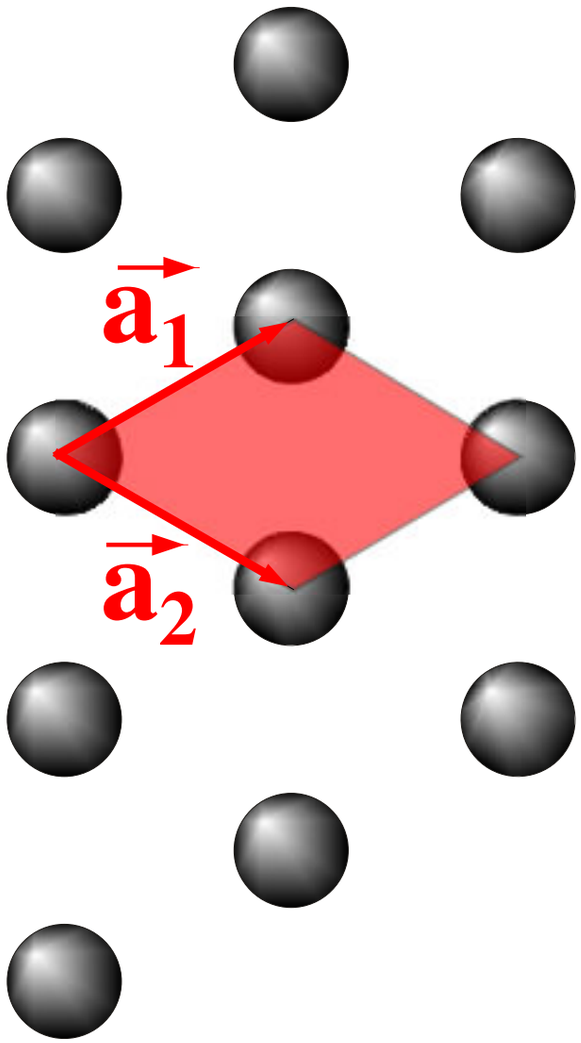
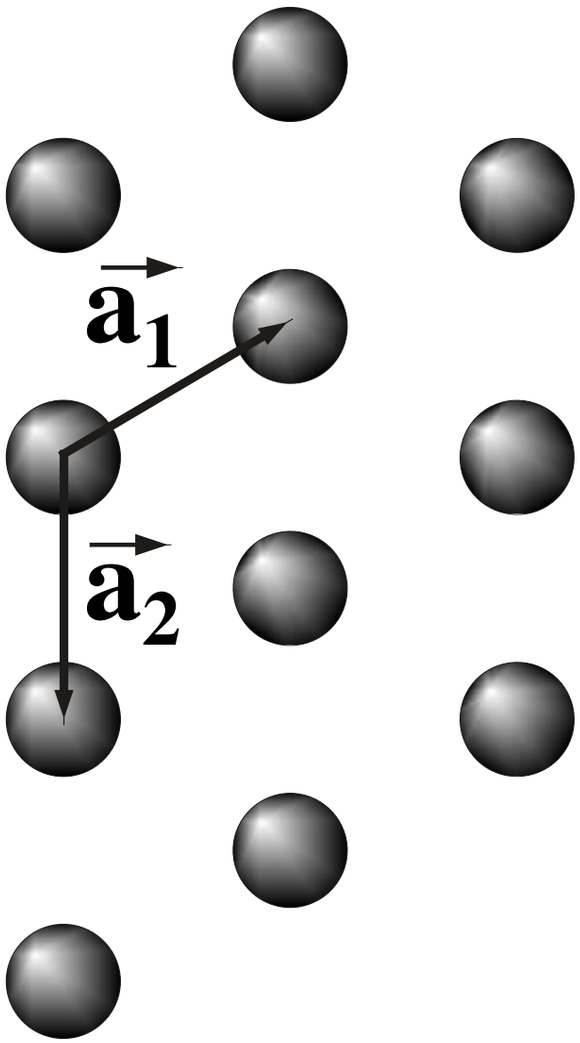
Wahl der Einheitszelle

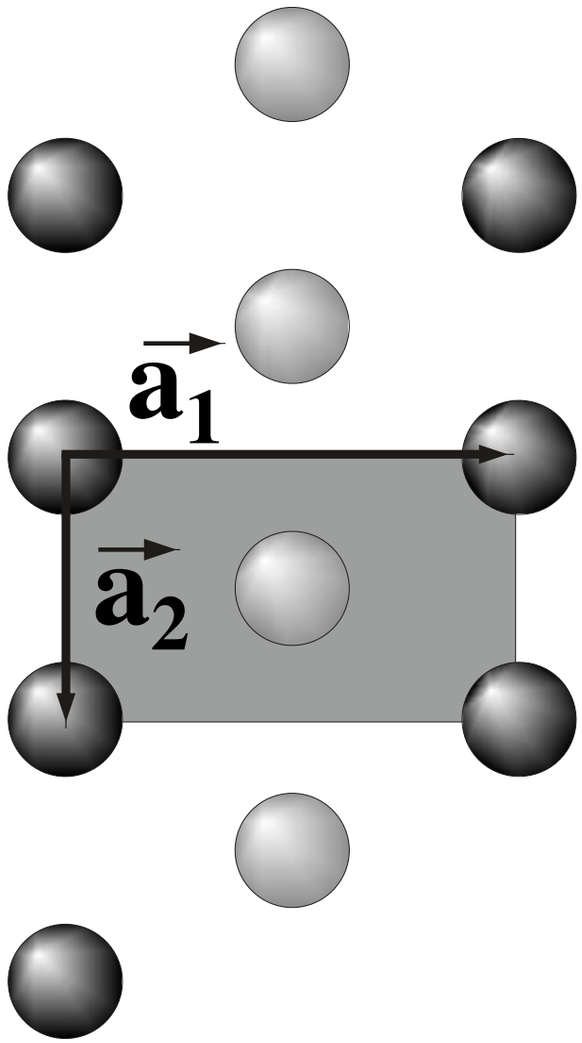
primitiv 1



primitiv 2



nicht primitiv



Punktsymmetrieklassen

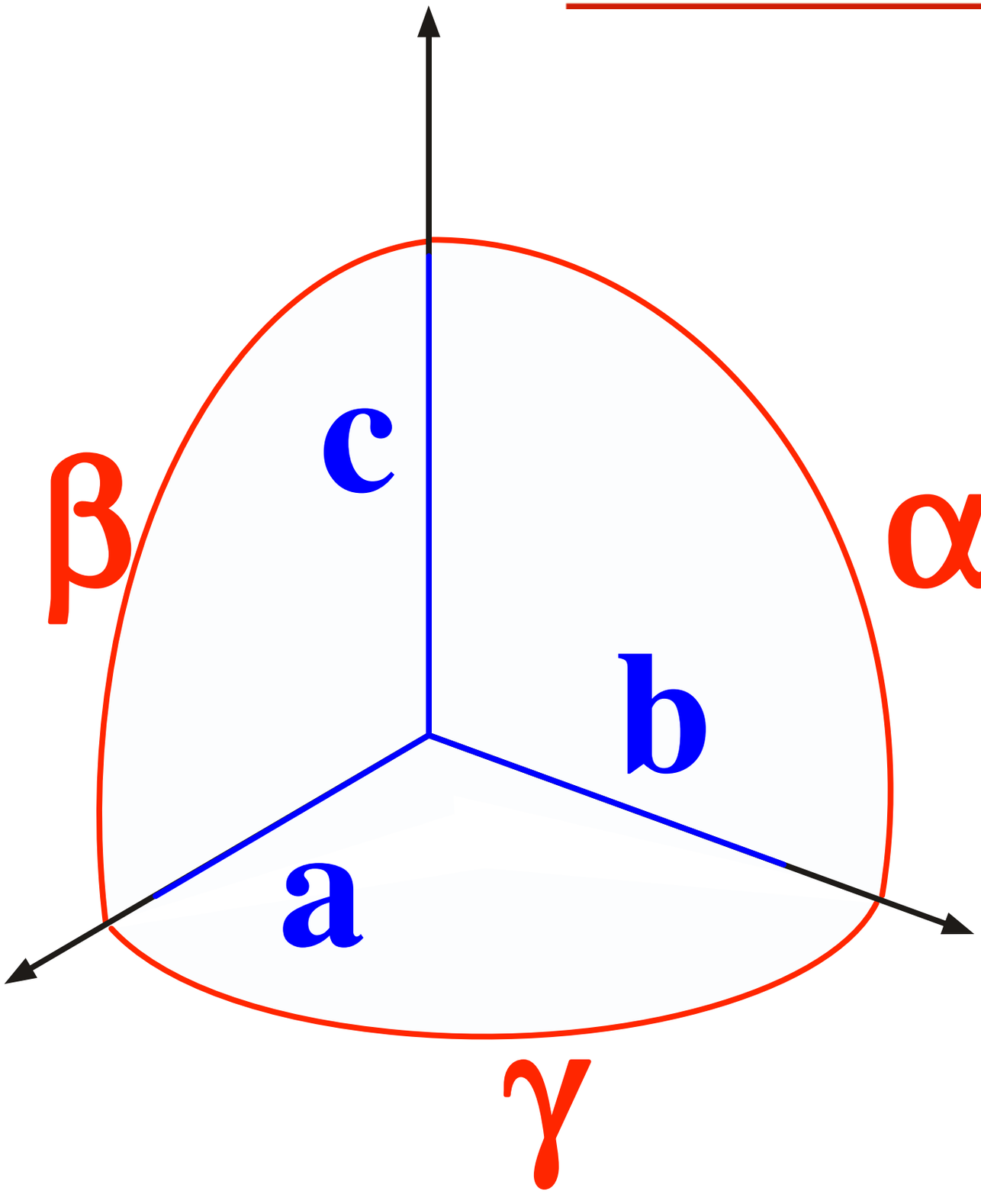
Tabelle 3.11. *Die 32 Punktsymmetrieklassen, geordnet nach den erzeugende Symmetrieelementen*

Nr.	Symbol nach Schönflies	Symbol nach Hermann-Mauguin	Erzeugende Symmetrieelemente unter Verwendung von Inversionsachsen	Erzeugende Symmetrieelemente unter Verwendung von Spiegelebenen	Ω	Kristallsystem (Ziffer 3.3)
1	C_1	1	A_1^z		1	triklin
2	C_2	2	A_2^z		2	monoklin
3	C_3	3	A_3^z		3	trigonal
4	C_4	4	A_4^z		4	tetragonal
5	C_6	6	A_6^z		6	hexagonal
6	$S_1 \equiv C_{i\dot{i}}$	$\bar{1}$	$I_1^x = Z$		2	triklin
7	$S_2 \equiv C_{is}$	m	I_2^z	σ_z	2	monoklin
8	$S_3 \equiv C_{3i}$	$\bar{3}$	$I_3^z \equiv A_3^z + Z$		6	trigonal
9	S_4	$\bar{4}$	I_4^z		4	tetragonal
10	$S_6 \equiv C_{3h}$	$\bar{6}$	I_6^z	$A_3^z + \sigma^z$	6	hexagonal
11	$D_2 \equiv V$	222	$A_2^z + A_2^v$		4	orthorhomb.
12	D_3	32	$A_3^z + A_2^y$		6	trigonal
13	D_4	42	$A_4^z + A_2^y$		8	tetragonal
14	D_6	622	$A_6^z + A_2^y$		12	hexagonal
15	C_{2v}	$m\,m\,2$	$A_2^z + I_2^y$	$A_2^z + \sigma_v$	4	orthorhomb.
16	C_{3v}	$3\,m$	$A_3^z + I_2^y$	$A_2^z + \sigma_v$	6	trigonal
17	C_{4v}	$4\,m\,m$	$A_4^z + I_2^y$	$A_4^z + \sigma_v$	8	tetragonal
18	C_{6v}	$6\,m\,m$	$A_6^z + I_2^y$	$A_6^z + \sigma_v$	12	hexagonal

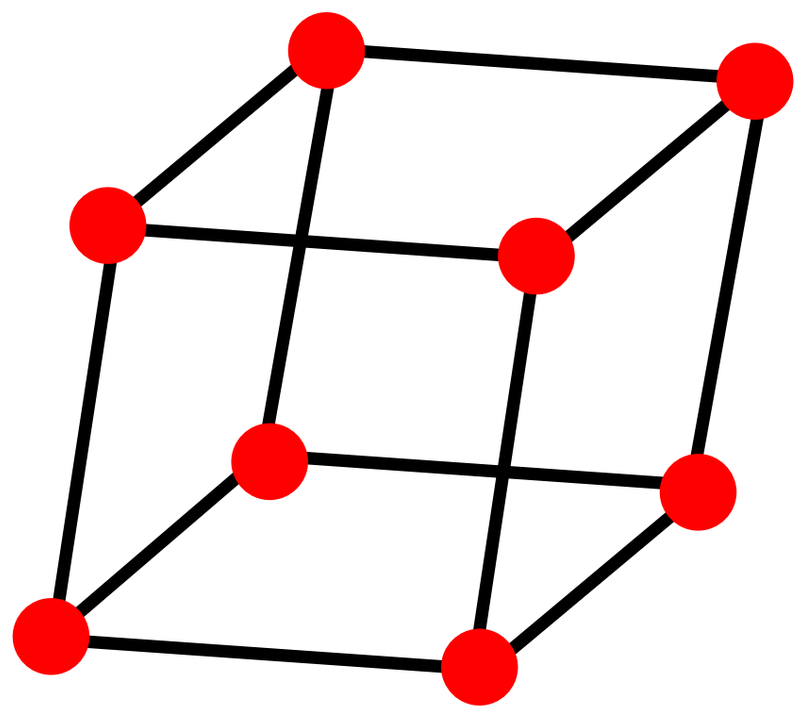
19	D_{3d}	$\bar{3}\,m$	$I_3^z + A_2^y \equiv A_3^z \dotplus A_2^y \dotplus Z$		12	trigonal
20	$D_{2d} \equiv V_d$	$\bar{4}\,2\,m$	$I_4^z + A_2^y$		8	tetragonal
21	D_{3h}	$\bar{6}\,2\,m$	$I_6^z + A_2^y = I_6^z + I_2^y$		12	hexagonal
22	C_{2h}	$2/m$	$A_2^z \dotplus Z$	$A_2^z \dotplus \sigma_z$	4	monoklin
23	C_{4h}	$4/m$	$A_4^z + Z$	$A_4^z + \sigma_z$	8	tetragonal
24	C_{6h}	$6/m$	$A_6^z + Z$	$A_6^z + \sigma_z$	12	hexagonal
25	$D_{2h} \equiv V_h$	$m\,m\,m$	$A_2^z + A_2^y + Z$		8	orthorhomb.
26	D_{4h}	$4\,m\,m\,m$	$A_4^z + A_2^y + Z$		16	tetragonal
27	D_{6h}	$6/m\,m\,m$	$A_6^z + A_2^y + Z$		24	hexagonal
28	T	23	$A_3^{\text{kub}} + A_2^z$		12	kubisch
29	O	432	$A_3^{\text{kub}} + A_4^z$		24	kubisch
30	T_d	$\bar{4}\,3\,m$	$A_3^{\text{kub}} + I_4^z$		24	kubisch
31	T_h	$m\,3$	$A_3^{\text{kub}} + A_2^z + Z$		24	kubisch
32	O_h	$m\,3\,m$	$A_3^{\text{kub}} + A_4^z + Z$		48	kubisch

