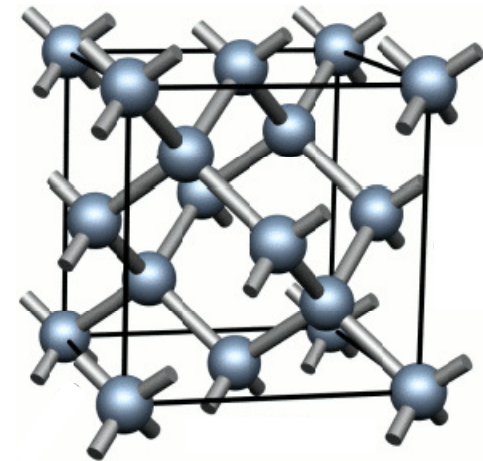
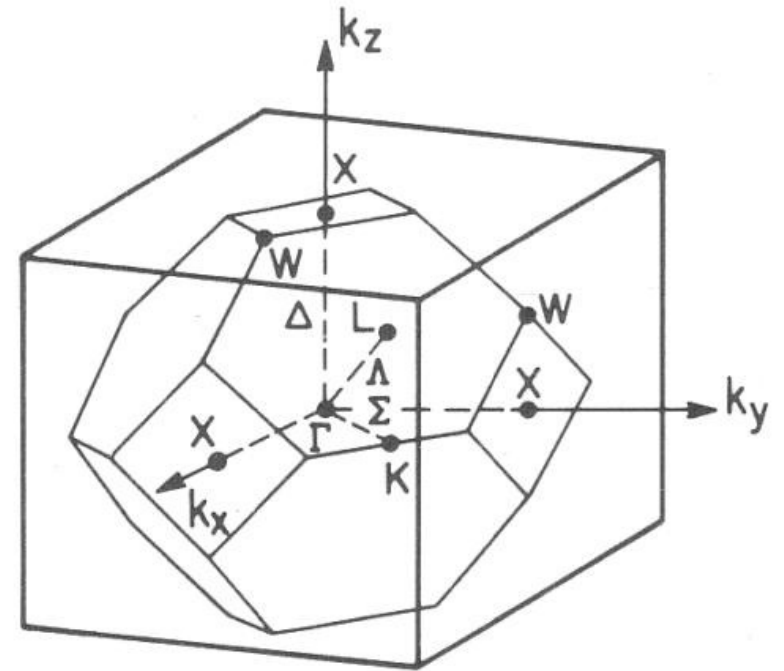
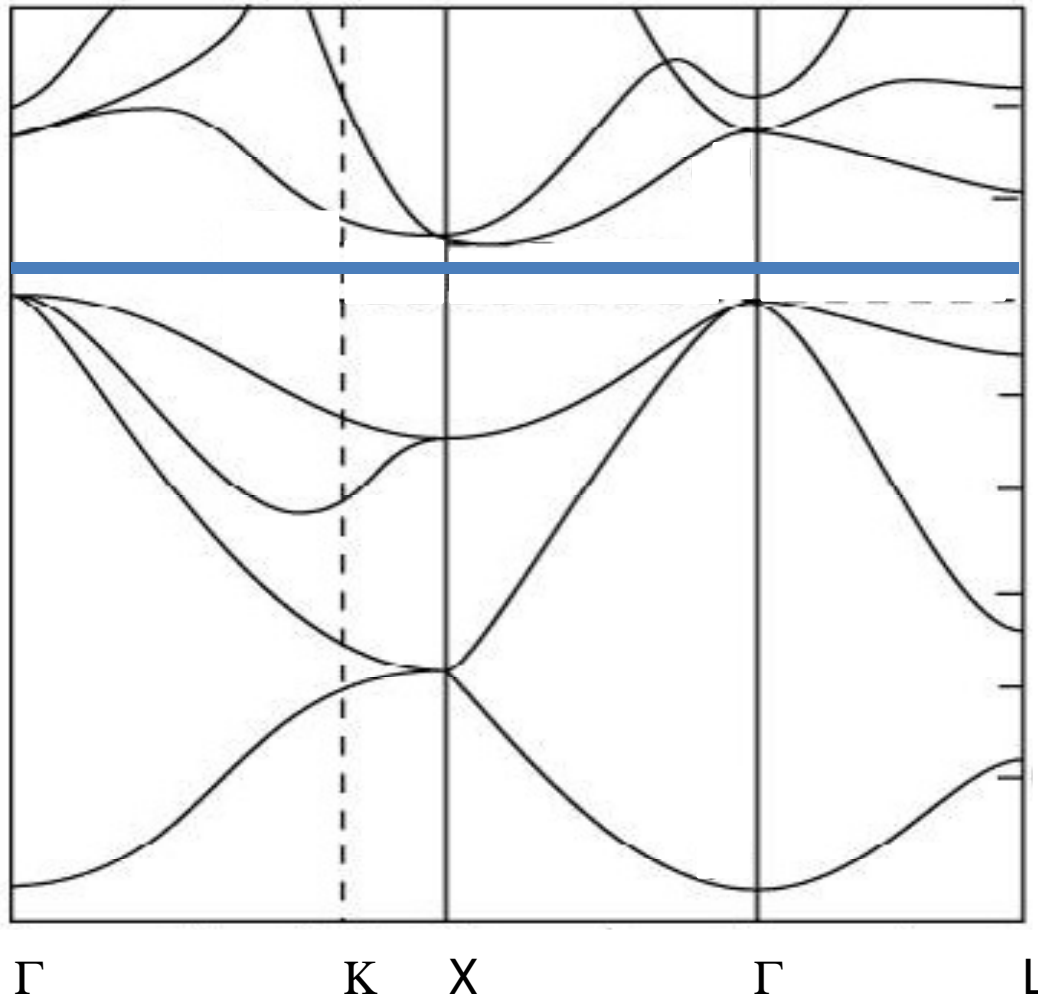


