

# Scintillator Frame Design and Construction

Anthony Nesbitt, Brookdale Community College

Junior Constanza, Queensborough Community College

Professor R. Armendariz, Queensborough Community College

July 14<sup>th</sup>, 2023



# Scintillator Frame Features

- We designed a wooden frame to hold plastic scintillators for a muon cosmic ray detector.
- The frame is designed to house scintillator panels of dimensions  $\sim 91.5\text{cm L} \times \sim 31.5\text{cm W} \times \sim 1.0\text{cm thick}$ , which are then wrapped with two layers of Tyvek and one layer of black light-tight paper.
  - However, the dimensions of the frame can be easily modified to fit scintillators of different sizes.
- The frame 2x3 wood features a 1.5cm wide and 1.3cm deep trench within which the scintillator panel is secured. This trench can optionally be lined with weather sealant or similar padding for extra protection or to absorb minor variances in scintillator panel sizes.
- The frame allows for easy maintenance due to its ability to be opened and closed, meaning the scintillator can be removed without disassembly.
- The mating junction of the photomultiplier tube (PMT) lens and the plastic scintillator is easily accessible for tools and for wrapping tape around the junction to block out ambient light.
- The wooden scintillator frame fits snug into the aluminum cosmic ray Alt/Az telescope frame, and is able to be installed and removed without requiring the disassembly of either frame.

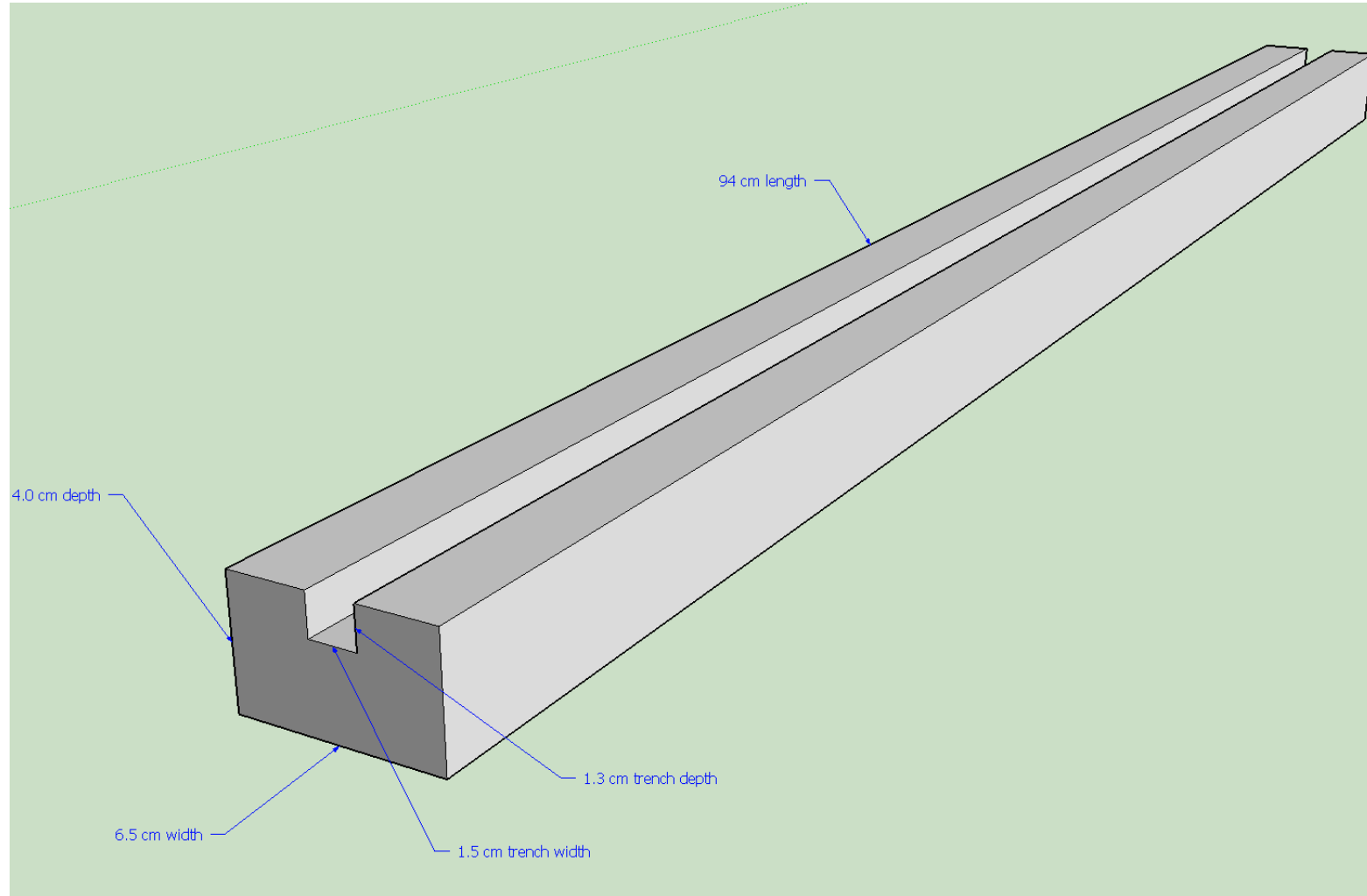
# Tools & Hardware Used During Construction

