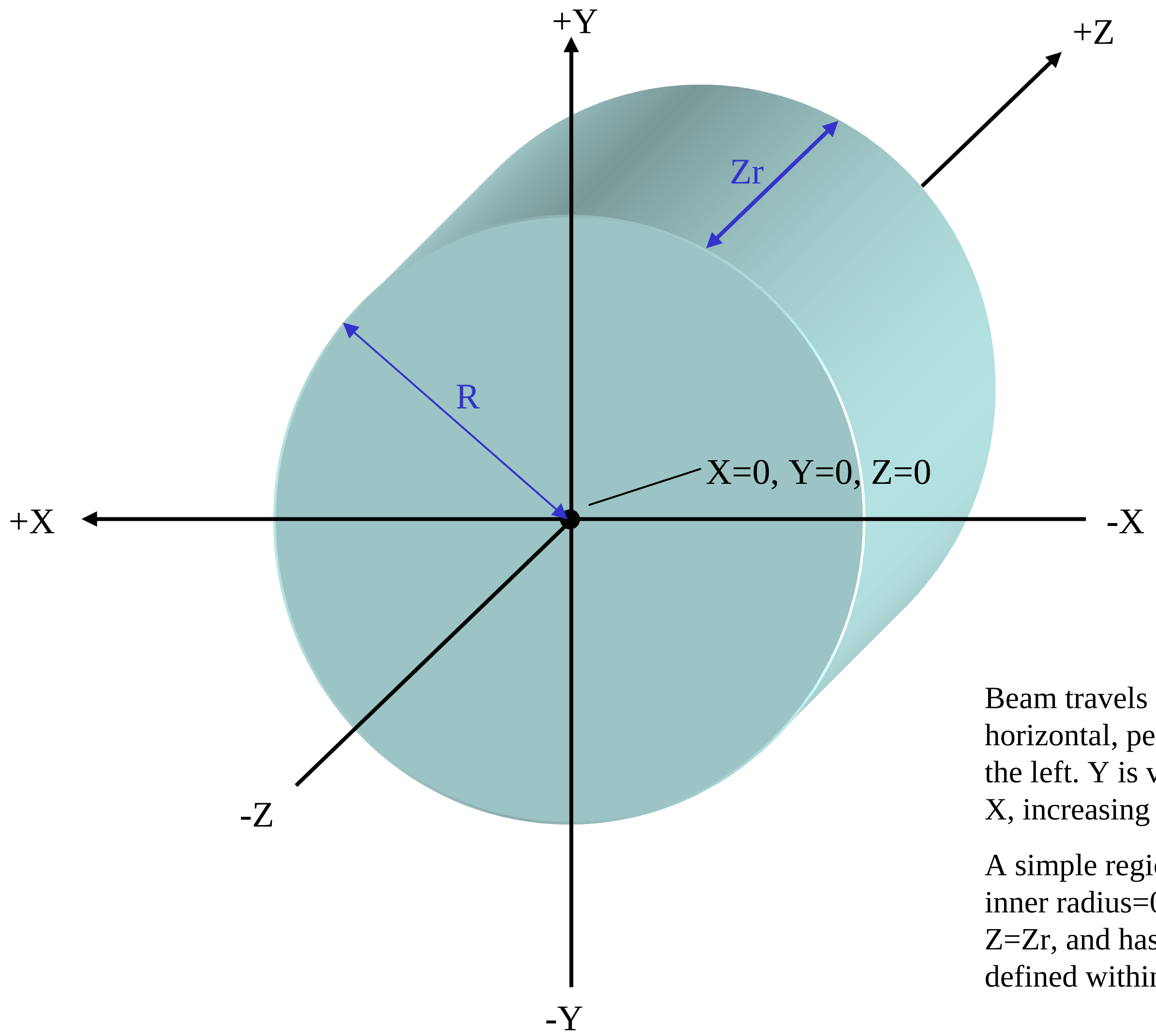
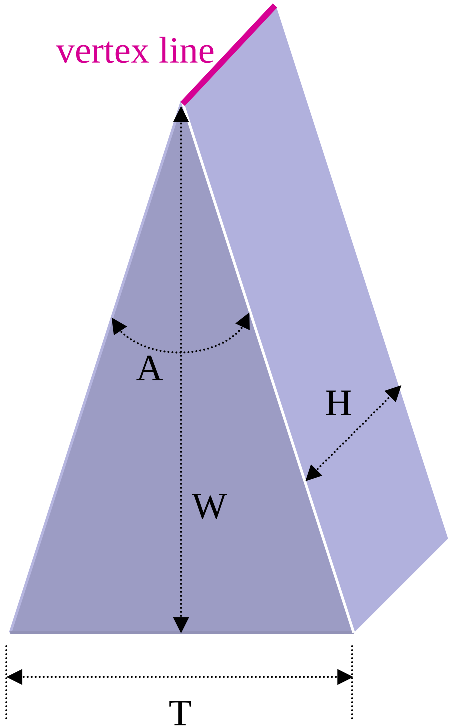
A Region Within Which a Wedge Is To Be Defined



