The CDC

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Physics Requirements and Specifications

Prototype Construction and Status

Final Chamber Construction

Software

Summary

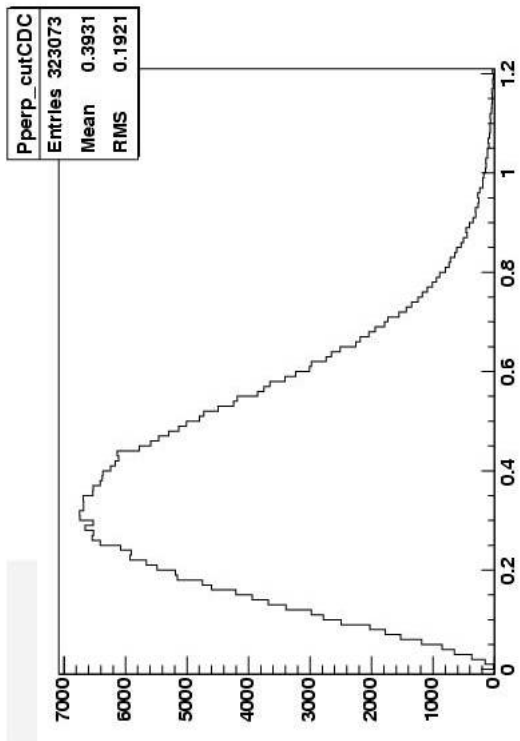
Physics Requirements

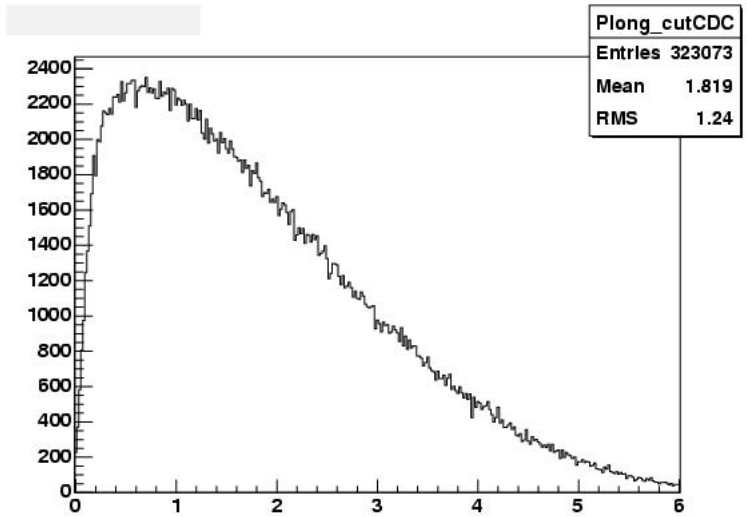
99% Charged particle acceptance
97% Photon acceptance

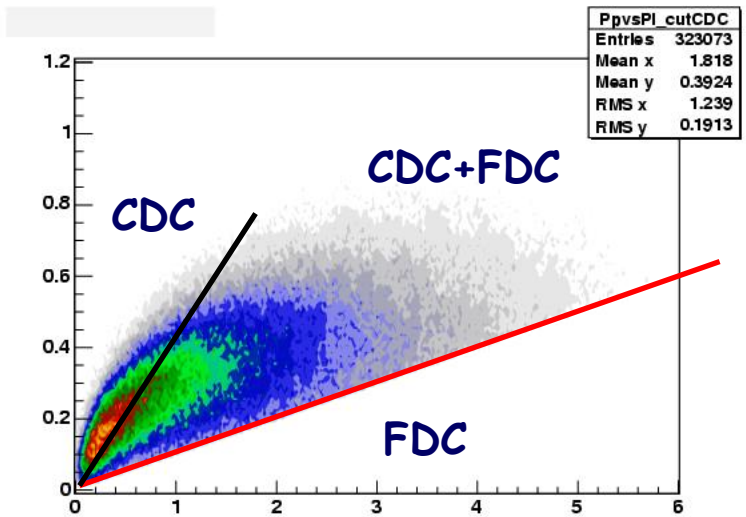
$\eta_1 \rightarrow 5\pi$
$\pi_1 \rightarrow \eta\ 3\pi$
$\pi_1 \rightarrow \omega\ 2\pi$
$b_2 \rightarrow 5\pi$
$h_2 \rightarrow \omega\ 2\pi$

