

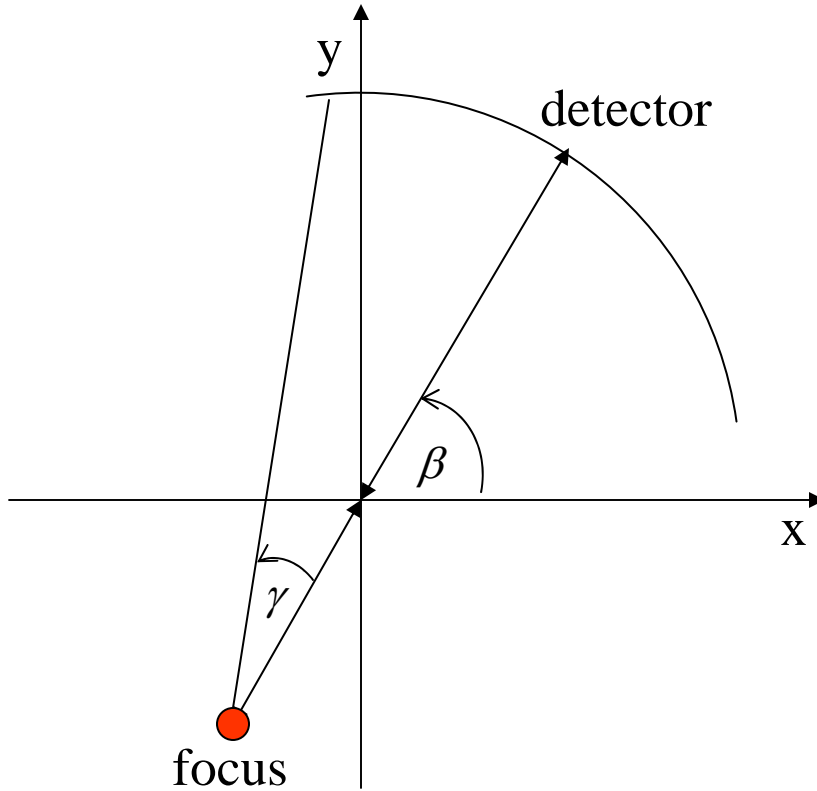
**Verify the nonzero entry  
for the 3D CT lookup table**

Measurement space Y:

( source angle index,  
detector row index,  
detector angle index in each row,  
z-direction rotation period index )

Image data space X:

( x, y, z )



In one z-direction period:

$$\beta \in [0, 2\pi)$$

$$\gamma \in [-\gamma_{\min}, \gamma_{\min}]$$

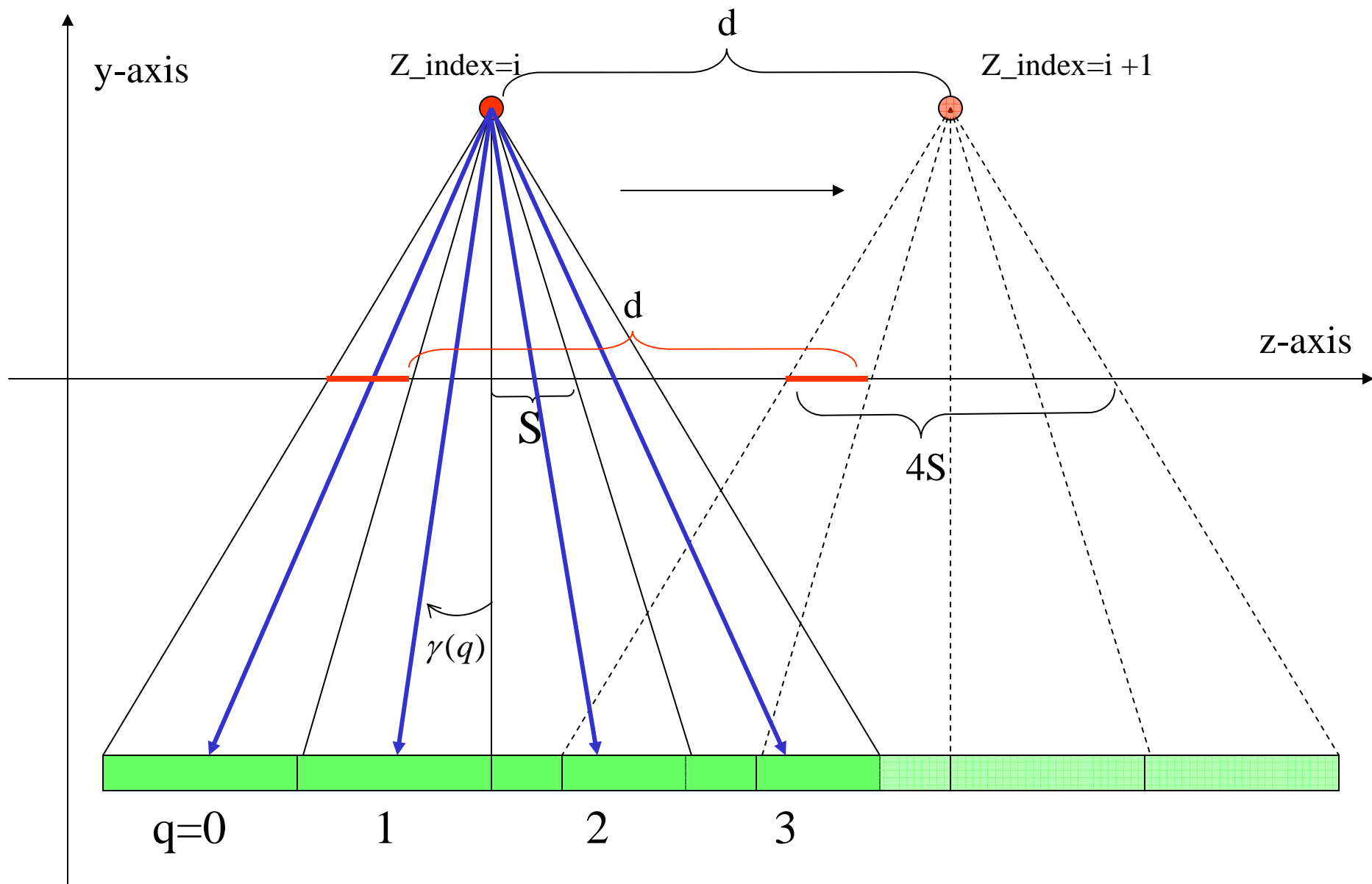
Z position of the focal spot:

$$z_F(\beta) = \frac{p \cdot S}{2\pi} \beta$$

Z position of slice q:

$$z(\beta, q) = z_F(\beta) + \left(\frac{M-1}{2} - q\right)S$$

# Multislice with $M=4$



# New parameters in geometry\_include\_file.h

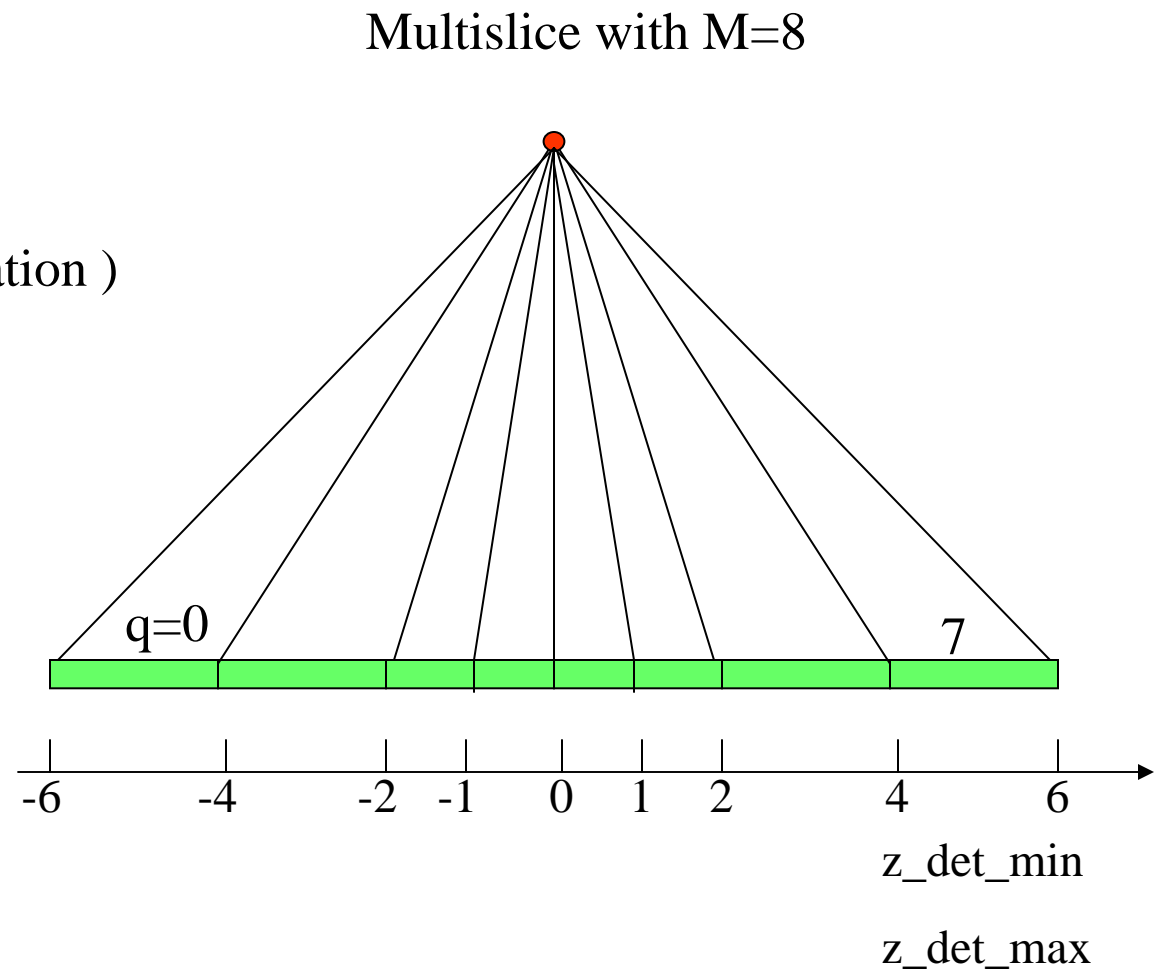
## Image space

- z\_index\_min
- z\_index\_max
- z\_index\_cent
- z\_sample

# New parameters in geometry\_include\_file.h

measurement space

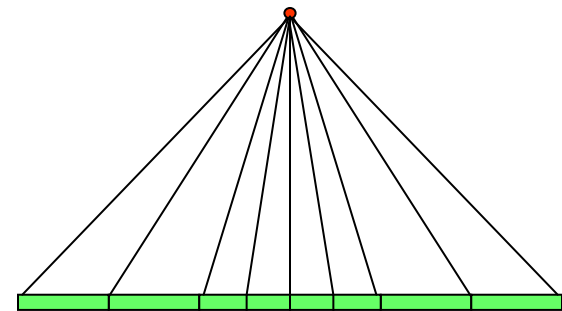