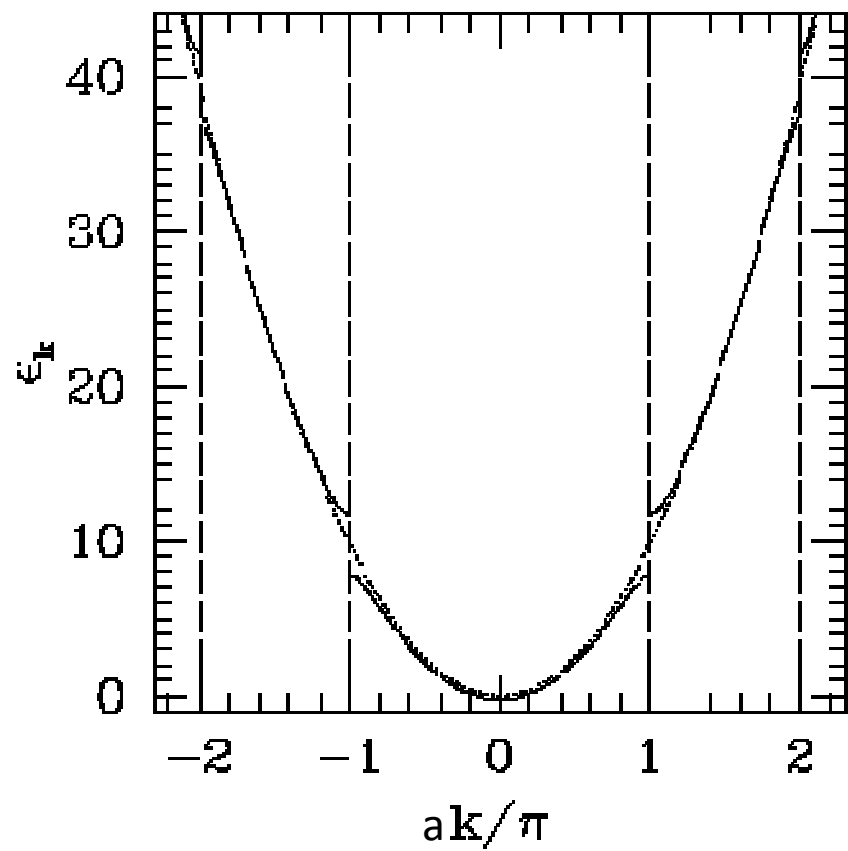
Slides  
Condensed Matter Physics  
Lecture 16

Silicon = FCC with a 2-atom basis  
 Si @  $[0,0,0]$  and Si @  $[\frac{1}{4}, \frac{1}{4}, \frac{1}{4}]$