Momentum of tracks in the CDC

$\gamma p \rightarrow \eta_1(1800)p \rightarrow 2\pi^+2\pi^-\pi^\circ p$







Chamber Resolution

To achieve the overall momentum and vertex goals of the experiment, the CDC needs to achieve:

$\sigma_{r\phi} \sim 150\mu$ m $\sigma_z \sim 2$mm

Stereo Layers $\sigma_z = \sigma_{r\phi}/\tan(\theta_{st}) \sim 1.4$ mm

Charge Division $\sigma_z \sim 1.5\% (2L) \sim 6$ cm

Sweep time should be as short as possible ~600-700ns

Electrostatics need to be very well understood and regular due to the large Lorentz Angle

Chamber Mechanics

In order to fully combine both the FDC and CDC for tracking, the material in the downstream end-plate of the chamber needs to be minimal.

Sense Wires: ~3500 ~70 gm tension 245kg

Straw Tubes are sufficiently rigid to fully support this load.
Straw Tubes provide very uniform electric fields
Garfield studies show that we can achieve the drift time limits.

Guard Wire Option: ~14000 ~200 gm tension 2800kg
Endplates and shells would need to be thick to support this!
Probably more than 4 per sense wire to get a uniform field.
Corners in the cells will produce large drift times.

Chamber Design

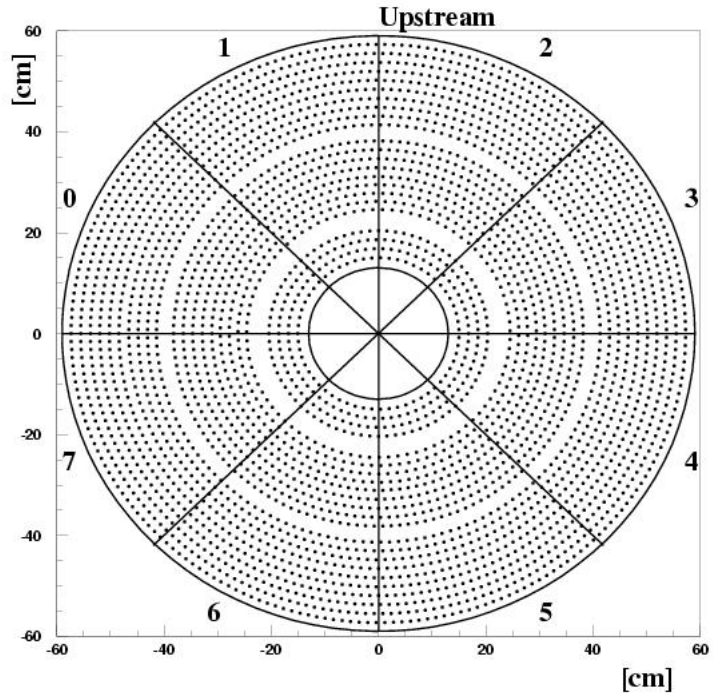
Active Length 2m long

Upstream Endplate:
0.95 cm thick Al tooling plate
Al donuts
All Electrical Connections

Down stream Endplate:
0.50 to 0.60 cm thick
Delrin donuts
Possible Termination Circuits

Inner Shell:
Thin Carbon fiber – mostly protection

Outer Shell:
Carbon fiber or Fiberglass
Alignment and protection



23 Layers from 14cm to 59cm

Layer 1-4	Straight
Layer 5-6	+6° stereo
Layer 7-8	-6° stereo
Layer 9-13	Straight
Layer 14-15	+6° stereo
Layer 16-17	-6° stereo
Layer 18-23	Straight

