Quasikristalle

Goethe Universität Frankfurt - 06.07.2016 - David Kaib

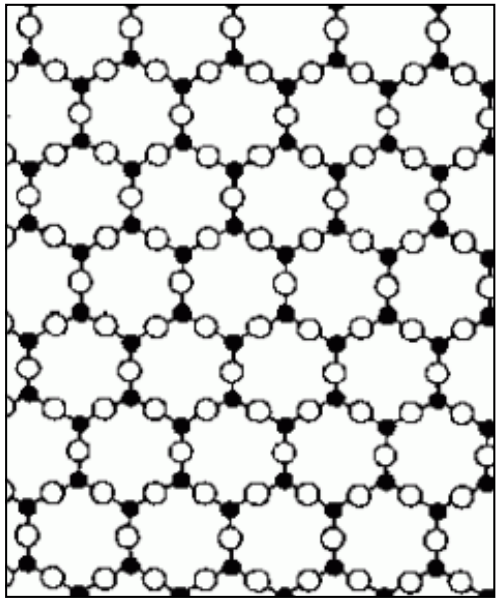
Arten von Festkörpern

Graphit

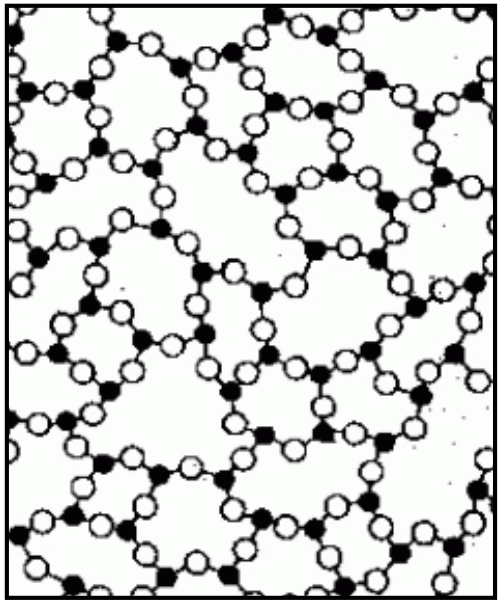
Kristalle

amorphe
Festkörper

Arten von Festkörpern

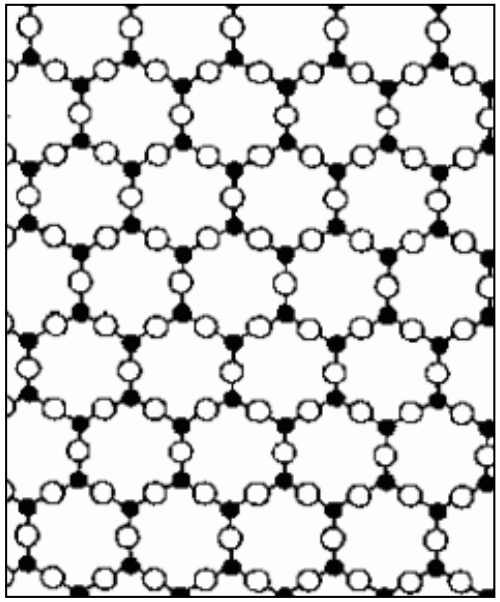


Kristalle

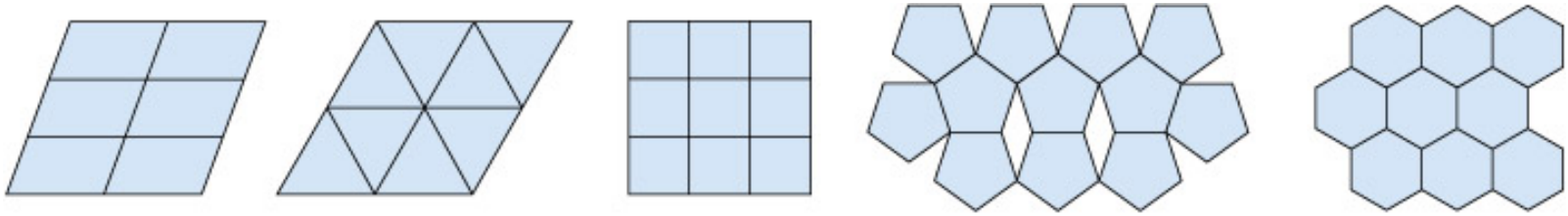


amorphe
Festkörper

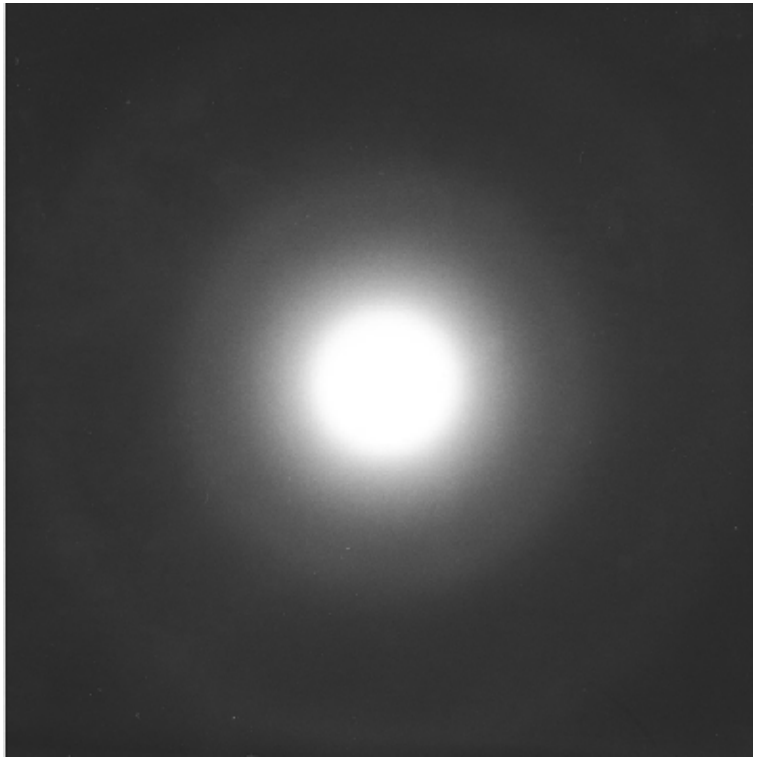
(konventionelle) Kristalle



- Definition:
  Ein Festkörper, der aus sich periodisch wiederholenden Elementarzellen aufgebaut ist.
- Translationssymmetrie
- mögliche Rotationssymmettrien:
  2,3,4 oder 6-zählig