- Multipurpose screws, 2.5" long, as many as needed to attach wood components.
- 4x 1.25" screws, for attaching PMT holder
- 2x Screw eyelets.
- 1x Strap hinge (and associated screws).
- 1x Clasp (and associated screws).
- JB Weld KwikWood putty, for filling gaps and misc. repairs that might become necessary.
- A lathe/milling machine with a 0.5" bit for cutting a trench into certain components, and a 6.5cm hole saw bit.
- A power drill with appropriate screwdriver bits and drills for tapping screws when necessary.
- A saw and tape measure for cutting lumber to the appropriate lengths.



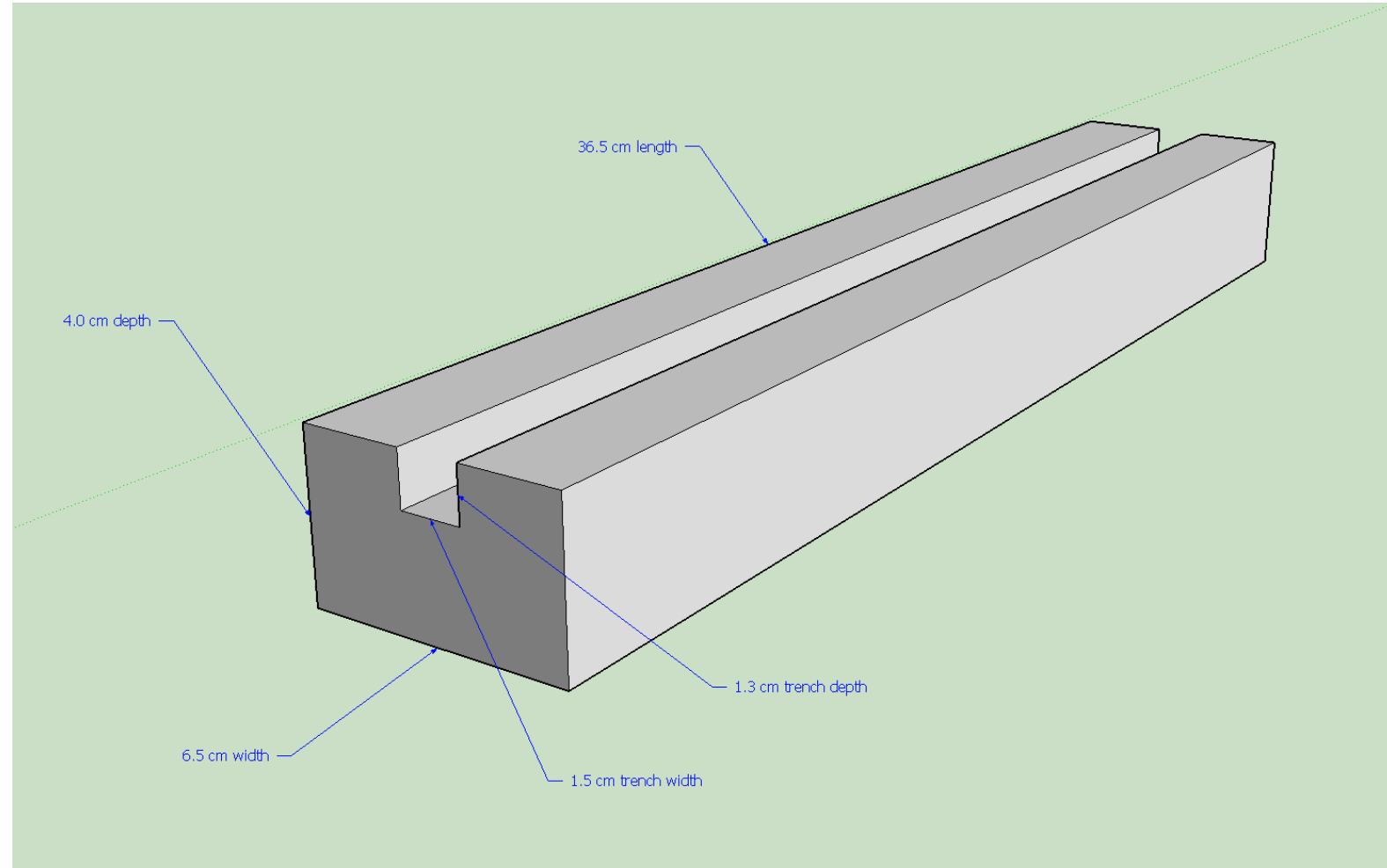
# 2"x3" wood for two Long Sides

- Two of these components are needed to make the frame.
- Two 2"x 3" sections of lumber were cut to the length shown at right using a tape measure and a saw.
- A lathe/milling machine with a 0.5" bit was used to mill out a centrally-located trench down the length of each component as shown at right.