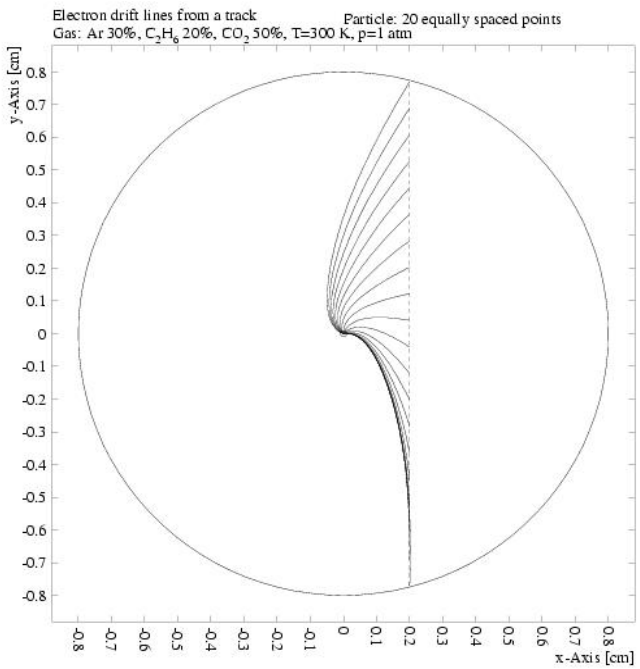
3250 Wires

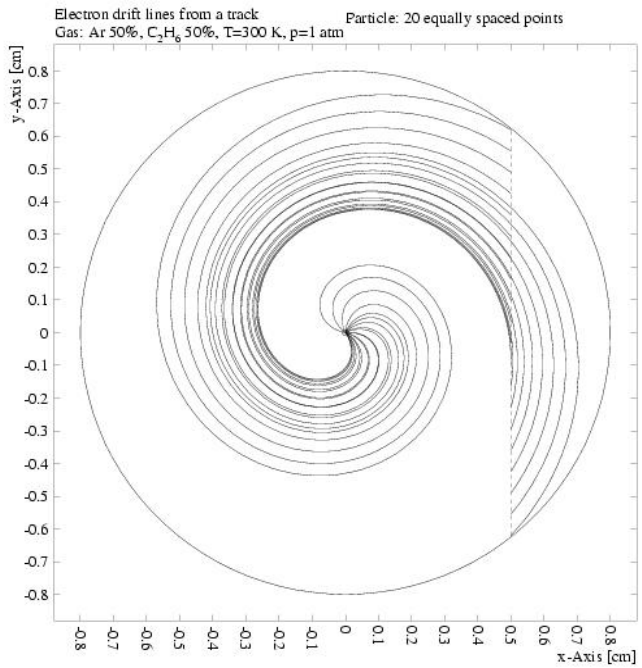
Gas Mixtures and Lorentz Angle

Slow Gas, small Lorentz angle.

LIVE HERE

Fast Gas, large Lorentz angle





Prototype Construction

The difficult part of the straw-tube chambers are the 6° stereo layers. Every step involving these has been a challenge with its own problems to solve.

Compound angles in machining of the endplates.

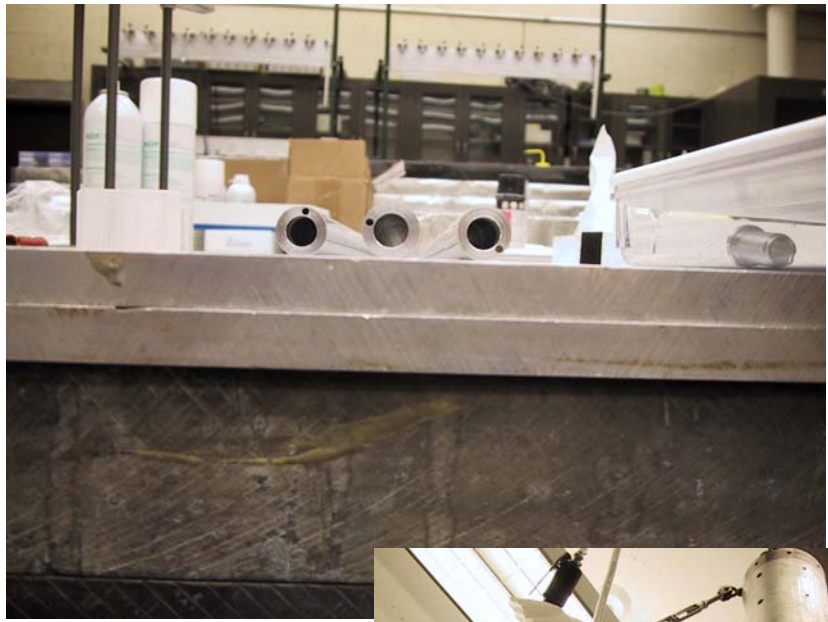
Aligning tubes in the chambers.