Beam travels in the +Z direction. X is horizontal, perpendicular to Z, increasing to the left. Y is vertical, perpendicular to Z and X, increasing up.

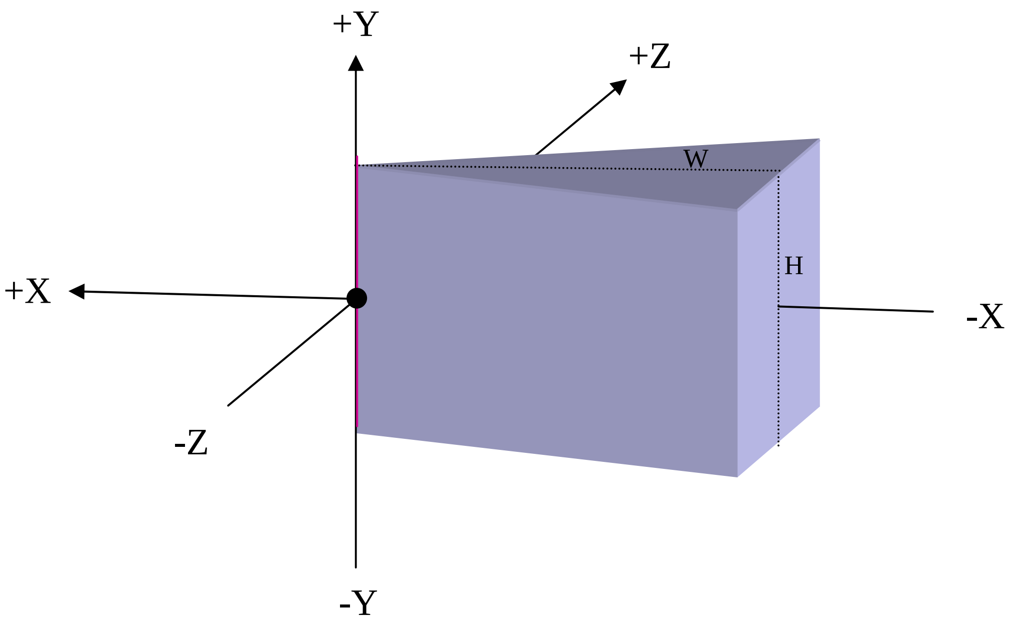
A simple region (one radial subregion with inner radius=0) begins at Z=0, extends to Z=Zr, and has radius R. A wedge will be defined within this region.

Size and Shape of the Wedge



We begin by defining the size and shape of the wedge:
The triangular sides of the wedge are isosceles triangles.
The base-to-vertex distance is W
The full angle at the vertex is A
The side-to-side length of the wedge is H
The vertex line of the wedge extends from one side’s vertex to the other, as shown.
The maximum thickness (T) of the wedge = 2W tan(A/2)