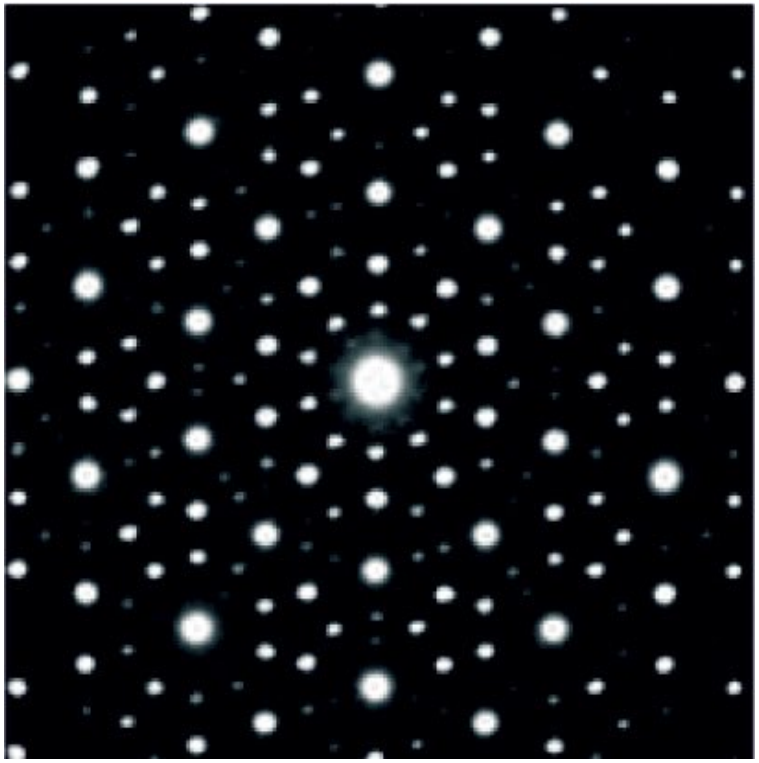


Kristalle

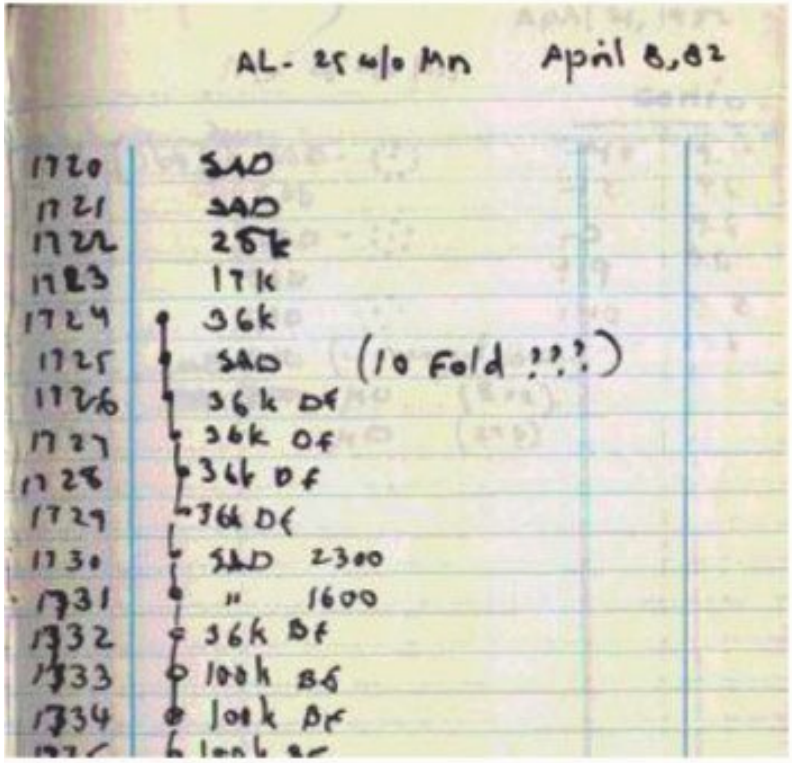


amorphe
Festkörper

Entdeckung der Quasikristalle



Al-Mn

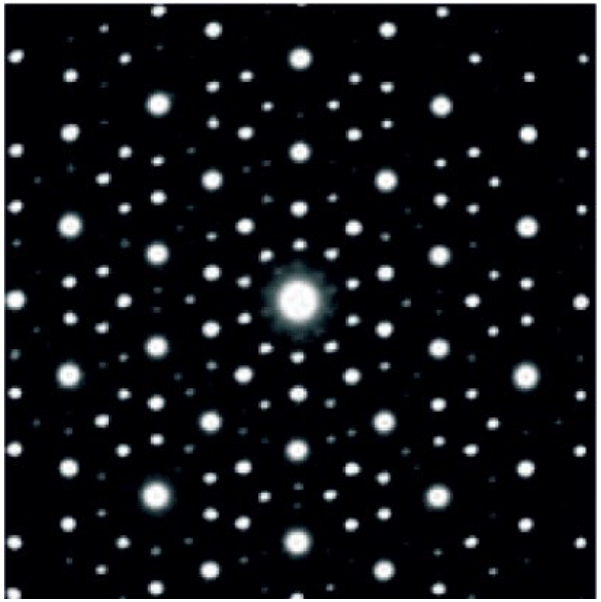


rapid abgekühlte Aluminium-Mangan-Legierung

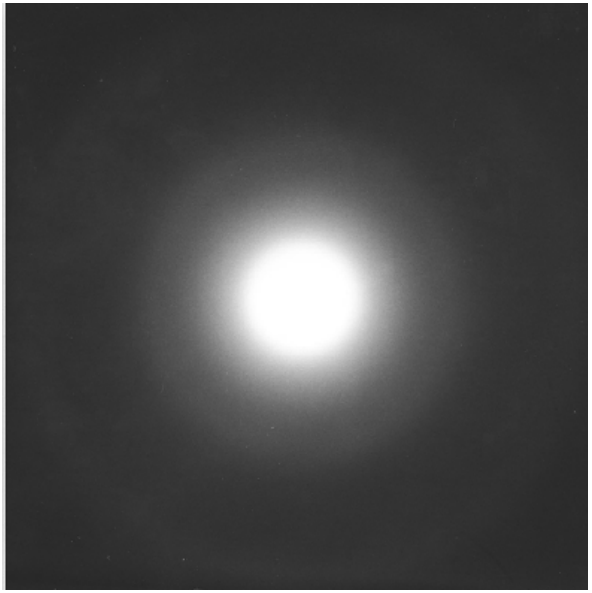
Dan Shechtman, 1982

Arten von Festkörpern

konventionelle Kristalle

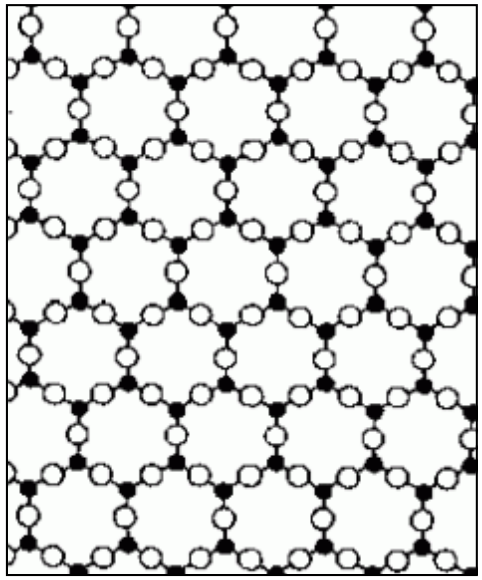


Quasikristalle



amorphe Festkörper

Arten von Festkörpern



konventionelle Kristalle

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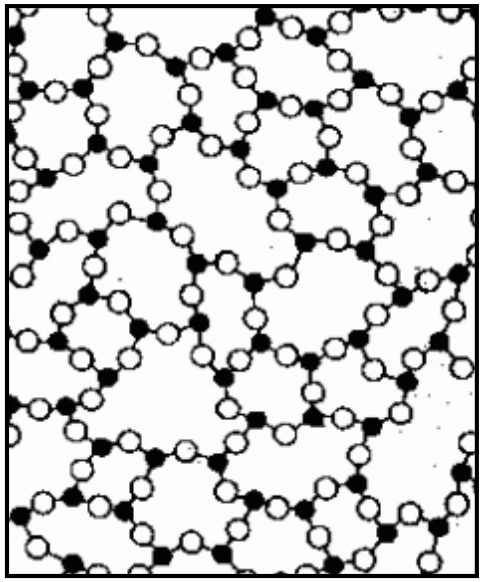
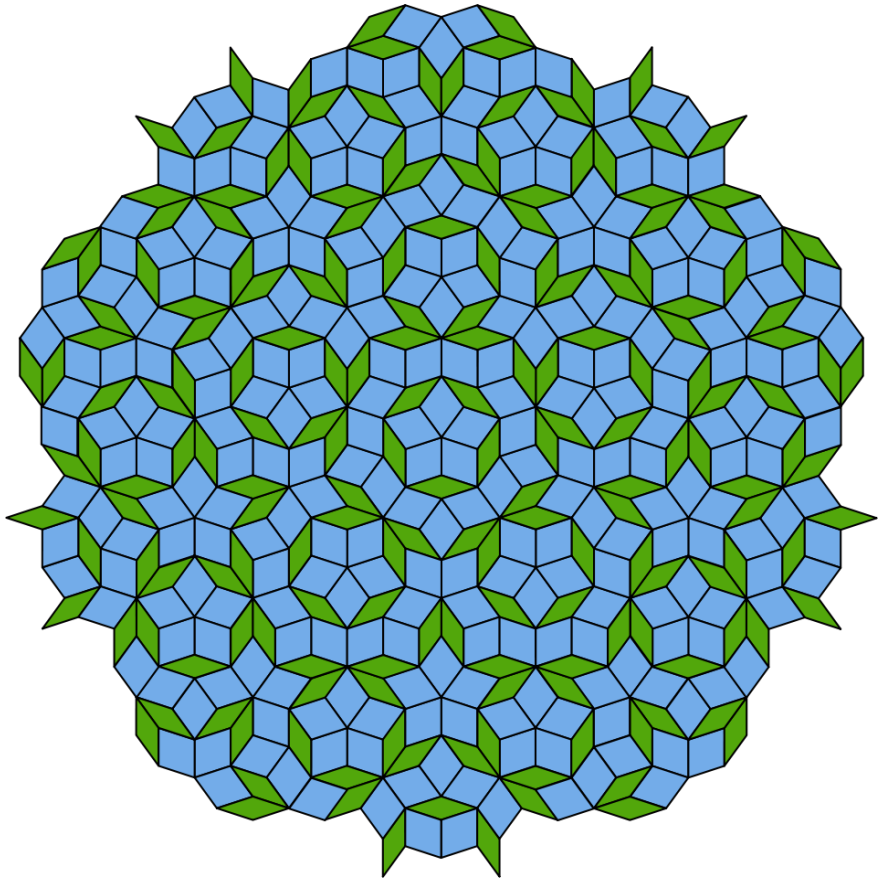
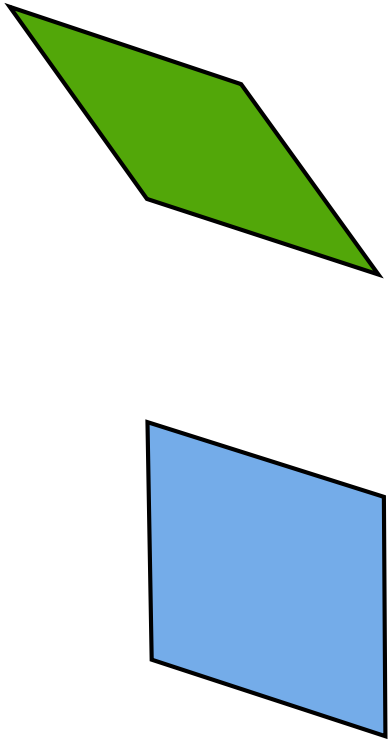
Quasikristalle