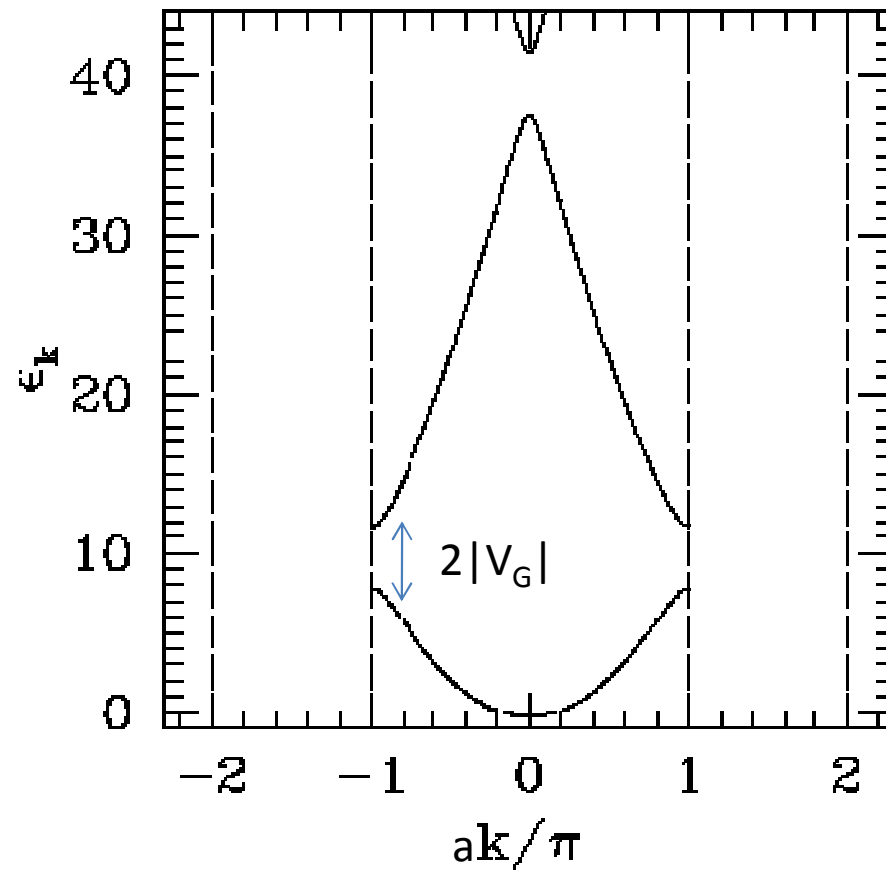


Si has valence = 4

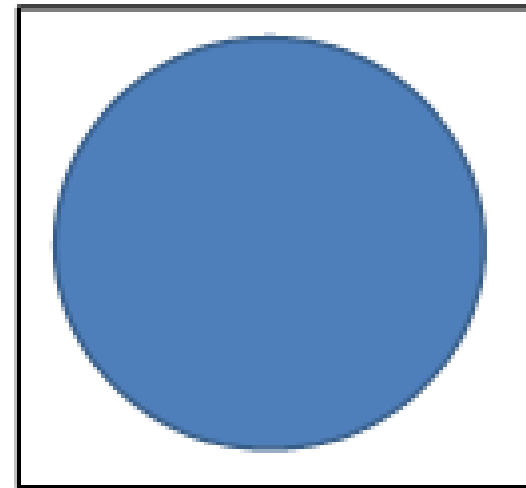
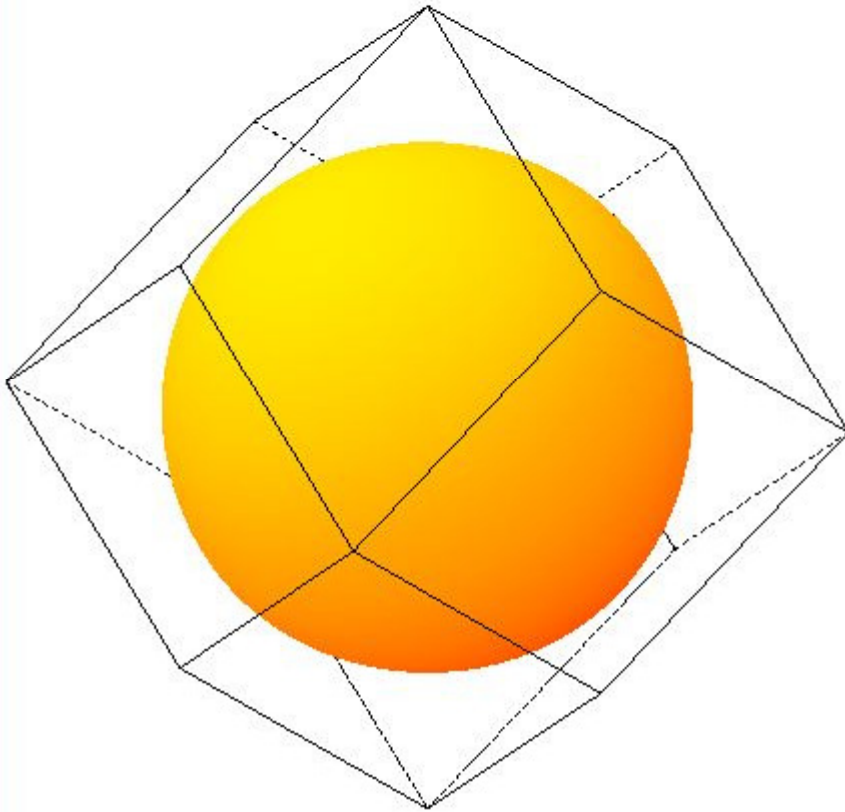
d=1 extended zone



d=1 reduced zone



Na  
bcc a=7.98au  
1st band  
electron Fermi surface  
Fermi surface  
file name: na1-1f.gif