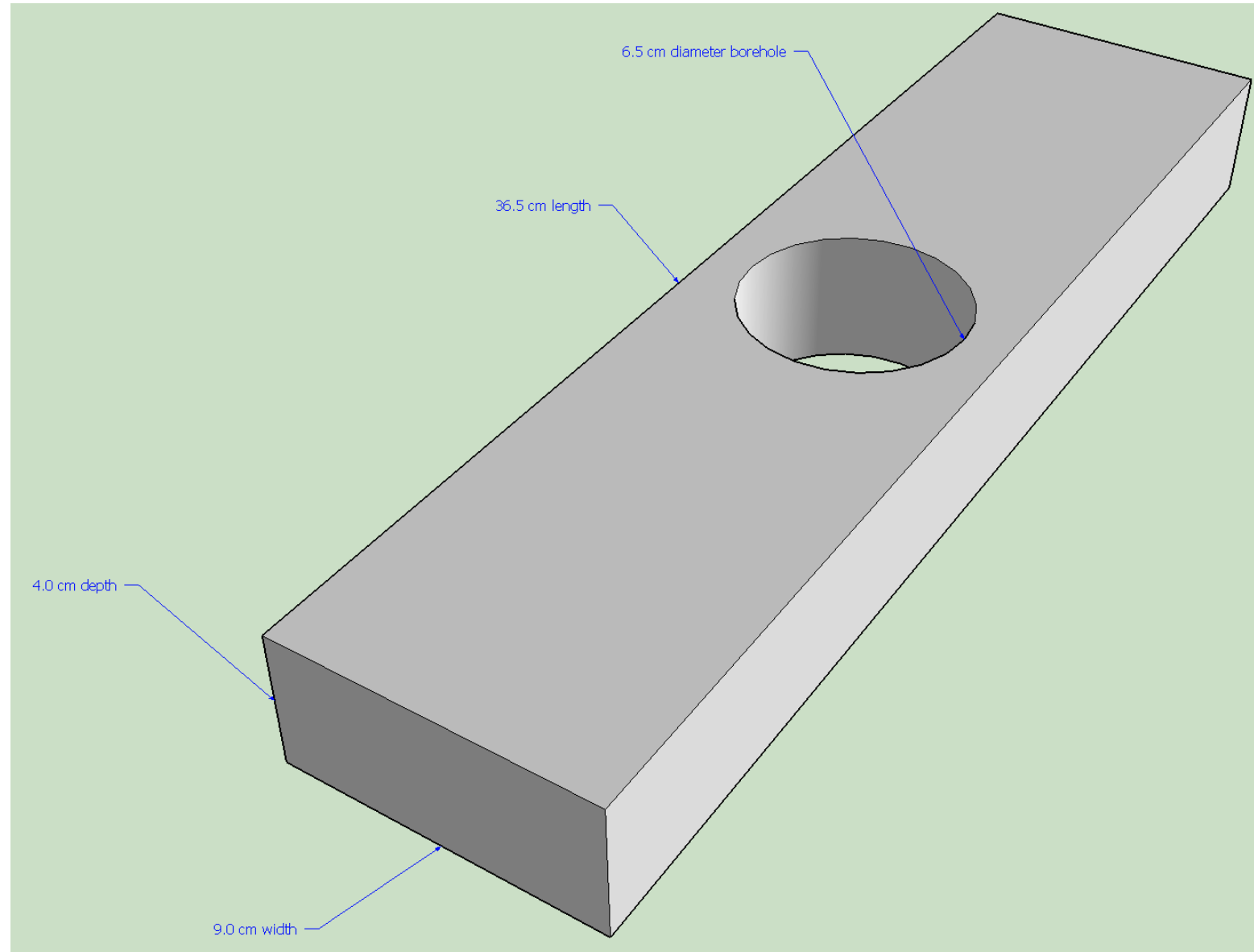
# 2"x3" wood for Short Side #1

- One of these components is needed to make the frame.
- A 2"x 3" section of lumber was cut to the length shown at right using a tape measure and a saw.
- A lathe/milling machine with a 0.5" bit was used to mill out a centrally-located trench down the length of the component, as shown at right.



