



Guide

Crystallography Miller indices: Cubic Planes and Directions

Kaitlin Tyler

Ansys Academic Program

education@ansys.com

Summary

This guide was created to help instructors support students learning Cubic Miller Indices. The goal is for students to be able to use this alongside homework assignments.

Detailed steps on how to draw and label directions and planes are included with two different example for each.

This method of identifying and drawing planes and directions is also covered in the Lecture from the Crystallography Teaching Package.

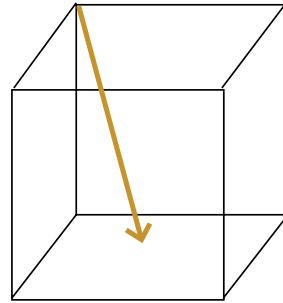
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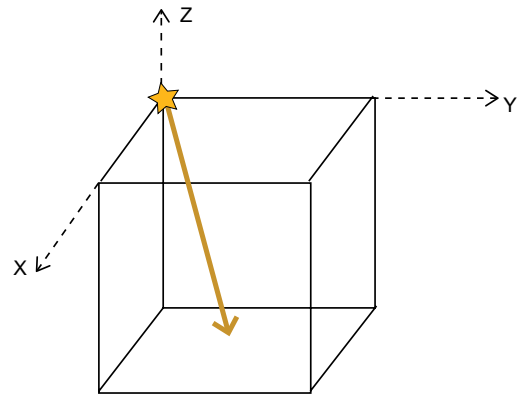
1. How to Label Directions

1.1 Example 1

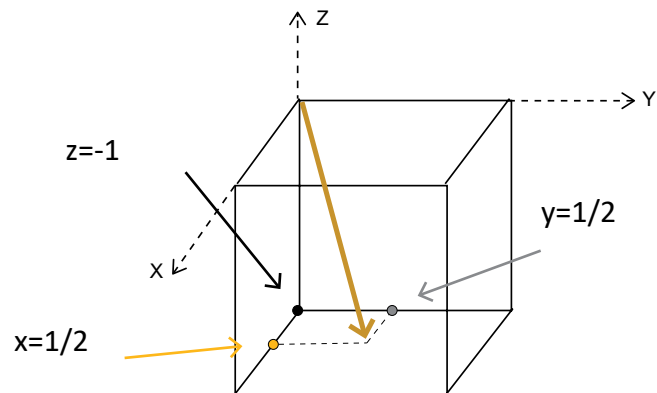
Direction of Interest:



1. Identify the origin of the direction and label origin and axis accordingly



2. Identify intercept coordinates



3. Reduce fractions if necessary

$$x=1/2*2=1$$

$$y=1/2*2=1$$

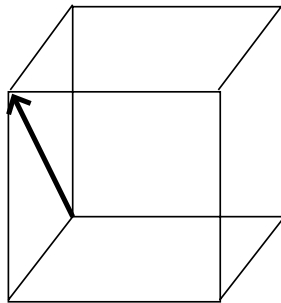
$$z=-1*2=-2$$

4. Label direction with appropriate notation

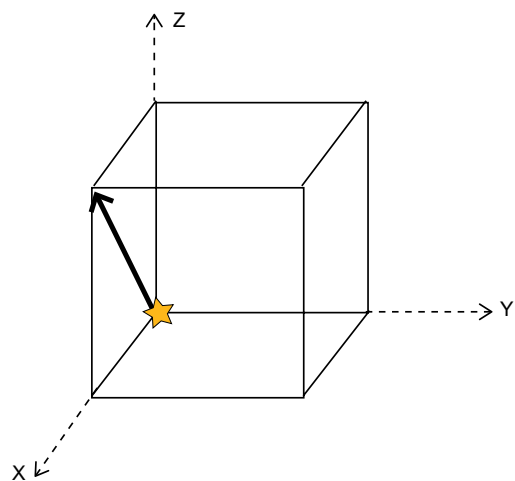
$[11\bar{2}]$

1.2 Example 2

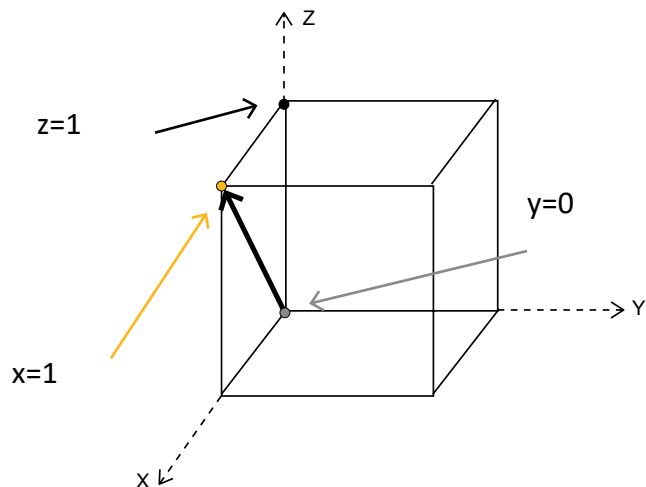
Direction of Interest:



1. Identify the origin of the direction and label origin and axis accordingly



2. Identify intercept coordinates



3. Reduce fractions if necessary

not necessary for this direction

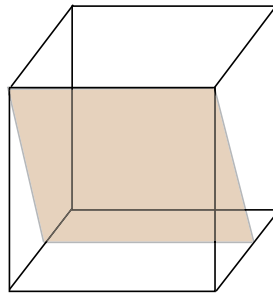
[101]

4. Label direction with appropriate notation

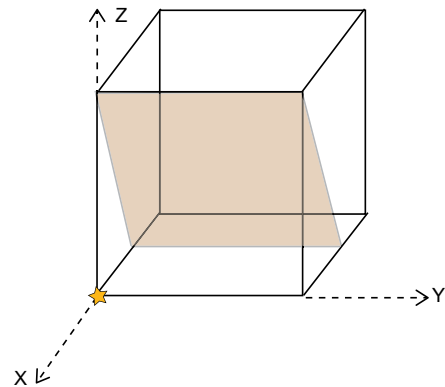
2. How to Label Planes

2.1 Example 1

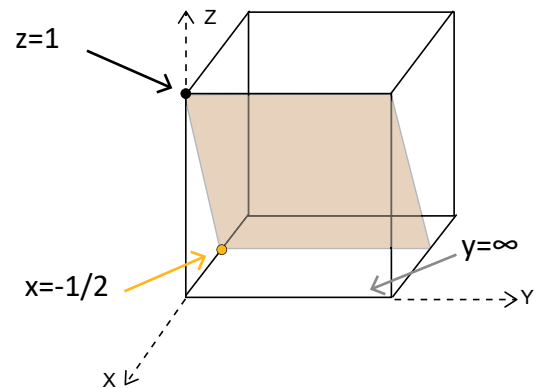
Plane of Interest:



1. Choose origin and label axis *Note: plane cannot pass through the origin



2. Identify intercept for each axis



3. Take the reciprocals of intercepts to get indices

$$x = 1/(-1/2) = -2$$

$$y = 1/\infty = 0$$

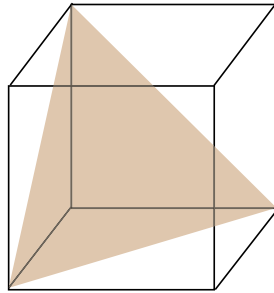
$$z = 1/1 = 1$$

4. Label direction with appropriate notation

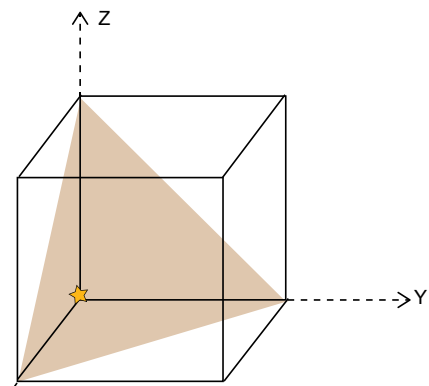
$(\bar{2}01)$

2.2 Example 2

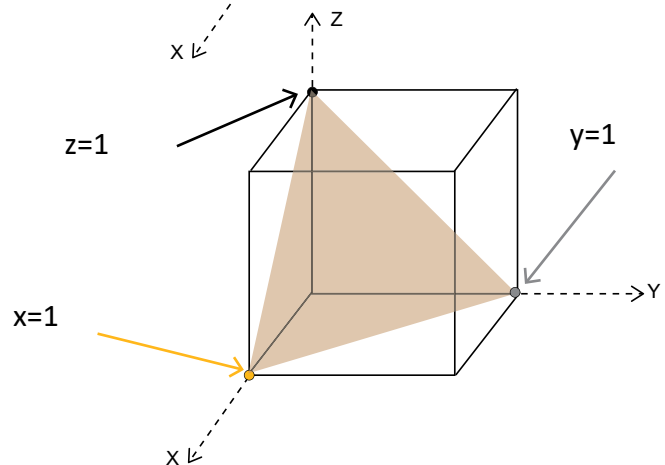
Plane of Interest:



Choose origin and label axis
*Note: plane cannot pass through the origin



2. Identify intercept for each axis



3. Take the reciprocals of intercepts to get indices

$$x=1/1=1$$

$$y=1/1=1$$

$$z=1/1=1$$

4. Label direction with appropriate notation

(111)