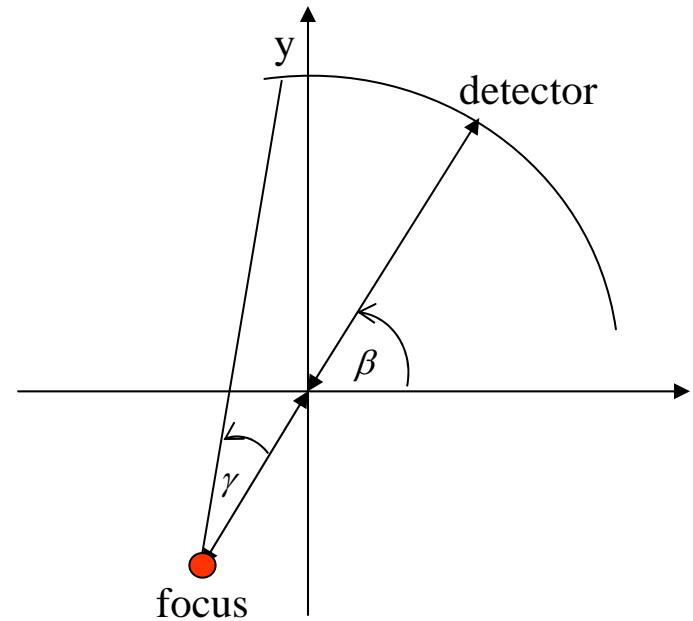
- `s_index_min`
- `s_index_max`
- `s_angle_sort`
- `pitch` (  $\Delta z$  / rotation )
- `z_det_ind_min=0`
- `z_det_ind_max=7`
- `z_det_min[]`
- `z_det_max[]`



# New parameters in geometry\_include\_file.h

measurement space

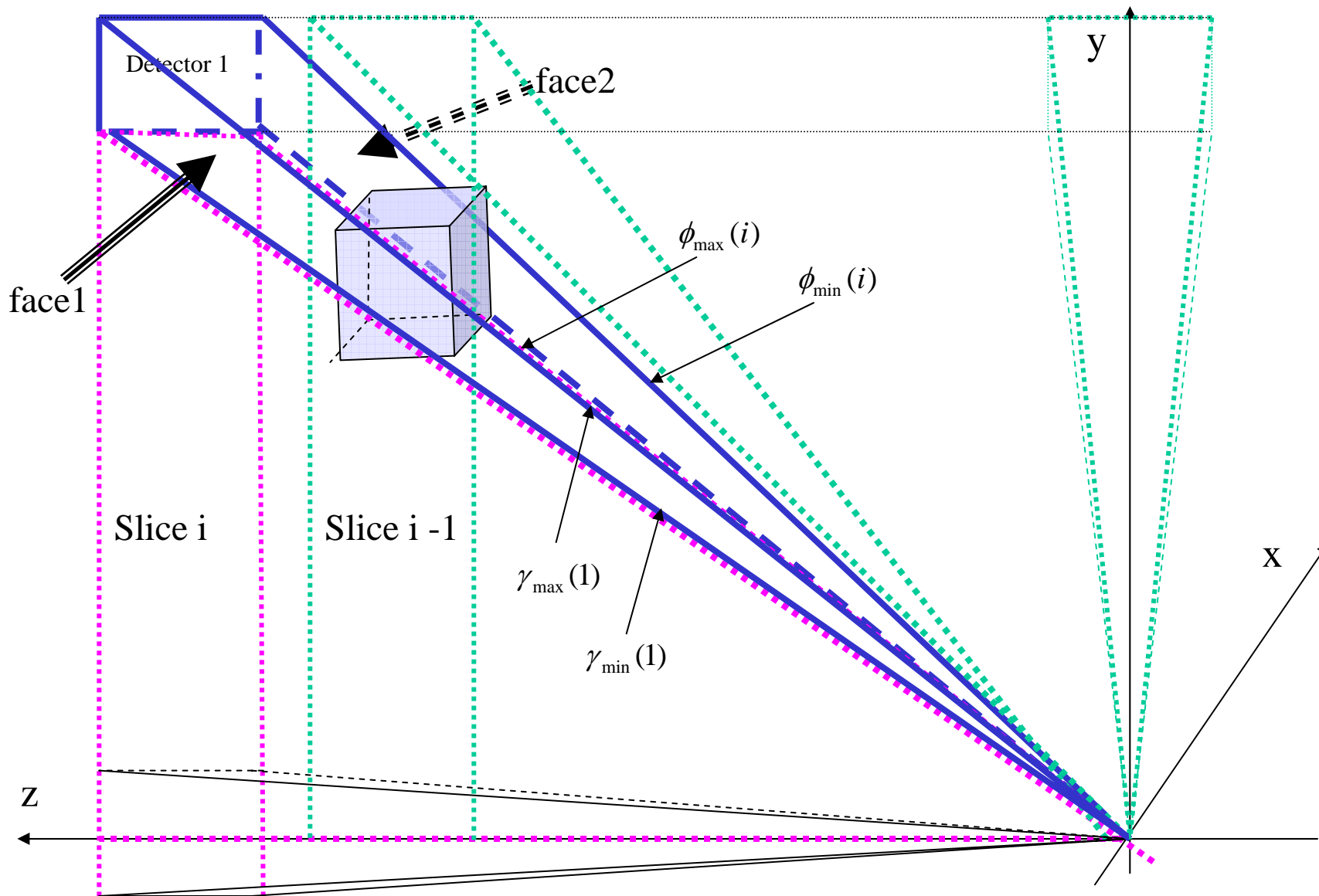
- `gamma_det_min[row index]`  
[detector angle index]
- `gamma_det_max[row index]`  
[detector angle index]