Gluing tubes together for structural support.

Better Clamshell clamps will be needed for the final chamber.

Electrical and Gas Hook-ups are next.

Prototype



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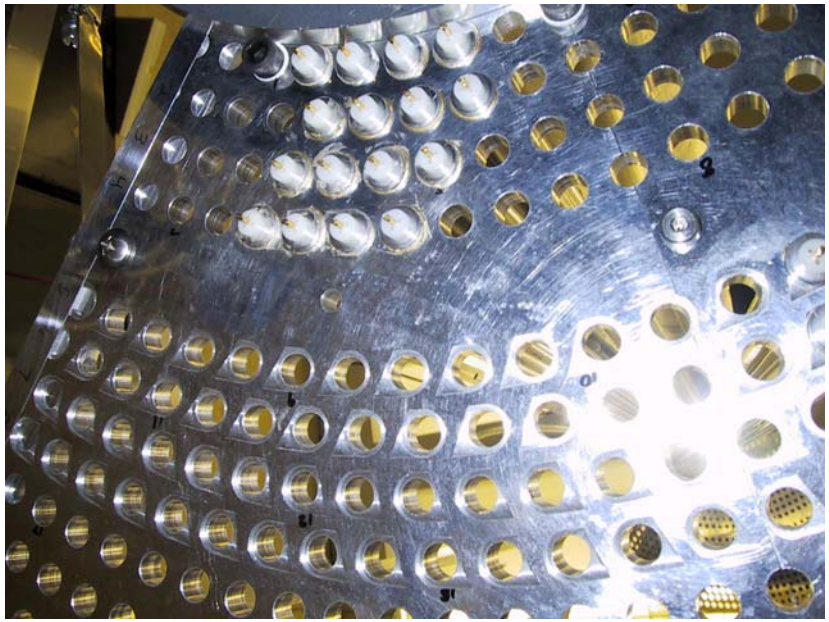
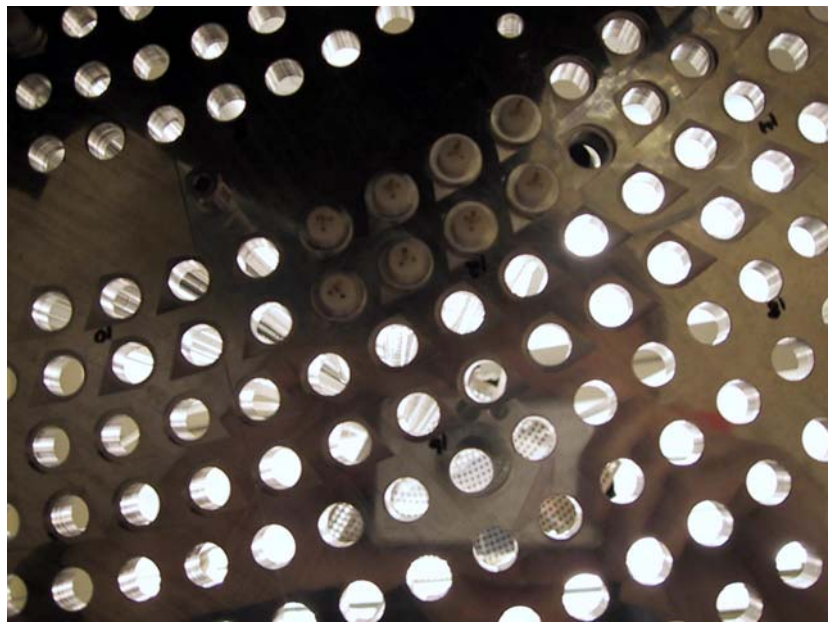


Straight Tubes

Stereo Tubes



Prototype Testing

Wire tensions are accurate and reproducible. We still need to do long-term stability tests.

