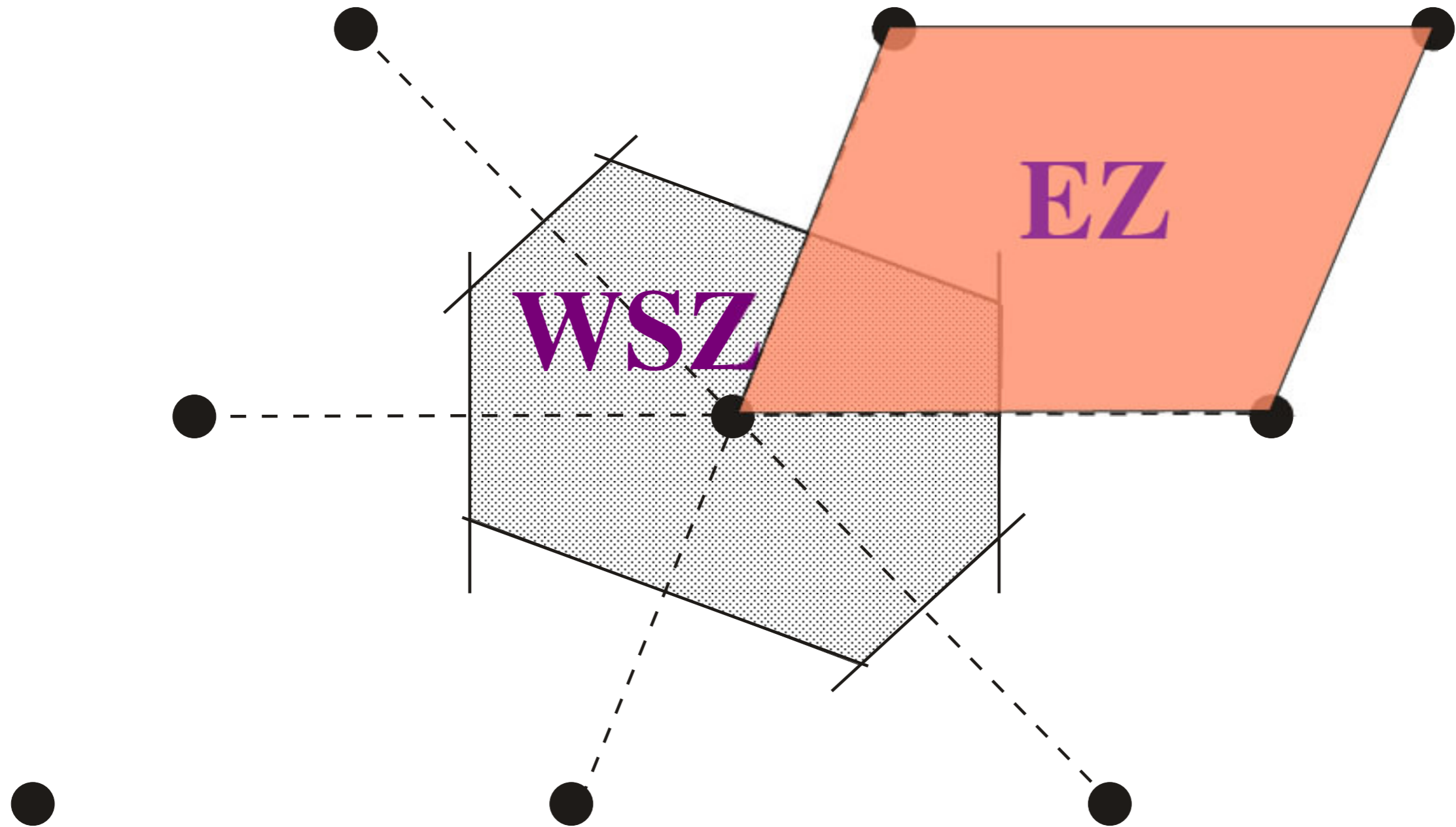
rechteckig



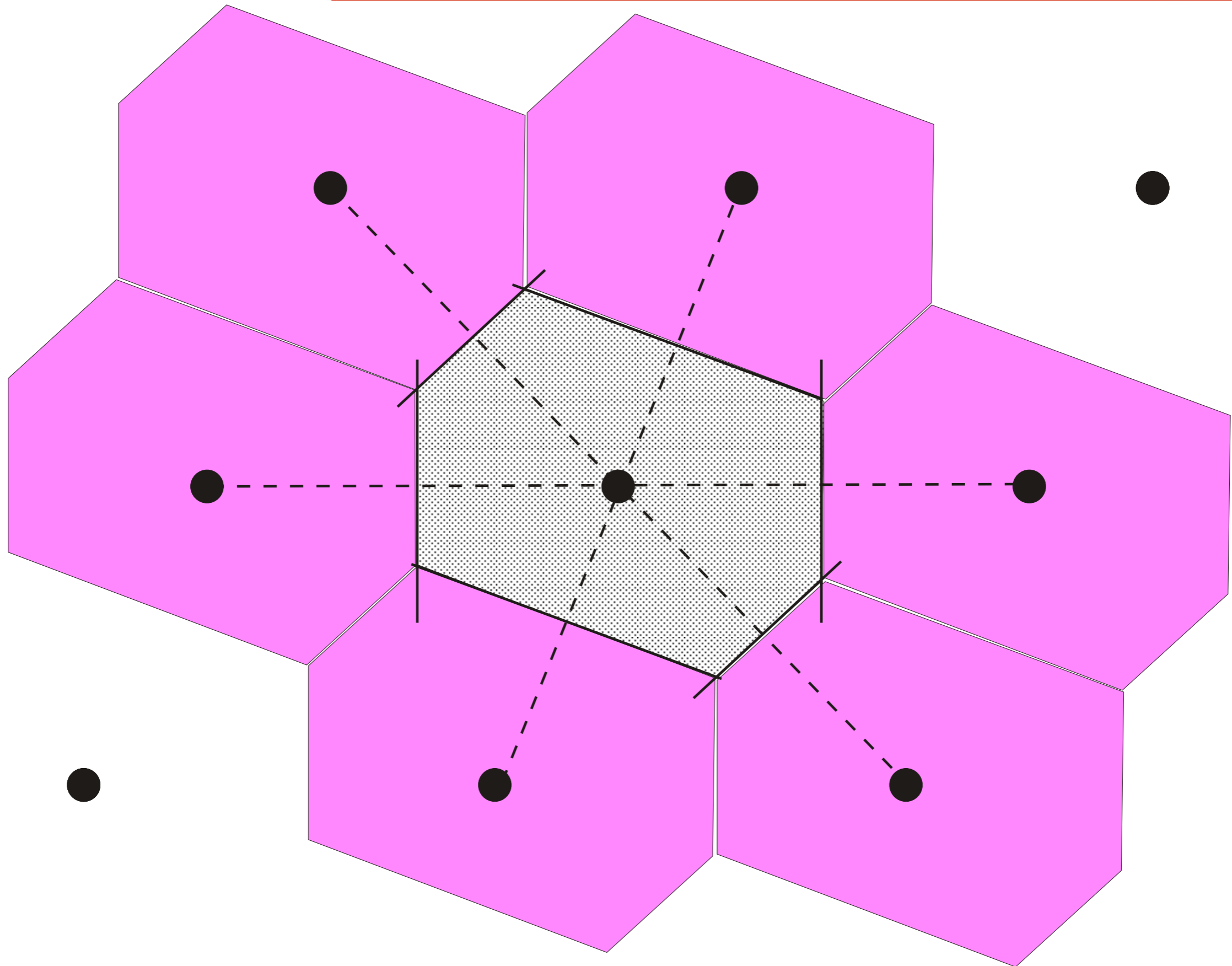
hexagonal



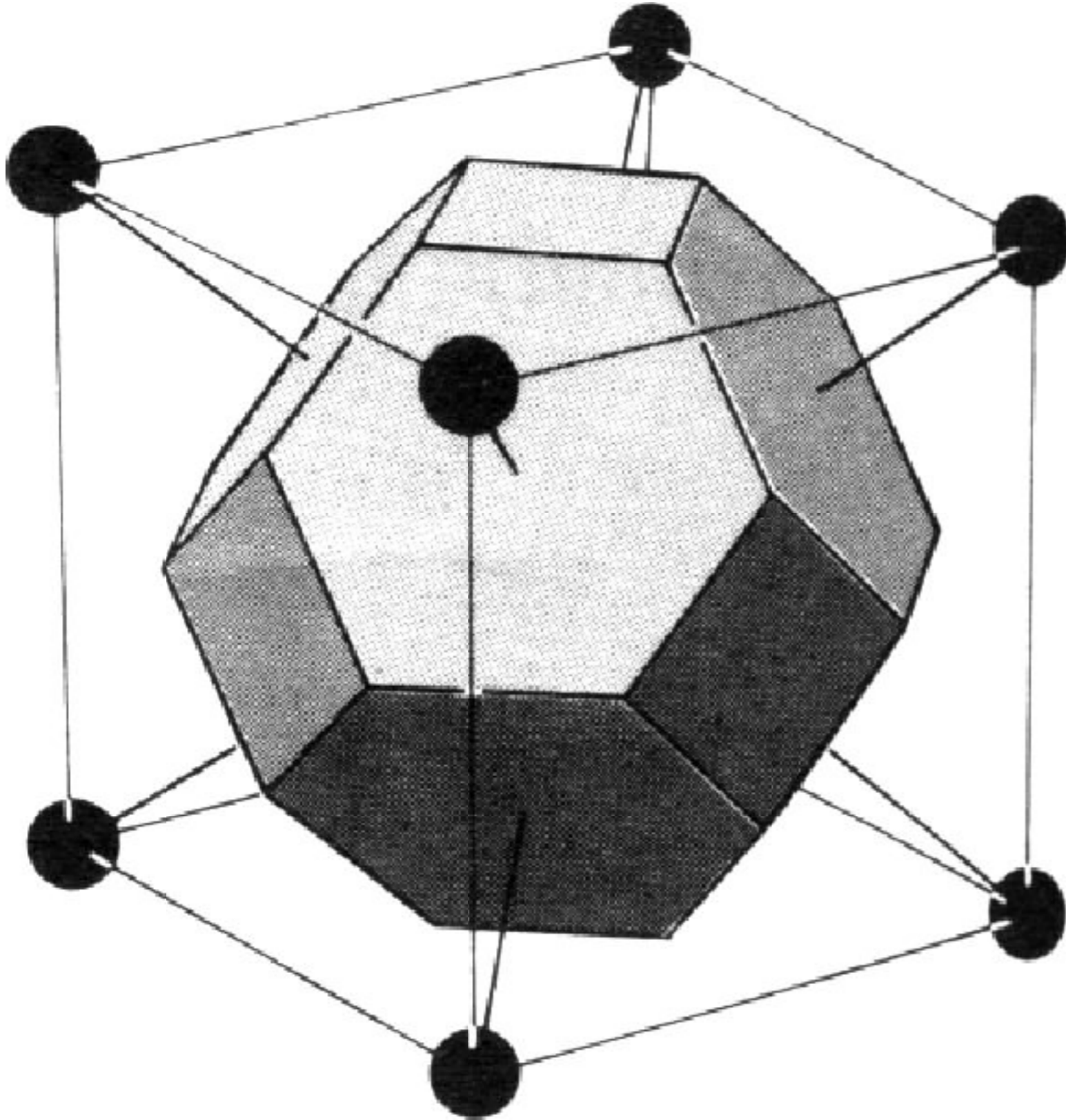
Wigner-Seitz Einheitszelle



Wigner-Seitz Einheitszelle