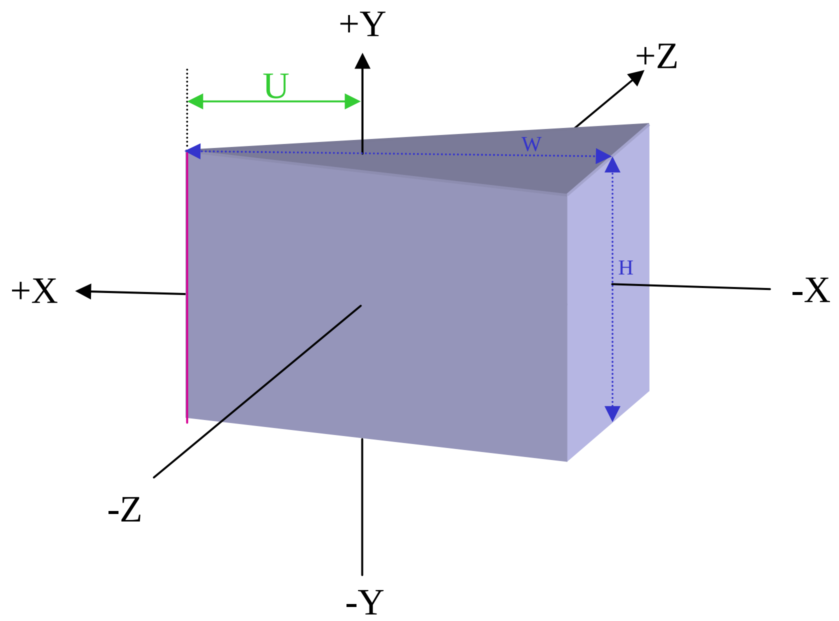
Initial Orientation of the Wedge



The wedge is initially oriented as shown. The vertex line of the wedge lies along the Y axis, extending from Y=-H/2 to Y=+H/2. The wedge is symmetric about the XY plane Z=0 and symmetric about the XZ plane Y=0. The wedge's Z-thickness gradient lies in the –X direction.

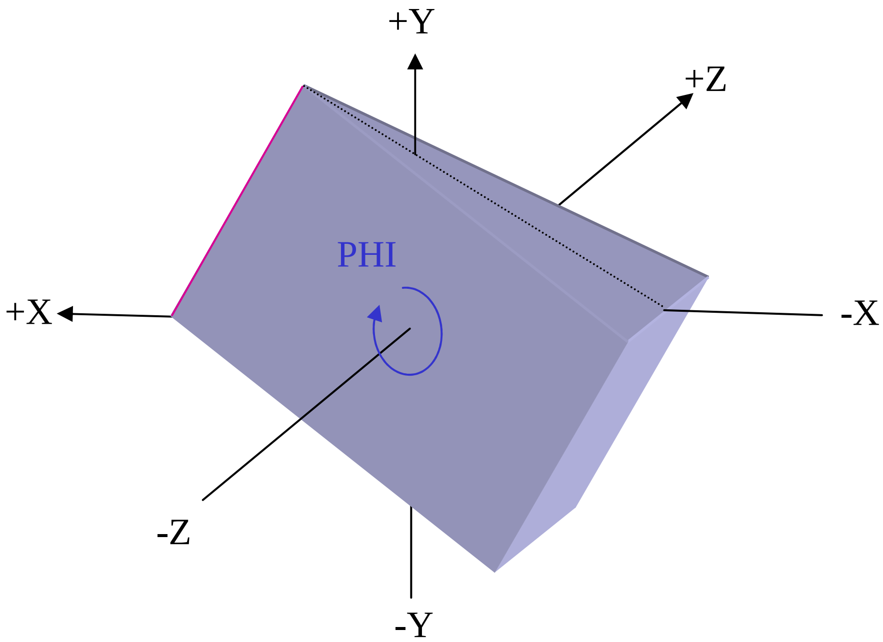
At present, half the wedge (those parts with Z<0) lies outside its region; we will adjust that later.

Translating the Wedge in the X Direction



The wedge may be translated in the X direction by adjusting parameter U. Setting U>0 moves the wedge a distance U in the +X direction. For example, setting U = W/2 centers the wedge in the X direction. The wedge retains its symmetry about the XY plane Z=0 and the XZ plane Y=0.