# 2"x4" wood for Short Side #2

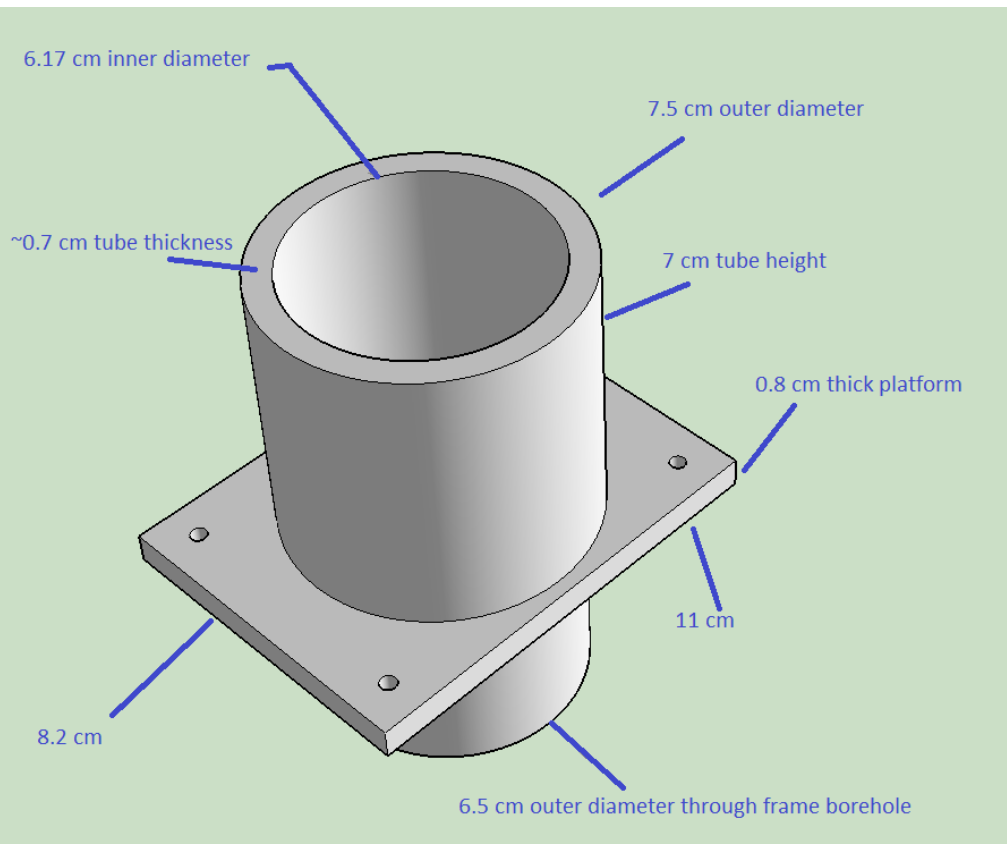
- One of these components is needed to make the frame.
- A 2"x 4" section of lumber was cut to the length shown at right using a tape measure and a saw.
- A lathe/milling machine with a circular cutting hole saw bit was used to bore a central hole through the component, as shown at right. The hole should be 6.5cm in diameter.