3. How to Draw Directions

3.1 Example 1

Direction of Interest: [011]

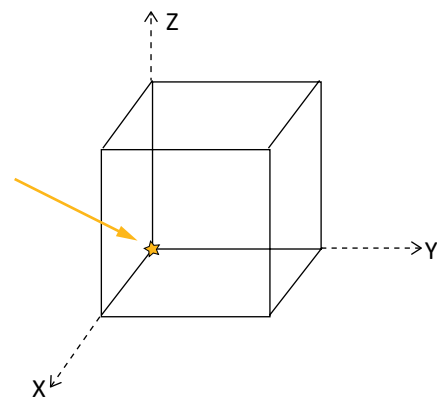
1. Divide indices by highest common denominator (if necessary) to get x,y,z coordinates

$$x = \frac{0}{1} = 0$$

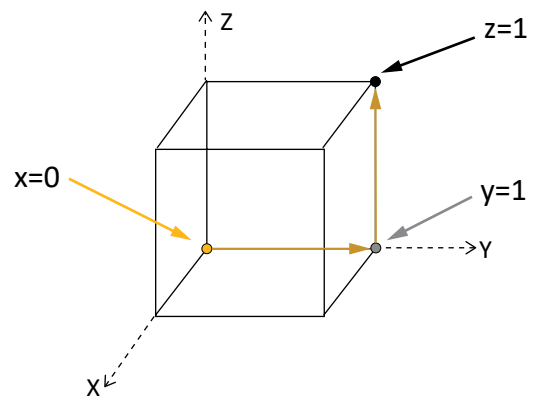
$$[011] \rightarrow y = \frac{1}{1} = 1$$

$$z = \frac{1}{1} = 1$$

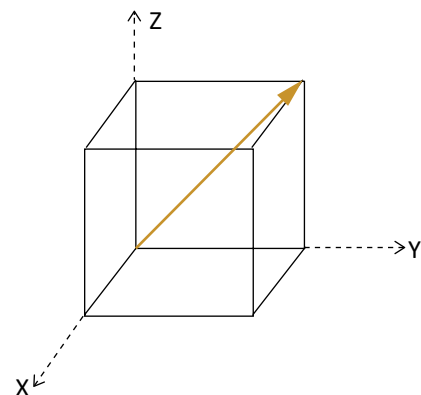
2. Choose origin and label axis on cube based on the sign of the x,y,z coordinates from Step 1



3. Note coordinates on cube and trace to find the end point of the direction



4. Draw direction from origin to end point from Step 3



3.2 Example 2

Direction of Interest: $[\bar{2}10]$

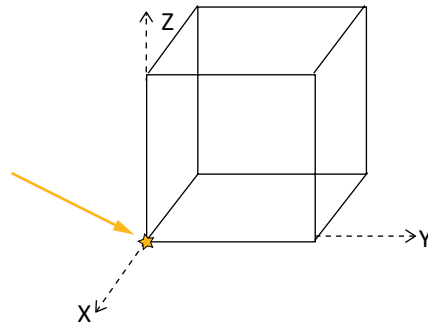
1. Divide indices by highest common denominator (if necessary) to get x,y,z coordinates

$$x = \frac{-2}{2} = -1$$

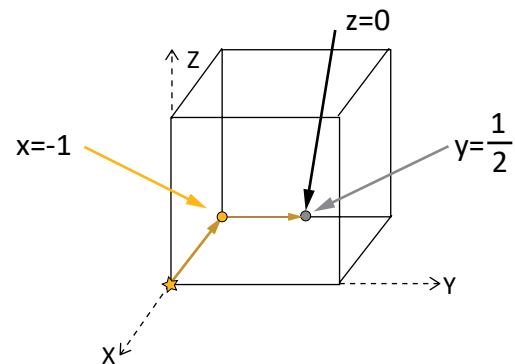
$$[\bar{2}10] \rightarrow y = \frac{1}{2} = \frac{1}{2}$$

$$z = \frac{0}{2} = 0$$

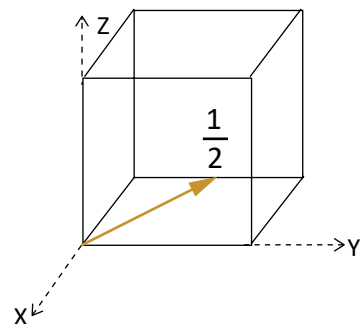
2. Choose origin and label axis on cube based on the sign of the x,y,z coordinates from Step 1



3. Note coordinates on cube and trace to find the end point of the direction



4. Draw direction from origin to end point from Step 3



4. How to Draw Planes

4.1 Example 1

Plane of Interest: (010)