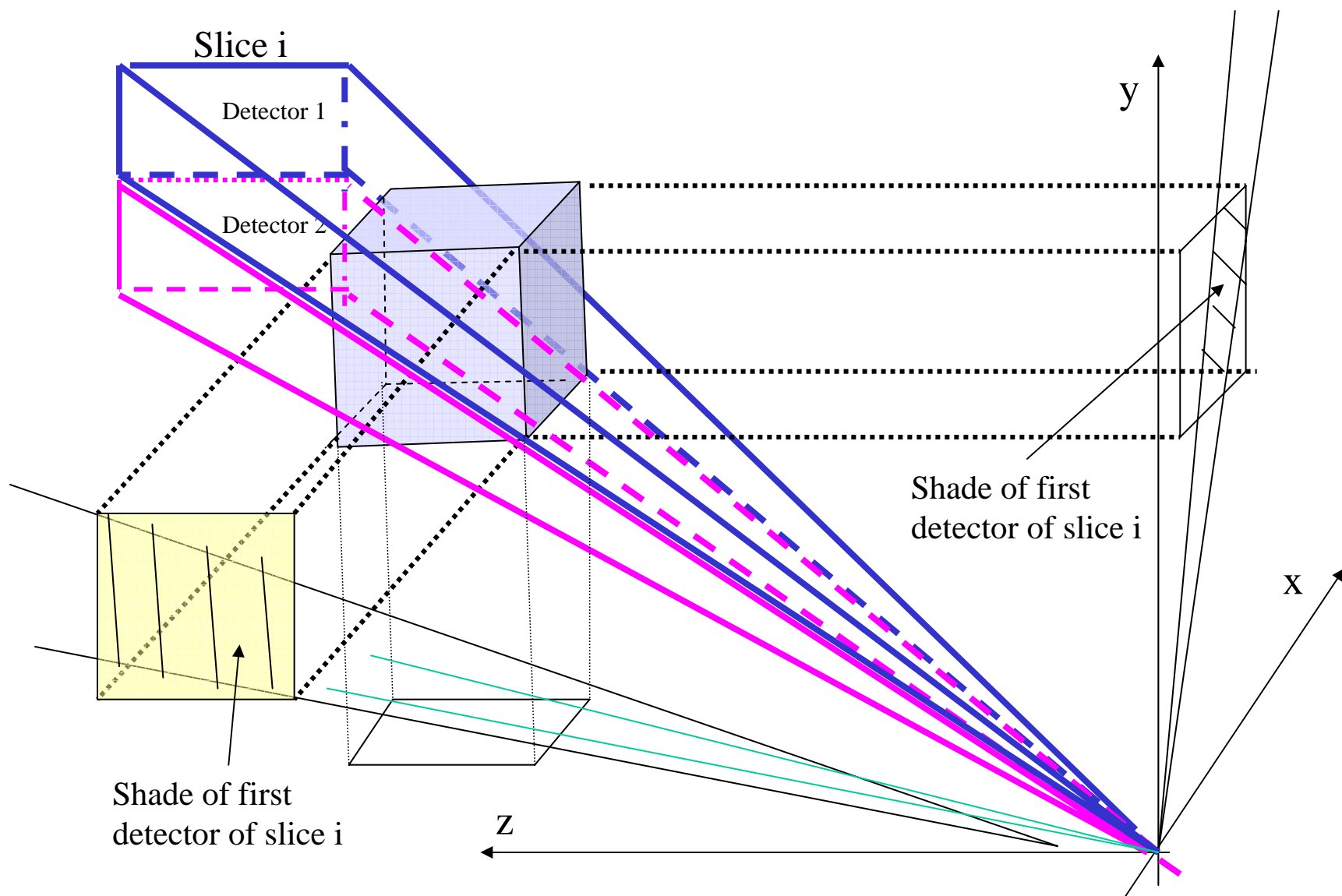
# Two Methods

1. Projection onto 3 basic planes
2. Eight-points method

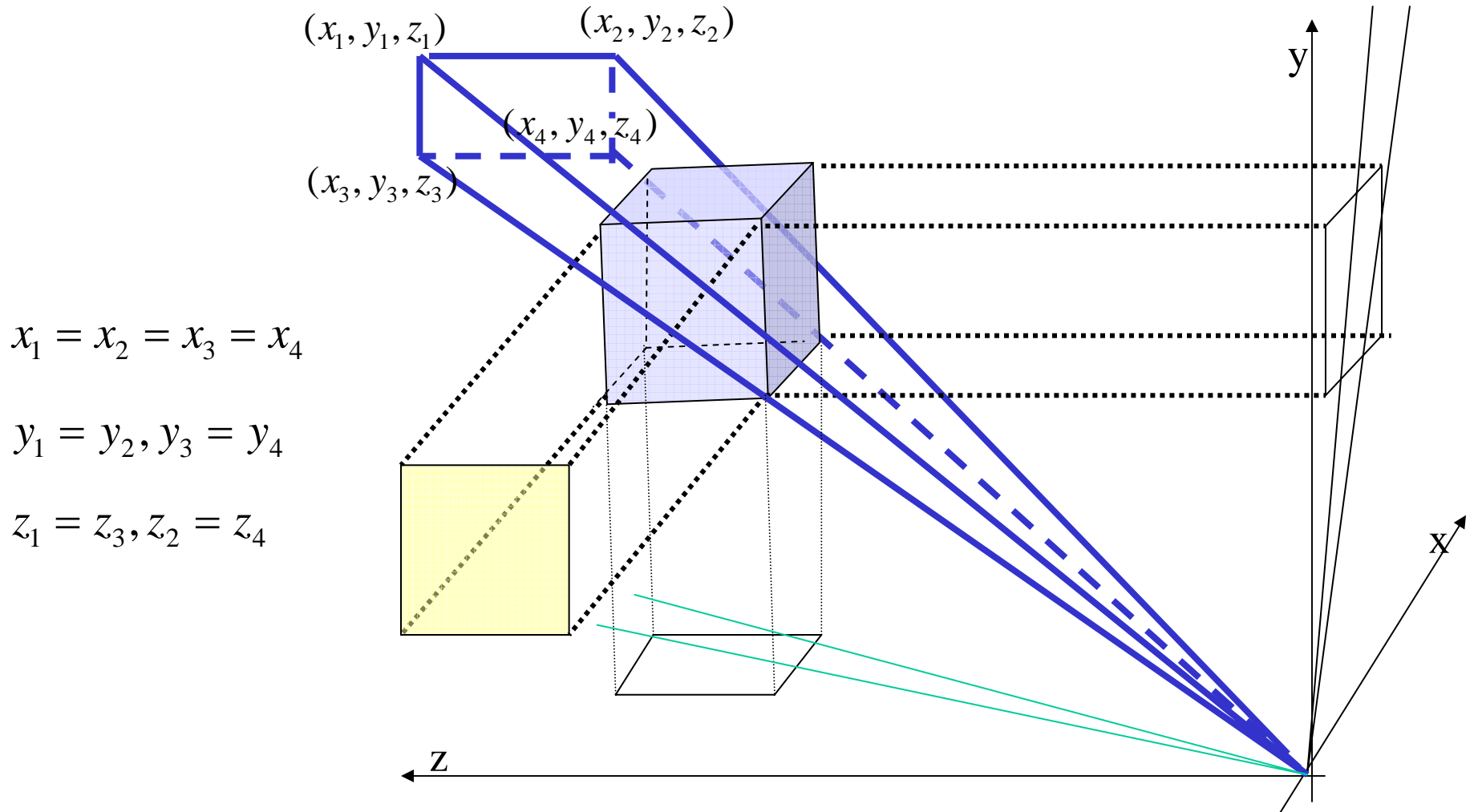
# Method 1



# Method 1

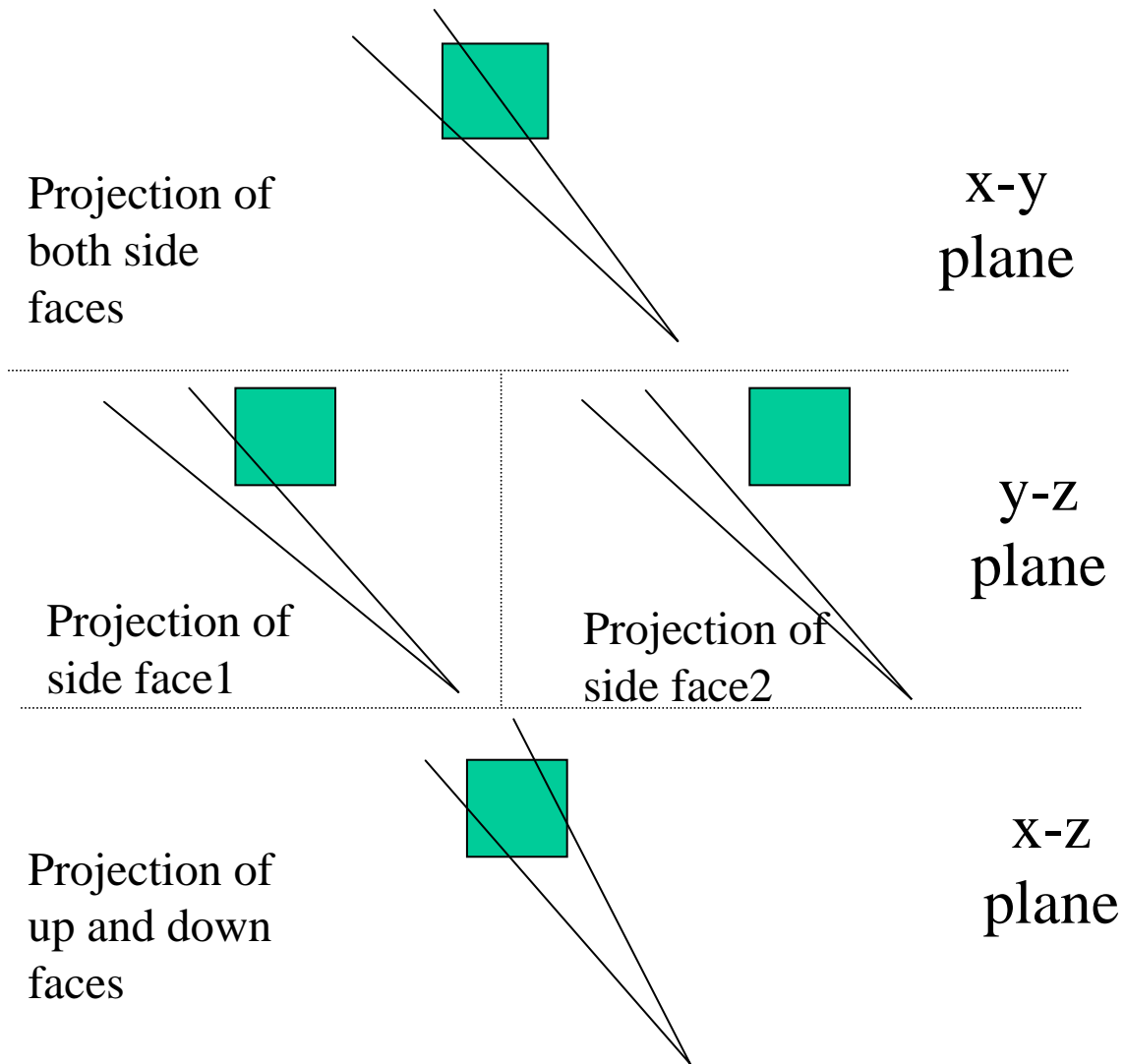


# Method 1



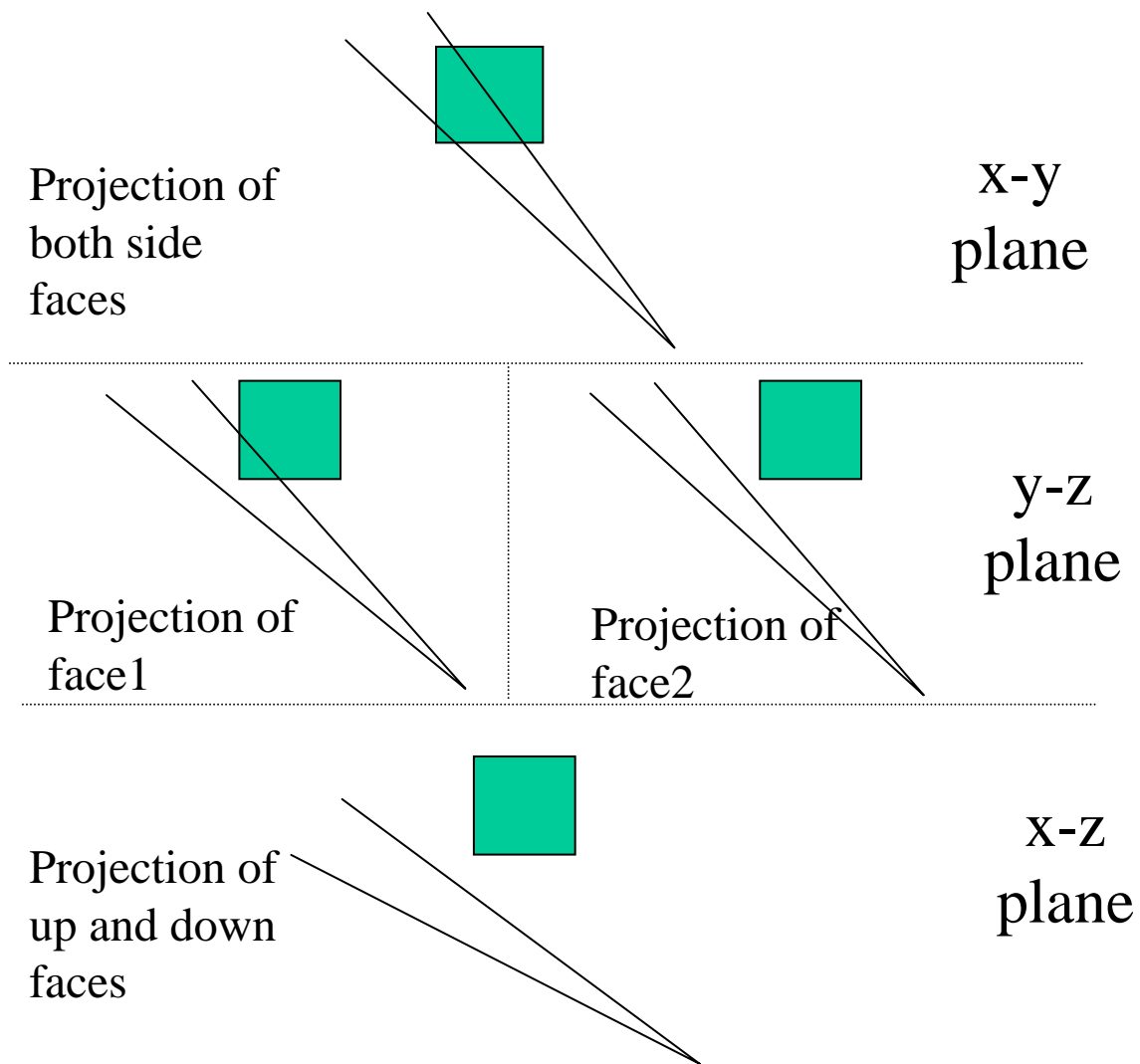
