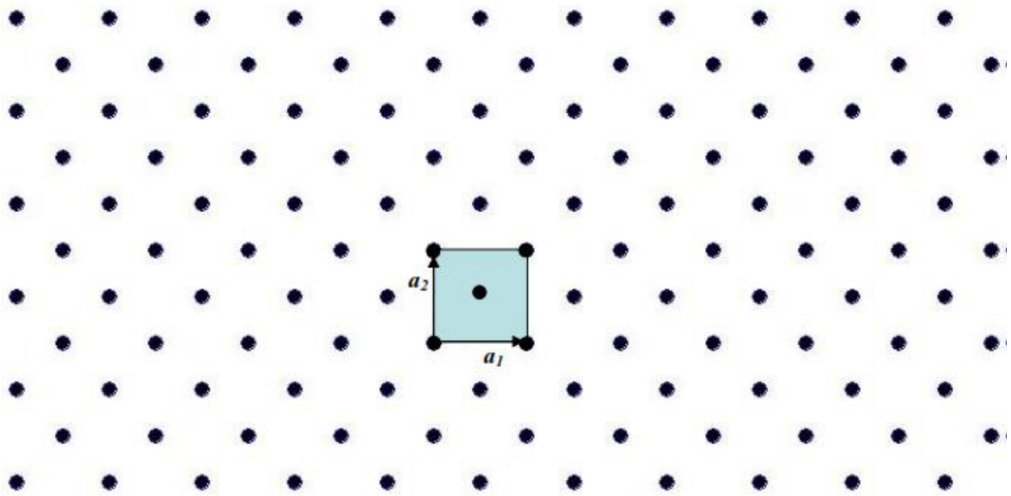
UNIVERSITÄT SIEGEN

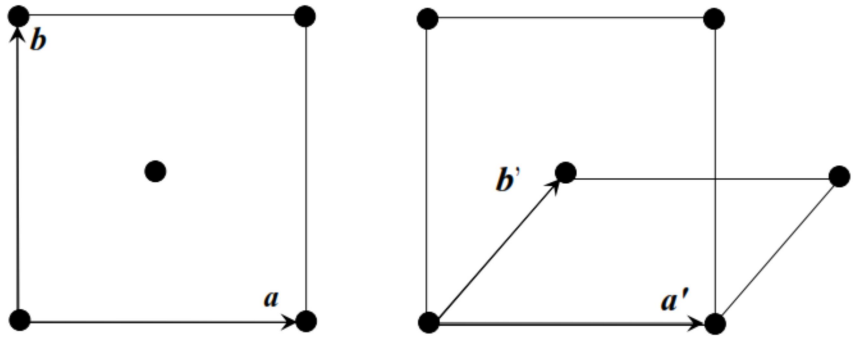
FESTKÖRPERPHYSIK

6. Homework "Symmetry of crystal lattice, 2D crystal system, 2D Bravais lattice"

1. 2D lattice has two basis vectors $\mathbf{a}_1$ and $\mathbf{a}_2$ (see figure below). These vectors have the same size and the angle of 90° in betweeen. The unit cell is non-primitive and contains an additional lattice point at the [1/2 1/2] position. Which type of a lattice is depicted in the figure, explain why this lattice cannot be a new type of Bravais lattice (No. 6) ?



2. The 2D Bravais lattice (*the centered-rectangular lattice*) can be constructed using the basis vectors of the primitive and non-primitive unit cell accordingly. The basis vector of the primitive unit cell is **a'** = **a**, **b'** = 1/2**a** + 1/2**b** (see figure below). Find the relation between their reciprocal vectors **a***, **b*** and **a'***, **b'***.



3. Find a type of Bravais lattice using the *Minkowski algorithm* to reduce lattice vectors. The initial vectors $\mathbf{A}_1$, $\mathbf{A}_2$ and α angle have the following values:

a) $|\mathbf{A}_1|=1$, $|\mathbf{A}_2|=1.6125$, $\alpha=7.125°$
b) $|\mathbf{A}_1|=1$, $|\mathbf{A}_2|=2.0276$, $\alpha=170.53°$
c) $|\mathbf{A}_1|=1$, $|\mathbf{A}_2|=1.5275$, $\alpha=169.100°$

4. A crystal has the following symmetry elements:

a) a 2-fold axis $\parallel \mathbf{e}_1$ and a 4-fold rotoinversion axis $\parallel \mathbf{e}_3$
b) a *2-fold axis* $\parallel \mathbf{e}_1$ and a *2-fold axis* $\parallel \mathbf{e}_3$

Find the **complete** symmetry group (all possible symmetry elements) of this crystal.