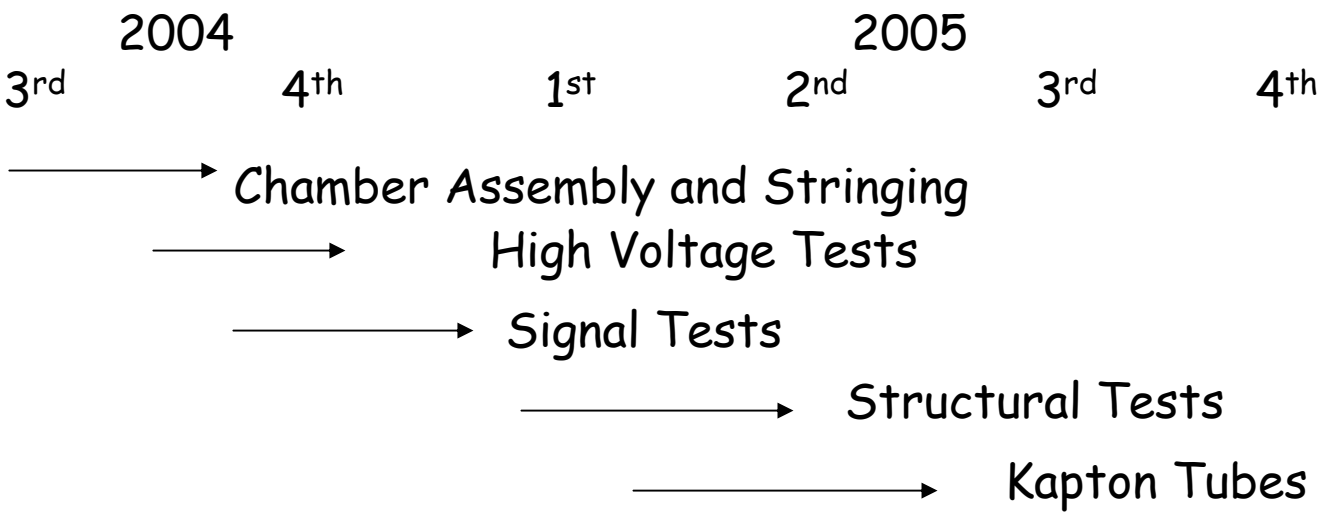
Mechanical Robustness tests will start as the chamber is taken off the stringing stand.

We are close to being able to perform high-voltage and signal tests.

Prototype Schedule

We are very close to starting electrical tests on the chamber.

We still want to test Kapton tubes, but they are at least a factor of three more expensive than the Mylar ones. We are also likely to need to place an order for about $\frac{1}{4}$ of the tubes in order to get a sample to test, ($20,000).



Final Chamber

Machine Endplates in industry
Acquire Shells
Machine Al and Delrin Donuts
Acquire Crimp pins
Acquire Straw tubes
Acquire Wire

} Parts need to be spec'd, ordered and checked.

Tube building takes about 15 minutes per tube (1 person)