Symbole:
- A_p^z, A_p^x A_p^y: p-zählige Deckachsen in z, x, y-Richtung
- I_p^z, I_p^x, I_p^y: p-zählige Inversionsachsen in z, x, y-Richtung
- A_3^{kub}: dreizählige Deckachse in Richtung der Raumdiagonalen
- $Z = i$: Inversionszentrum
- σ_z: Spiegelebene $\perp z$
- σ_v: (vertikale) Spiegelebene durch z
- $1, 2, 3, \cdots p$: p-zählige Deckachse
- $\bar{1}, \bar{2}, \cdots \bar{p}$: p-zählige Inversionsachse
- m: Spiegelebene
- p/m: p-zählige Deckachse und Spiegelebene $\perp$ dazu

Einheitszelle quantitativ

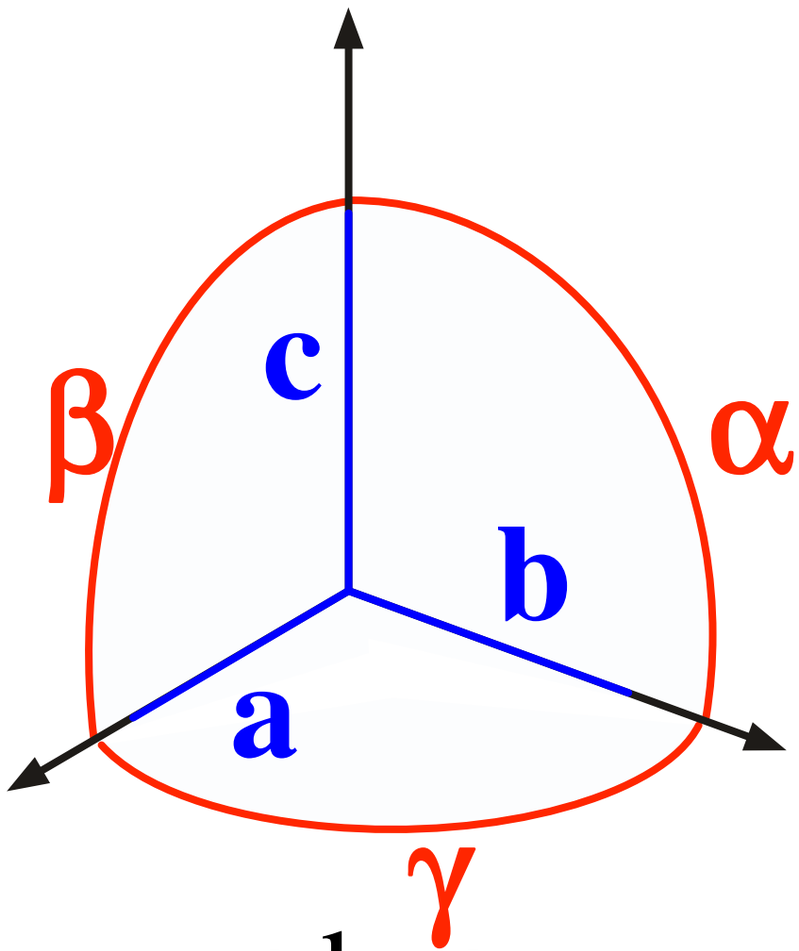


allgemeinster Fall:
Triklin



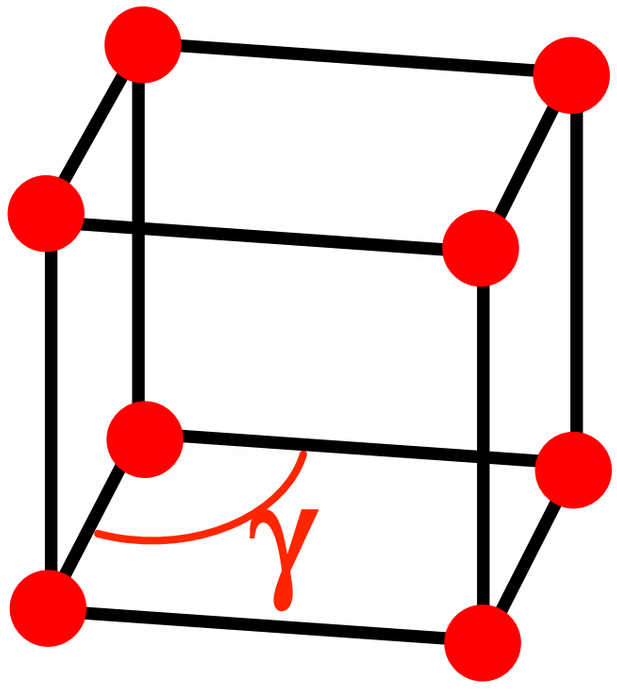
$a \neq b \neq c, \ \alpha \neq \beta \neq \gamma$

Monoklines Kristallsystem

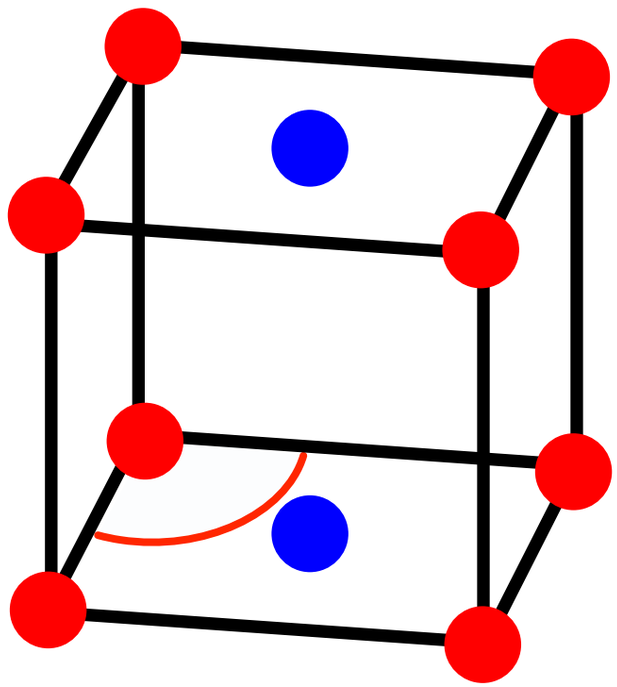


$a \neq b \neq c,$

$\alpha = \beta = 90^{o} \neq \gamma$

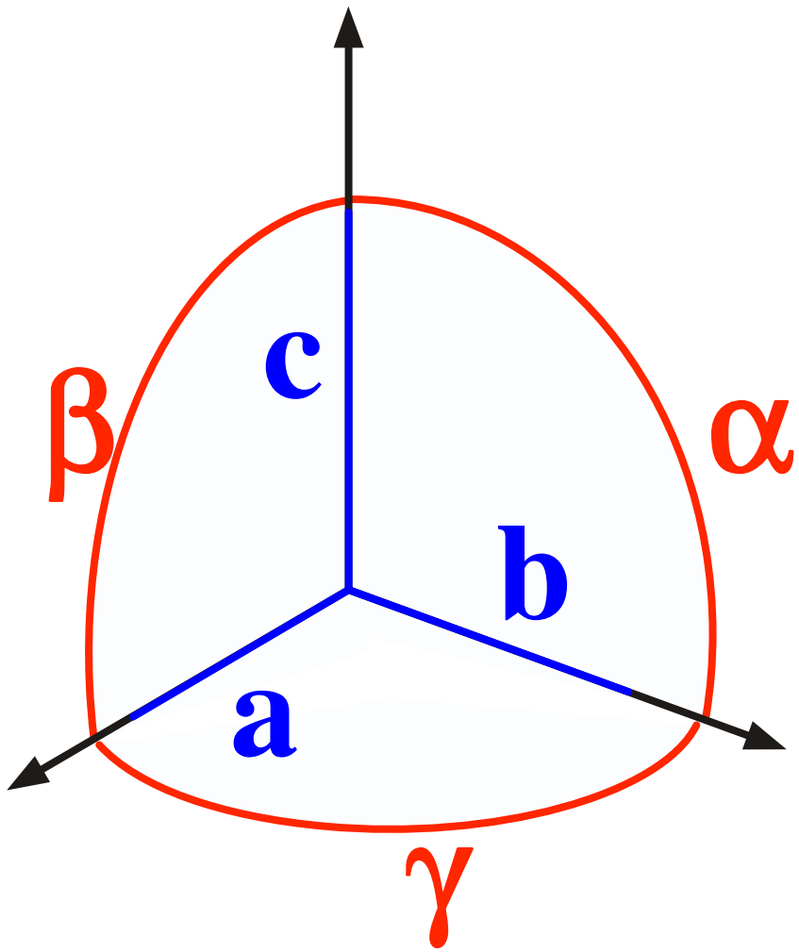


Primitiv



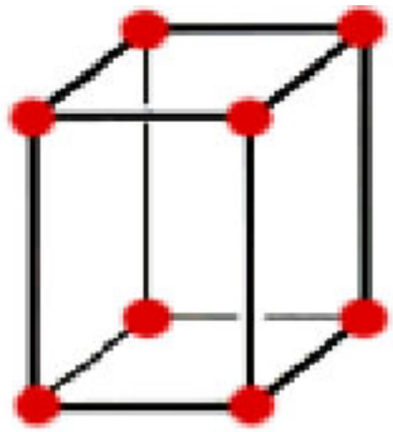
Basiszentriert

Orthorombisches Kristallsystem

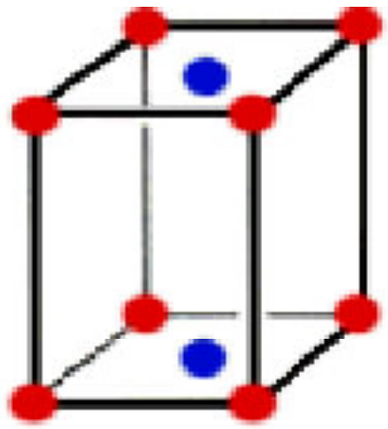


$a \neq b \neq c,$

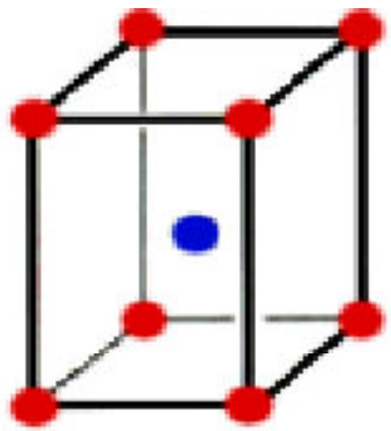
$\alpha = \beta = \gamma = 90^{o}$



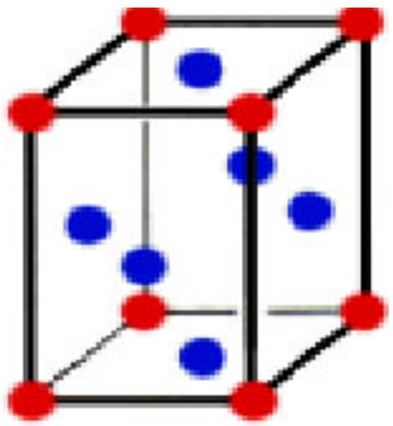
Simple orthorhombic



Base-centered orthorhombic

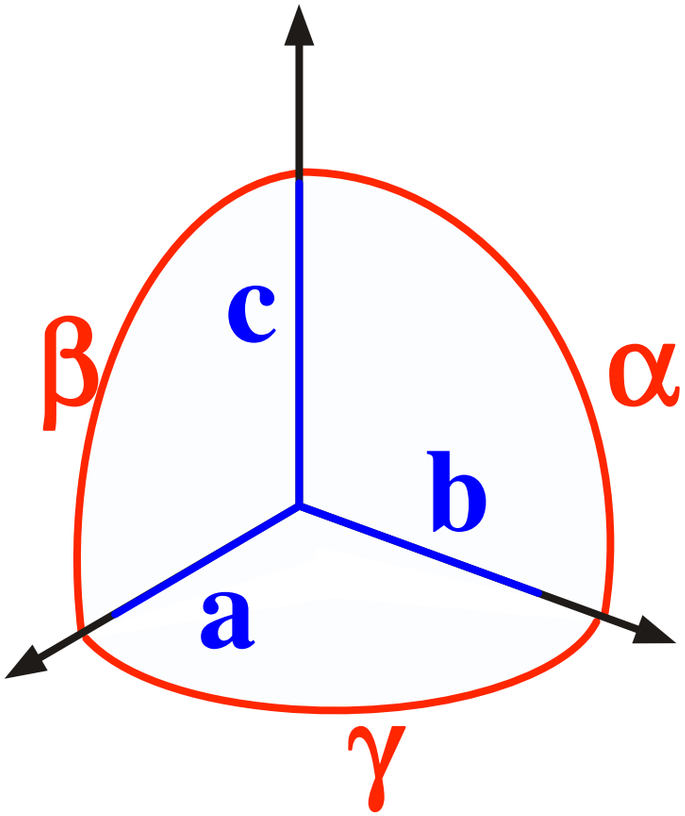


Body-centered orthorhombic



Face-centered orthorhombic

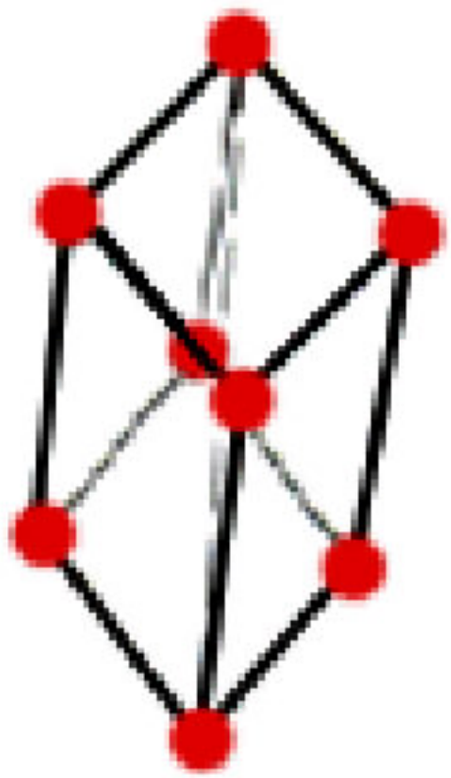
Rhomboedrisch, Hexagonal



Rhomboedrisch (trigonal)