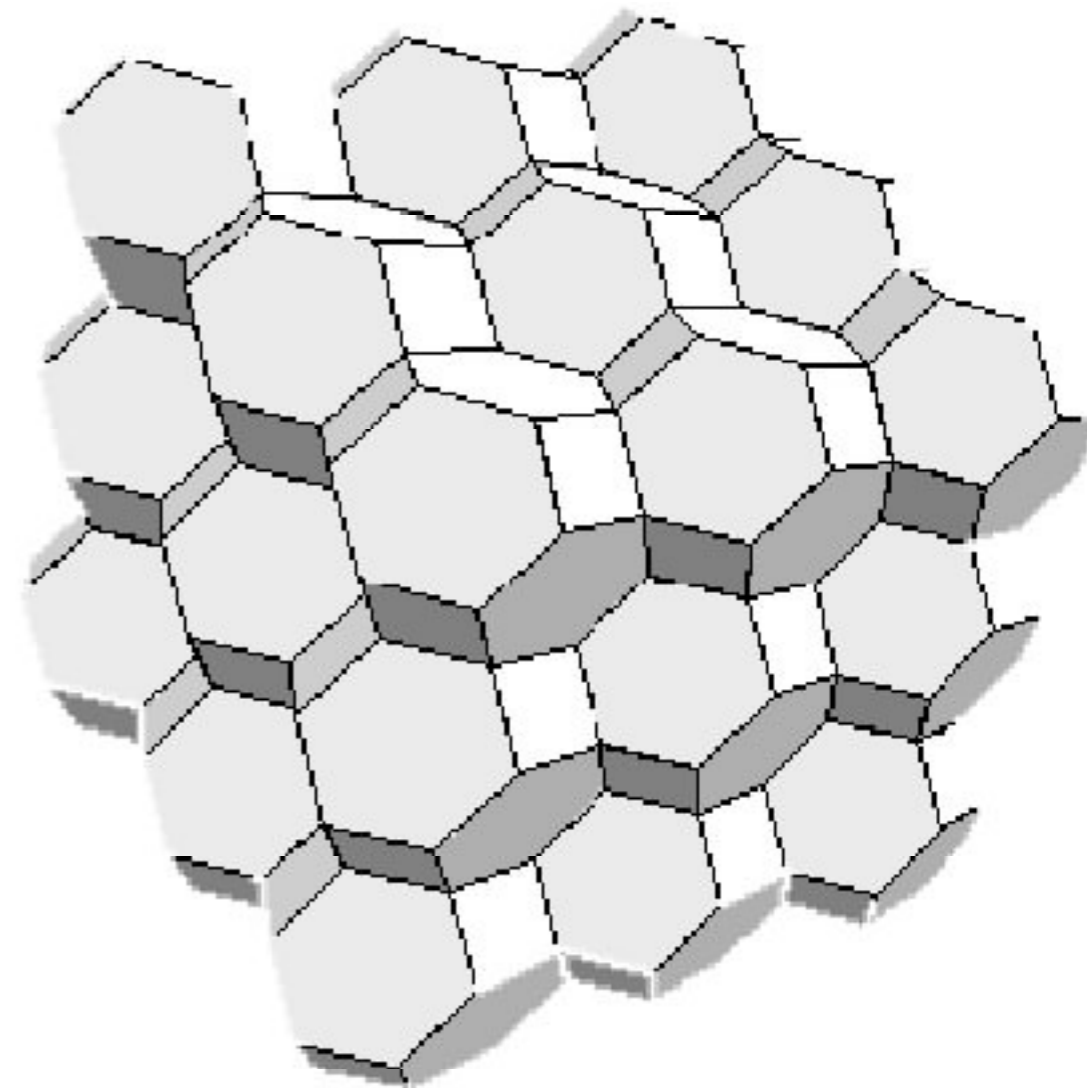


Wigner-Seitz Zelle in 3D

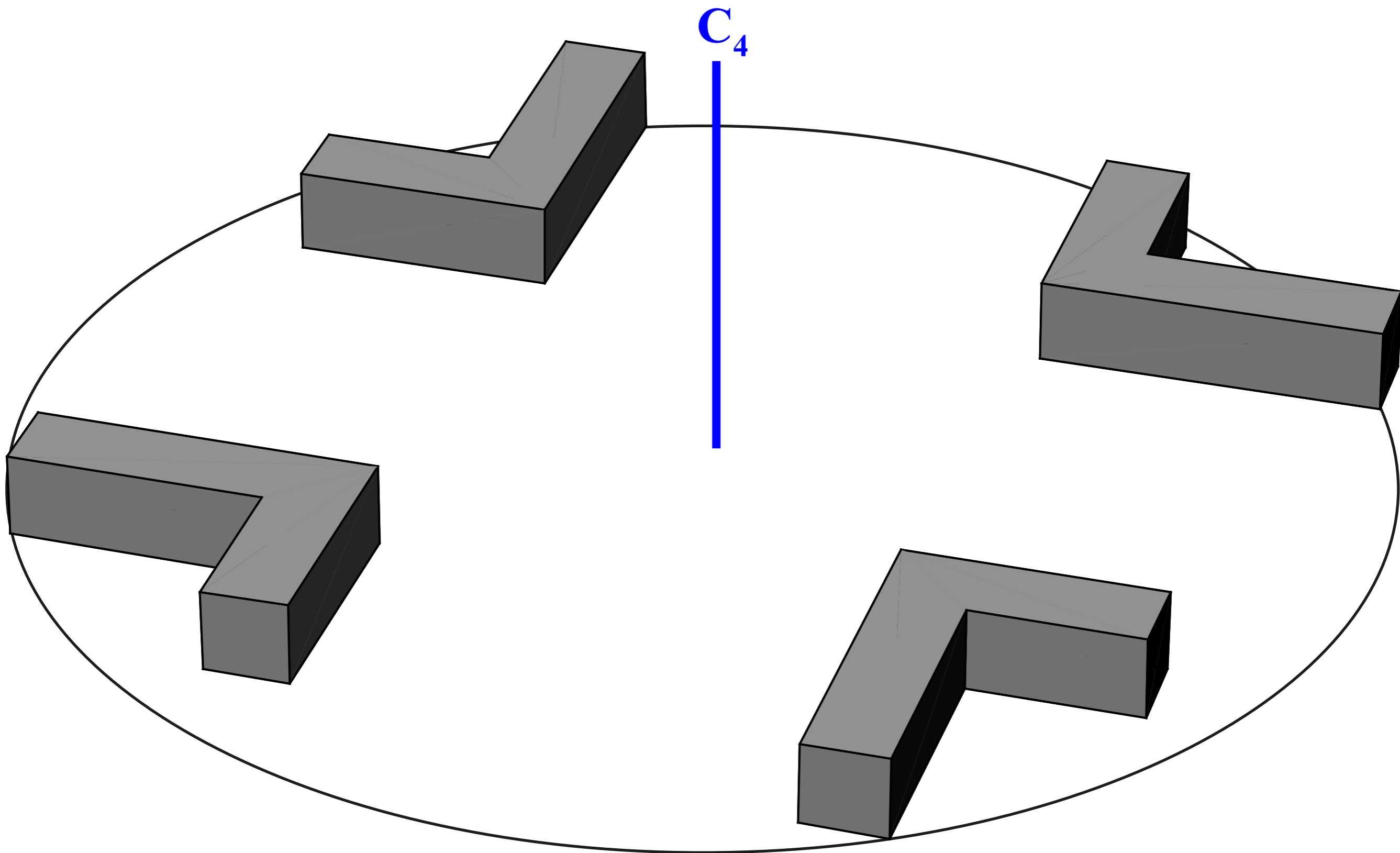


**kubisch
innenzentriertes
Gitter**

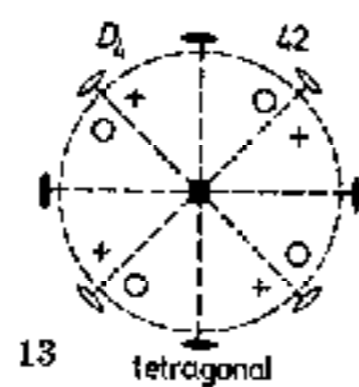
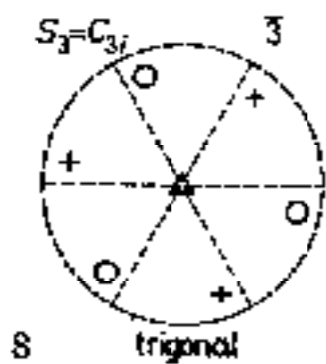