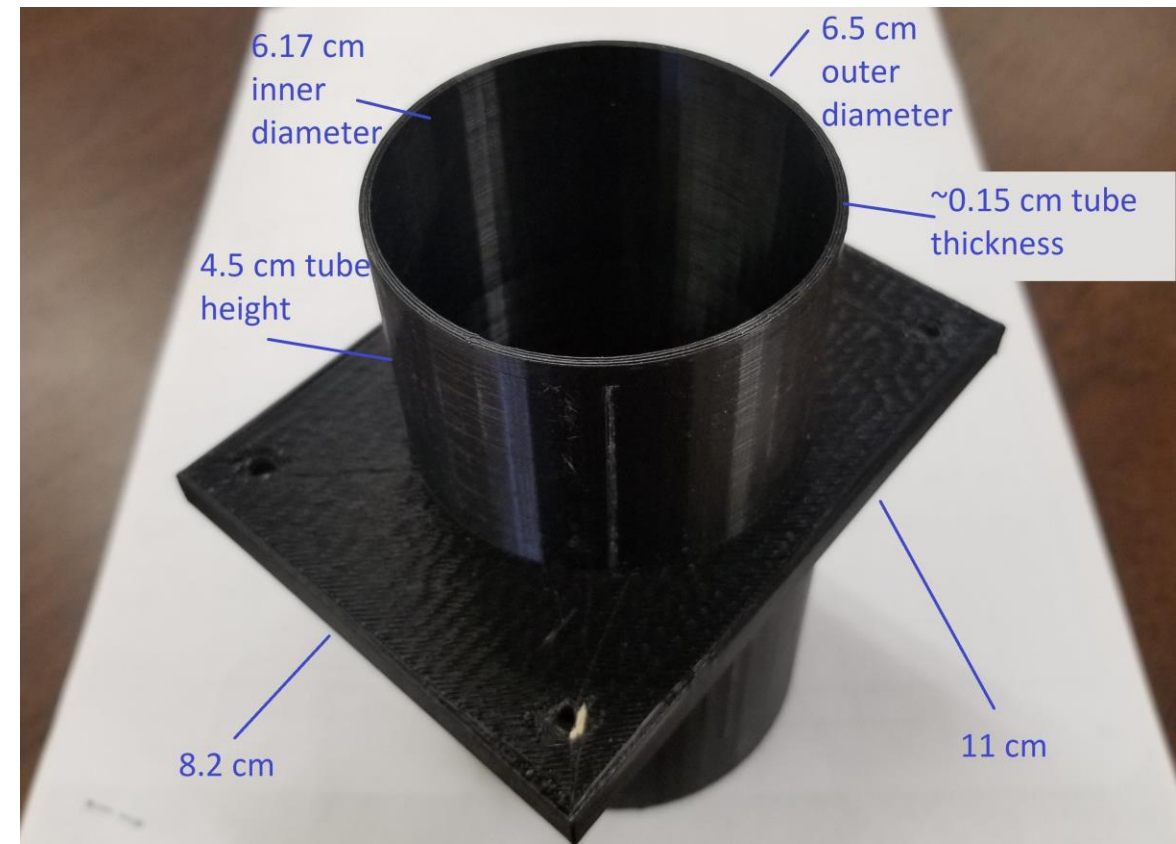
# PMT Holder – 3D printed

- One of these components is needed to make the frame.
- The model was designed using 3d modeling software. The design is shown below.
- A 3D printer (PLA filament) was used to produce this component.