$a = b = c,$

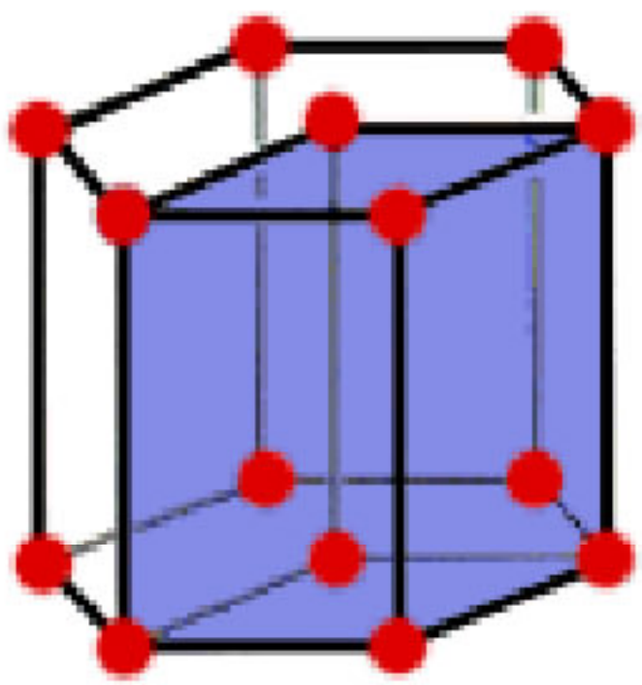
$\alpha = \beta = \gamma \neq 90^o; < 120^o$



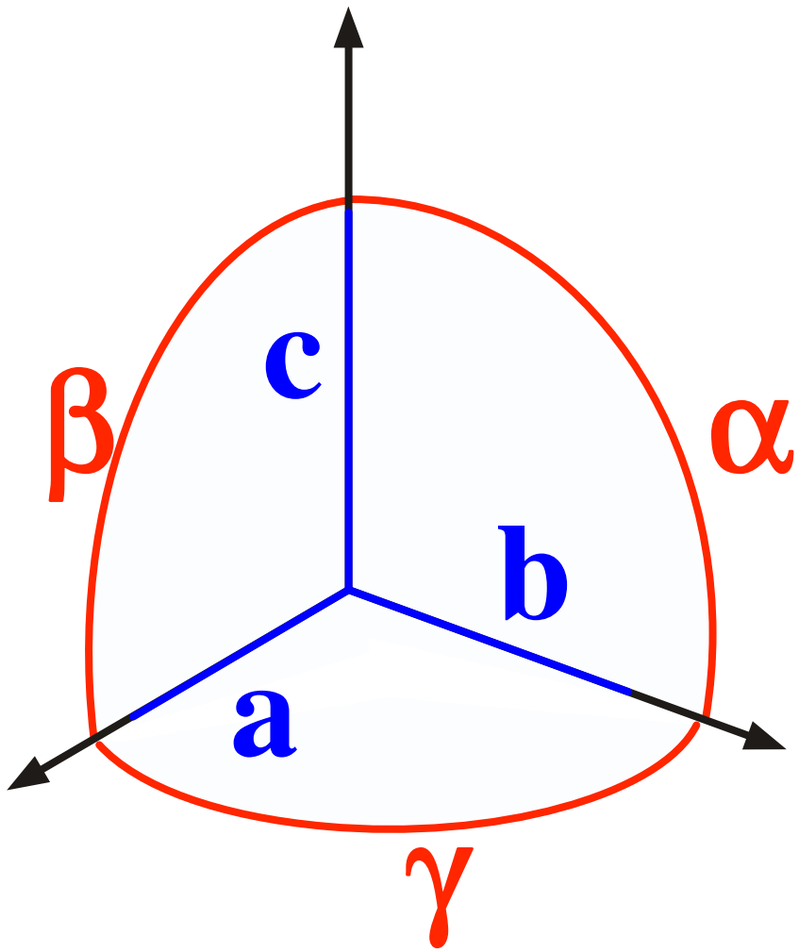
Hexagonal

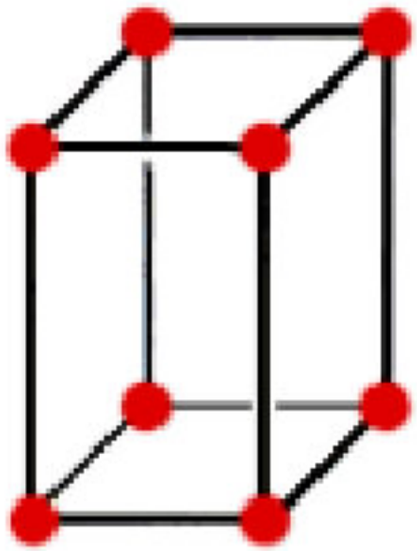
$a = b \neq c,$

$\alpha = \beta = 90^o; \gamma = 120^o$

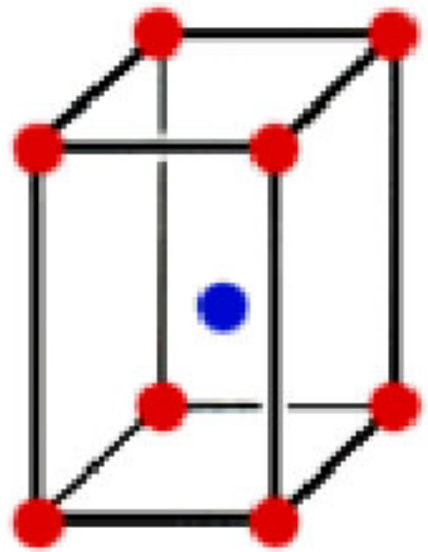


Tetragonales Kristallsystem





Simple tetragonal

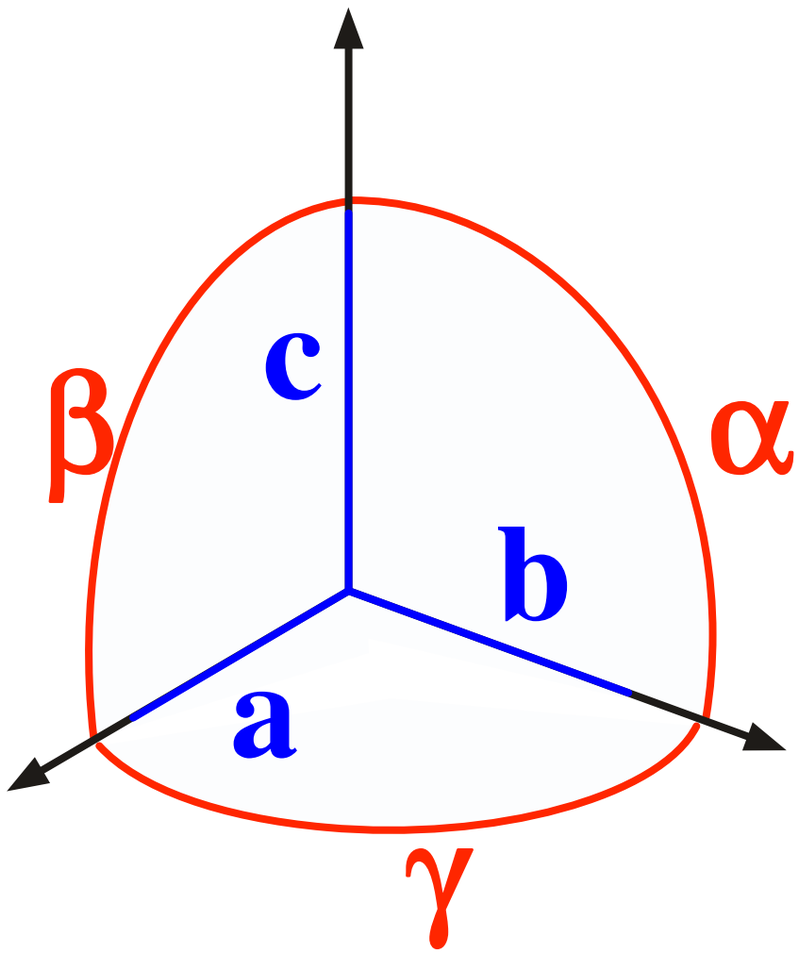


Body-centered tetragonal

$$a = b \neq c,$$

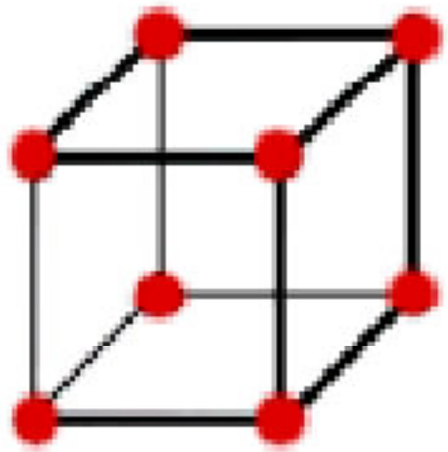
$$\alpha = \beta = \gamma = 90^{o}$$

Kubisches Kristallsystem

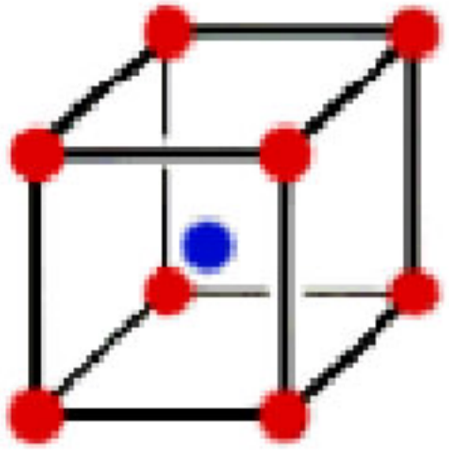


$a = b = c,$

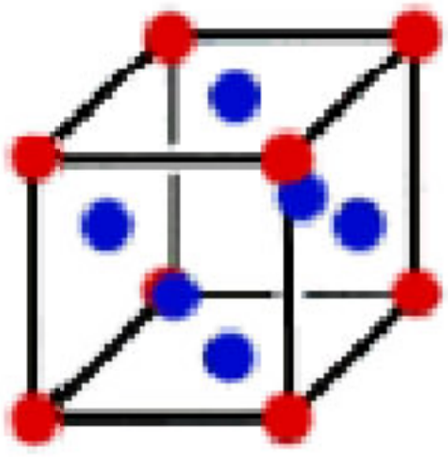
$\alpha = \beta = \gamma = 90^{o}$



Simple cubic



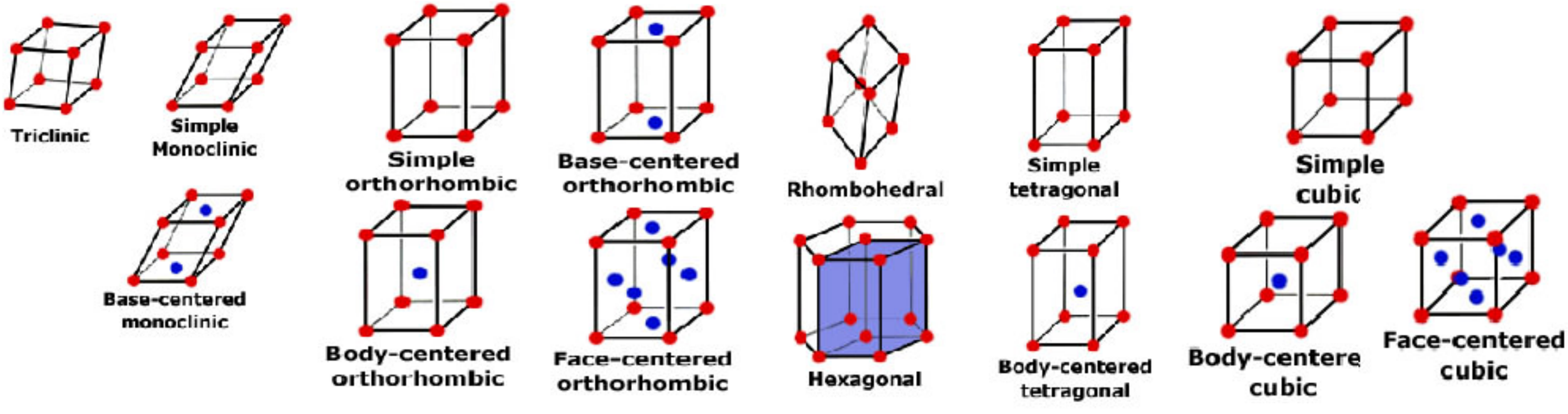
Body-centered cubic



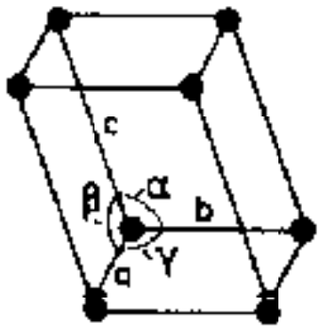
Face-centered cubic

Kristallsysteme und Translationsgitter

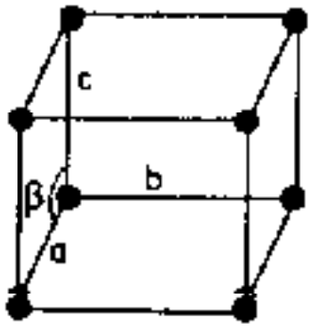
System	**Bedingungen**	**Symmetrie**	**Gitter** (Translations- /Bravais Gitter)
Triklin	$a \neq b \neq c,\ \alpha \neq \beta \neq \gamma$	keine	primitiv
Monoklin	$a \neq b \neq c,\ \alpha = \beta = 90^o \neq \gamma$	1 C_2	primitiv, basiszentriert
Orthorombisch	$a \neq b \neq c,\ \alpha = \beta = \gamma = 90^o$	3 C_2	primitiv, basis-, raum-, flächenzentriert
Rhomboedrisch (trigonal)	$a = b = c,\ \alpha = \beta = \gamma \neq 90^o; < 120^o$	1 C_3	primitiv
Hexagonal	$a = b \neq c,\ \alpha = \beta = 90^o;\ \gamma = 120^o$	1 C_6	primitiv
Tetragonal	$a = b \neq c,\ \alpha = \beta = \gamma = 90^o$	1 C_4	primitiv, raumzentriert
Kubisch	$a = b = c,\ \alpha = \beta = \gamma = 90^o$	4 C_3	primitiv, raum-, flächenzentriert



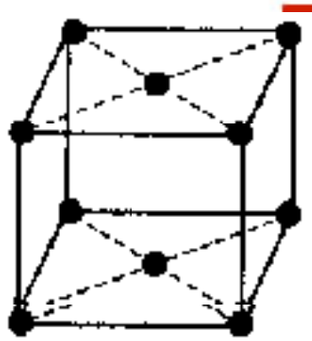
Bravais Gitter in 3D



(1)

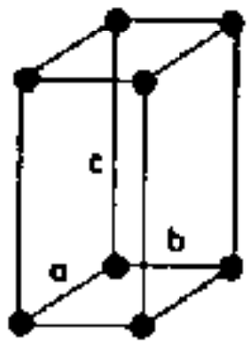


(2a)