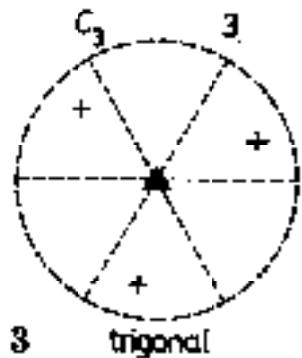
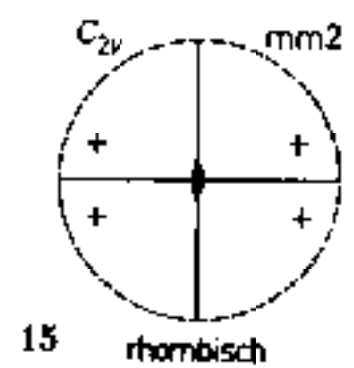
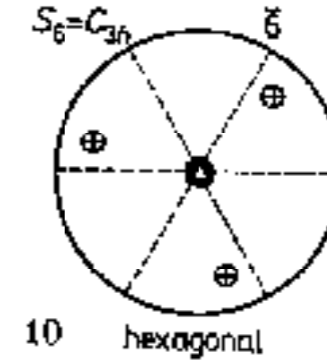
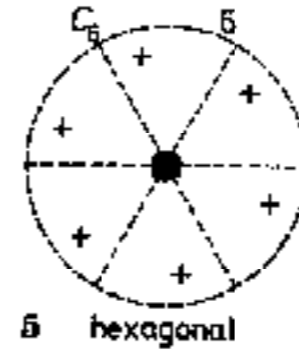
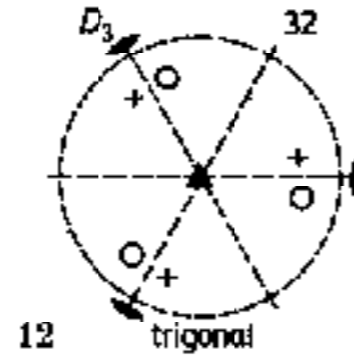
