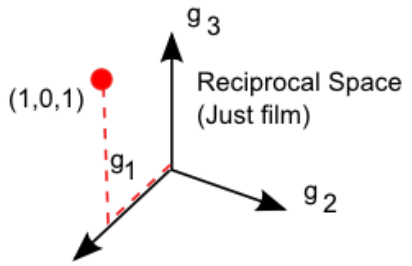
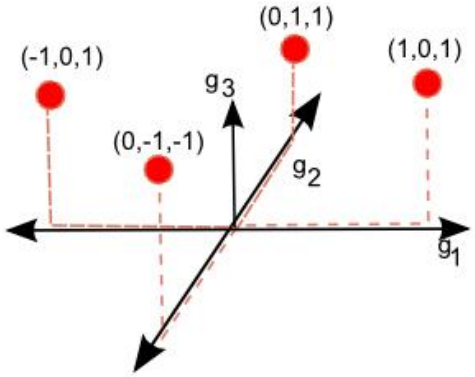
Topic 4-4: Psi Scans

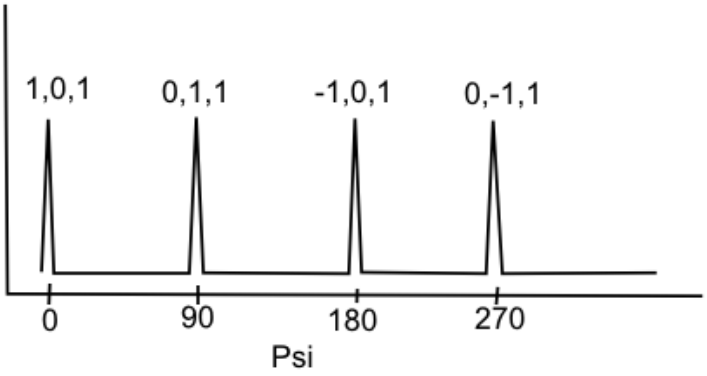
**Summary:** In the last video we could measure the out-of-plane alignment but could get no in plane alignment information. In this video we discuss psi scans as a way to measure the in plane alignment; that is the say the slight rotation of the crystals, in a 2D plane, relative to one another.

- Ψ-scans- rotate the sample about its normal and allow for characterization of the in plane alignment of the film
- Set up source and detector so that Δk lines up with a G vector at a specific h, k, l
- Example: simple cubic film with $\vec{g}_1\ film\ \|\ \vec{g}_1\ substrate$

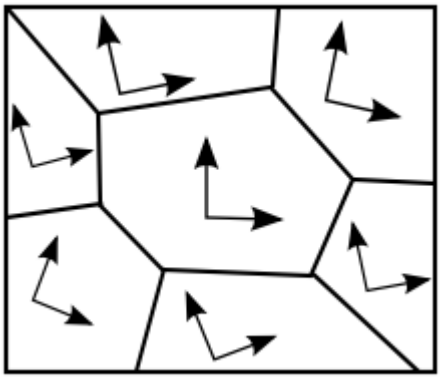



- Align to (1,0,1) shown above
  - Doesn't matter what G vector we align to as long as it is off the sample normal
- Keep Δk fixed, no movement of the source or detector
- Now rotate film about $\vec{g}_3$
  - Get reflections every 90 degrees






- **Practical implication:**
- Look down on thin film, so $\vec{a}_3$is into the page
    - Crystals will have slight rotations in the $\vec{a}_1, \vec{a}_2$ plane as shown in the figure below
    - The arrows in the figure represent the orientation of $\vec{a}_1 \; and \; \vec{a}_2$ for each crystal



- When this happens we will see broadening of the intensity spectrum just like the ω-rocking curve
    - We will again use the full width half maximum to quantify the in plane alignment

Questions to Ponder

1. If you sputter polycrystalline copper onto single crystalline Si what would you see in a ψ-scan?

2. If a ZnO wurtzite film with $\vec{a}_3$ normal to the substrate is created, using the (1,0,1) reflection, how many peaks will you pick up on a ψ-scan?