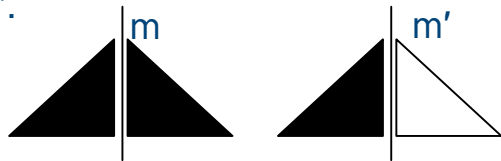


Assignment 2: Due Tuesday Jan 29th

1. Explain a , n and d glides in 3D crystals using sketches.
2. Cubic cells always have a -3 or 3 in the space group label. What is the -3 symmetry element in a cube.
3. Sketch the following structures as sections along different heights: (a) hcp along the c direction and fcc along the body diagonal.
4. What kind of a unit cell is obtained if one of the axis (the c) of an close packed fcc cell is elongated to give a tetragonal cell. Try and guess the space group. Remember to look for more compact unit cells in the a - b plane as well.
5. In addition to normal symmetry operations, Shubnikov has described elements of *color* symmetry. For example, the mirror m' would take a black object and reflect it to a white one as shown below. Sketch 2D objects with the following symmetries: (i) $4mm$ (ii) $4'm'm'$ (iii) $2m'm'$ (iv) $6'$.



6. Color could represent a physical property such as spin (black = spin up and white = spin down). Can you sketch an object with $3'$ symmetry. What does this say about spins at the corners of a triangle ?
7. Calculate the efficiency of packing in the diamond structure. Remember that there are 8 atoms in the cell, and that the atom at $(0,0,0)$ touches the atom at $(1/4,1/4,1/4)$.
8. Sketch the following structure in sections, and in "3D", and determine the coordination of each atom (how many neighbors, and at what distance):
 Cu_3Au , $Pm-3m$, $a = 3.74 \text{ \AA}$, Cu at $(\frac{1}{2}, \frac{1}{2}, 0)$ and Au at $(0,0,0)$
9. Use VESTA to draw all the structures whose data have been presented to you (from α -Po to ...)