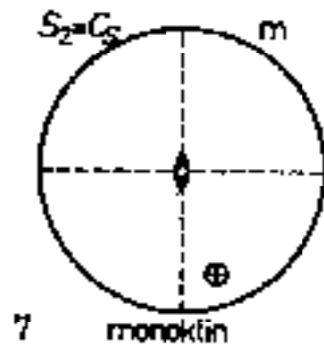
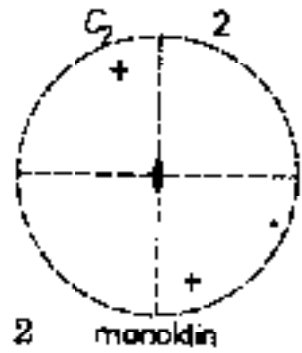
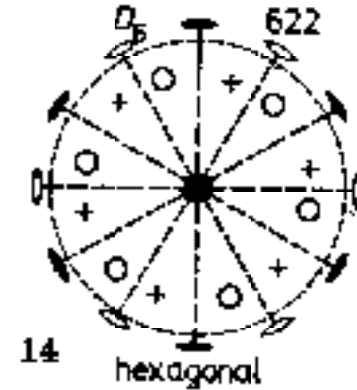
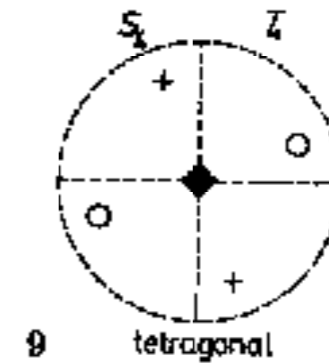
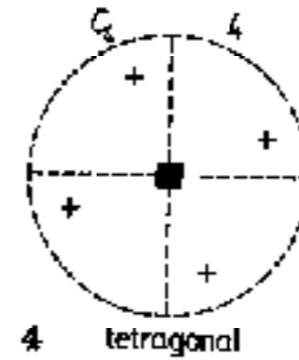