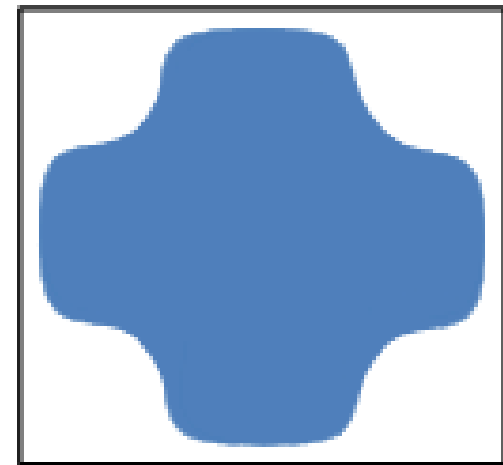
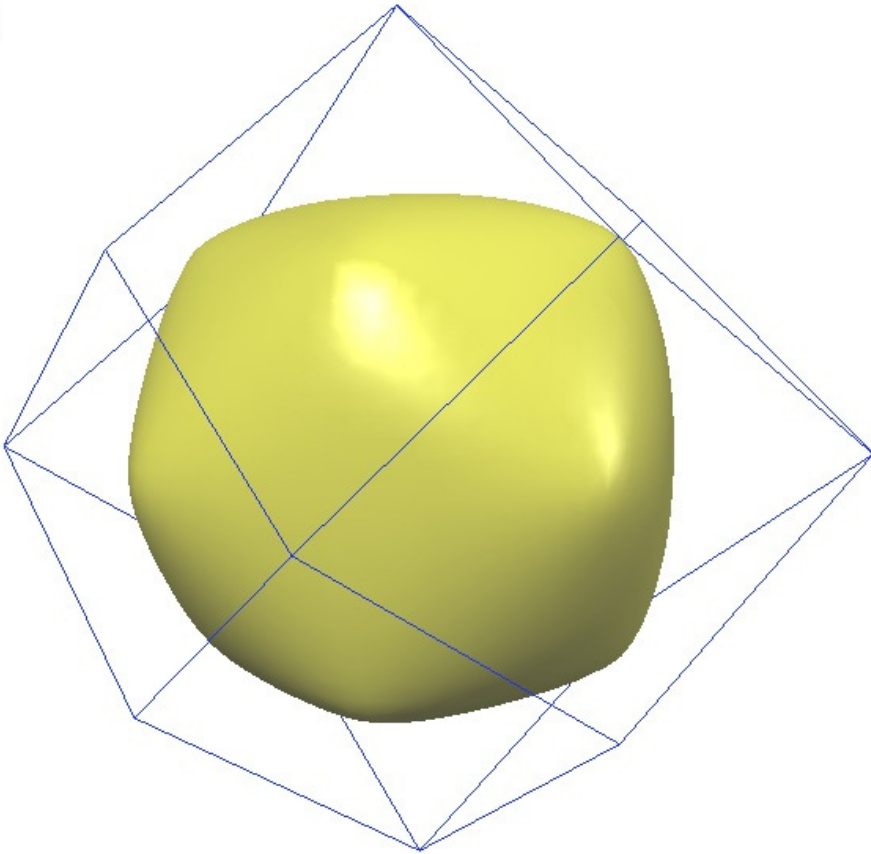
2d analogue

Fermi Surface of Sodium (BCC)

Monovalent = Half-Filled Brillouin Zone

Li  
bcc a=6.59au  
1st band  
electron Fermi surface  
Fermi surface  
file name: li1-1f.gif

