

3D Collimator Construction

Starting points and vector

To create the collimator, vectors are defined to outline hexagonal prisms. To begin, an initial point is defined based on the minimum x input, and the maximum y input (so it begins in the top left corner in the 2D plane). The start point is defined as the minimum x value, and half of a collimator hole diameter subtracted from the maximum y value. This defines the tail of the first vector of the first hexagon. The head of the vector is calculated by defining the angle from -180° , which at the beginning is 120° greater, so the angle 300° using standard Euclidean axes. To determine the point in space defined by the head, the cosine of this angle (120°) is multiplied by the length of a hexagon side, and the y by the sine of this angle. This forms this initial line in space.

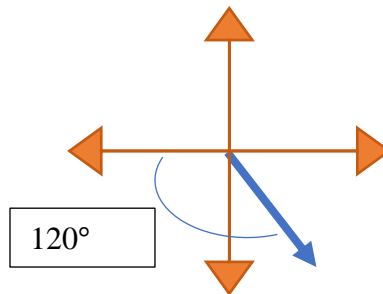


Fig. 1. One side of a hexagon defined about an axes

Making it 3D

In order to use the plot function and create the 3D portion of these hexagonal prisms, lines are used to define the shape. This is simple, as only this vector is used and with the z-portion added to it to create the rectangle that defines this collimator hole wall. The array added to this hexagonal prism is defined below, where t is the vector tail and h is the vector head.

X points = [t{x}, h{x}, h{x}, t{x}, t{x}, h{x}];

Y points = [t{y}, h{y}, h{y}, t{y}, t{y}, h{y}];

Z points = [0, 0, zval, zval, 0, 0];

The sixth point may seem redundant, as it is the same as the second and adds an extra line to the shape, but this is how the positioning for the next tail is determined. So, after saving these points to the hexagon array, we currently have this shape.

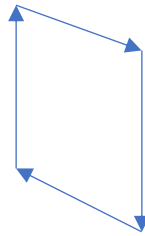


Fig. 2. One side of a hexagonal prism

Creating the rest of the hexagonal prism

After this step, 60° gets added to the angle, so it equals 180° . The old vector head h now becomes the tail t , and the new head is calculated using sine and cosine. We then repeat the step of making it 3D using the new head and tail, giving the shape shown below. This is then repeated 4 more times until we obtain full hexagonal prisms.

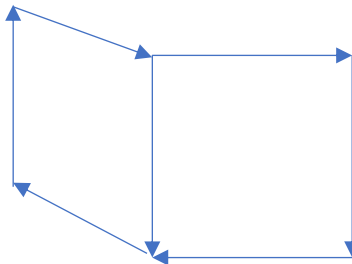


Fig. 3. Two sides of a prism

Making multiple hexagonal prisms

Once the head of the sixth vector reaches the tail of the initial vector, this hexagon is saved to the “hexagons” cell array. A new start point is defined by adding the skip vector to the current x value, and the process of creating a hexagonal prism is repeated. After this, the following shapes are obtained (looking from the top view).

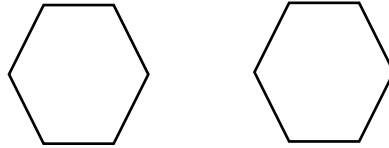


Fig. 4. Two prisms

This gets repeated until the maximum x value is reached, in which case a new row of hexagons is started. New rows are made until the minimum value of y is reached, which gives the following collection of shape (continuing until these minimums/maximums are reached).

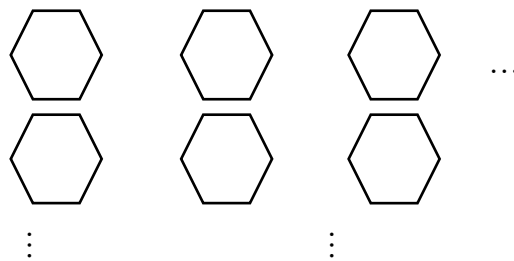


Fig. 5. Collimator without filled in second layer

Next, the missing hexagonal holes need to be filled in. This is done by calculating the new start point, and then filling them in repeating the whole process explained above. When all of this is completed, an outline of the collimator is found, by determining the minimums/maximums of the physical shapes, to obtain a collimator shape similar to what is pictured below.

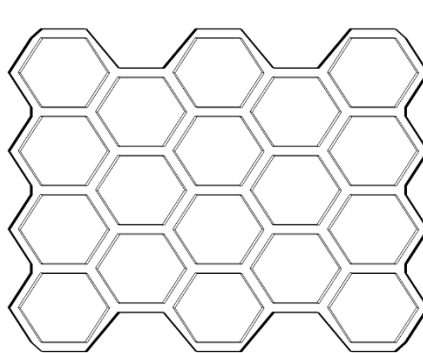


Fig. 6. Final collimator design