1. Take the reciprocal of each index to find the intercepts. *Note that infinity means the plane is parallel to the axis

$$x = \frac{1}{0} = \infty$$

$$(010) \rightarrow y = \frac{1}{1} = 1$$

$$z = \frac{1}{0} = \infty$$

2. Identify the shape of the plane.

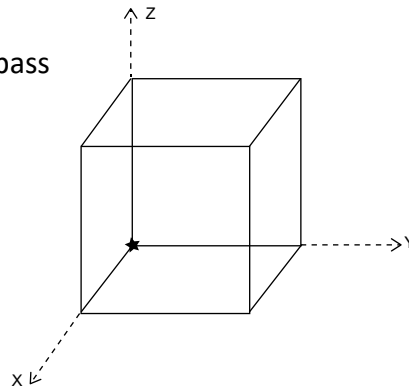
2 infinity intercepts=square

1 infinity intercept= rectangle

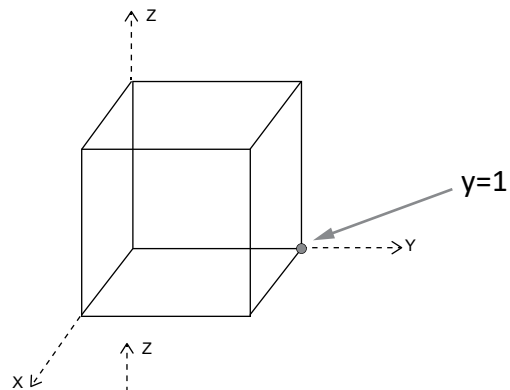
0 infinity intercepts=triangle

Square

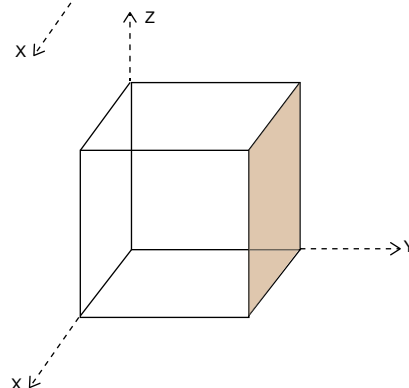
3. Choose origin and label axis based on intercepts and shape. *Note: plane cannot pass through the origin



4. Mark intercepts



5. Draw plane



4.2 Example 2

Plane of Interest: $(2\bar{2}\bar{1})$

1. Take the reciprocal of each index to find the intercepts. *Note that infinity means the plane is parallel to the axis

$$x = \frac{1}{2} = \frac{1}{2}$$

$$(010) \rightarrow y = \frac{1}{2} = \frac{1}{2}$$

$$z = \frac{-1}{1} = -1$$

2. Identify the shape of the plane.

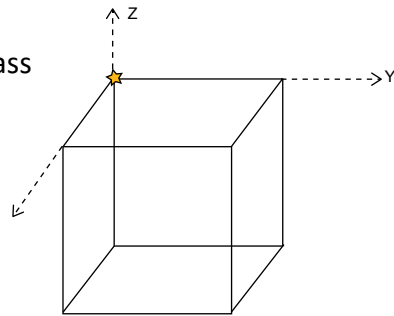
2 infinity intercepts=square

1 infinity intercept= rectangle

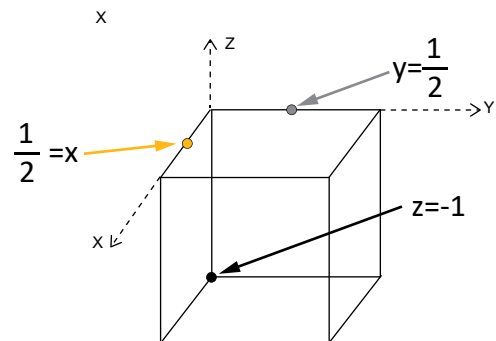
0 infinity intercepts=triangle

Triangle

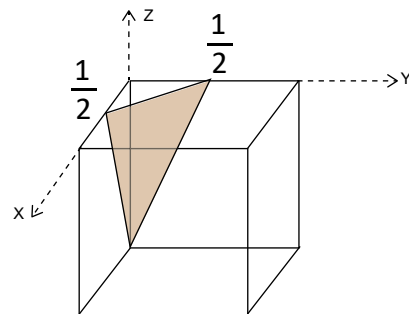
3. Choose origin and label axis based on intercepts and shape. *Note: plane cannot pass through the origin



4. Mark intercepts



5. Draw plane



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ANSYS, Inc.
Southpointe
2600 Ansys Drive
Canonsburg, PA 15317
U.S.A.
724.746.3304
ansysinfo@ansys.com

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