Thick tube side up

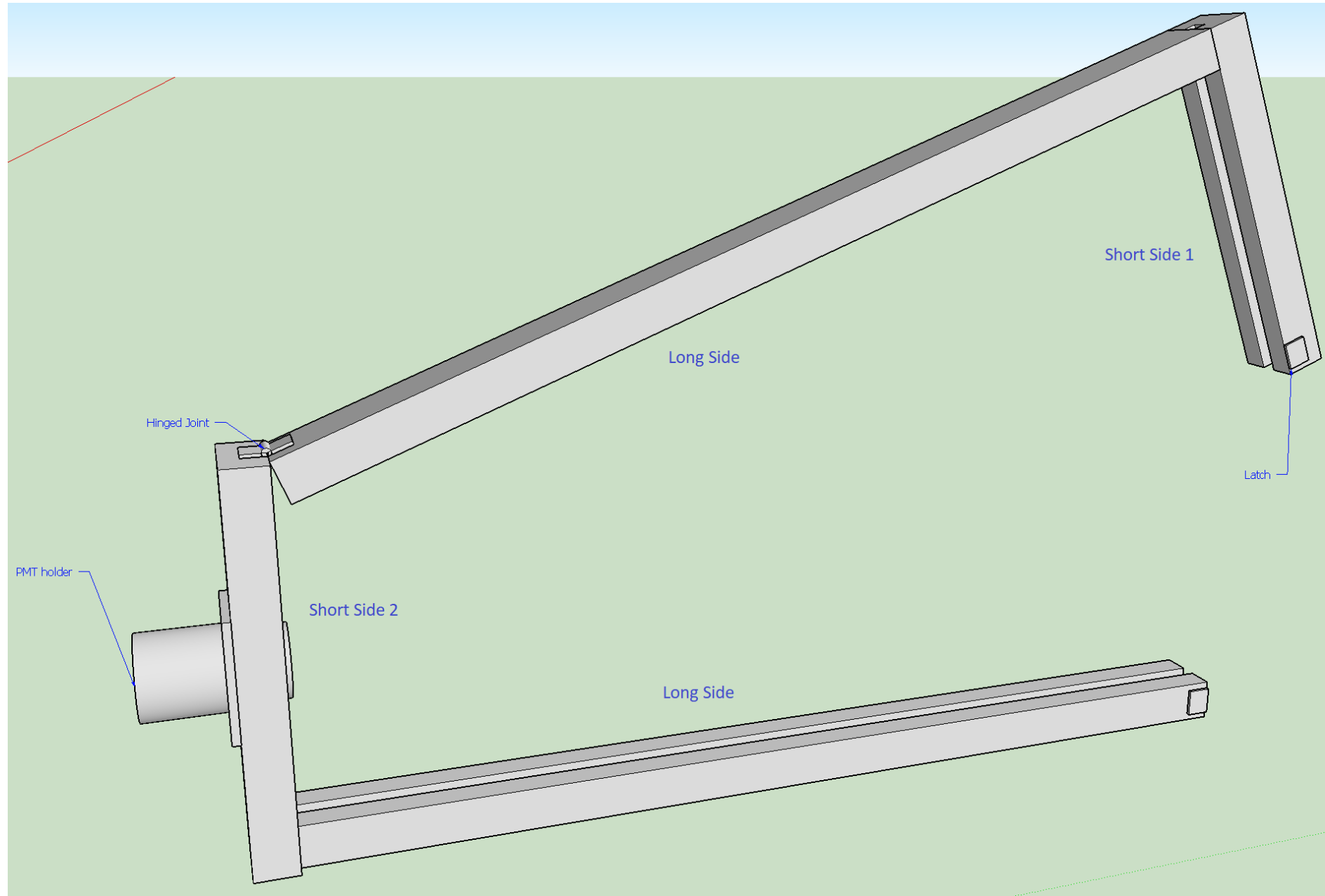


Thin tube side up



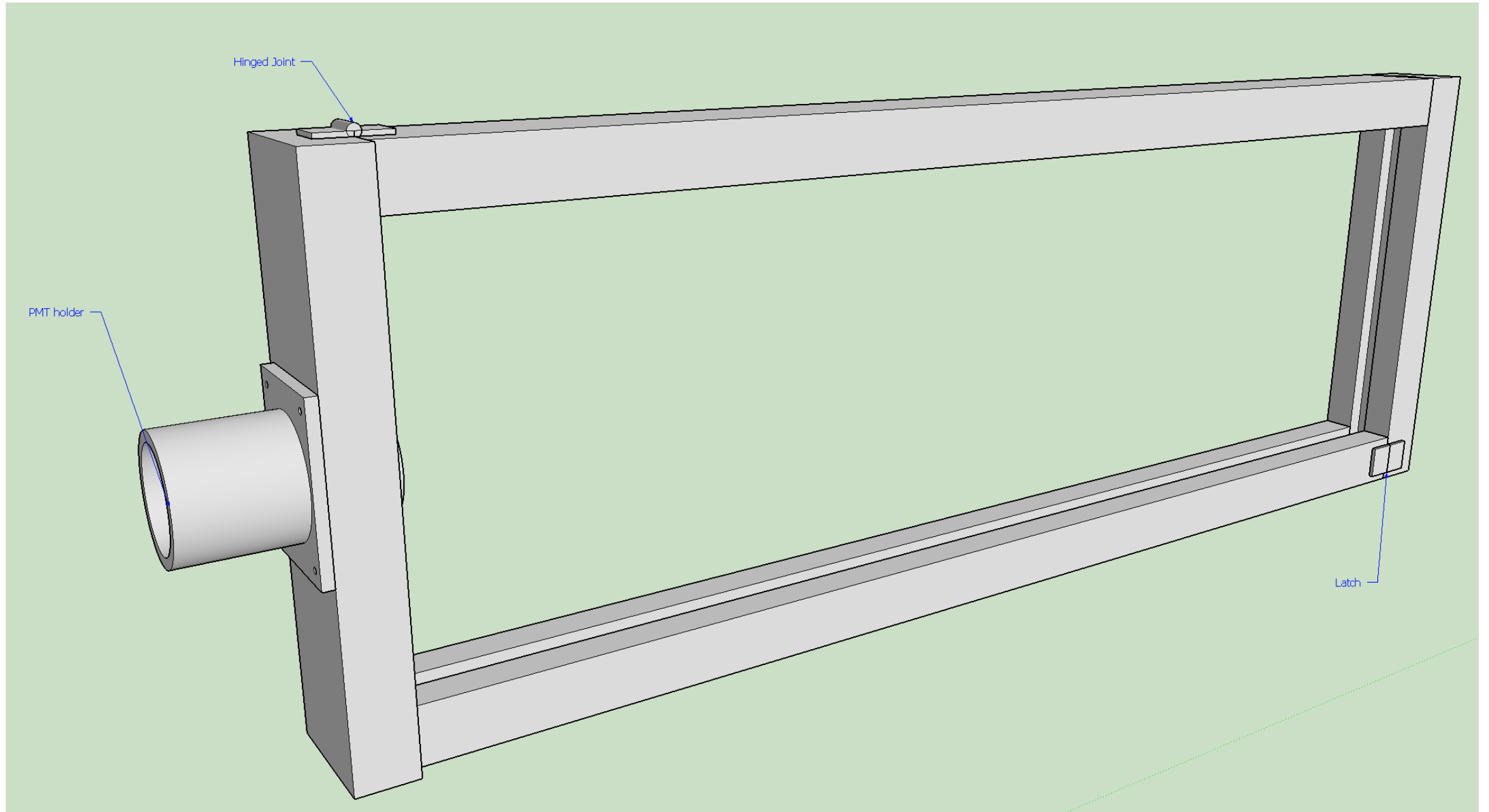
# Assembly

- The wooden components were arranged in two halves as follows, and the two rigid joints were secured to each other using 2.5" multipurpose screws.
- The two halves were joined using the hinge (and its appropriate screws).
