Exercises for the lecture:
"Experimental physics 5c, Condensed matter physics"
Winter semester 2019/20
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Exercise sheet # 3
Group A: Monday 13-14, Lorentz-Room
Group B: Tuesday 10-11, Seminar room A
Group C: Wednesday 10-11, Galilei-Room
Group D: Friday 14-15 Seminar room 1 KP

Issued: 29/10/2019
Due: 04/11/2019, 12:00 p.m.
Mailbox No. 23 in the physics building

Exercise 7 (2+2P)

For a primitive lattice, defined by its primitive vectors $\vec{a}, \vec{b}, \vec{c}$, its reciprocal lattice can be defined by the vectors:

$$\vec{A} = 2\pi \cdot \frac{\vec{b}\times\vec{c}}{\vec{a}\cdot(\vec{b}\times\vec{c})},\ \vec{B} = 2\pi \cdot \frac{\vec{c}\times\vec{a}}{\vec{b}\cdot(\vec{c}\times\vec{a})},\ \vec{C} = 2\pi \cdot \frac{\vec{a}\times\vec{b}}{\vec{c}\cdot(\vec{a}\times\vec{b})}$$

a) Show that the reciprocal lattice of the reciprocal lattice is again the original lattice. Is this also true, if $\vec{a}, \vec{b}, \vec{c}$ are not perpendicular?

b) Calculate the reciprocal lattice for an fcc-lattice with the lattice constant a.
Advice: Use the primitive rhombohedral lattice of the fcc-structure.

Exercise 8 (2P)

Show that the angle between any two of the bonds joining a site of the diamond lattice to its four nearest neighbors is given by $\theta = \cos^{-1}(-\frac{1}{3}) \approx 109.5°$.

Exercise 9 (2+2P)

Iron transforms from bcc to fcc at about 1000 K (martensitic transformation).
a) Assuming that the density remains constant during this transition, find the lattice constant a_{fcc} of the fcc phase, given that $a_{bcc} = 2.87$ Å in the bcc phase.
b)What is the ratio $\frac{d_{nn,fcc}}{d_{nn,bcc}}$ of the nearest-neighbor distances?