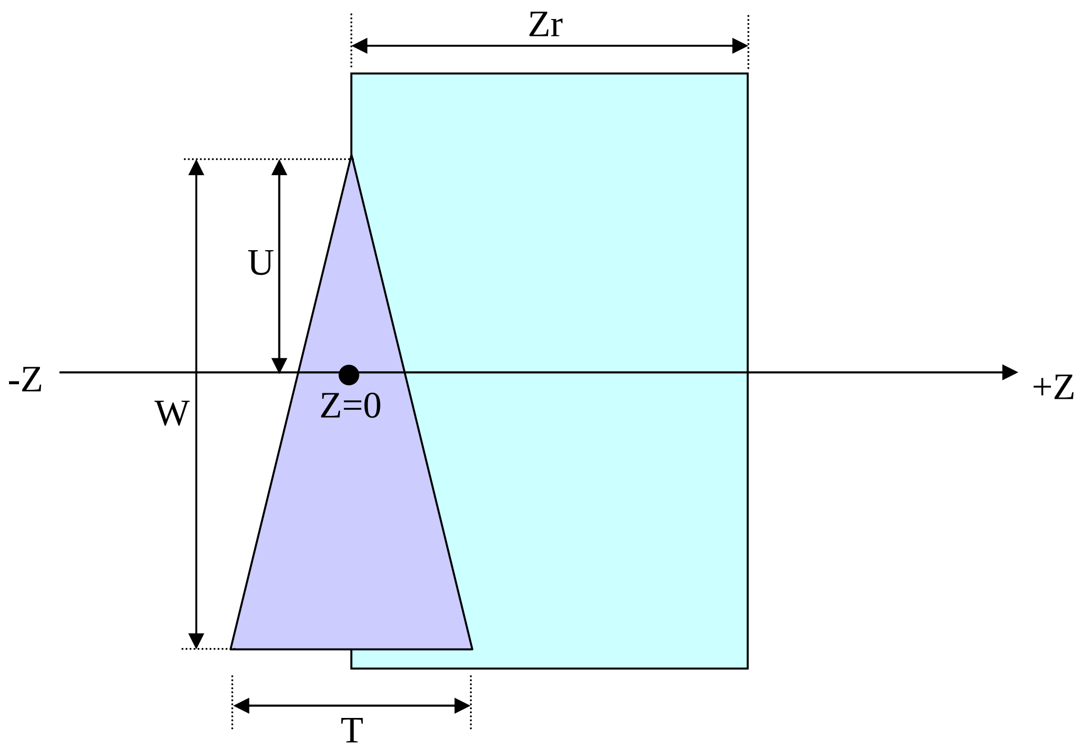
Rotating the Wedge about the Z Axis



Next, the wedge may be rotated about the Z axis by an angle PHI. Looking in the beam direction (+Z), clockwise rotations are positive. In the illustration above, PHI is about +30 degrees. Setting PHI = +90 degrees would place the vertex line horizontal at Y=U, with the Z-thickness gradient lying in the –Y direction. The wedge retains its symmetry about the XY plane Z=0, but in general the symmetry about the XZ plane Y=0 is broken by the rotation.

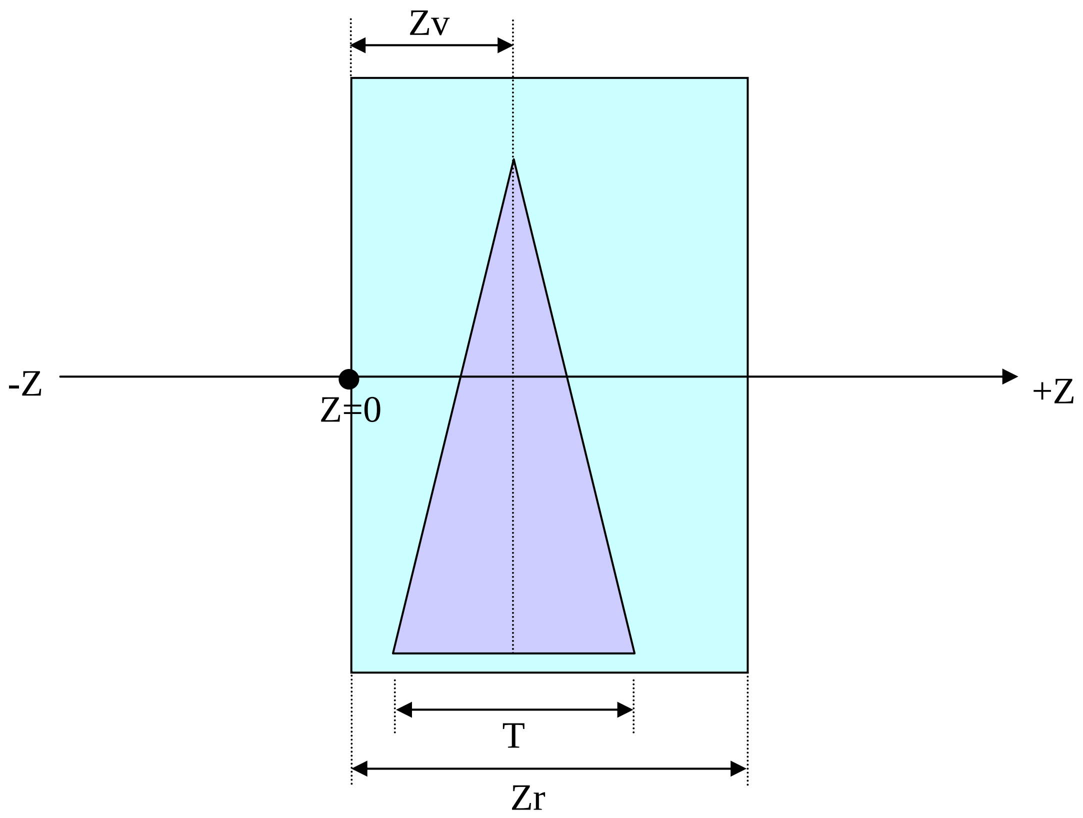
Note that translation by U and rotation by PHI do not commute; first you translate, then rotate.