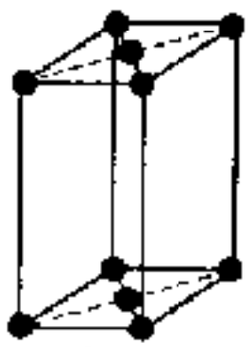

(2b)

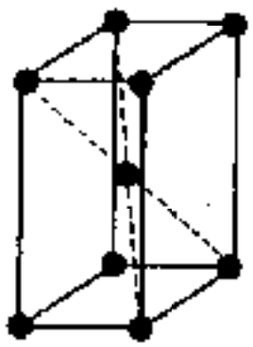
Triklin

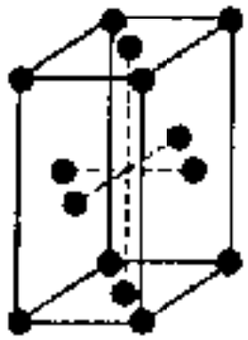
Monoklin



(3a)

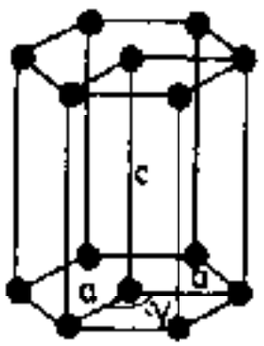

(3b)


(3c)

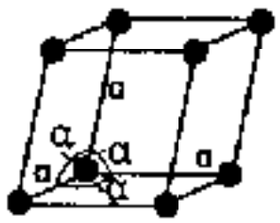

(3d)

Orthorombisch

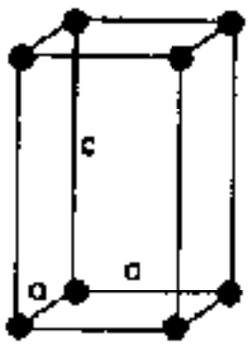
Rhomboedrisch (trigonal)



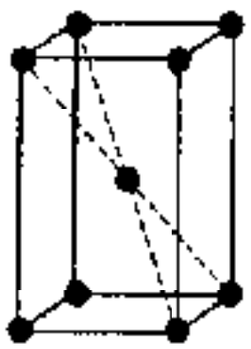
(4)



(5)

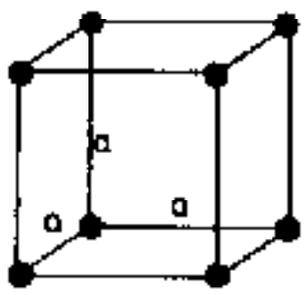


(6a)

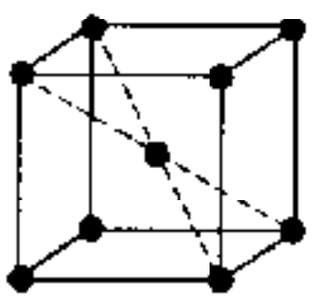

(6b)

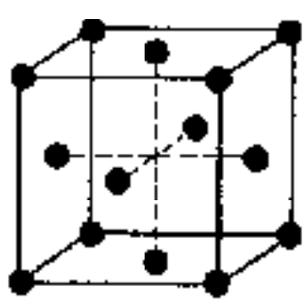
Hexagonal

Tetragonal



(7a)


(7b)


(7c)

Kubisch

Bravais Gitter in 3D

Crystals are classified into seven categories based on their overall shapes.

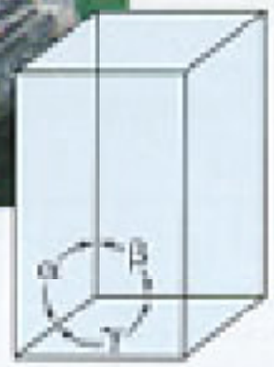
Fluorite

$a = b = c$

$\alpha = \beta = \gamma = 90°$

Cubic

Rutile

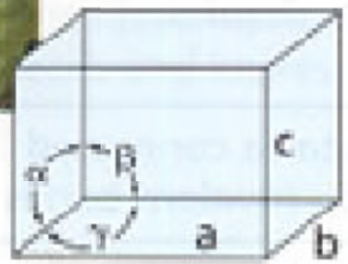


$a = b \neq c$

$\alpha = \beta = \gamma = 90°$

Tetragonal

Barite

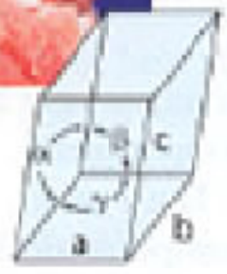


$a \neq b \neq c$

$\alpha = \beta = \gamma = 90°$

Orthorhombic

Rhodonite

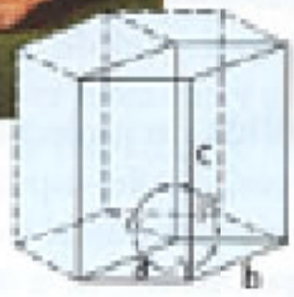


$a \neq b \neq c$

$\alpha \neq \beta \neq \gamma \neq 90°$

Triclinic

Corundum



$a = b \neq c$

$\alpha = \beta = 90°, \gamma = 120°$

Hexagonal

Cerussite

$a = b = c$

$\alpha = \beta = \gamma \neq 90°$

Rhombohedral

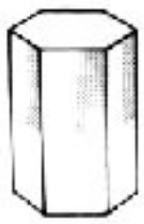
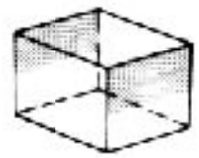
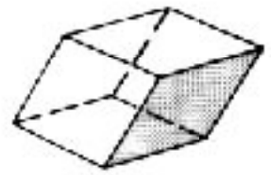
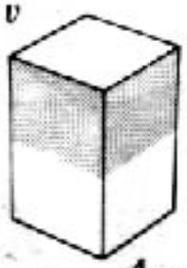
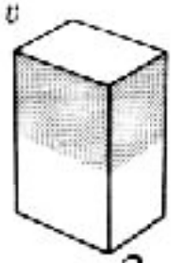
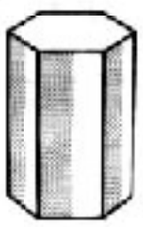
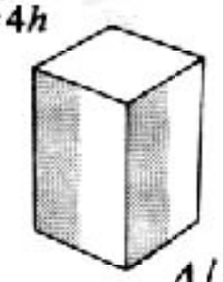
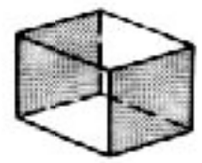
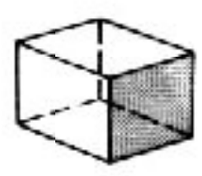
Boron

$a \neq b \neq c$

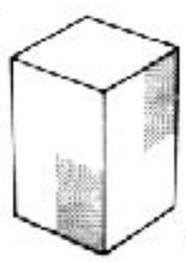
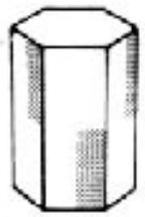
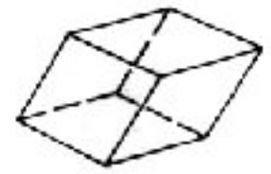
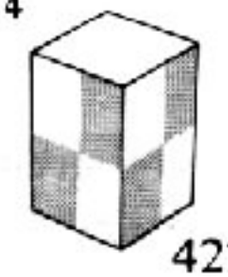
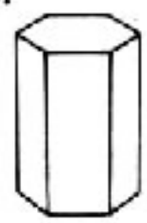
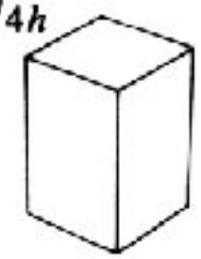
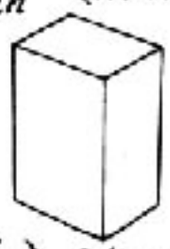
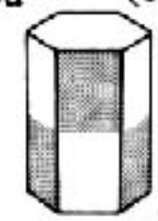
$\alpha = \gamma = 90° \neq \beta$

Monoclinic

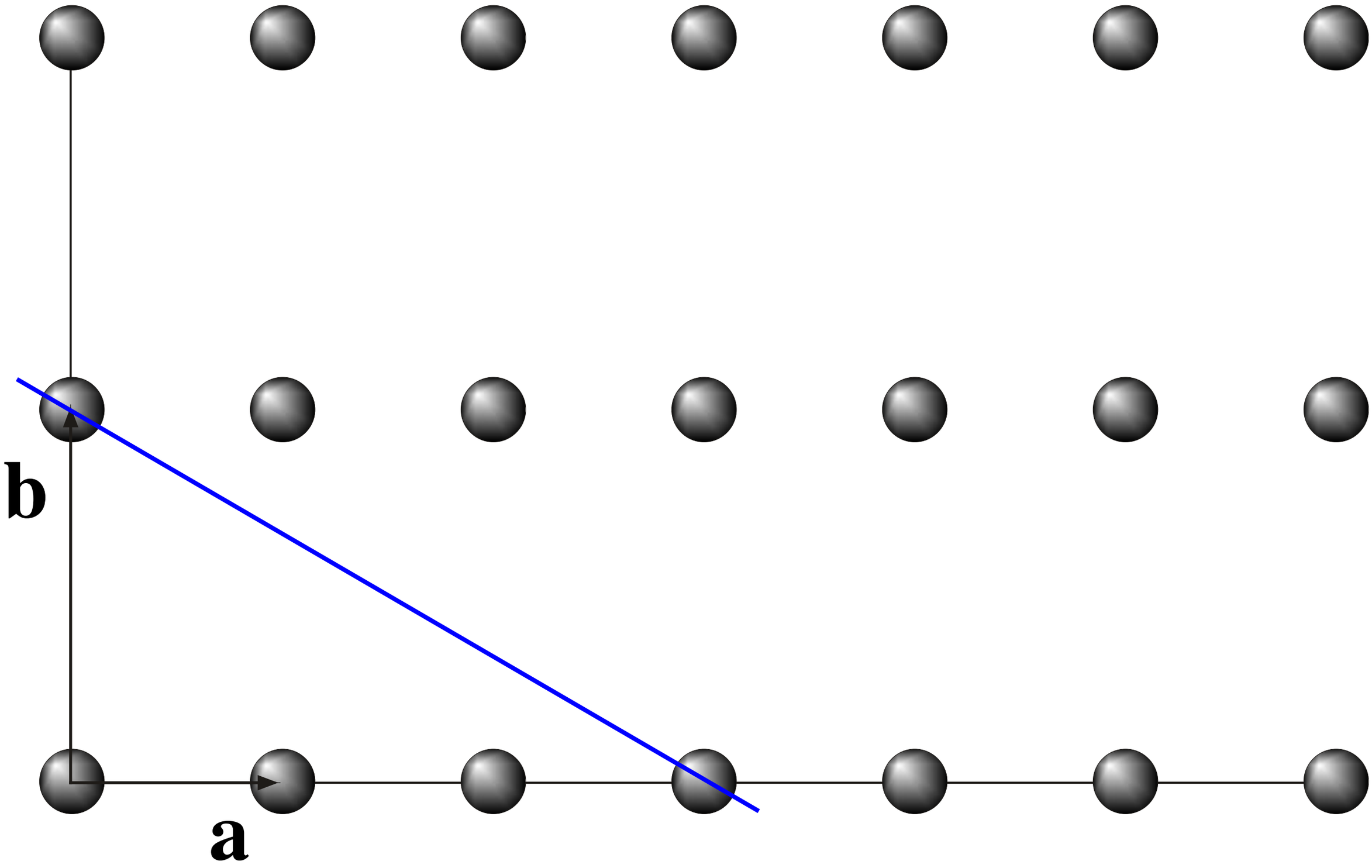
Kristallklassen

SCHOEN-FLIES	HEXAGONAL	TETRAGONAL	TRIGONAL	ORTHO-RHOMBIC	MONOCLINIC	TRICLINIC	INTER-NATIONAL
C_n	C_6  6	C_4  4	C_3  3		C_2  2	C_1  1	n
C_{nv}	C_{6v}  $6mm$	C_{4v}  $4mm$	C_{3v}  $3m$	C_{2v}  $2mm$			nmm (n even) nm (n odd)
C_{nh}	C_{6h}  $6/m$	C_{4h}  $4/m$			C_{2h}  $2/m$		n/m
	C_{3h}  $\bar{6}$				C_{1h} ($\bar{2}$)  m		$\bar{n}$

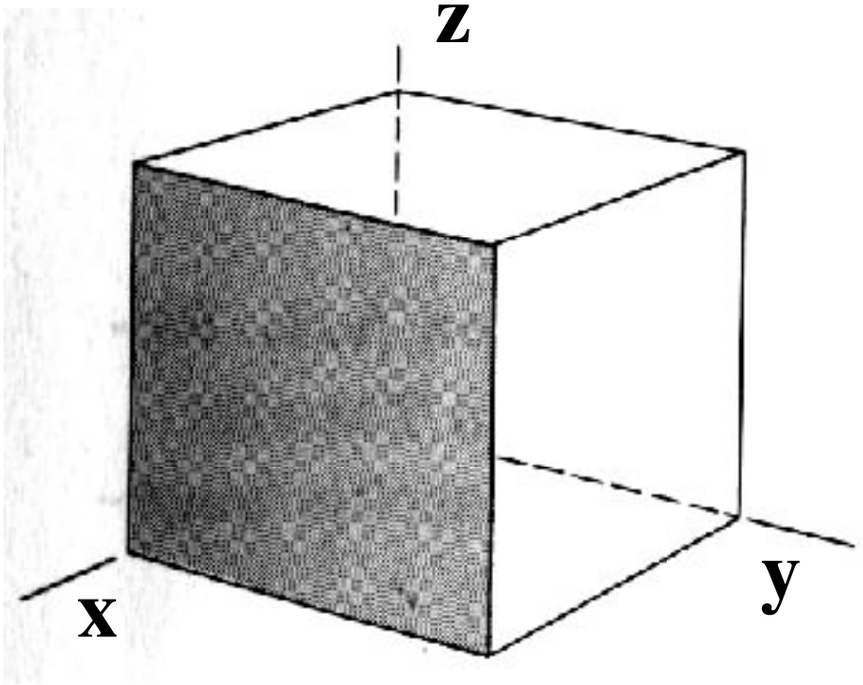
Kristallklassen

S_n		S_4  $\bar{4}$	S_6  (C_{3i}) $\bar{3}$			S_2  (C_i) $\bar{1}$	$\bar{n}$
D_n	D_6  622	D_4  422	D_3  32	D_2  (V) 222			$n22$ (n even) $n2$ (n odd)
D_{nh}	D_{6h}  $6/mmm$	D_{4h}  $4/mmm$		D_{2h} (mmm)  (V_h) $2/mmm$			$\frac{n}{m}\frac{2}{m}\frac{2}{m}$ (n/mmm)
	D_{3h}  $\bar{6}2m$						$\bar{n}2m$ (n even) $\bar{n}\frac{2}{m}$ (n odd)
D_{nd}		D_{2d}  (V_d) $\bar{4}2m$	D_{3d} $(\bar{3}m)$  $\bar{3}\frac{2}{m}$				

