The Most Relevant Lattices in S.C Physics

fcc | bcc | hexagonal

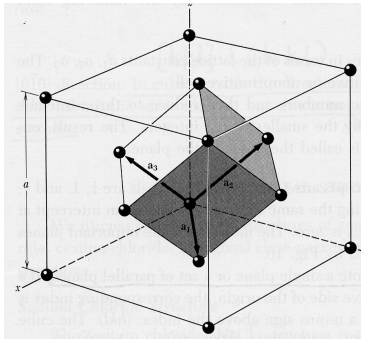
real space

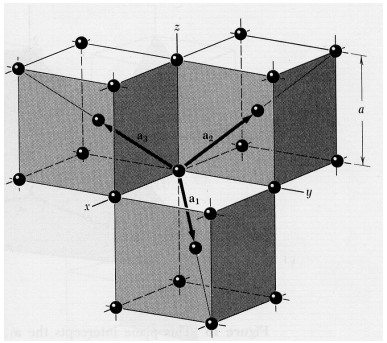
alternative notation:

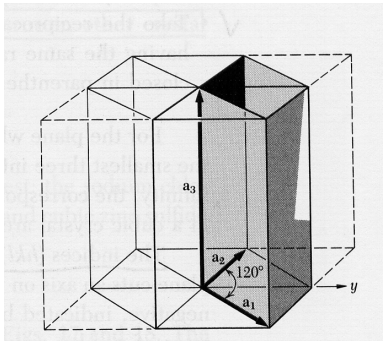
$\vec{a}_1 = \vec{a}$

$\vec{a}_2 = \vec{b}$

$\vec{a}_3 = \vec{c}$







reciprocal space

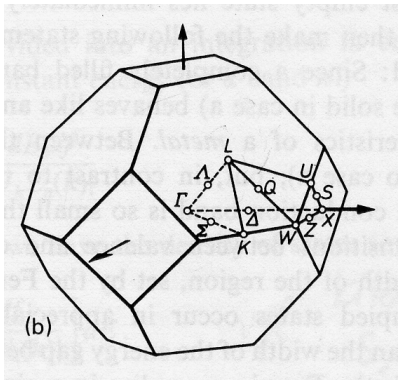
same, rotated

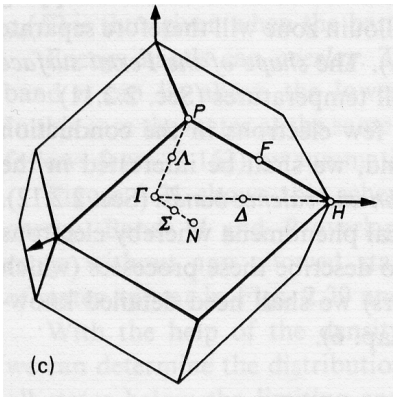
but by 60°

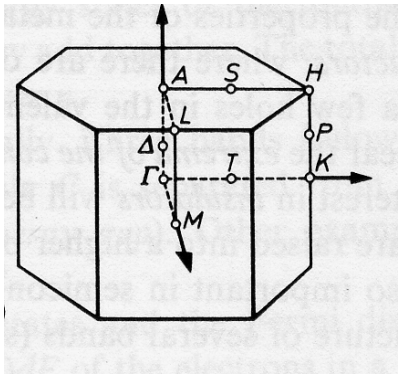
$\vec{A} = 2\pi \frac{\vec{b} \times \vec{c}}{\vec{a} \cdot (\vec{b} \times \vec{c})}$