- A latch was added where the two halves close together in order to secure them against unwanted movement and rotation.
- The PMT holder was mounted through the borehole in Short Side 2, and fastened using 1.25" screws.



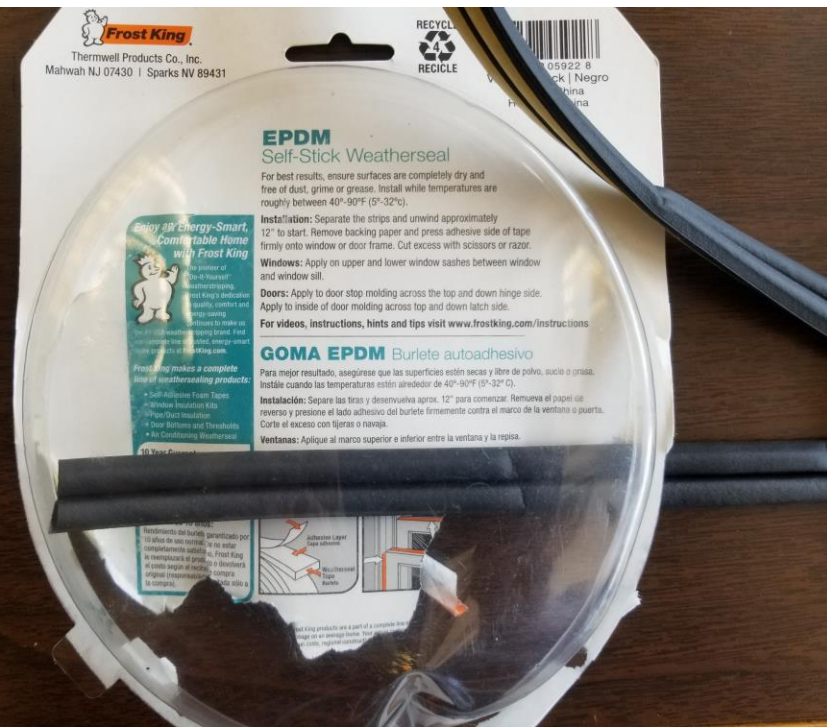


# Assembly (Closed)



# Assembly: Final Steps

- Two screw eyelets were inserted on either side of the PMT holder. These serve as attachment points for the straps that hold the PMT itself in place.
- Any overhanging components, such as too-long hinges, were cut down to size.
- Optional: weather sealant or other similar padding material can be applied to the trenches for extra protection or to account for discrepancies in scintillator panel sizes.



# Final Assembly (Closed)



# Cosmic Ray Telescope Frame (Empty)



# Cosmic Ray Telescope Assembly (w/ Wooden Scintillator Frames)