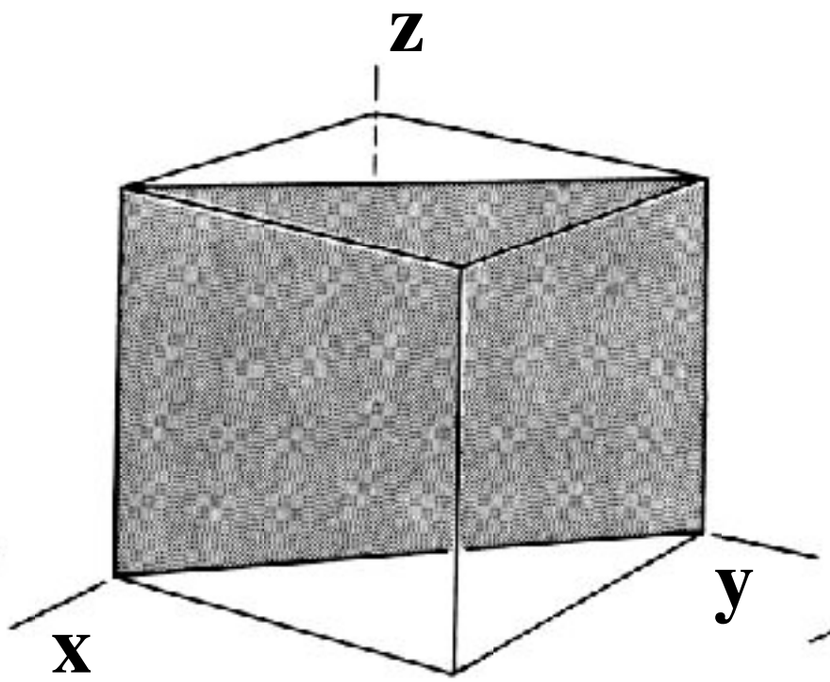
Miller Indizes



Miller Indizes



(100)



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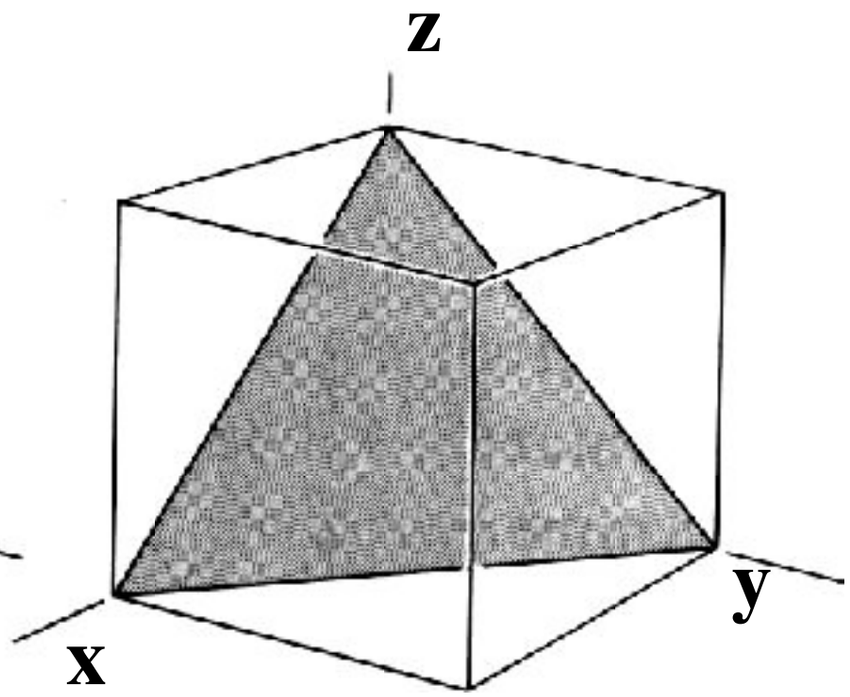
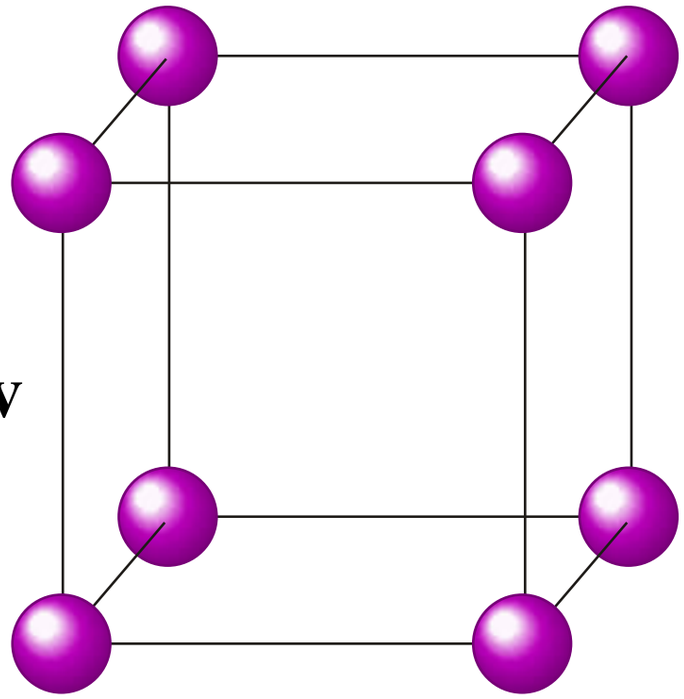
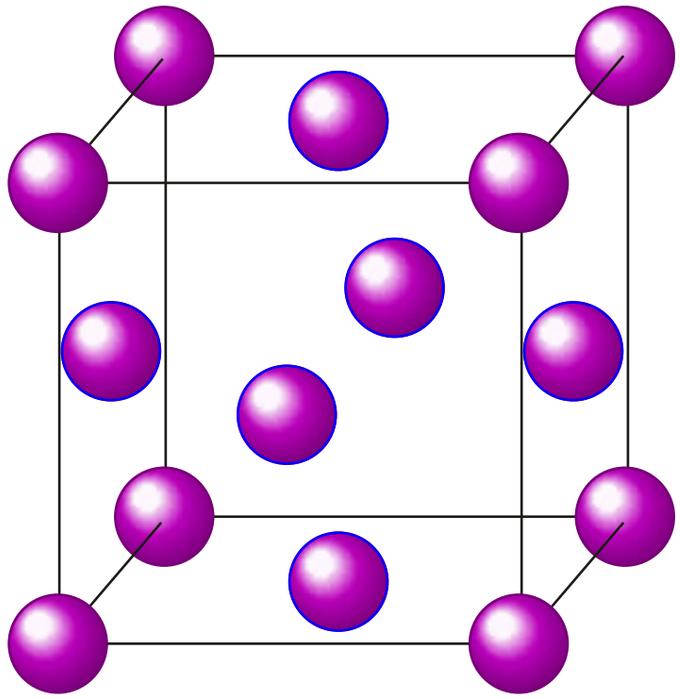


(111)

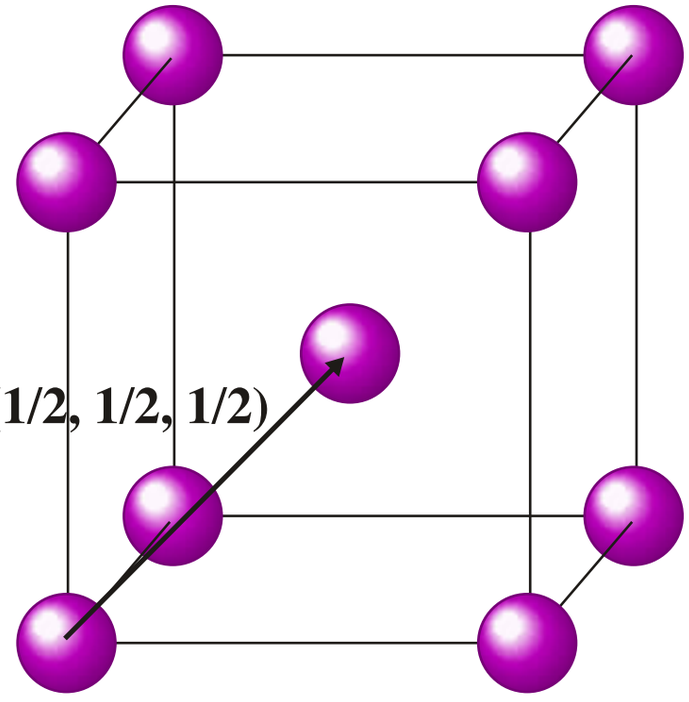
Kubische Einheitszellen

Primitiv

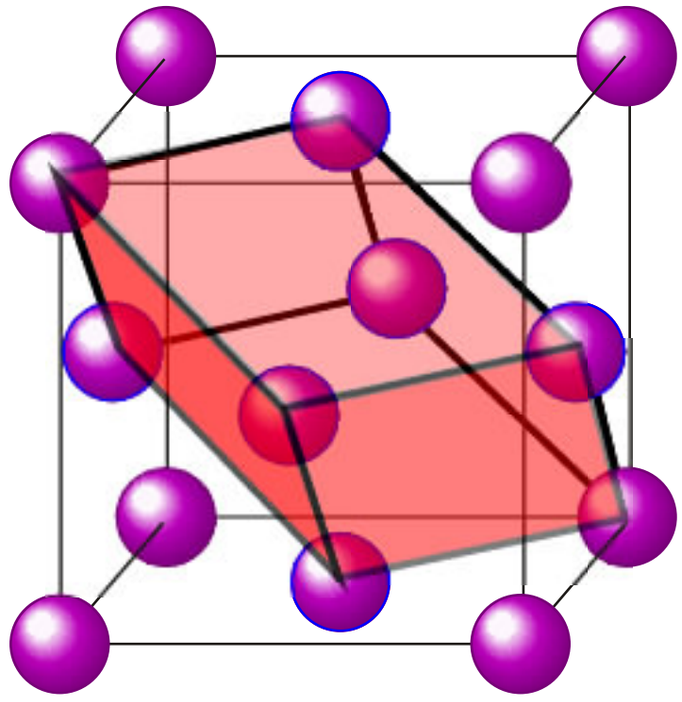




Flächen-zentriert (fcc)

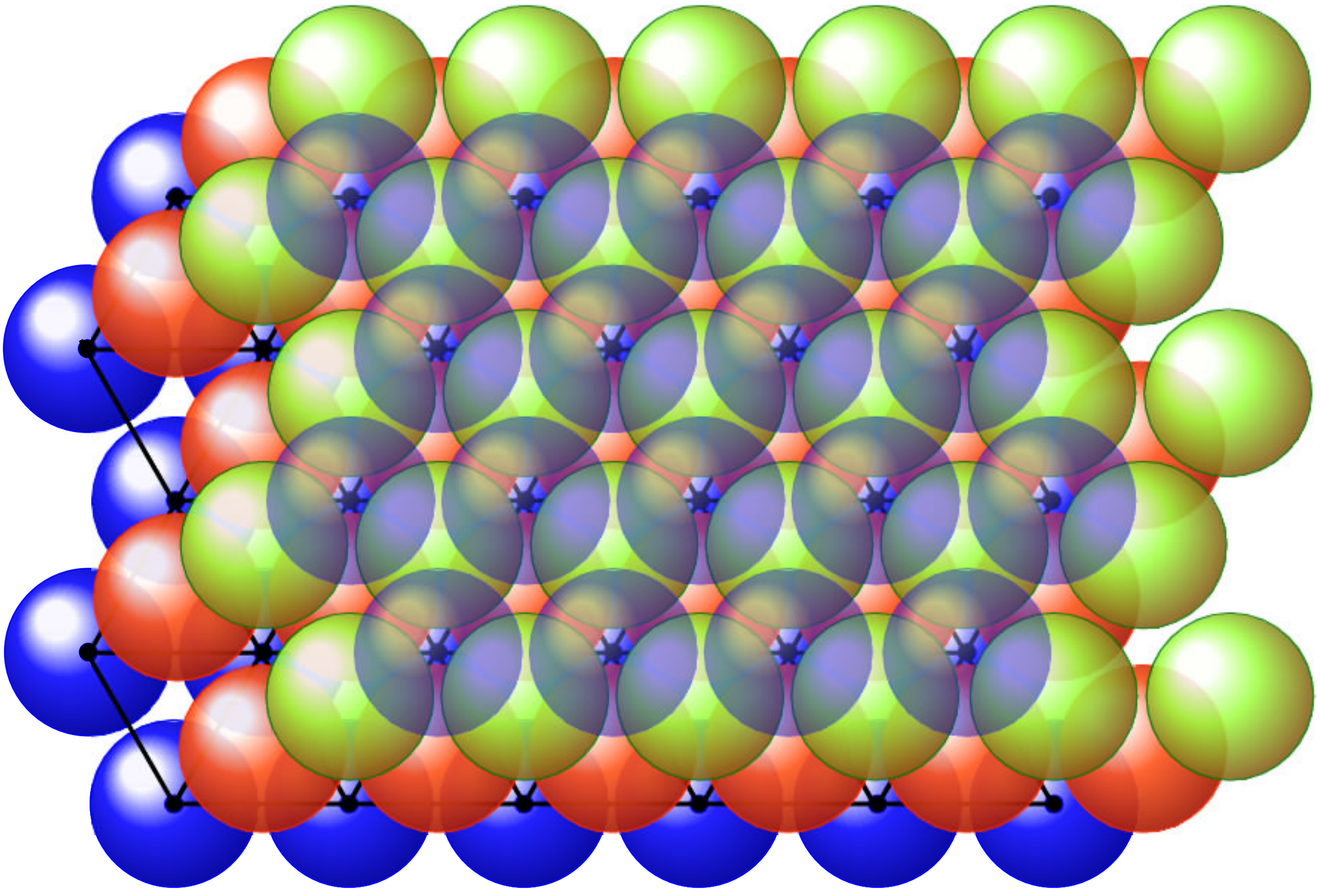


Raumzentriert (bcc)