# Method 1

The cone beam is transmitting through the voxel

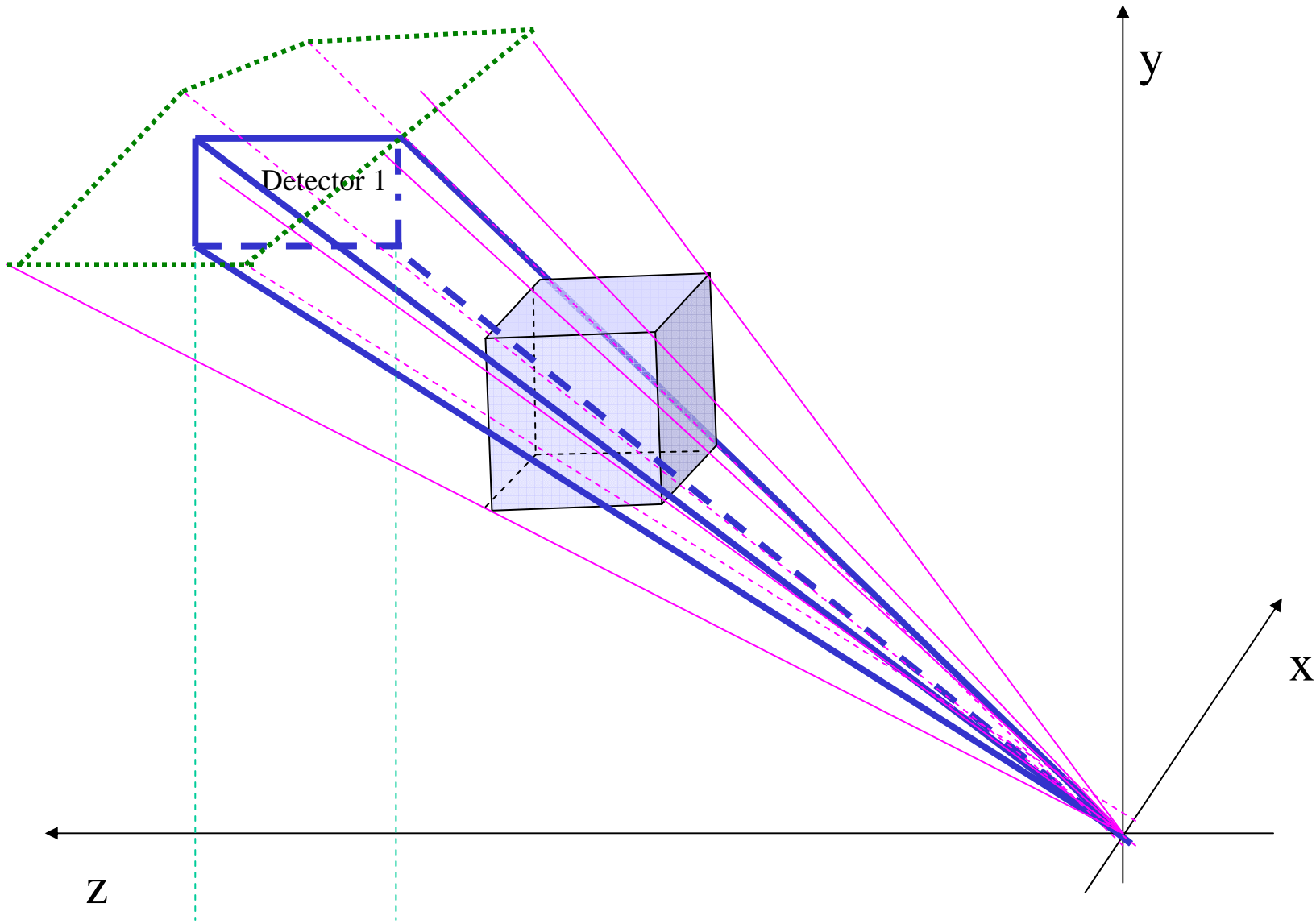


# Method 1

The cone beam is **NOT** transmitting through the voxel

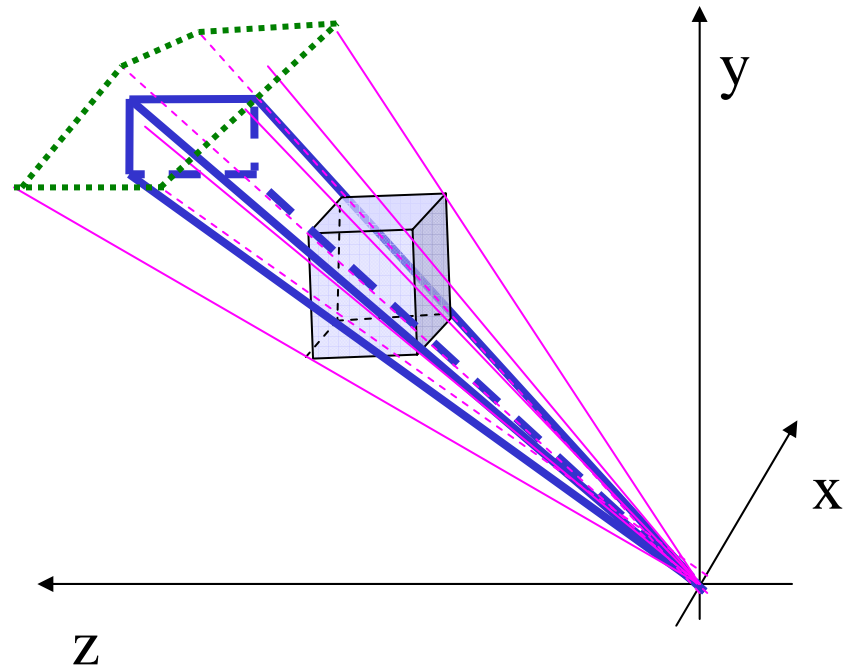


# Method 2



## Method 2

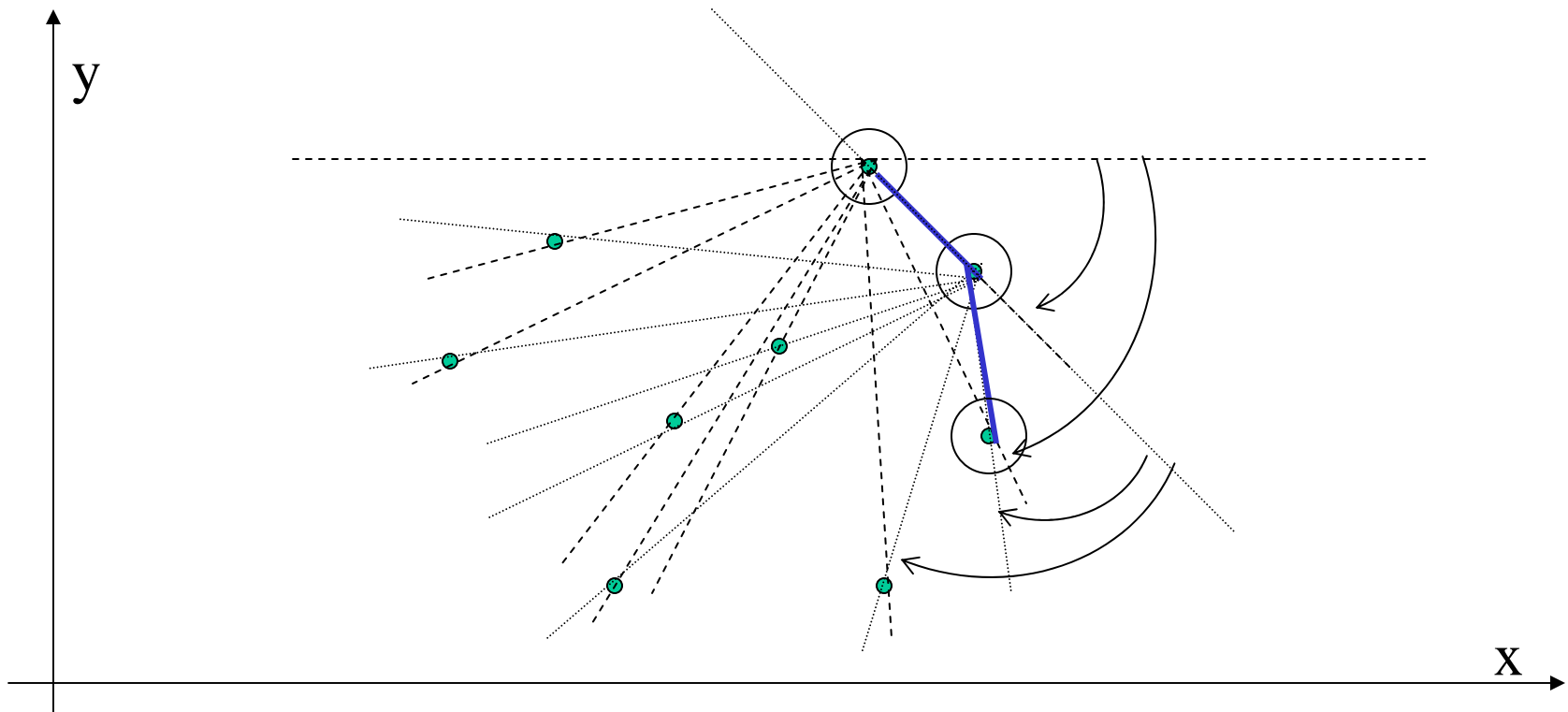