Positioning the Wedge Within Its Region (Z)



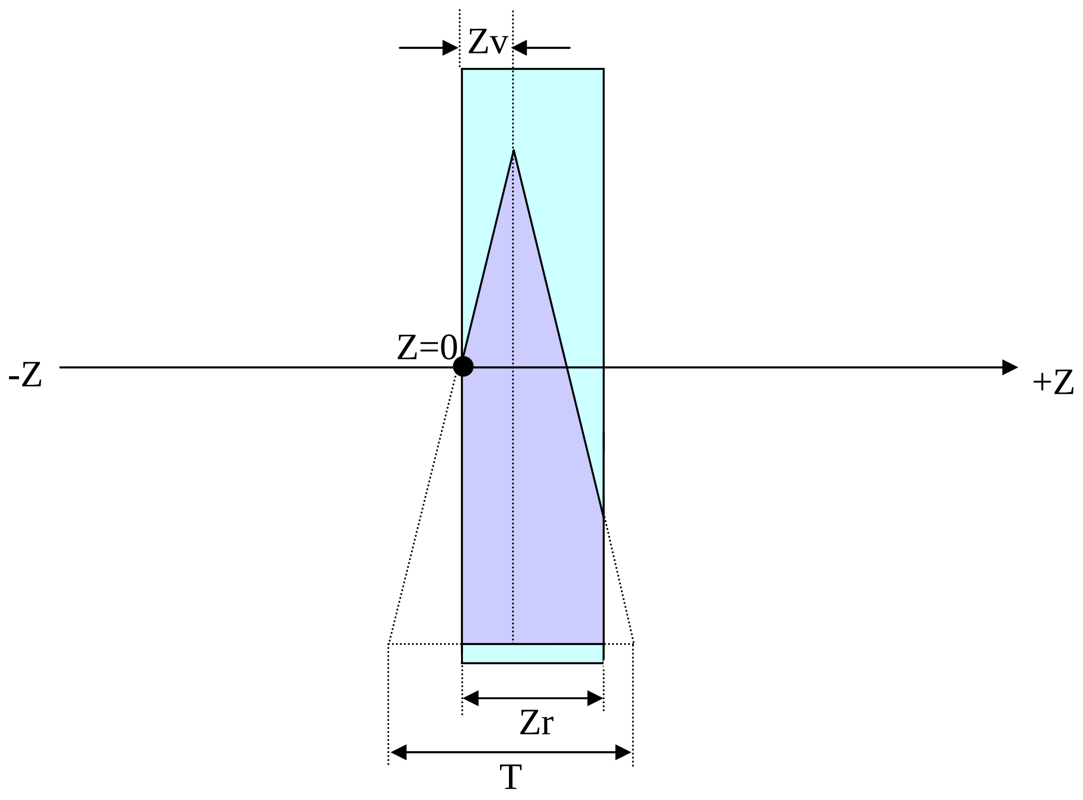
In this illustration, we look at the wedge from the side, superimposed on its region. Half the wedge still lies outside the region. Normally, one intends to place the entire wedge inside its region, as material outside the region boundaries will be ignored during particle propagation. To do this, the wedge is translated by a distance Zv in the +Z direction (next drawing).