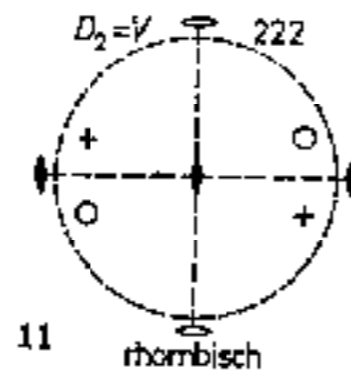
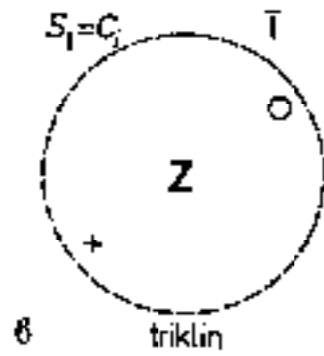
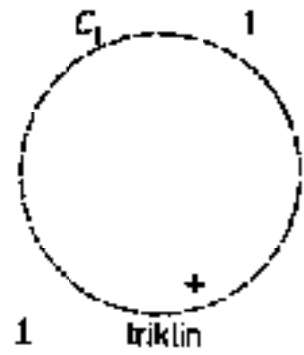
Raumfüllung



Rotationssymmetrie



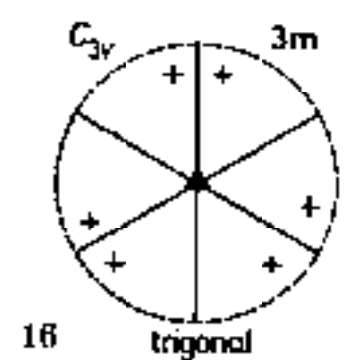
Symmetriegruppen



\parallel A_2
 \circ I_2
 \blacktriangle A_3
 \triangle I_3
 \blacksquare A_4

\blacklozenge I_4
 \bullet A_6
 \odot I_6
 Z I_1

z-Achse \perp Papierebene
 x,y-Achsen in Papierebene



Symmetriegruppen