amorphe Festkörper

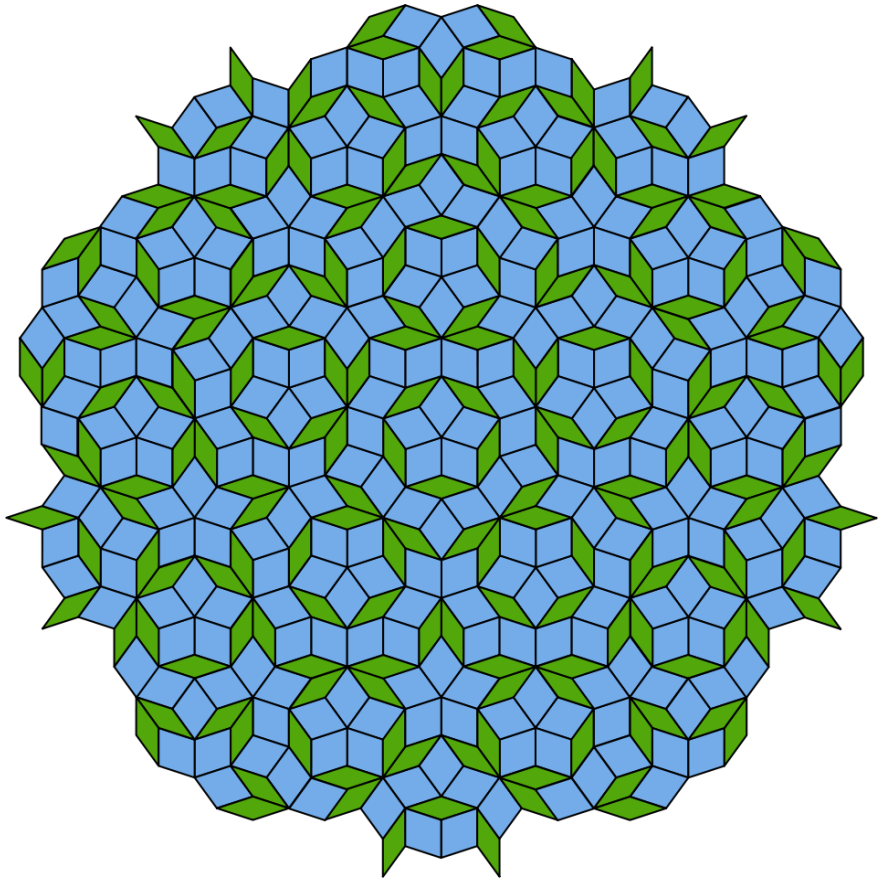
Penrose-Parkettierungen





Peter Penrose, 1974

Penrose-Parkettierungen



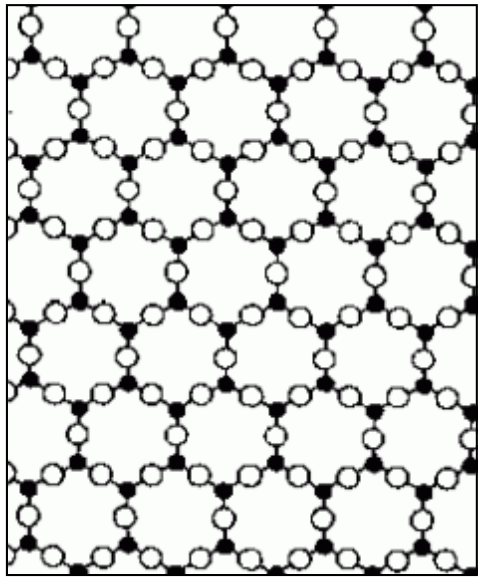
Peter Penrose, 1974

- 5-zählige Rotationssymmetrie in einem einzigen Punkt
- 10-zählige statistische Symmetrie
- füllen den Raum ohne Periodizität lückenlos aus
- endliche Teilmuster tauchen unendlich oft auf
- ergeben sich als proj
  aus höherdimensiona
  Gitter
- es existieren unendlich viele zueinander isomorphe Muster