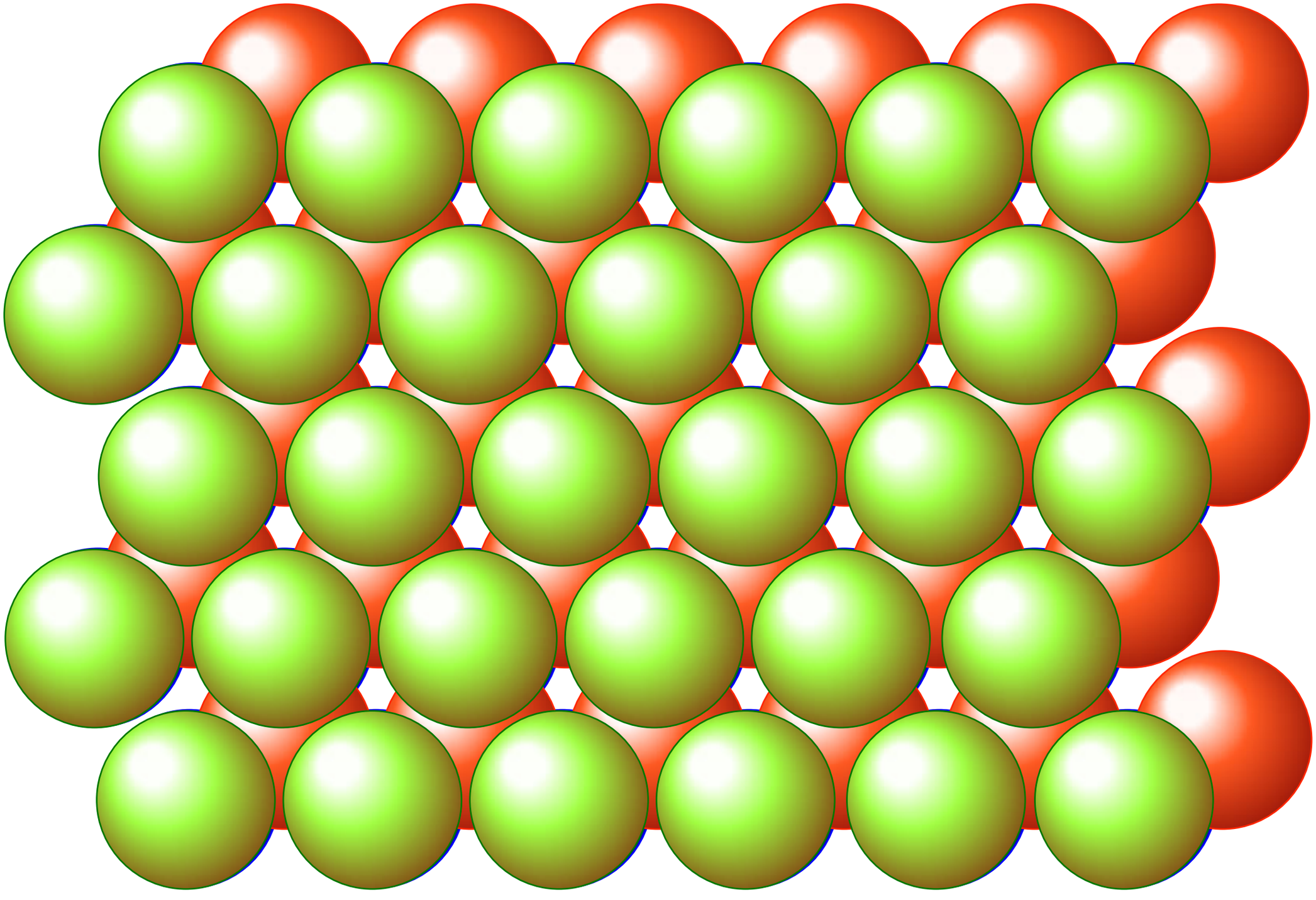
Primitive EZ für flächenzentriertes Gitter

Dichteste Kugelpackung



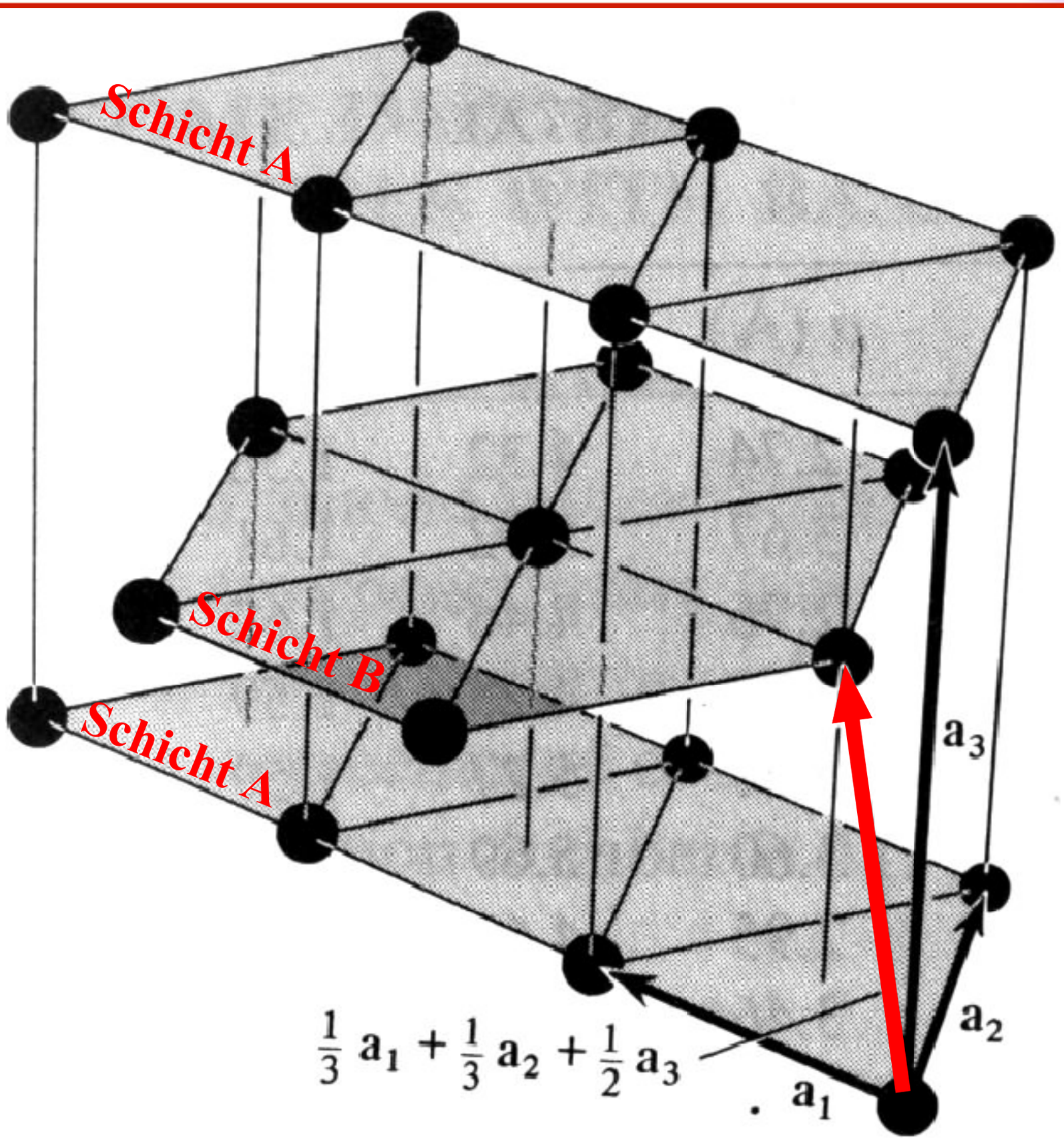
Sequenz: ABCABC ...

Dichteste Kugelpackung

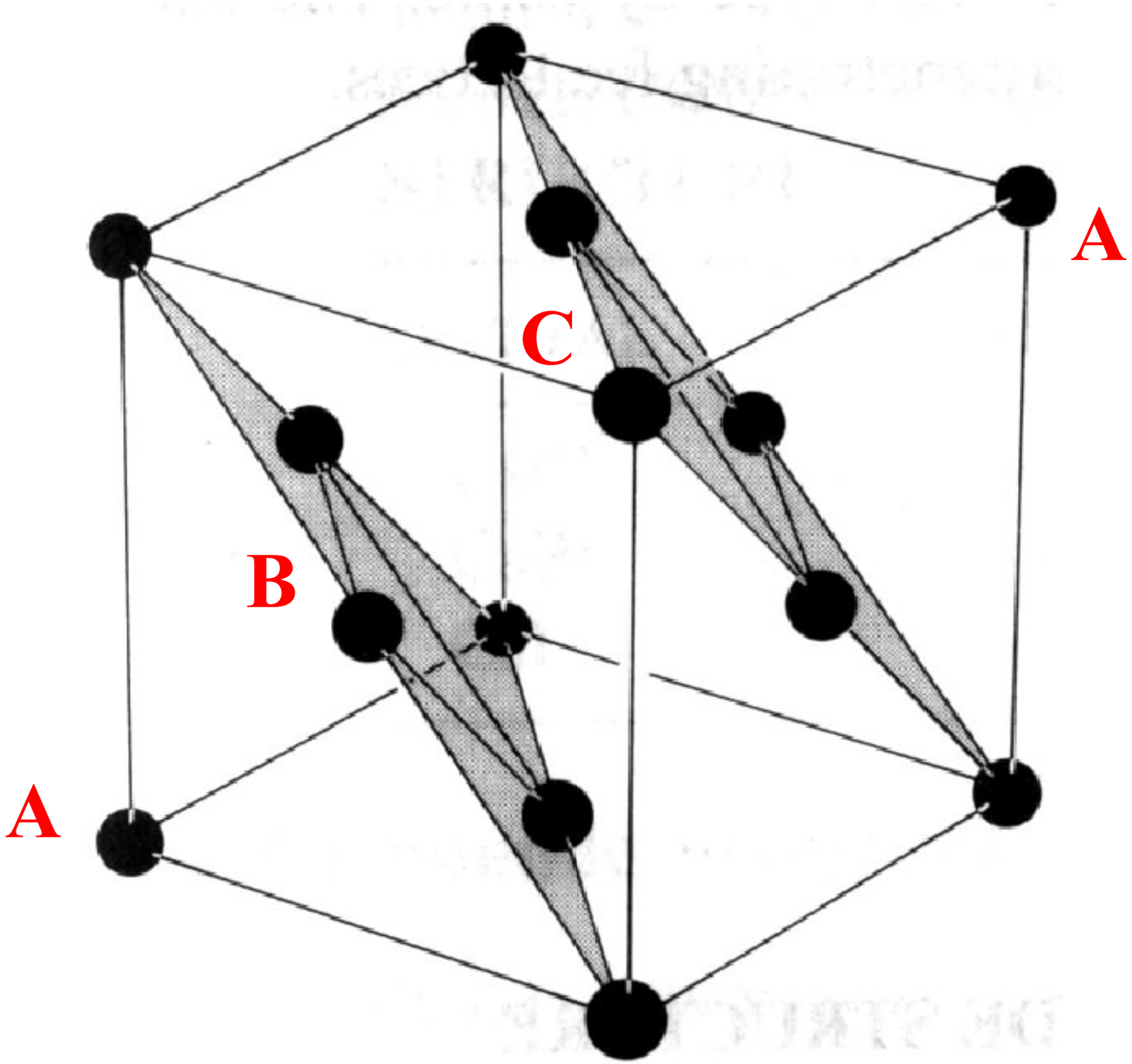


Sequenz: ABABAB ...