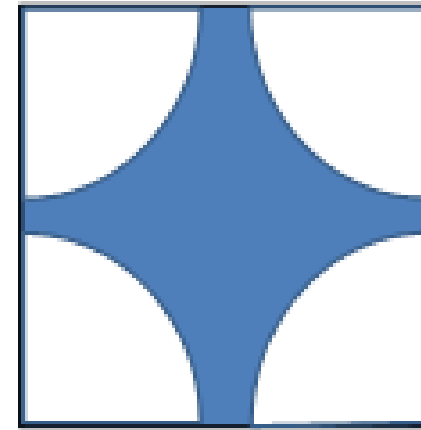
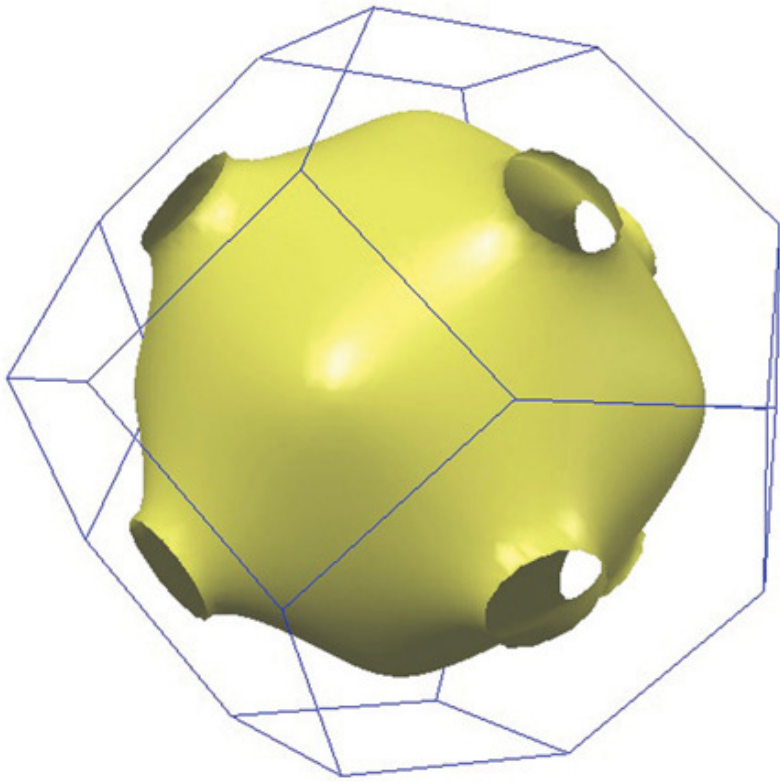
Li



2d analogue

Fermi Surface of Lithium (BCC)

Monovalent = Half-Filled Brillouin Zone



2d analogue

Fermi Surface of Copper (FCC)

Monovalent = Half-Filled Brillouin Zone



No periodic Potential  
 Divalent=  
 Enough electrons  
 To fill 1<sup>st</sup> zone



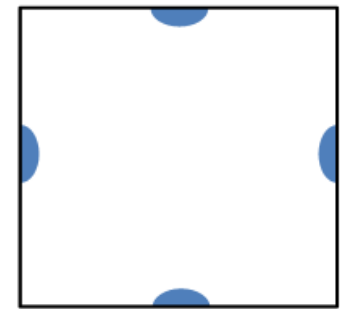
with strong periodic potential – 1<sup>st</sup> BZ exactly filled (insulator)



with weak periodic potential

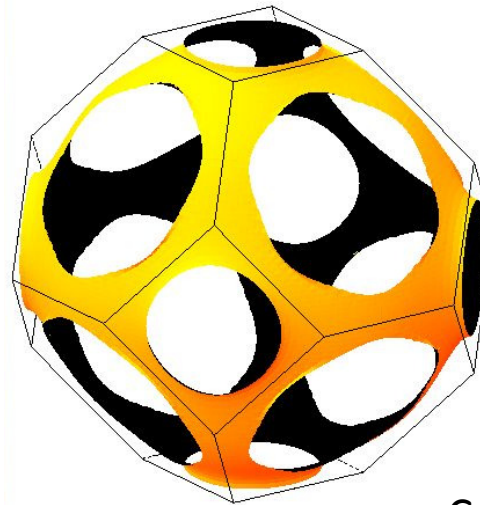


weak potential  
 Lowest Band  
 (in 1<sup>st</sup> BZ)



2<sup>nd</sup> band

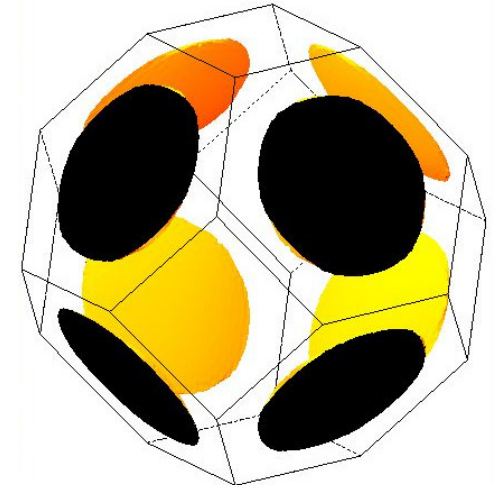
Ca  
 fcc a=10.53au  
 1st band  
 electron Fermi surface  
 Fermi surface  
 file name: ca1-1f.gif