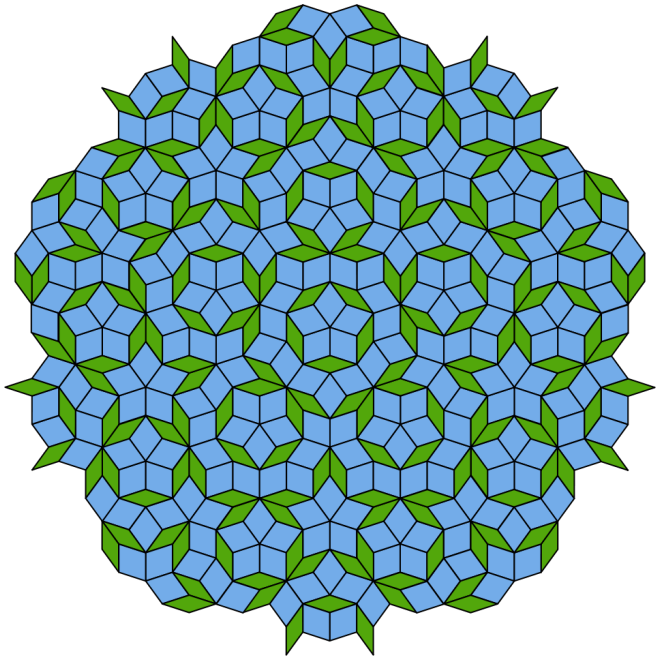
statistisch=ununterscheidbar

die letzten beiden punkte werden noch klarer bei eindimensionalem Beispiel

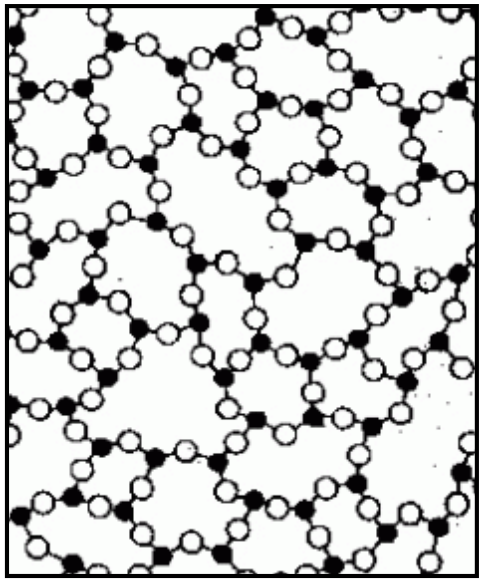
Arten von Festkörpern



konventionelle Kristalle



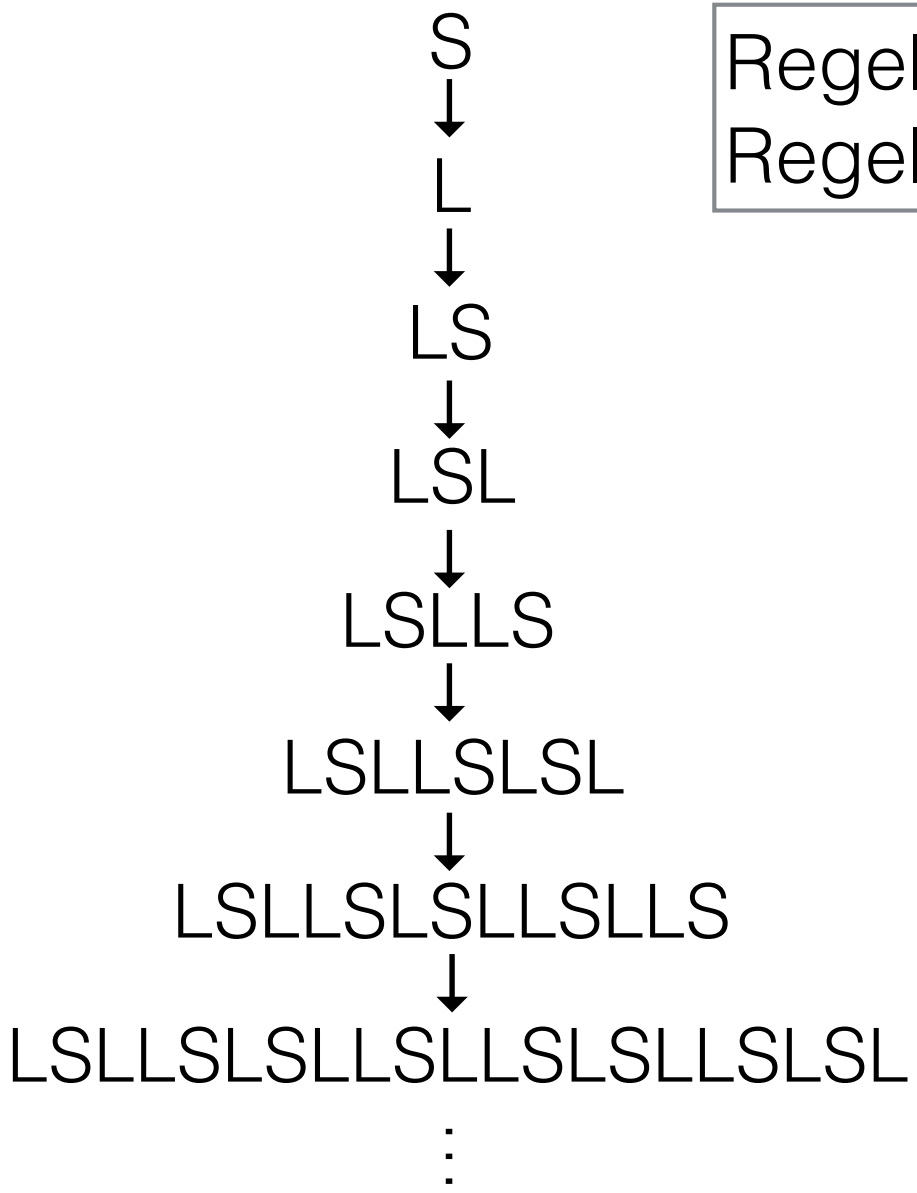
Quasikristalle



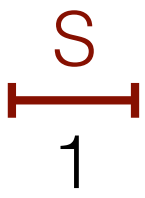
amorphe Festkörper

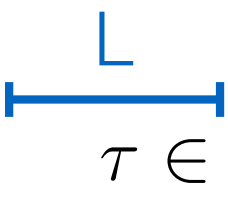
Konstruktion quasiperiodischer Muster

quasiperiodischer Kristall in 1D: Fibonacci-Kette



Regel 1: S→L
Regel 2: L→LS

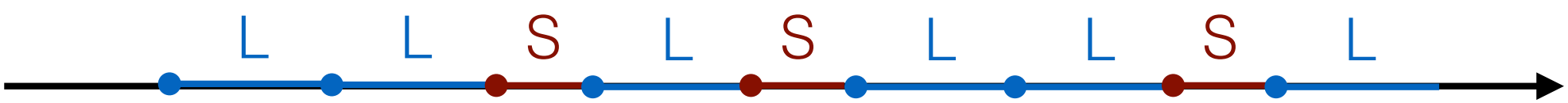




$\tau \in (\mathbb{R} \setminus \mathbb{Q})$

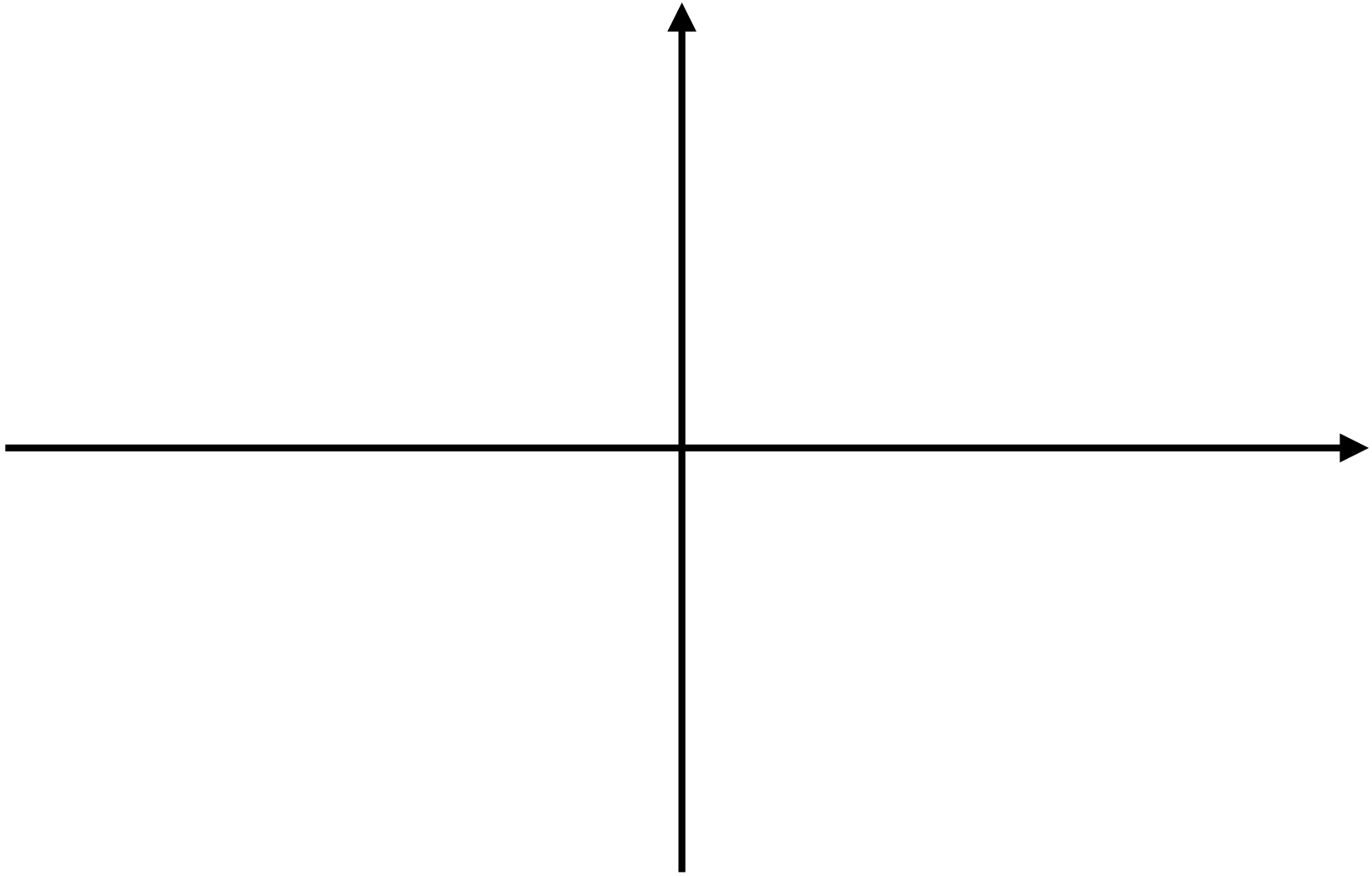
$hier : \tau = \frac{1+\sqrt{5}}{2}$

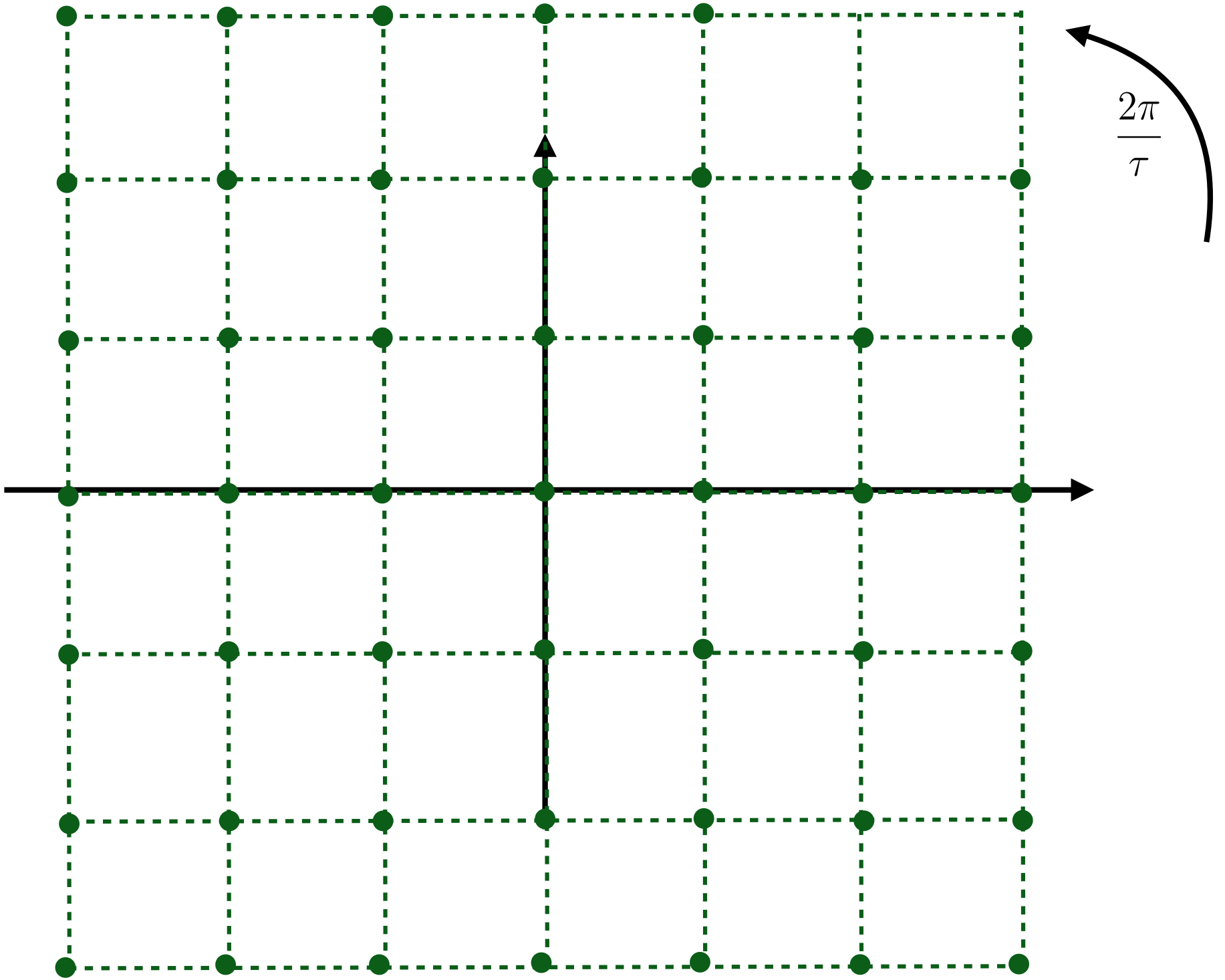
quasiperiodischer Kristall in 1D: Fibonacci-Kette