- for each detector index in each row, approximate it as a plane which is perpendicular to x-y plane/x-z plane and parallel to y-z plane;
- project 8 nodes of the voxel to the same plane as this index
- get a convex shape polygon from this 8 points
- if at least one point of the detector node is inside this polygon, the cone beam is transmitting through this voxel



## Method 2

Algorithm to find a convex polygon in 2d plane

1. Pick one point with highest y coordinate value
2. Select the point with smallest angle
3. From second point, repeat 1, 2

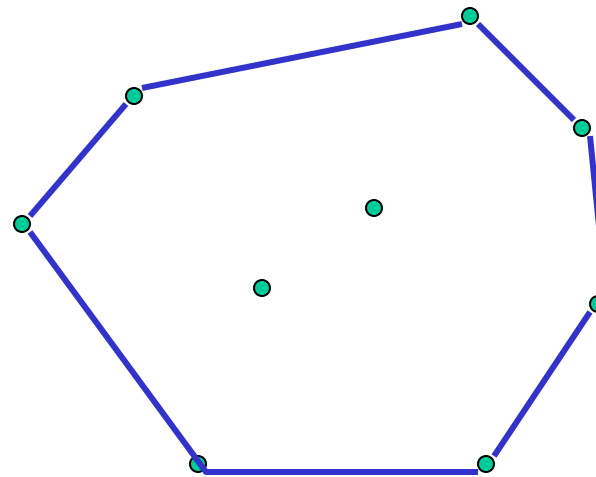


## Method 2

Algorithm to find a convex polygon in 2d plane

Example:

Get the polygon of 7  
points from 9 points



## Method 2

Algorithm to judge whether the point is in polygon or not

*inside* :  $\alpha_2 < \alpha_1$

*outside* :  $\beta_2 > \beta_1$