Hexagonal dichteste Kugelpackung

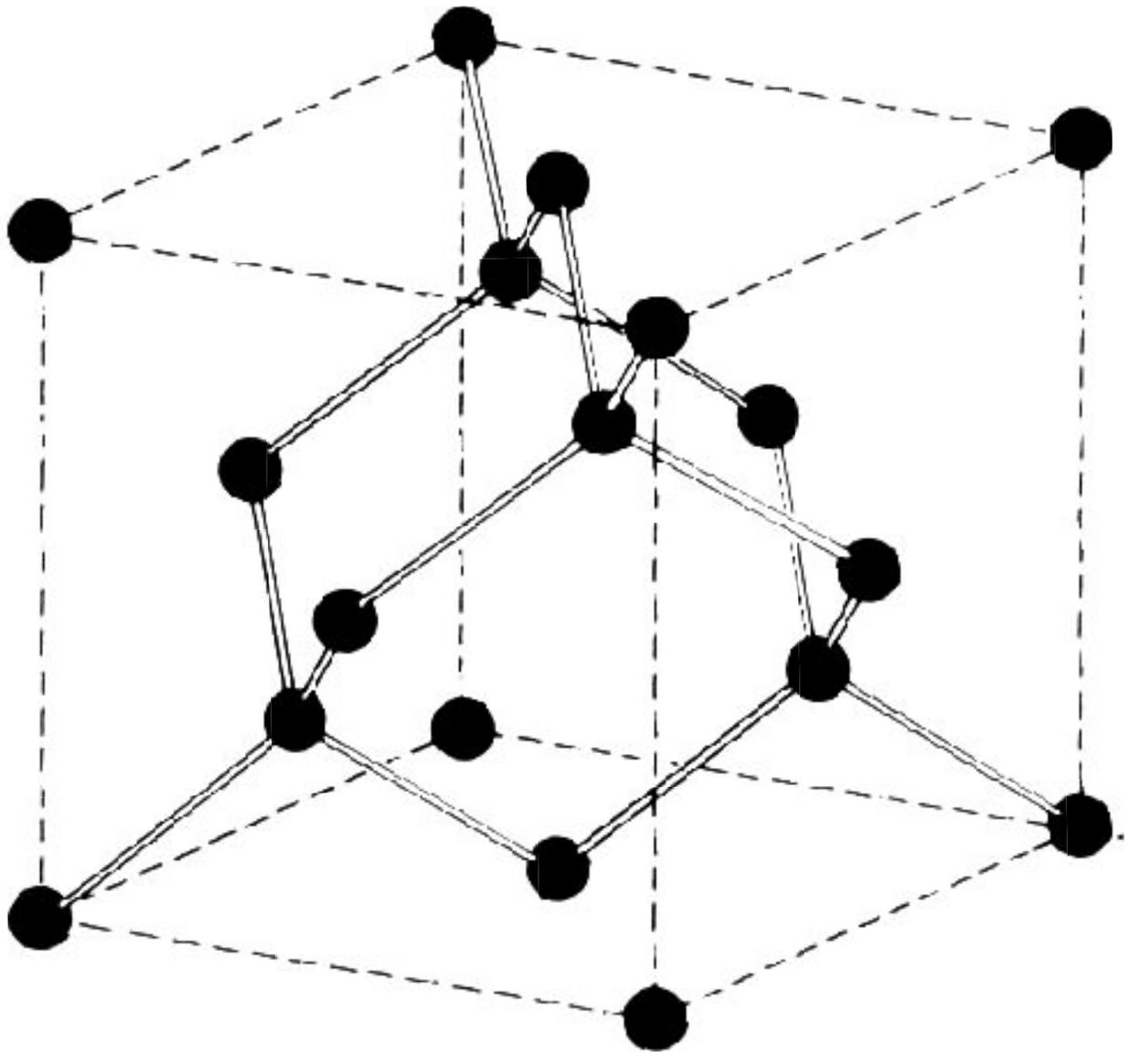


Kubisch flächenzentriertes Gitter



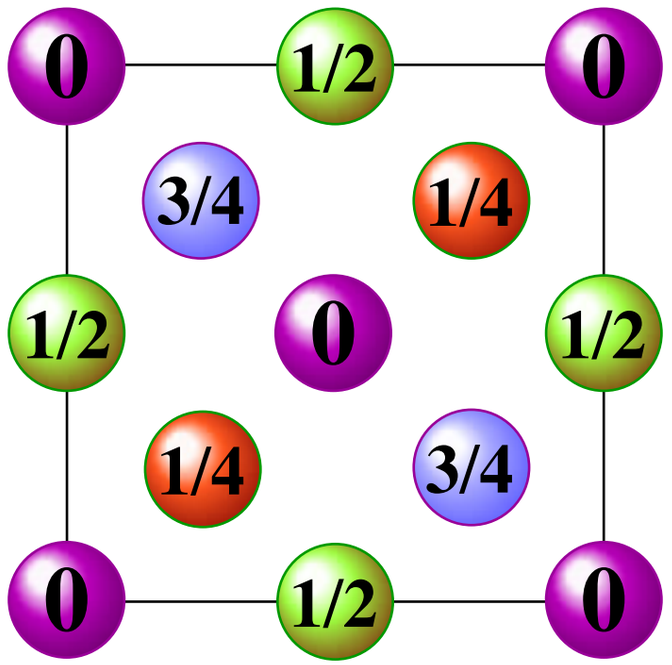
Kristallstrukturen

Diamant

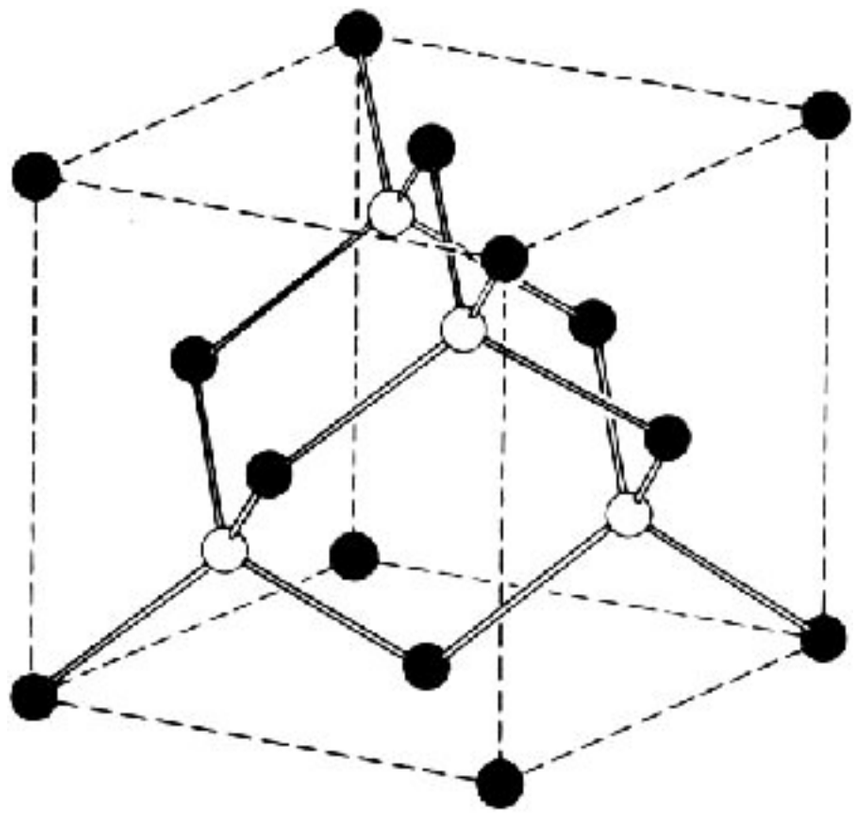


kubisch flächenzentriert

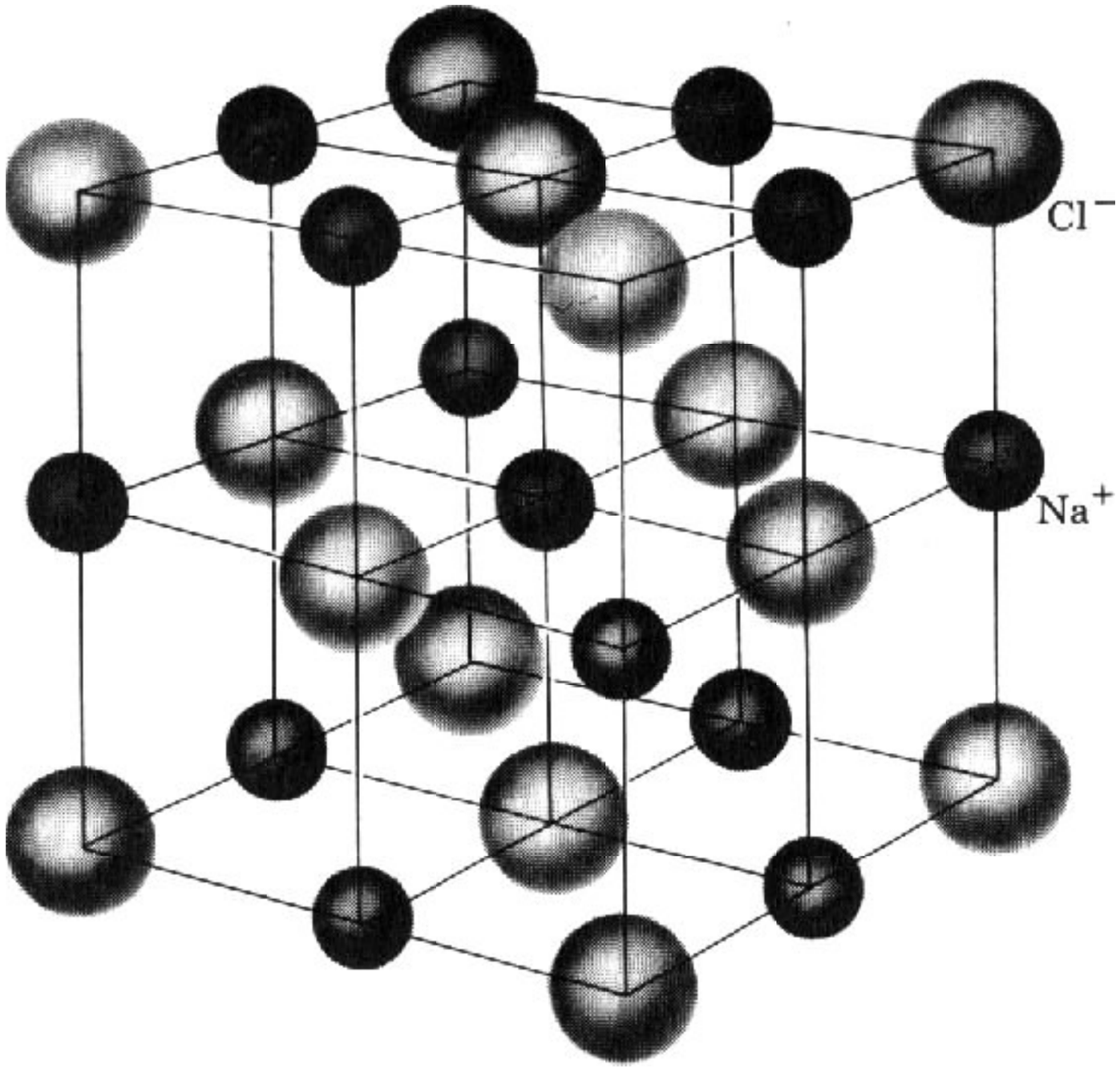
2-atomige Basis

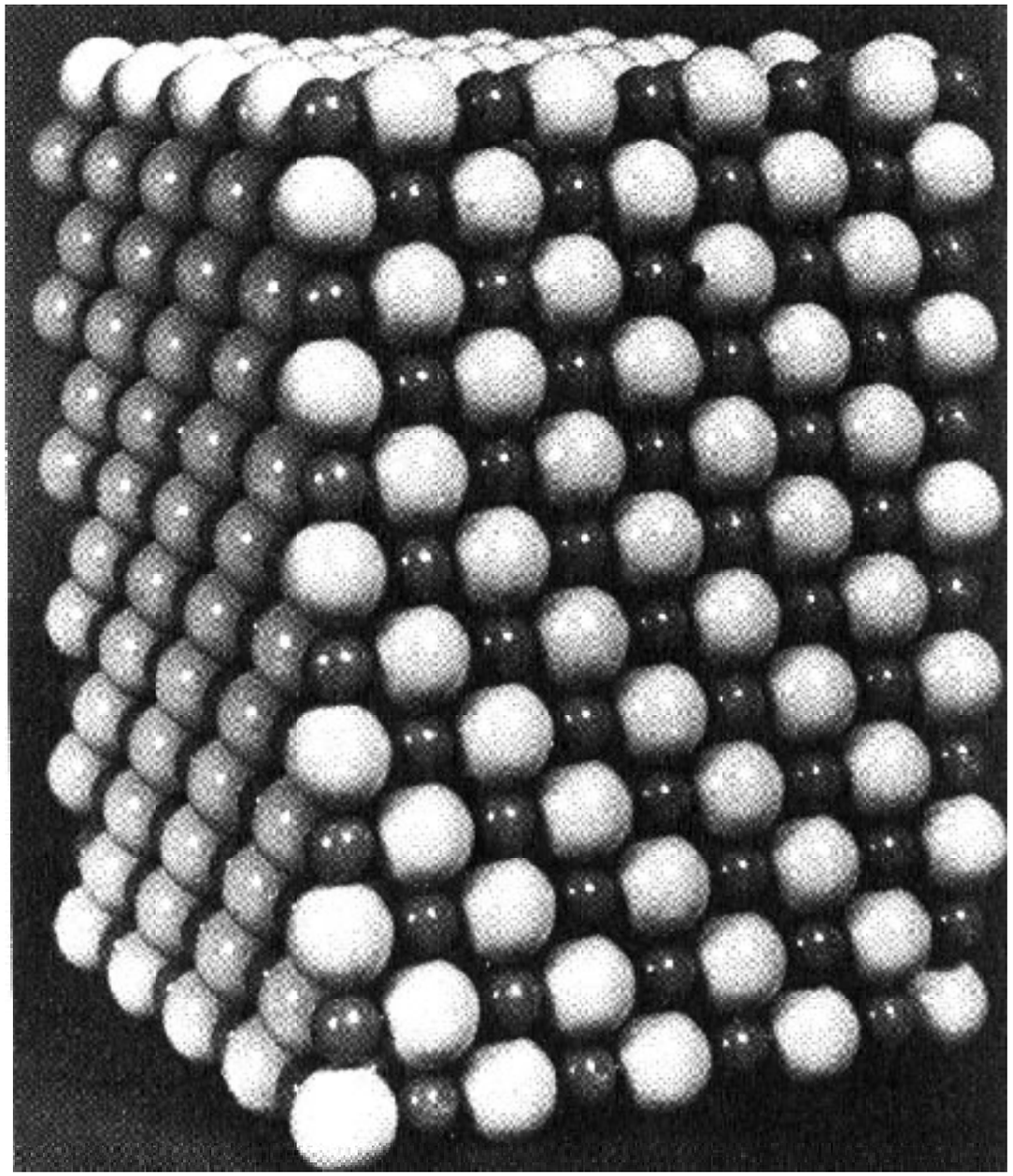


GaAs, AlAs