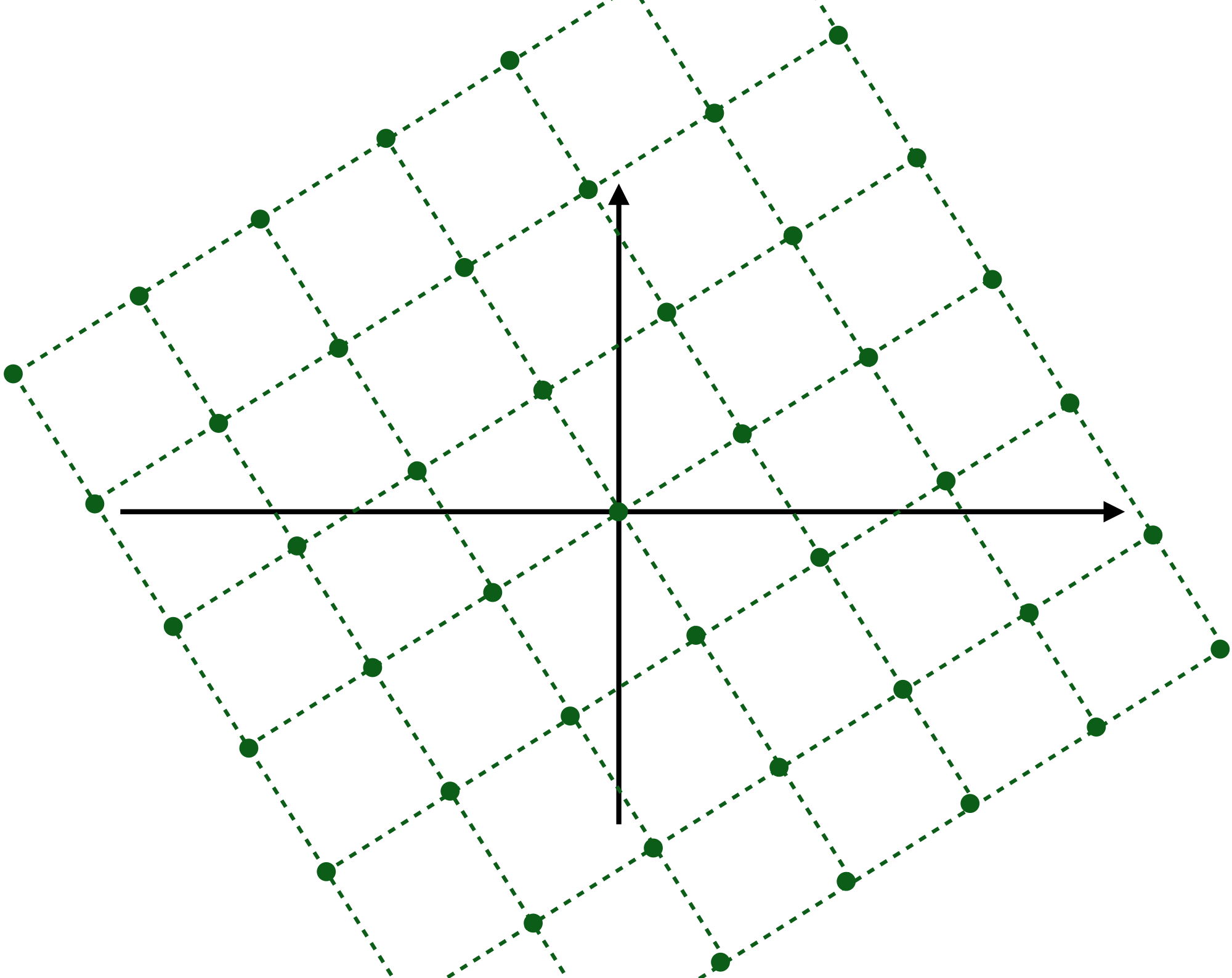


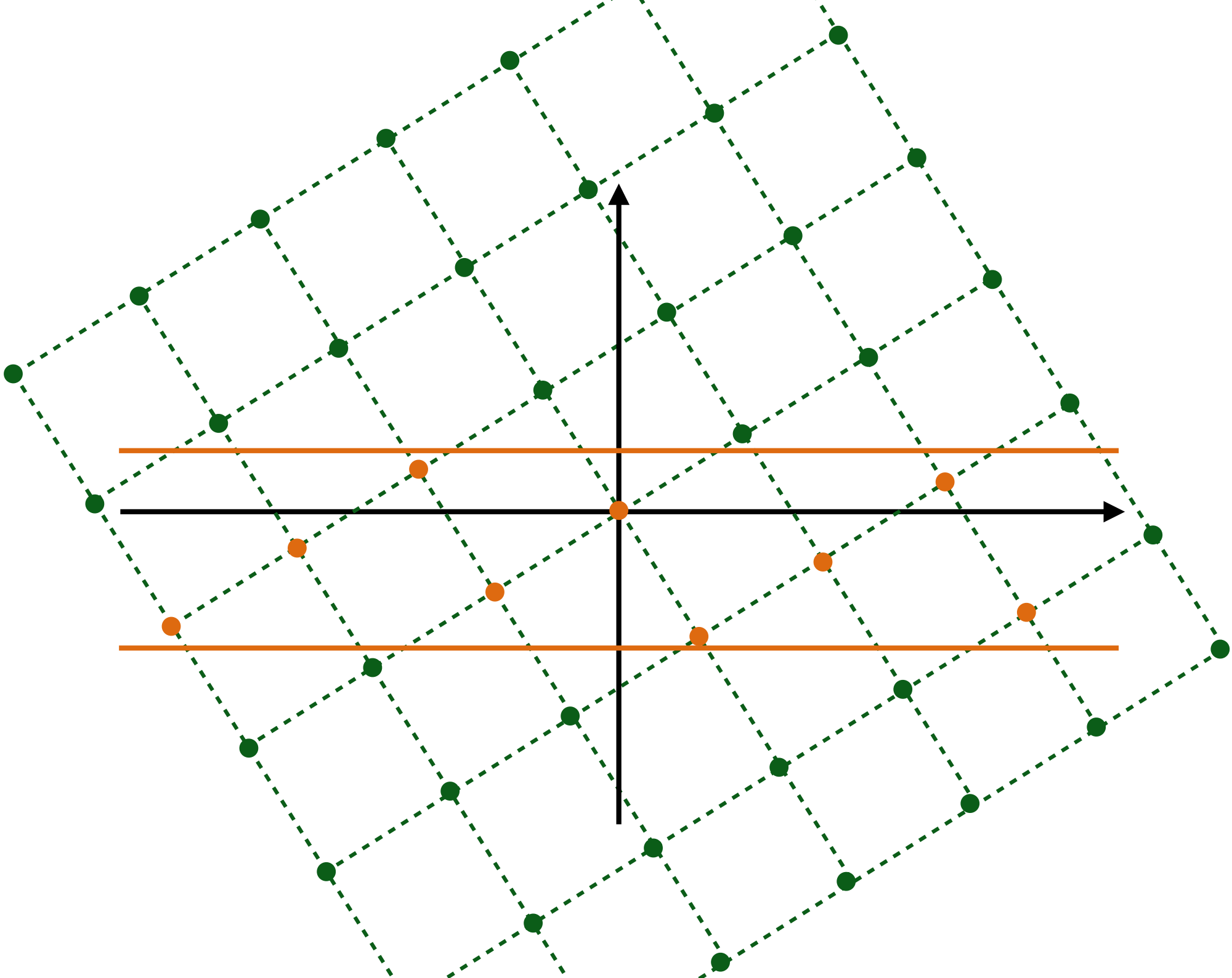
LSLLSLSLLSLLS

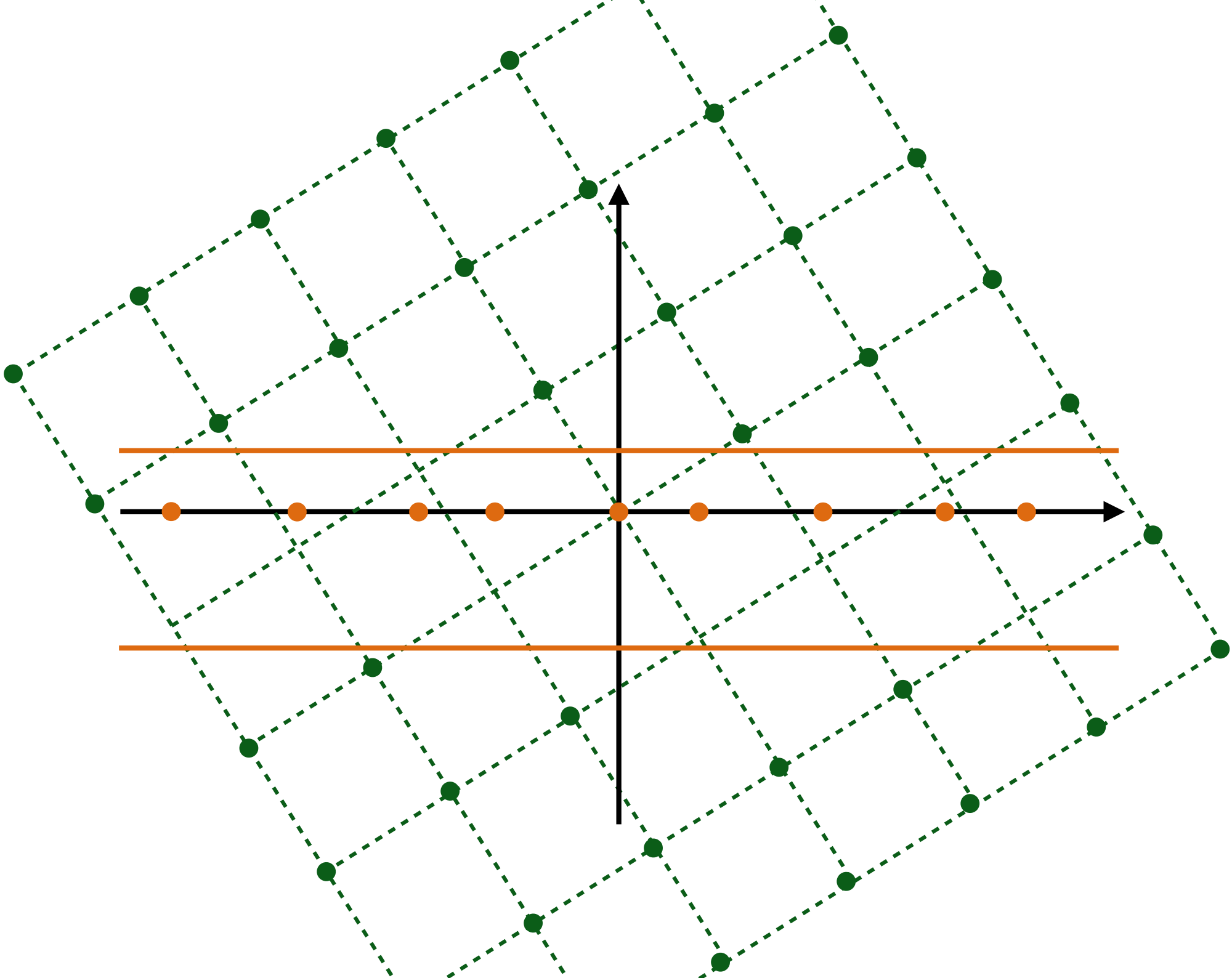
1D-quasiperiodisch als Schnitt aus 2D-Gitter