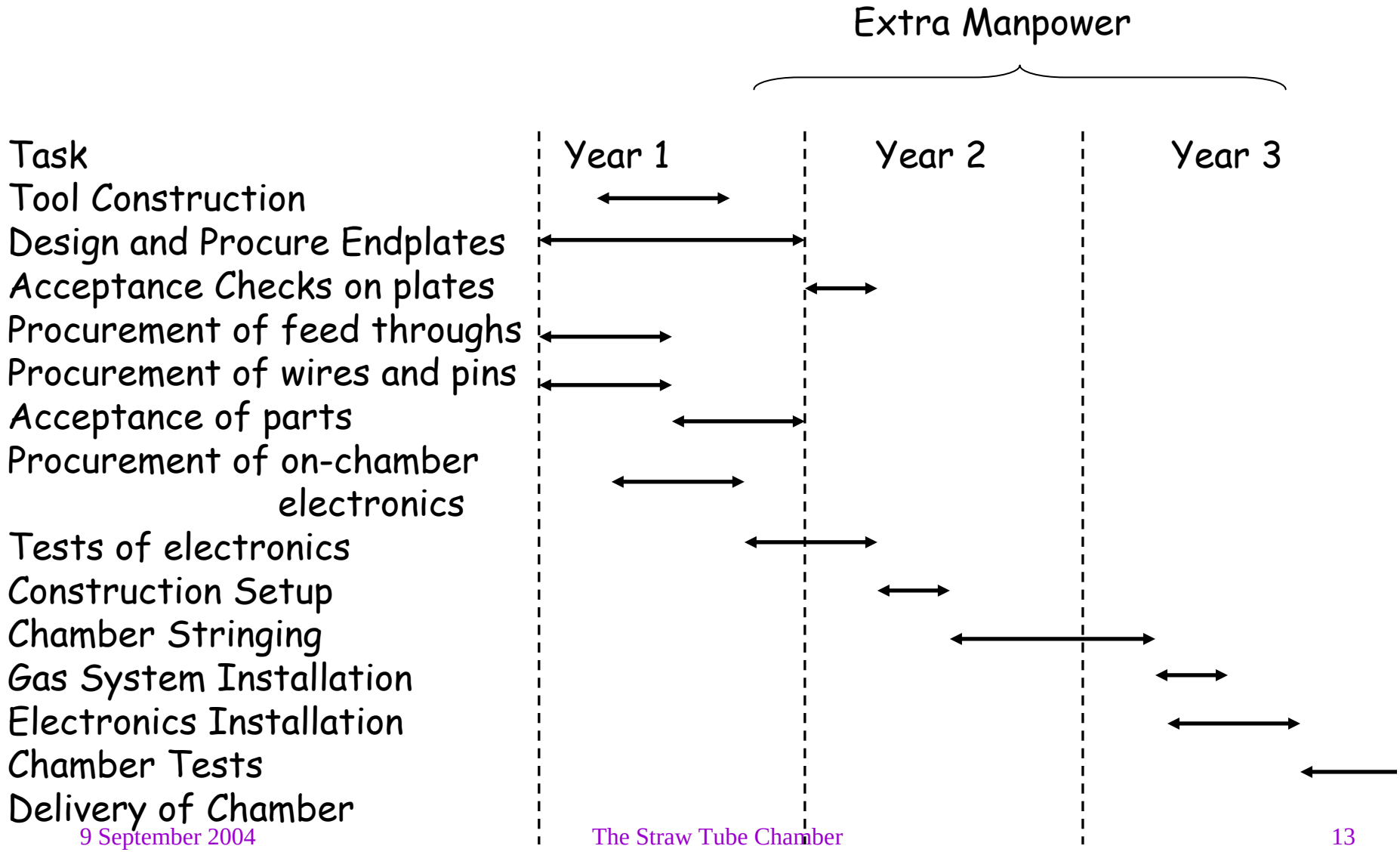
Tube installation takes about 15 minutes per tube (2 people)

Tube stringing takes about 15 minutes per tube (2 people)

Electrical and gas hookup times are still not definitive.

Chamber Schedule

Best estimate is 3.5 years from start of procurement to delivery



Simulations

Detailed GARFIELD simulations have been carried out for the CDC, and information on a number of potential gas mixtures have been cataloged.

Detailed Acceptance studies using HDFast have been carried out for the combined CDC/FDC system, and show that for typical channels with exotic Hybrids, we have about 99% of 4π acceptance for charged tracks.

A very detailed description of the CDC is in HDGEANT, but we have not written digitization routines yet.

Until we have reconstruction software, I don not see a need for additional simulations at this point in time.

Chamber Software

The tracking software for both the CDC and the FDC needs to be developed as one common package that can treat all the hits from Both chambers in a consistent fashion.

As soon as the chambers are in Geant, we should start developing this package.

Summary

The CDC together with the FDC forms a complete tracking package for the GlueX detector that covers roughly 99% of 4π .

The most challenging construction detail of the chamber is The stereo layers.

There are still some issues with aligning tubes and the likely use of Kapton tubes.