1<sup>st</sup> band

Analogue

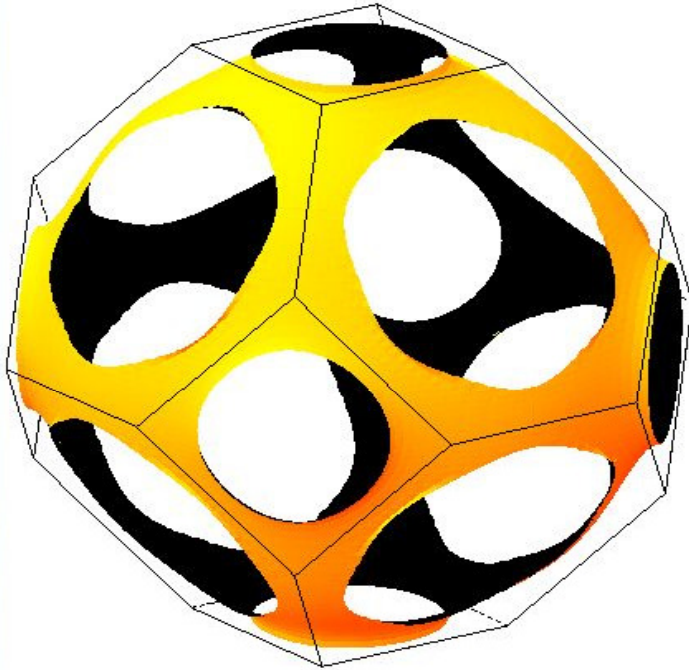
2nd band  
 electron Fermi surface  
 Fermi surface  
 file name: ca1-2f.gif



Calcium FCC  
 (Divalent)

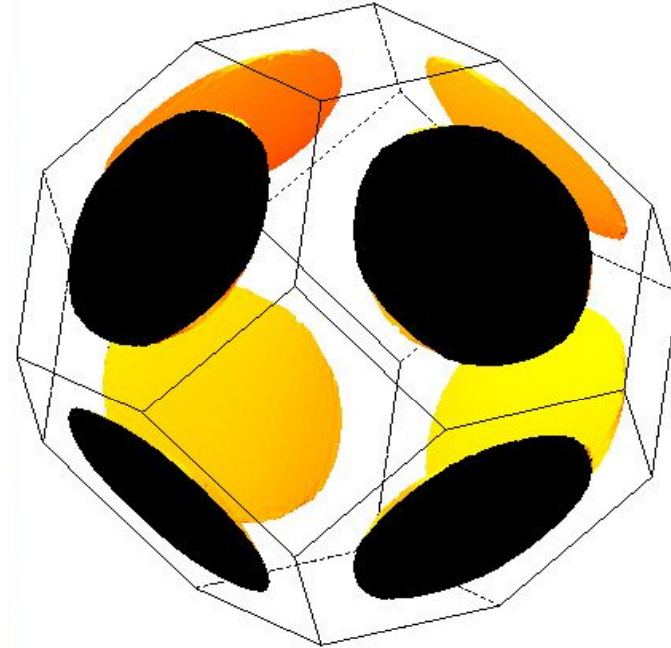
2<sup>nd</sup> band

Ca  
fcc a=10.53au  
1st band  
electron Fermi surface  
Fermi surface  
file name: ca1-1f.gif



1<sup>st</sup> band

Ca  
fcc a=10.53au  
2nd band  
electron Fermi surface  
Fermi surface  
file name: ca1-2f.gif



2<sup>nd</sup> band

Calcium FCC  
(Divalent)