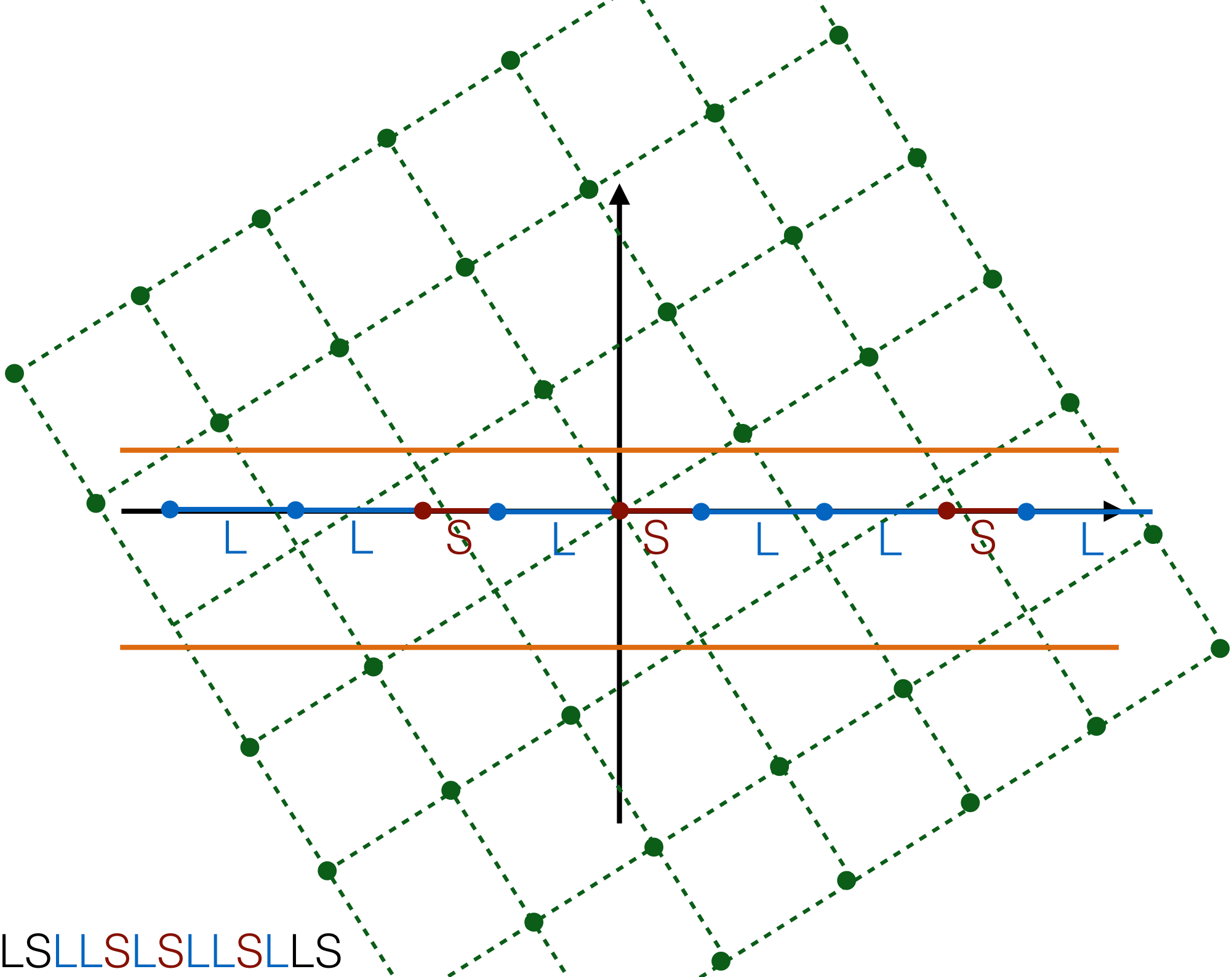



$\frac{2\pi}{\tau}$

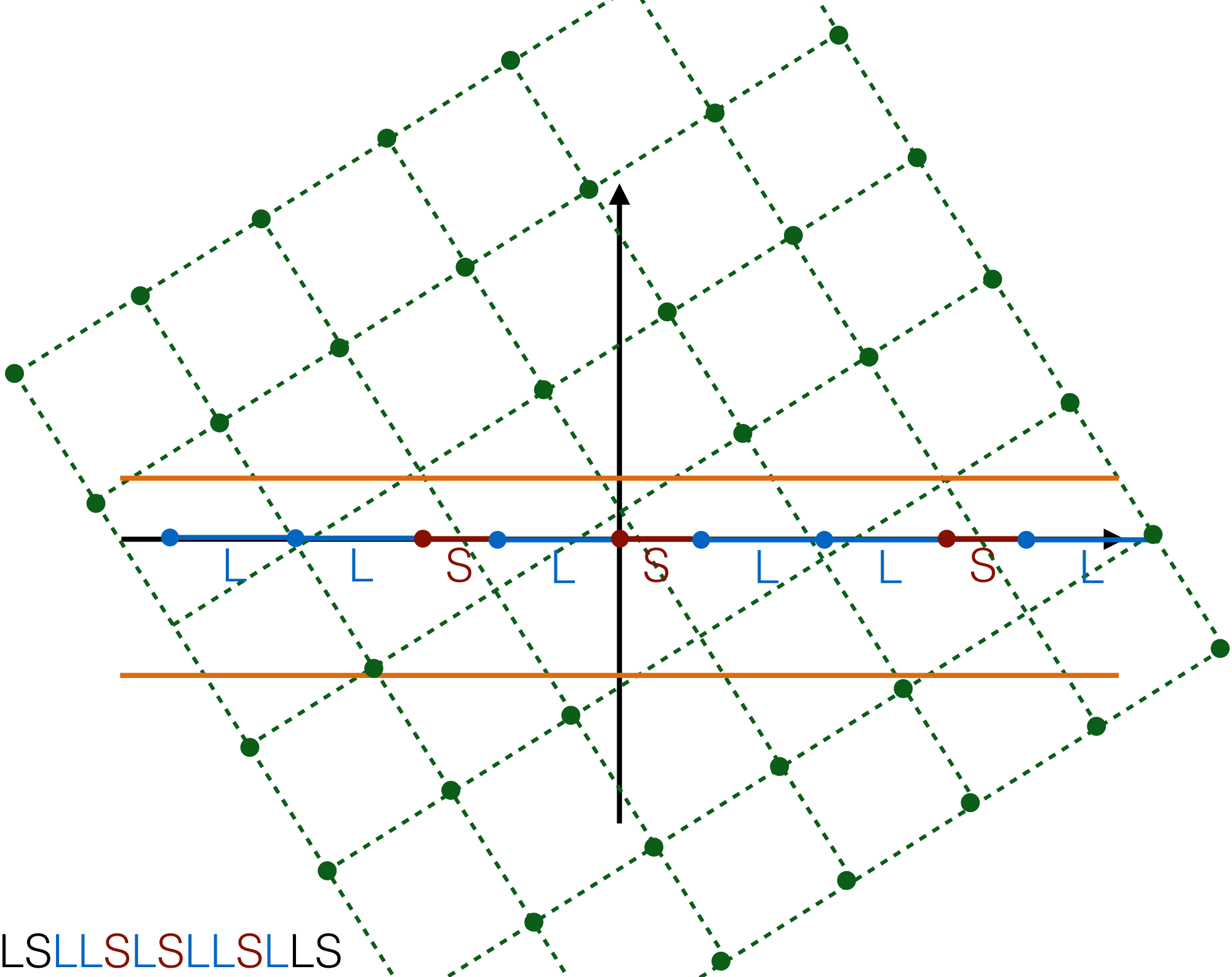




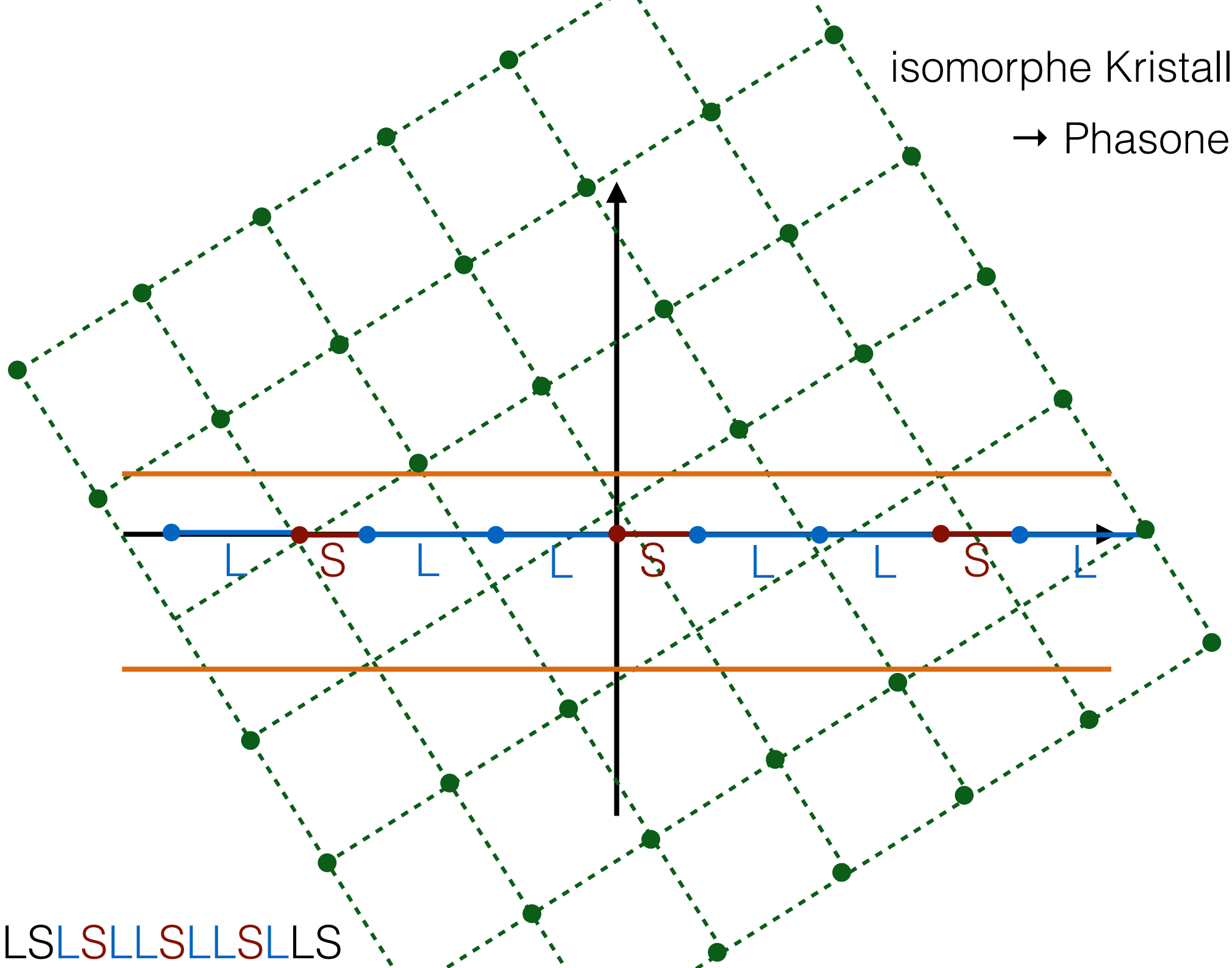




LSLLSLSLLSLLS

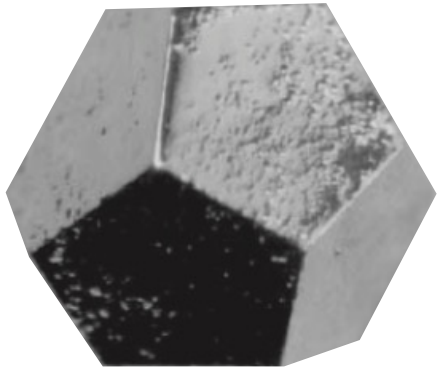


LSLLSLSLLSLLS


isomorphe Kristalle
→ Phasonen
L S L L S L L S L
LSLSLLSLLSLLS

Arten von Festkörpern

konventionelle Kristalle



$Zn_{56.8}Mg_{34.6}Ho_{8.7}$