Positioning the Wedge Within Its Region (Z)



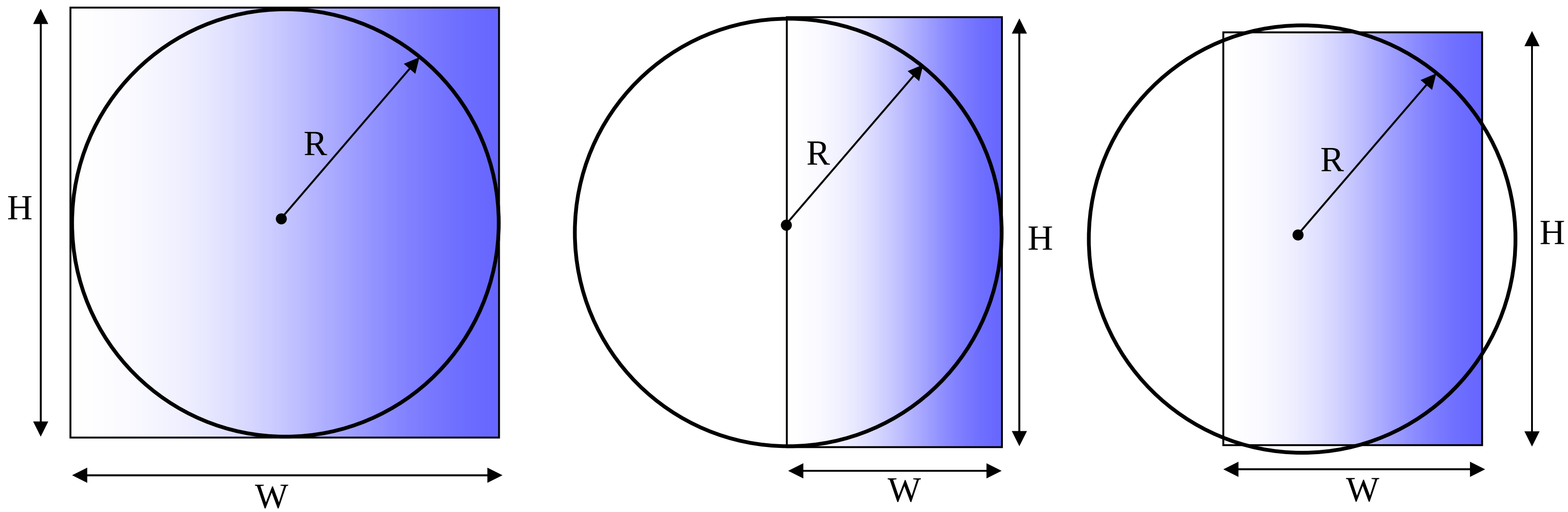
By setting Zv > 0, the wedge is translated in the +Z direction. If Zv > T/2 and Zr > Zv + T/2, then the entire wedge is within its region in the Z direction. Recall that T = 2W tan(A/2). It is perfectly normal to define wedges that do not fill their region in Z; the region's material outside the wedge is assumed to be vacuum.

Positioning the Wedge Within Its Region (Z)



This wedge does not fit within its region. $Zv < T/2$ and $Zr < Zv + T/2$. The material outside the region boundaries is not seen when particles are propagated through the wedge. There are probably few cases in which this sort of truncation is useful.

