Fachbereich C – Mathematik und Naturwissenschaften
– Physik –

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Theoretical Solid State Physics, WS 08/09

5th practice sheet

Closing date: 20.11.2008, at 12:00 into the PO Box

12. **Van-Hove singularities (12 points)**

The density of states $D_n(E)$ of the n-th energy band is given by

$$D_n(E) = \frac{1}{(2\pi)^3} \int\limits_{E_n(\vec{k})=E} \frac{dS}{|\nabla_{\vec{k}} E_n(\vec{k})|}. \tag{1}$$

The total density of states is the sum over all band indices n. Analyse the different types of singularities. Expand the energies close to the critical point $E_0 = \Delta/2$:

$$E_n(\vec{k}) \approx E_0 + \left(\frac{k_1^2}{2m_{1n}^*} + \frac{k_2^2}{2m_{2n}^*} + \frac{k_3^2}{2m_{3n}^*} \right) + O(k^4), \tag{2}$$

and discuss the four different cases of relative signs of $1/2m_{jn}^*$, $j = 1, 2, 3$.

13. **Band structure of bcc lattices in Tight-Binding-Approximation (6 points)**

Consider a base-centered cubic lattice with a one-atomic basis. Calculate the band structure in Tight-Binding-Approximation taking only the s-states and the matrix elements of nearest neighbours into account.