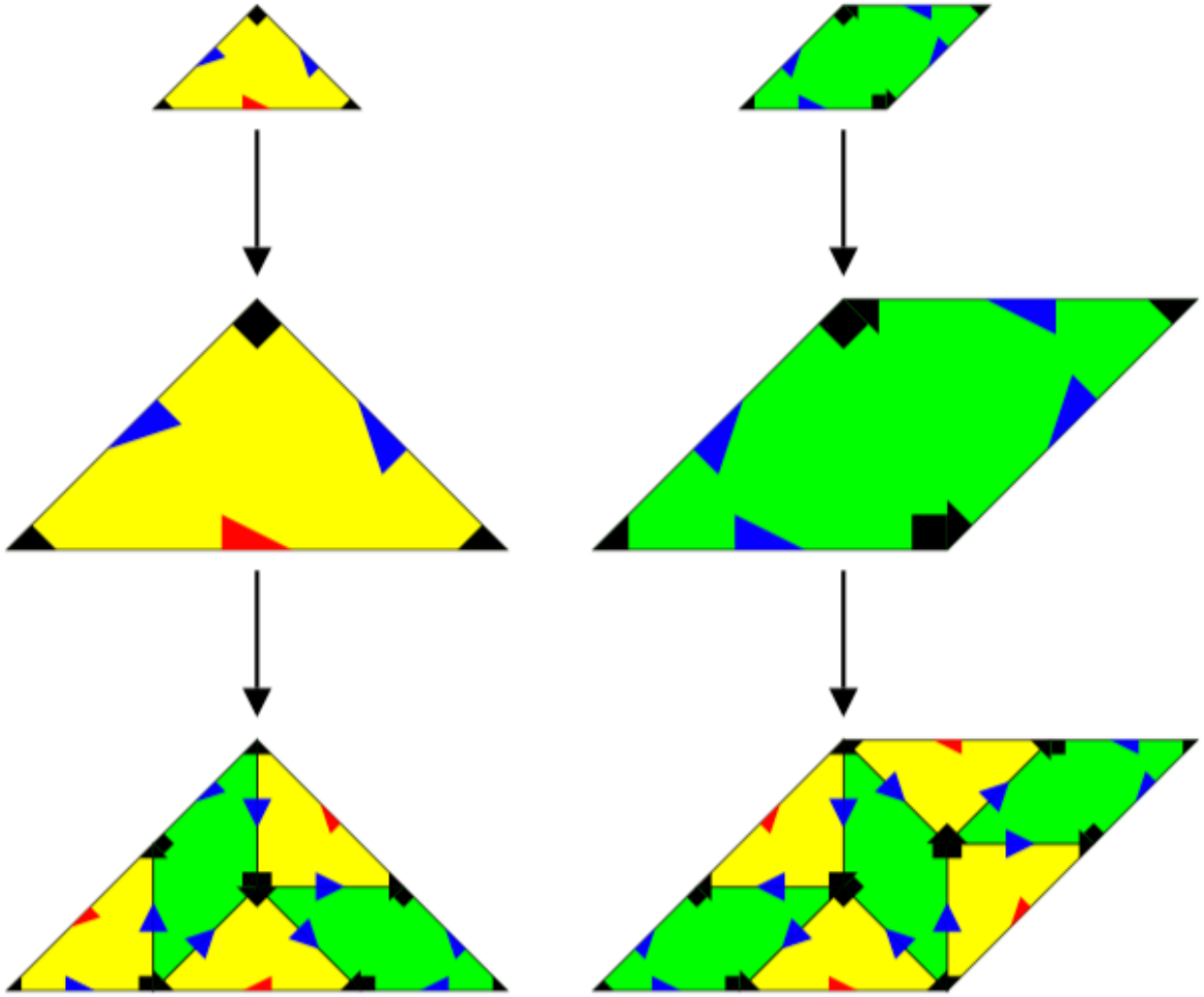
Pentagondodekaeder

Quasikristalle

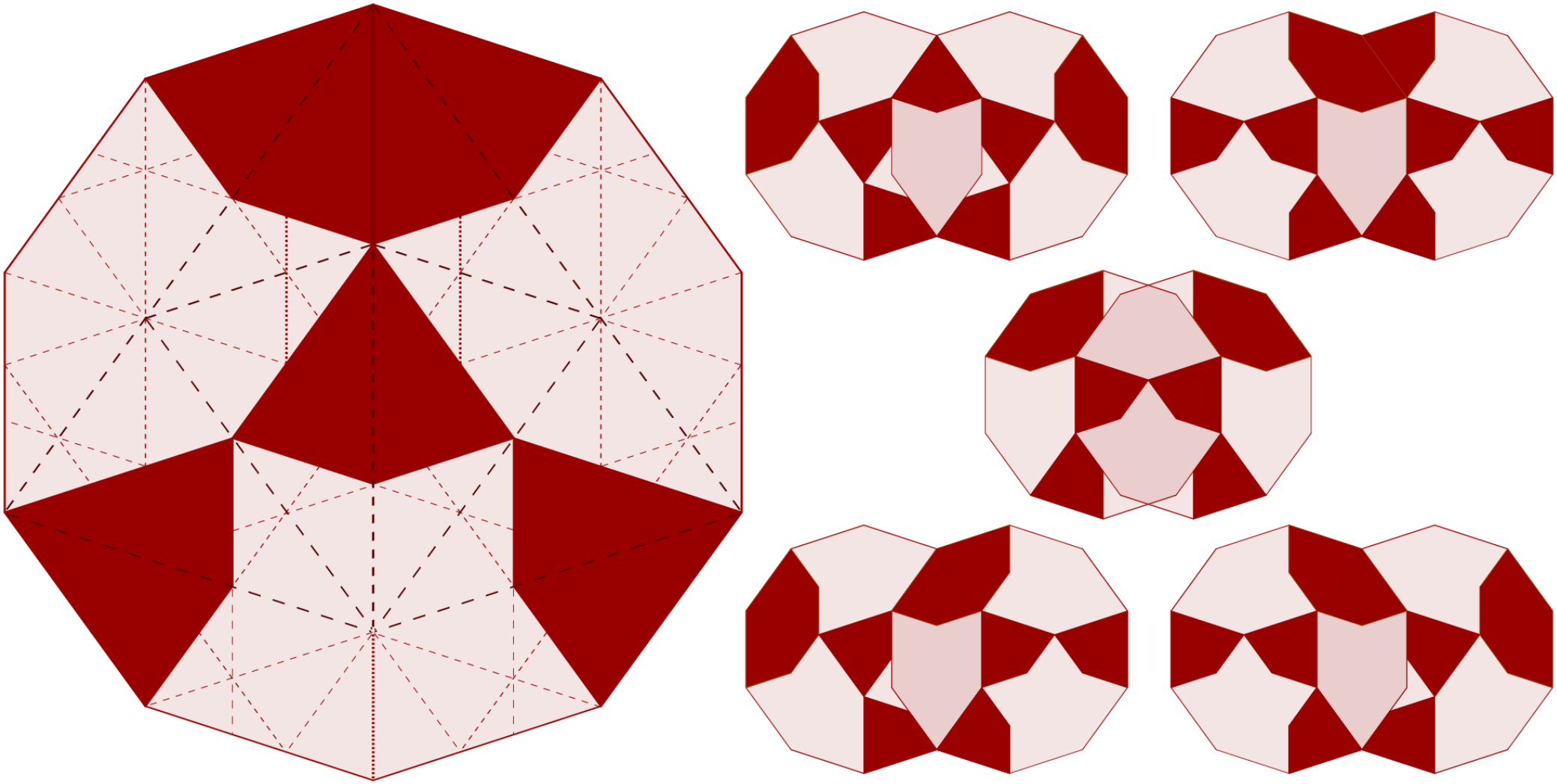
amorphe Festkörper

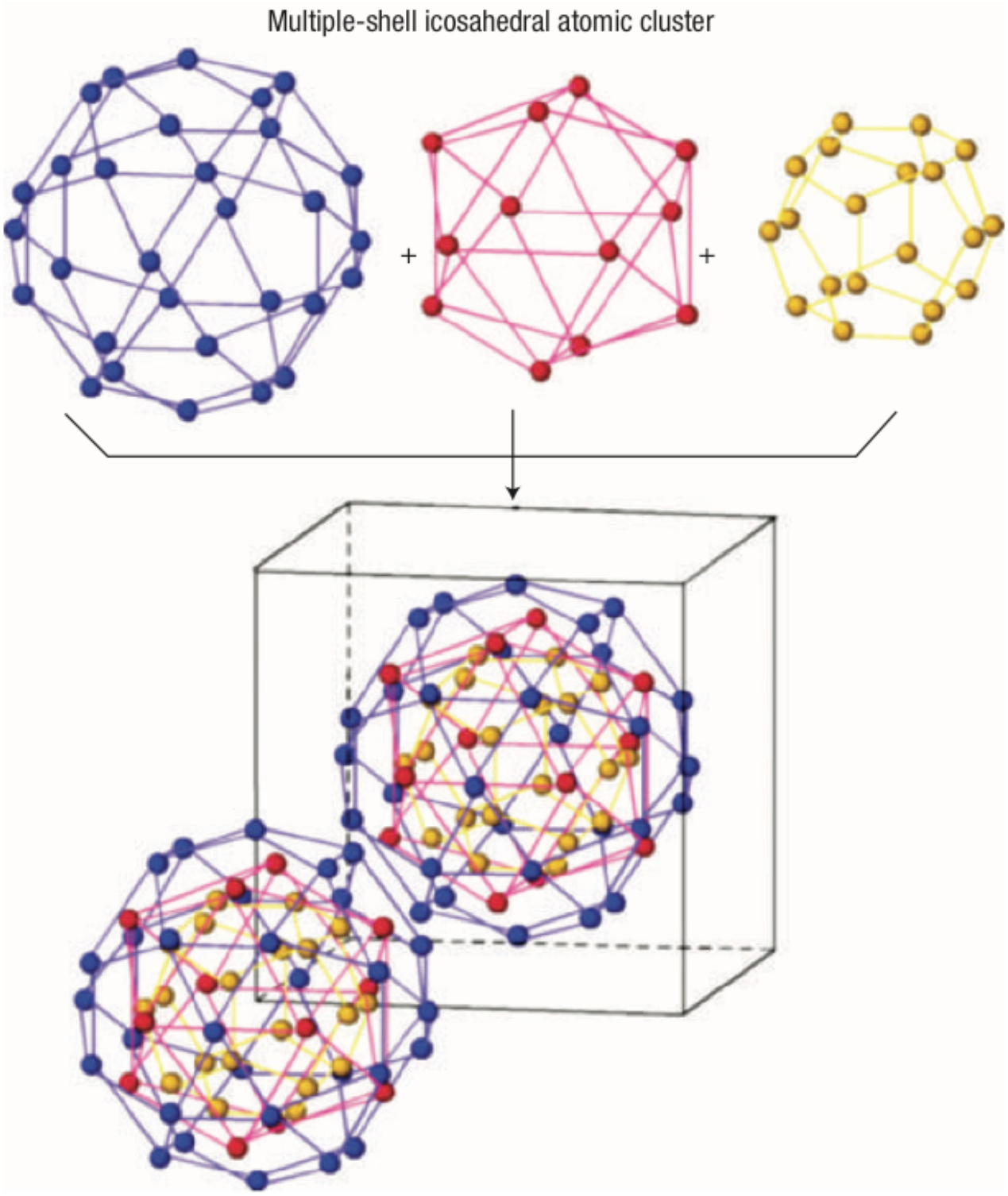
Arten von Festkörpern

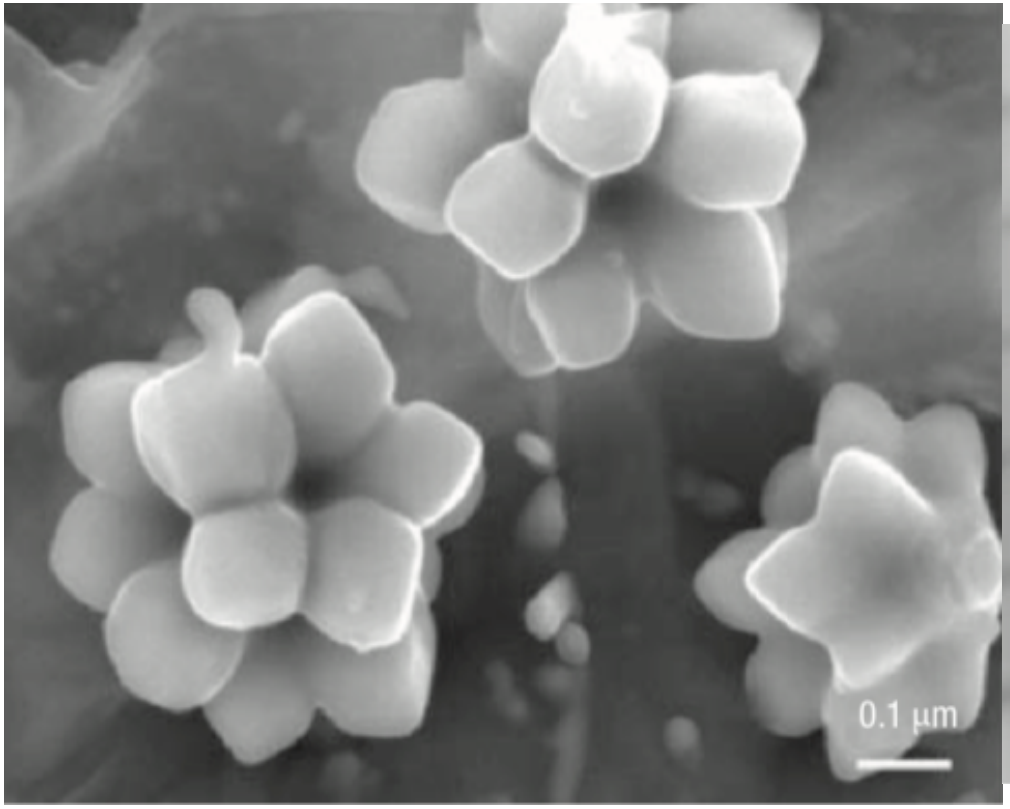
	konventionelle Kristalle	Quasikristalle	amorphe Festkörper
langreichweitige Ordnung	✓	✓	✗
diskretes reziprokes Gitter (d Basisvektoren)	d = Anzahl der Raumdimensionen ✓	d > Anzahl der Raumdimensionen ✓	✗