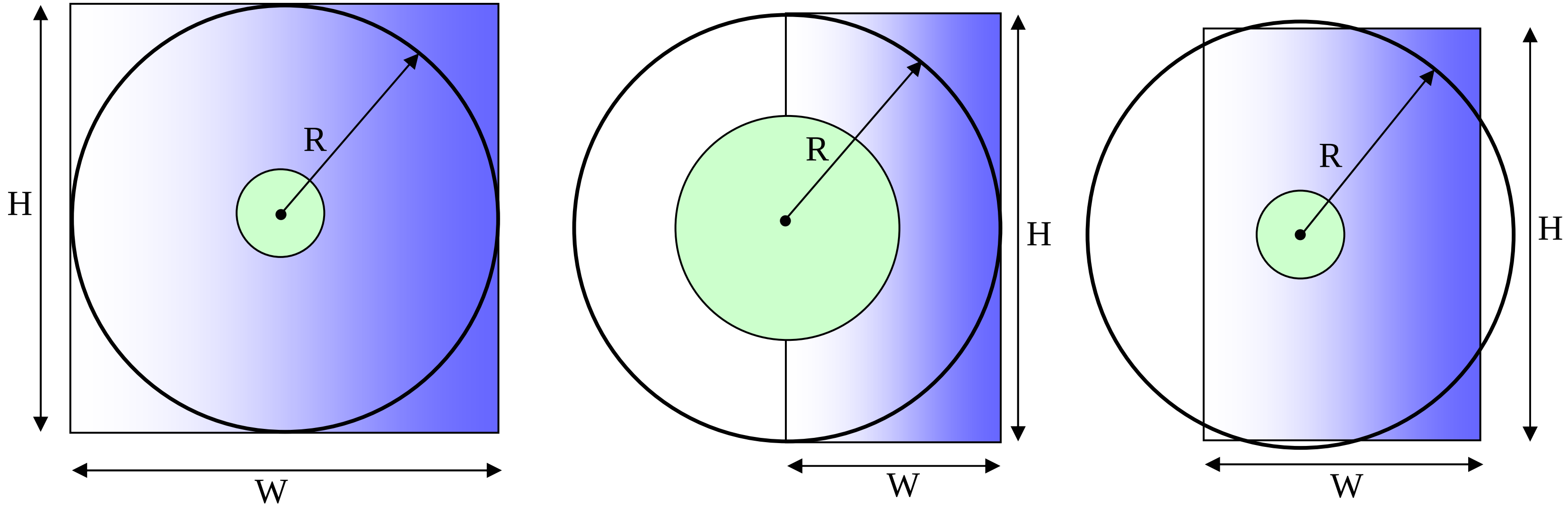
Positioning the Wedge Within Its Subregion (R)



Here we view a wedge from the beam's perspective. The Z axis is in the center of a radial subregion (circle) of radius R. The wedge presents a cross-section of width W and height H to the incoming beam. In all three examples, PHI=0; the gradient of increasing thickness (blueness) lies in the –X (right) direction. (In these examples we presume that the entire wedge lies within the Z-boundaries of its region, and that the subregion has an inner radius of zero.)

In the leftmost example, H=2R and W=2R; the wedge covers the entire aperture of the subregion and U = R. In the center example, the wedge covers the right half of the region; W=R and H=2R and U=0. The rightmost example illustrates the general case; the wedge does not cover the entire subregion, but extends beyond it in some directions. In all cases, (1) particles passing through the subregion and through the wedge encounter the prescribed thickness of absorber, (2) particles passing outside the subregion do not see any of the wedge's absorber, whether they pass through it or not, and (3) particles passing throught the subregion but missing the wedge encounter no absorber.

Positioning the Wedge Within an Annular Subregion



It is possible (though seldom useful) to define a wedge within a radial subregion having non-zero inner radius – an annular subregion. In such cases, particles passing through the wedge inside the inner radius of the subregion (green) do not encounter any of the wedge's absorber.

Defining the Wedge in ICOOL format

A wedge is defined within a radial subregion (r-subregion) of a region (s-region).

Within the subregion definition - - -

MTAG defines the material the wedge is made of (e.g. LIH for lithium hydride). The volume of the subregion that lies outside the wedge is vacuum.

MGEOM = WEDG

The ten GPARM parameters are:

1. A – full vertex angle of the wedge (degrees)
2. U – translation in X direction (meters)
3. Zv – Z position of the wedge's vertex line, relative to the upstream edge of the region (meters)
4. PHI – azimuthal rotation angle about the Z axis (degrees). Looking downstream along the beamline (+Z), clockwise rotations are positive angles.
5. W – base-to-vertex dimension of the wedge (meters)
6. H – side-to-side dimension of the wedge (meters)

Parameters 7-10 are unused (set to zero).

Parameters A, W and H specify the size and shape of the wedge. Parameters Zv, U and PHI define the wedge's position and orientation within its region and subregion.