Budget Justifications for The GlueX Central Drift Chamber

GlueX-doc-764 (version 1)

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1 Materials

1.1 The Kapton Straws

The straw material for the CDC has an inside diameter of 1.6 cm and a nominal length of 175 cm. They are made out of 10 inch wide strips of 3.0 mil thick kapton. While the prototype had 1000 Angstroms of vapor deposited aluminum, we would like about 2500 Angstroms for the final chamber.

The kapton material was purchased from Sheldahl at a cost of $ 8280 for 2000 linear feet of material. This was sufficient for about 1000 straws. To make about 3850 straws to allow for about 15% rejection, we will need about 7700 linear feet of kapton, which if costs scale from the original purchase, we arrive at a cost of $ 31878.

To make the straws, the kapton is wound (non-overlapping) on a mandrel and then couter wrapped in a 1 mil think tape. The straws were manufactured by Precision Products Group/Stone Industrial at a cost of $ 7565 for 940 straws. Extrapolating to 3850 straws yields a cost of $ 30984.

Based on these estimates, we anticpate a cost $ 62862 for for the total cost of all the straws.

1.2 The End Plates

The two endplates are each single item purchases. The upstream endplate is $9\,mm$ thick aluminum while the down stream endplate is likely to be a $\approx 4\,mm$ thick composite material. The plates are machined out of $60\,cm$ radius circular stock. Each plate has roughly 3300 wire holes drilled in them in precision locations. Of these, about $\frac{1}{3}$ are drilled at compound angles and counter bored to provide a flat surface for the pin holding the straw tube. The overall precision on the holes is at the $100\,\mu m$ level, which will be corrected to the $40\,\mu m$ level by measuring the location of each wire after the chamber is strung.

In addition to the holes for wires, there are on the order of 100 additional precision holes drilled for assembly and alignment as well as around 25 fiducial marks precision located on the plates.

1.3 Hole Location

After the chamber is strung, it will be necessary to measure the position of each of the wires at both ends of the chamber (relative to the fiducial points). This will require contracting with a vendor to come in and make these measurements.

1.4 Outer Shell Lips

The end plates will be attached to the outer shell of the CDC via a lip which is bolted onto outside face of the endplates at the outermost radius. These will be machines with groves to hold o-rings and holes through which the outer shell can be bolted.

1.5 The Outer Shell

The outer shell is anticpated to be a fiberglass tube which will acctach to the outer lips at each end of the chamber.

1.6 The Inner Shell

This shell needs to be a $176\,cm$ long, thin shell which will be glued to the inside edges of the the two endplates. This is not load bearing, and is mainly

to provide a gas seal at the inner edges of the chamber and present as little material as possible. The most likely scenario is a tube made from 10-mil thick mylar which has been formed to the correct diameter on a mandrel and then glued in place.

1.7 The Crimp Pins

The crimp pins are simialr to the straight pins used in region 1. However, we anticpate have a $\approx 100\,\mu m$ diameter hole in the middle. We nominally need about 7000 pins, but they all need to be checked for burs. With 50% rejection, we need about 10500 of these. Most such pins are purchased from MEDELEC in Switzerland.

1.8 The Plastic Pin Holder

The crimp pins sit is an injection molded plastic piece that has a precision hole in the center to hold the pin, and three holes to allow gas through the ends. As with the pins, we need approximately 7000 of these, and allowing for 50% rejection, this goes to 1000 pieces.

1.9 The Donut Assembly

The upstream and down stream donut assemplies are similar, but not the same. In particular, the upstream is aluminum and the downstream is delrin. Each one consistes of two pieces which can be turned out on a numerically controlled machine using round stock material. About 4000 of each piece is needed.

1.10 The High Voltage Distribution Boards

These boards will match the channel count of the preamplifier. Assuming 24 channels per board, we anticpate 140 of these plus 25 spares gives is 165 boards. Based on experience with the prototype, the boards can be made for about $ 15 each. The resistors, capacitors and High-voltage connectors exist at CMU and the connector for the preamplifier is about $ 5 per piece. There are 26 capacitors and 50 resistors per board that need to be attached. A vendor with a machine like was purchased for IU could do the boards for

$ 15 each, leading to a per board cost of about $ 35. The total cost for these boards for the CDC is $ 5775 .

1.11 Preamplifiers

There will be 140 preampliers used in the CDC. With spares, we anticptae needing about 165 of these.

1.12 The High Voltage Cables

There are about 140 High Voltage cables that come off the end plate of the CDC and go into a High Voltage system. We anticpate that these will be multiplexed so that all the tubes can be driven by about 20 High voltage pods.

1.13 The Signal Cables

There will be 140 signal cables

1.14 The Gas Flange

The upstream and down stream flanges are made out of plexiglas. The most difficult part is the feedthroughs for the 3300 channels of electronics. This still needs to be designed.

1.15 The Chamber Rails and Rollers

1.16 The Alignment System

The initial alignment of the chamber will involve pins on the downstream endplate that seat in the stops on the chamber rails. This will allow us to restore the position to an accuracy on the order of 1 millimeter. A survey of the the fiducial marks can then be used to determine where the chamber is to a higher level of accuracy. Finally, the relative alignment along the beam line can be assessed using a laser system with reflectors mounted on the down stream end plate.

1.17 Assemply Equipment

Assembpl of the chamber will take place in a temprary clean room that will be erected at Carnegie Mellon. The chamber endplates will be attached to an axle (already exists) that can be suspended vertically for installation of the tubes and stringing the wires. In addition to the axle, rods will need to be installed that hold the two endplates relative to each other.

2 Construction of The Final Chamber

References