Periodizität	✓	quasiperiodisch	✗



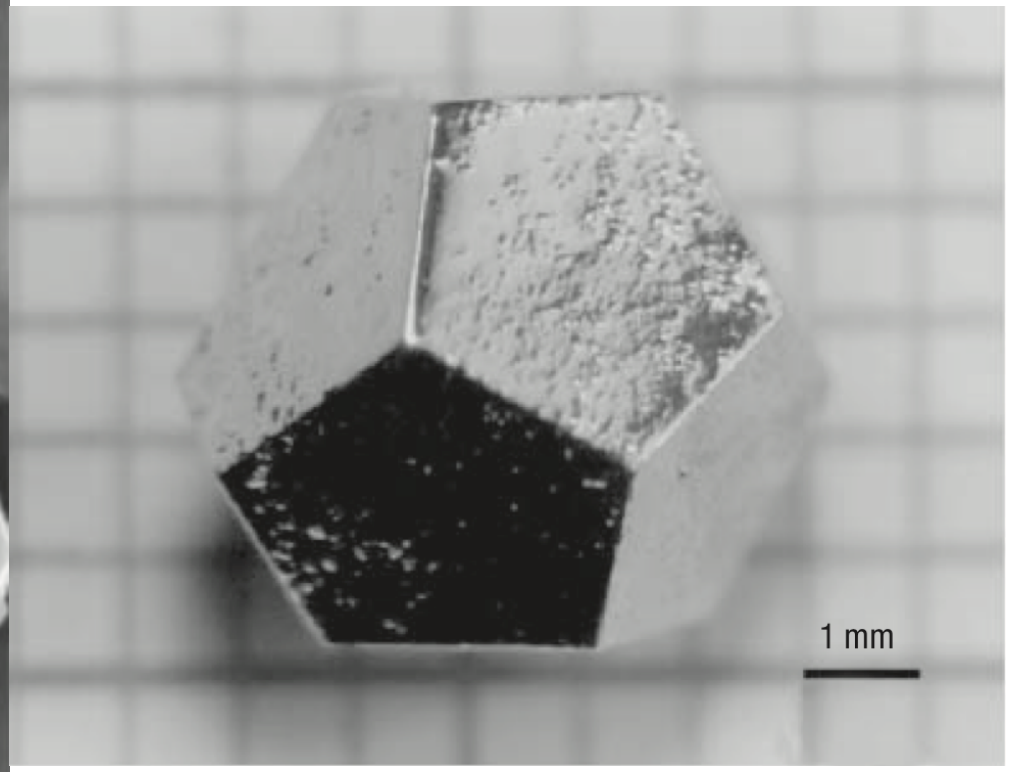
Box 6 *Inflation rule for the octagonal Ammann-Beenker tiling*




Multiple-shell icosahedral atomic cluster
+
+



Al-Mn Isokaeder
mit Elektronenmikroskop



Zn_56.8 Mg_34.6 Ho_8.7 Dodekaeder

Quellen

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