+... cylcic permutations

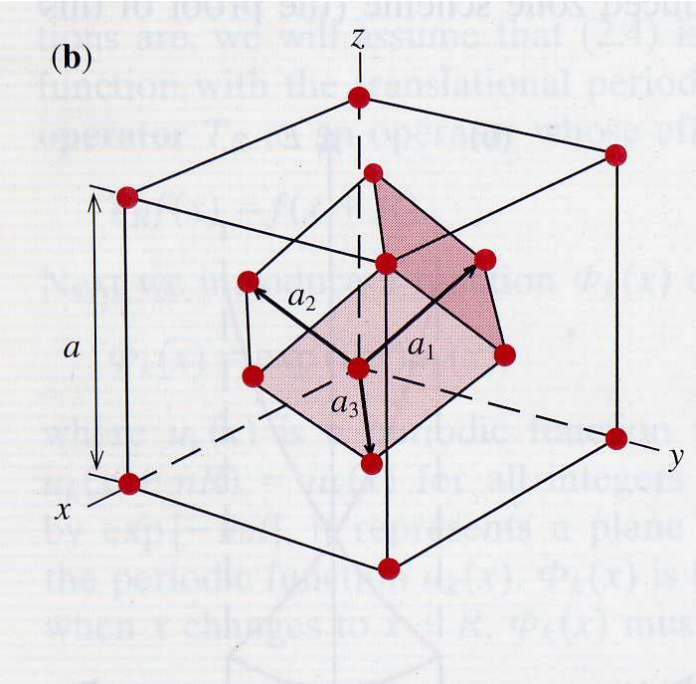
(1.) Brillouin zone

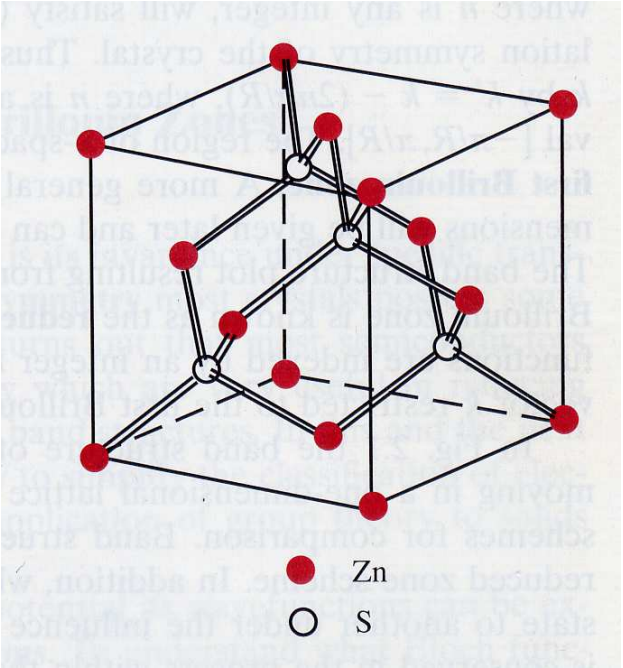






Caveat: Note the Difference!!