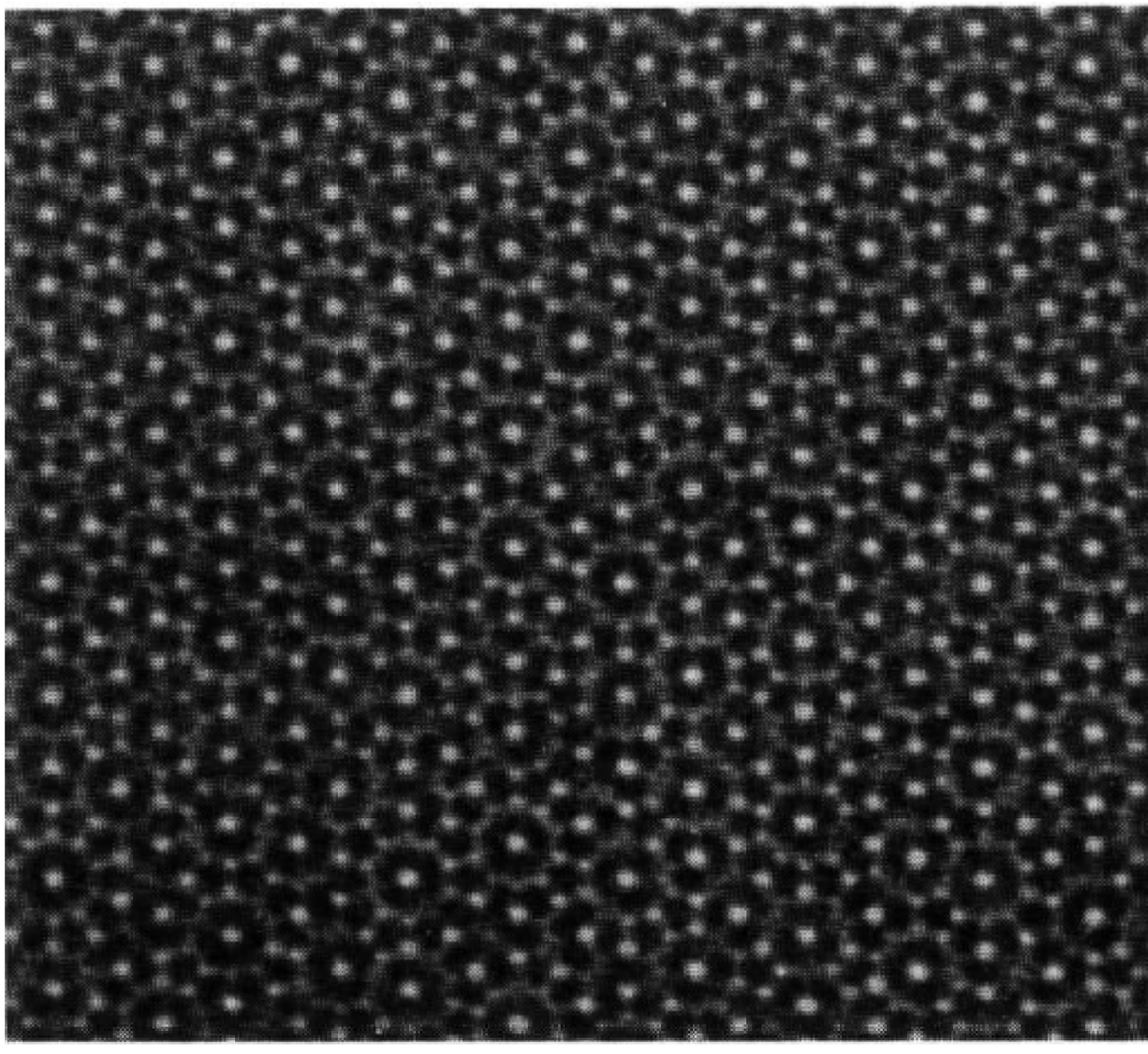


Kochsalz



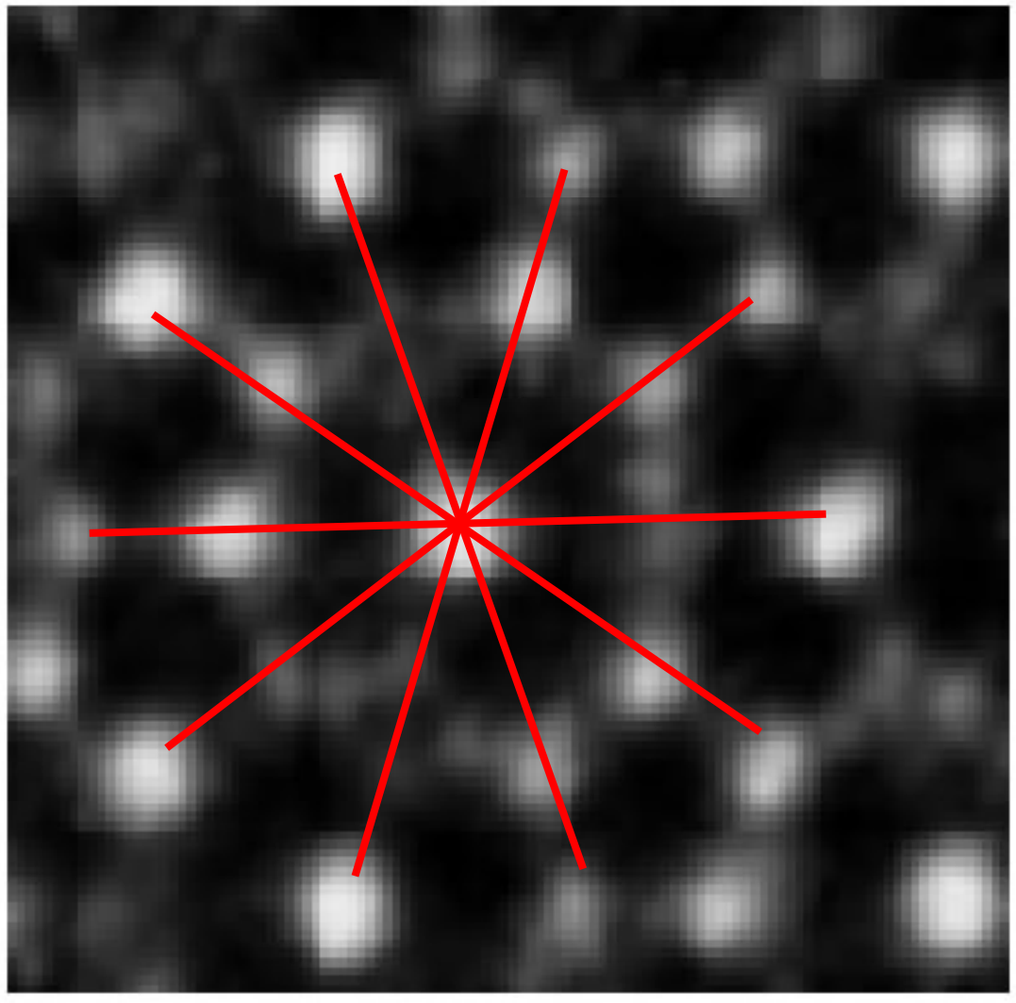


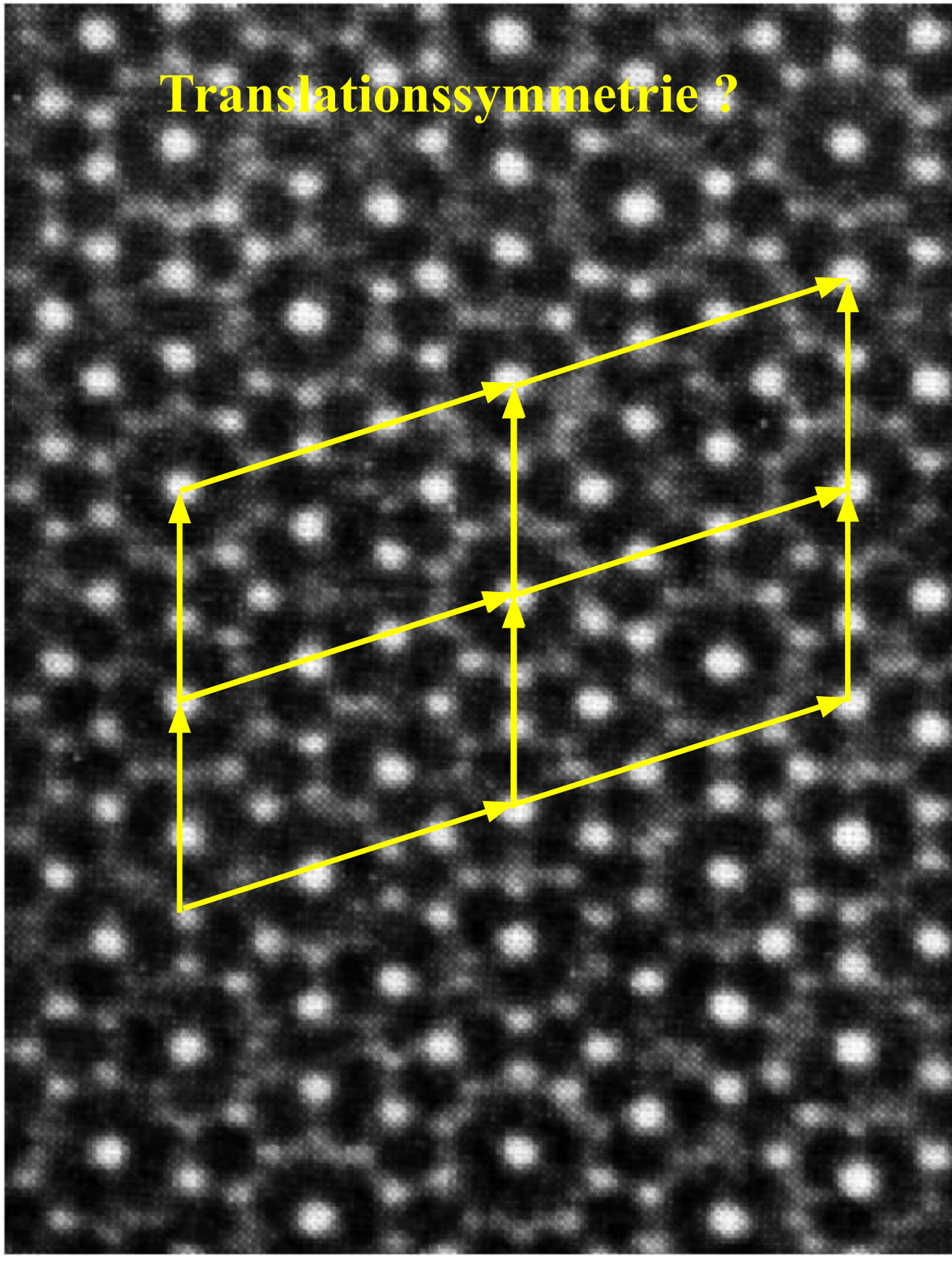
Quasikristalle



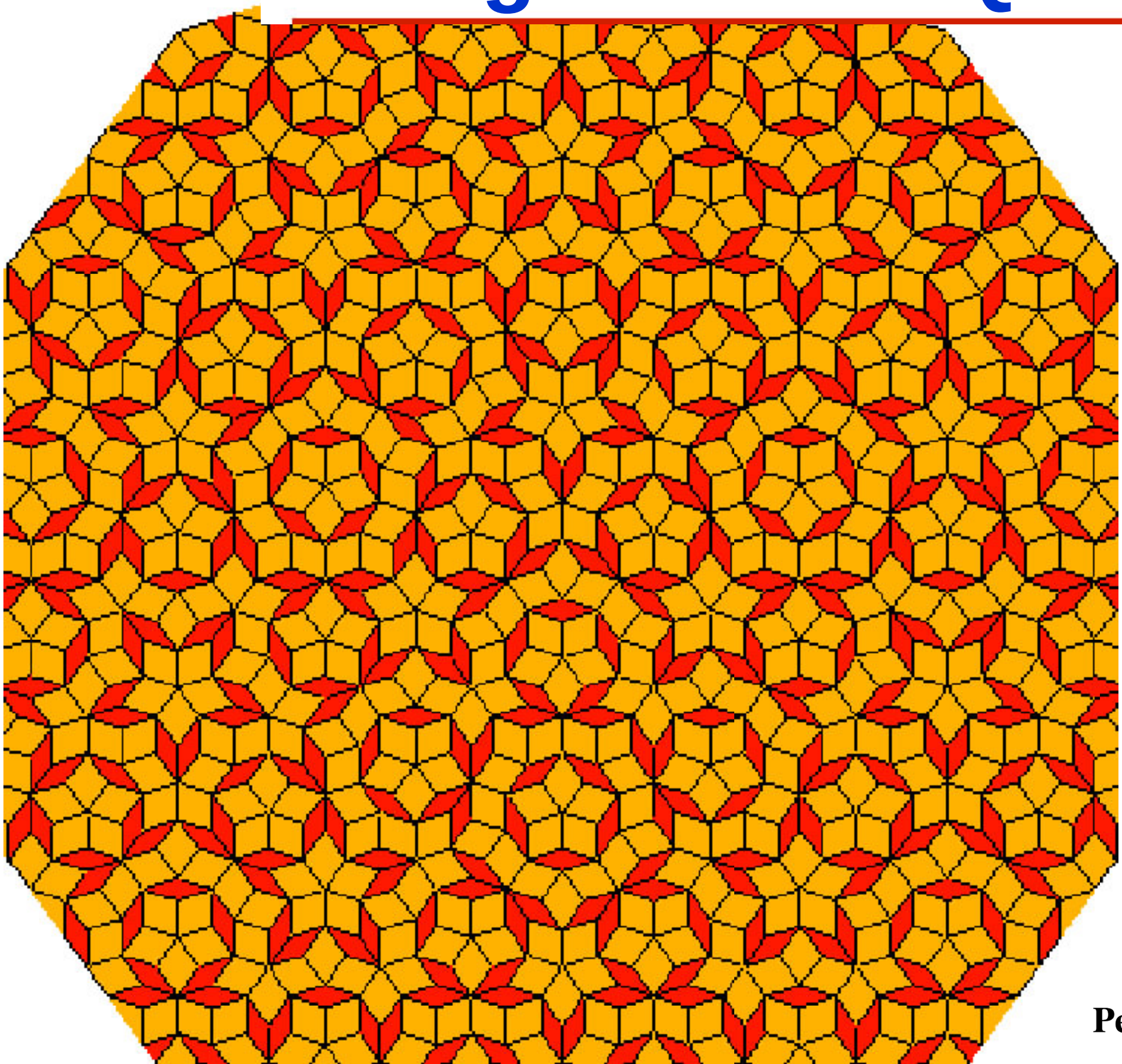
Quasikristalle

Nahordnung



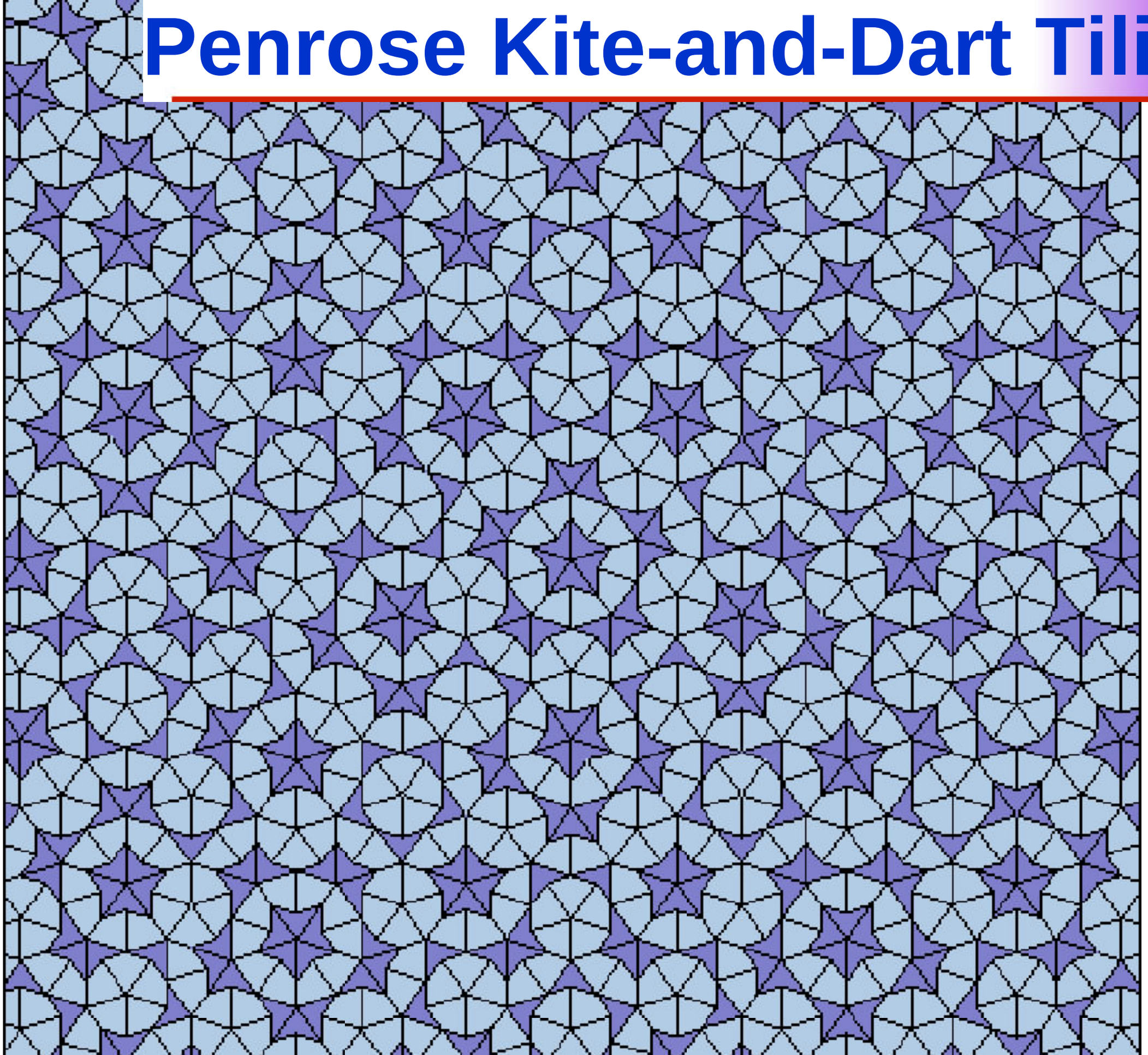


Ordnung in einem Quasikristall



Penrose-Rhombus-Tiling

Penrose Kite-and-Dart Tiling



Octagonales Ammann-Beenker Tiling