Texture Component → Pole Figure

- To calculate where a texture component shows up in a pole figure, there are various operations that must be performed.
- The key concept is that of thinking of the pole figure as a set of crystal plane normals (e.g. {100}, or {111}) in the reference configuration ("cube component") and applying the orientation as a *transformation* to that pole (or set of poles) to find its position with respect to the sample frame.
- *Step 1*: write the crystallographic pole (plane normal) of interest as a unit vector;
  e.g. $(111) = 1/\sqrt{3}(1,1,1) = \mathbf{h}$. In general, you will repeat this for all symmetrically equivalent poles (so for cubics, one would also calculate {-1,1,1}, {1,-1,1} etc.). In the future, we will use a set of symmetry operators to obtain all the symmetry related copies of a given pole.
- *Step 2*: apply the inverse transformation (passive rotation), g^{-1}, to obtain the coordinates of the pole (Miller indices, normalized, crystal axes) in the pole figure (direction in sample axes):
  $\mathbf{h'} = g^{-1}\mathbf{h}$
  (pre-multiply the vector by, e.g. the transpose of the orientation matrix, g, that represents the orientation; Rodrigues vectors or unit quaternions can also be used).
- *Step 3*: convert the rotated pole into spherical angles (to help visualize the result, and to simplify Step 4) where Θ is the co-latitude and ϕ is the longitude:
  $\Theta = \cos^{-1}(h'_z)$, $\phi = \tan^{-1}(h'_y/h'_x)$.
  Remember - use $\mathrm{ATAN2}(h'_y, h'_x)$ in your program or spreadsheet and be careful about the order of the arguments!
- *Step 4*: project the pole onto a point, $\mathbf{p}$, in the plane (stereographic or equal-area):
  $p_x = \tan(\Theta/2)\cos\phi$; $p_y = \tan(\Theta/2)\sin\phi$. *[corrected sine and cosine for p_y and p_x components 25 i 08]*
  The previous slide explains where this formula comes from.
- Note: why do we use the inverse transformation (passive rotation)?! One way to understand this is to recall that the orientation is, by convention (in materials science), written as an axis transformation from sample axes to crystal axes. To construct a pole figure, we need to transform a known crystal direction (i.e. the plane normal) to the sample frame so that we know its coefficients in the latter system.