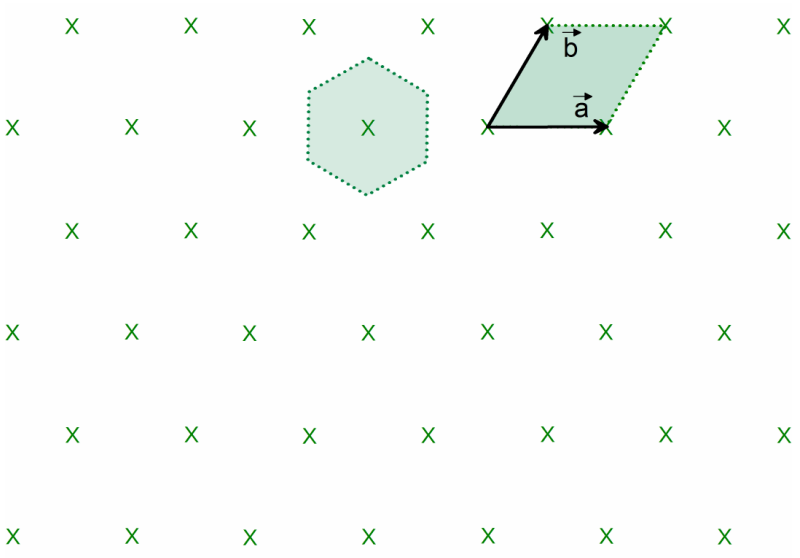
Lattice points…

… and atoms

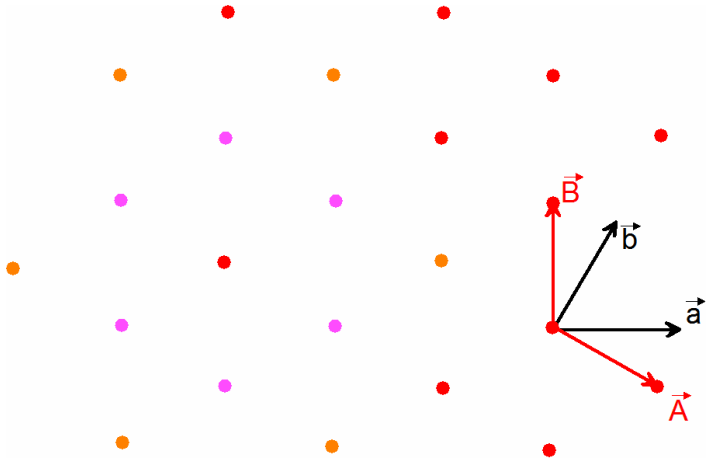
of the zincblende crystal structure

Lattice & Brillouin Zone of the 2d-Hexagonal Lattice

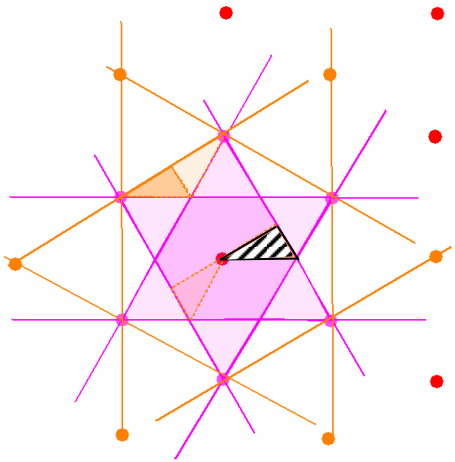
real space lattice



reciprocal lattice



BZ construction

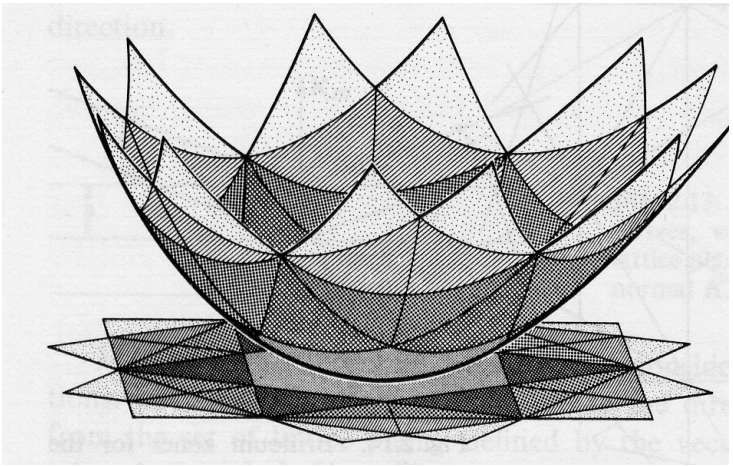


Find the smallest volume (here area) that covers exactly the (1.) BZ when all the symmetry operations of the point group (here 6 rotations and 6 reflections) are applied on it. This part is called the

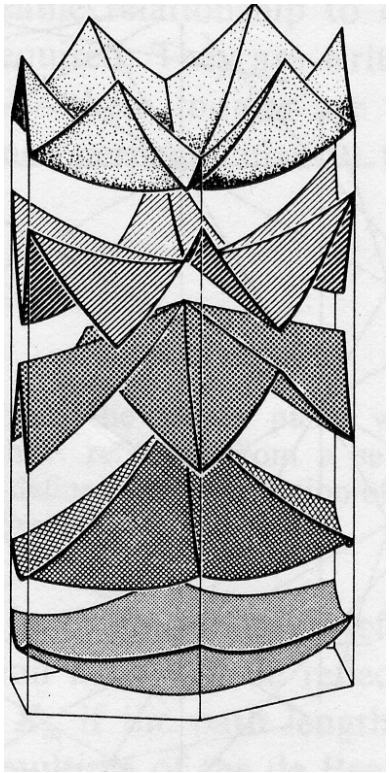
irreducible part of the BZ: 

in the rest of the BZ, the energy and the wave functions of the Bloch states can be deduced from that part exclusively by symmetry arguments!