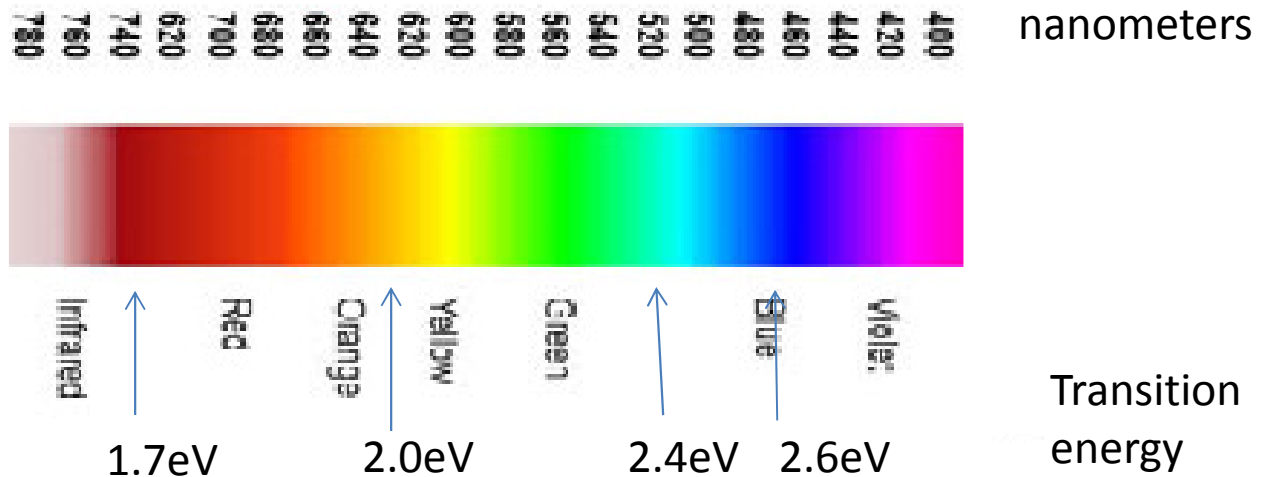
Cinnabar (HgS)  
Gap = 2.0 eV

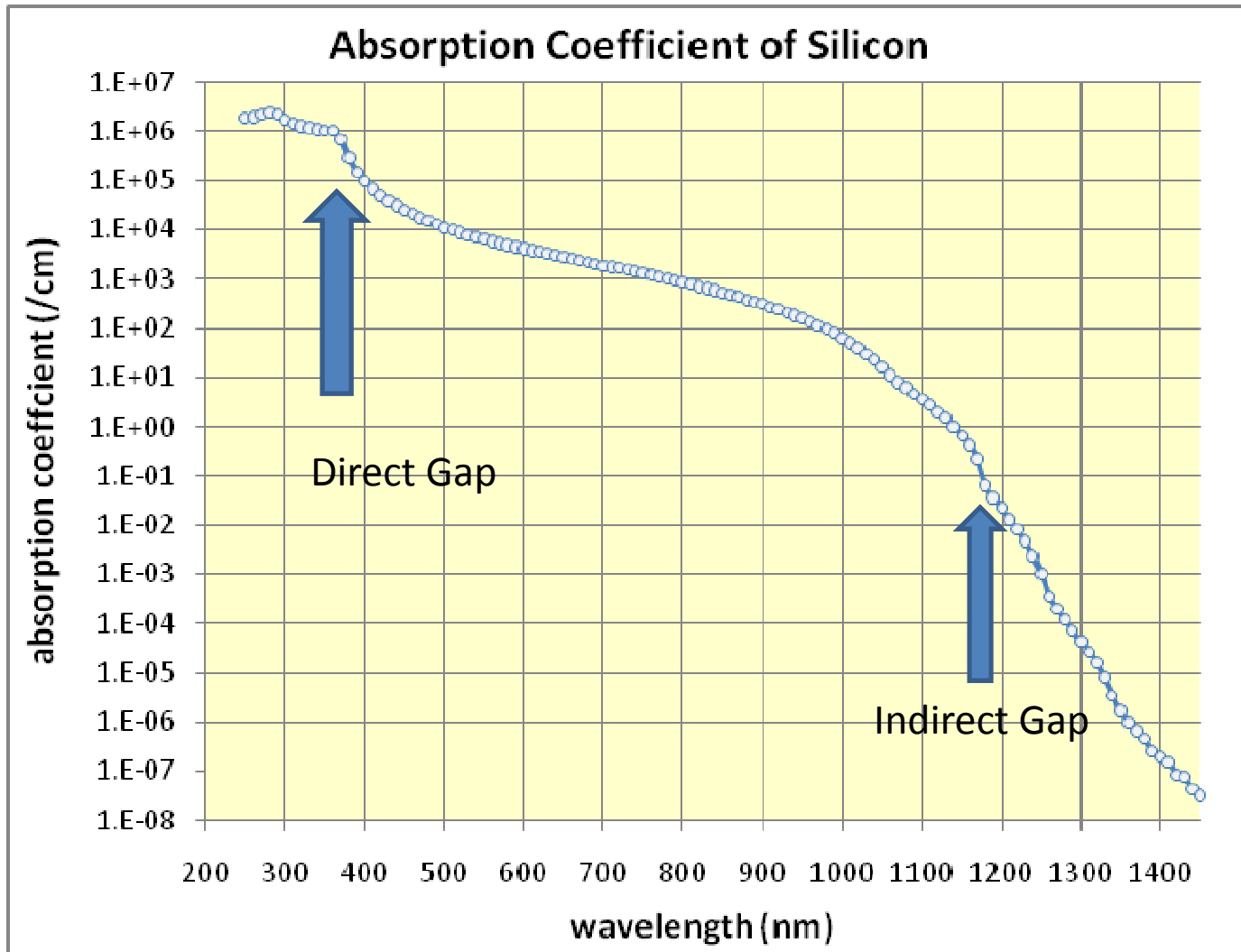


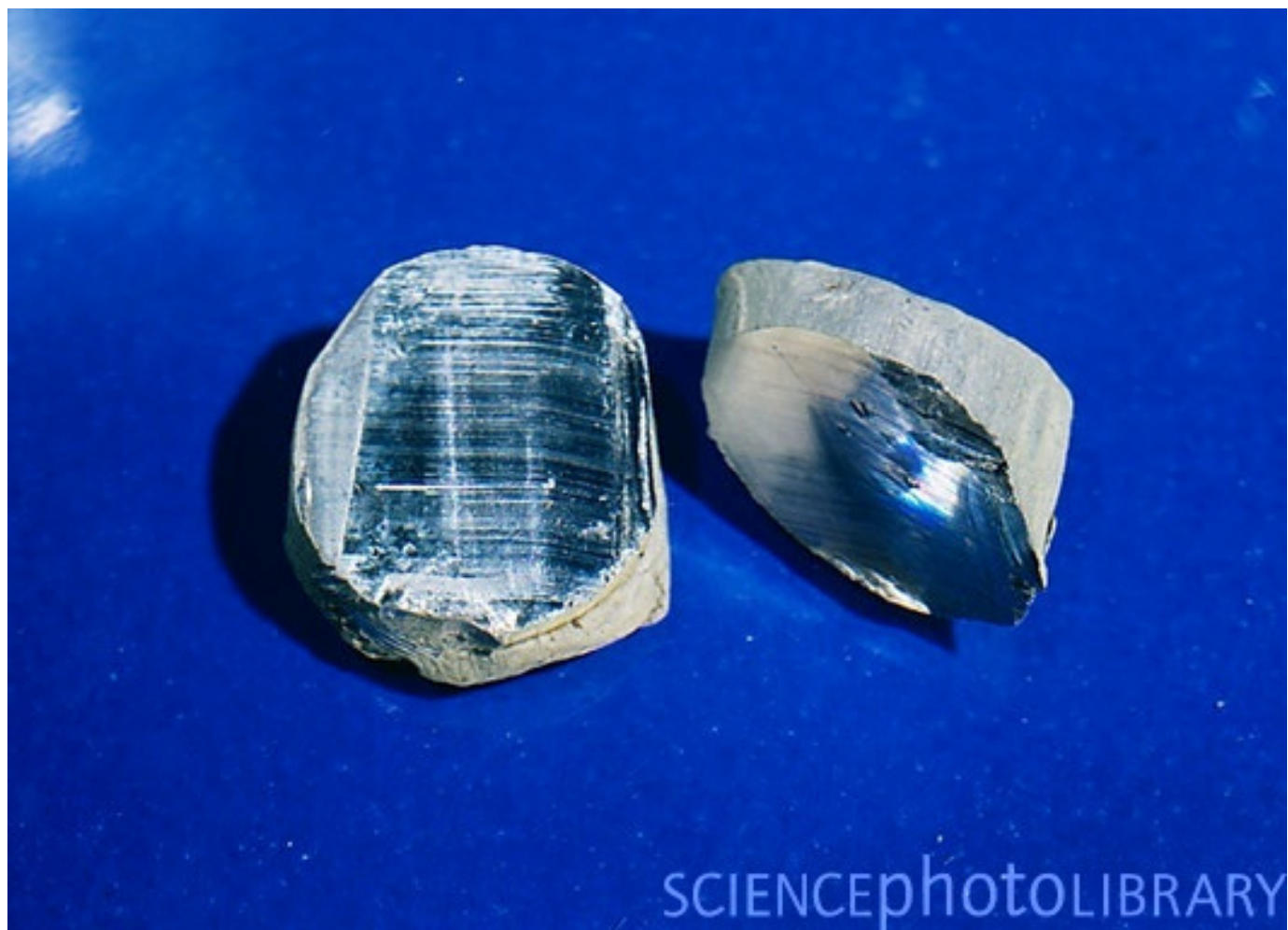
Realgar (As<sub>4</sub>S<sub>4</sub>)  
Gap = 2.4 eV



Sulfur  
Gap = 2.6 eV







Freshly cut sodium



Hope Diamond (Blue)  
Roughly 1 Boron impurity per  $10^7$  carbon.  
Estimated current value = 250 Million \$



Tiffany Diamond (Yellow)  
Roughly 1 Nitrogen impurity per  $10^6$  carbon.

Estimated value 12 Million\$ (1983)



Synthetic Diamonds =

“Cheap” and any impurities  
you want. (this example is  
clear meaning no impurities)