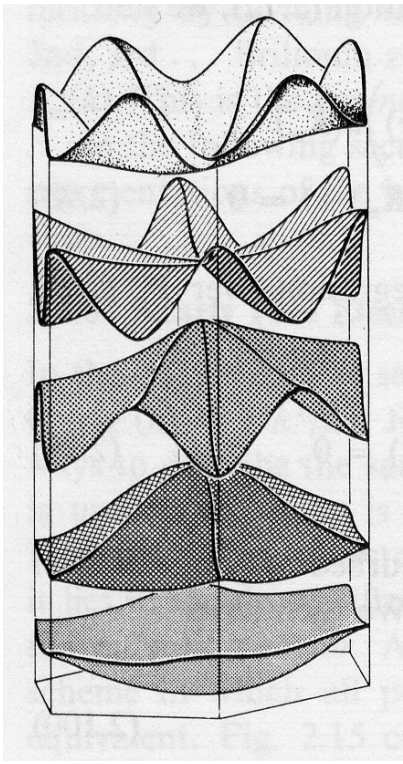
The Band Structure of the 2d-Hexagonal Lattice



NFE band structure
in the extended zone
scheme

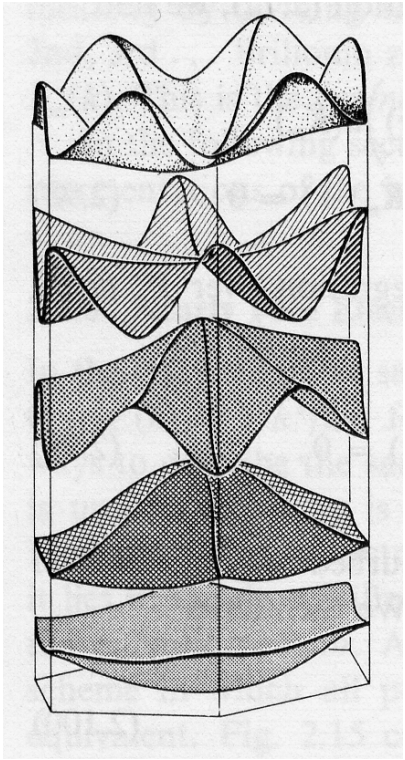


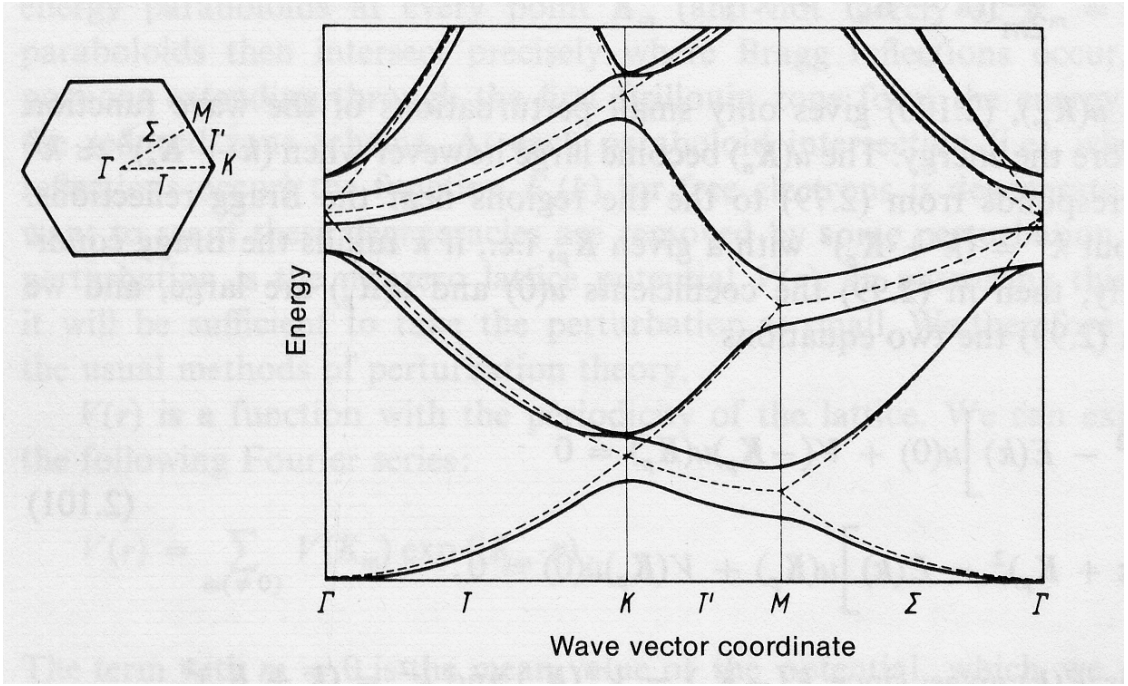
reduced to the first
Brillouin zone (and
offset for clarity).



with finite periodic
potential included.

The Band Structure of the 2d-Hexagonal Lattice





projection along
high symmetry
lines

The Band Structure of the 2d-Hexagonal Lattice