

Ideas on Improving a Straw Tracker Construction

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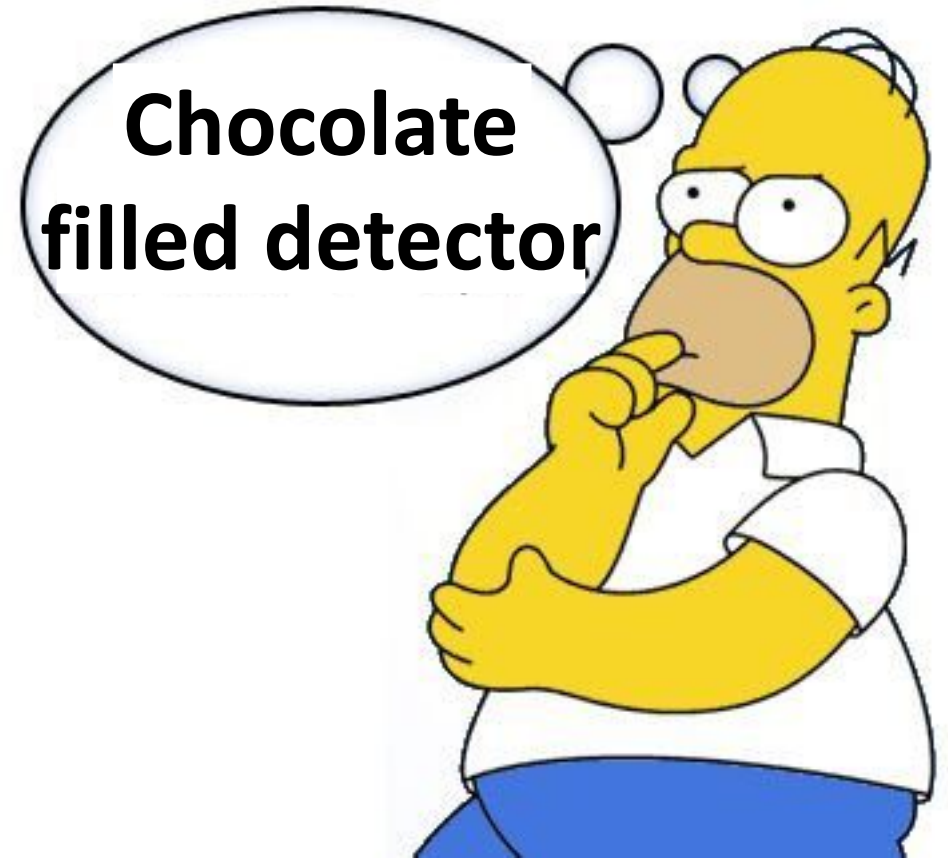
Motivation

We have learned a lot of lessons from constructing the Mu2e tracker and additional expertise.

I've been talking with a few people both in the tracking group and outside to generate ideas for improving construction for Mu2e-II.

This talk is to get some of these ideas out there for discussion.

Now is a good time for outlandish ideas.



Handling Straws

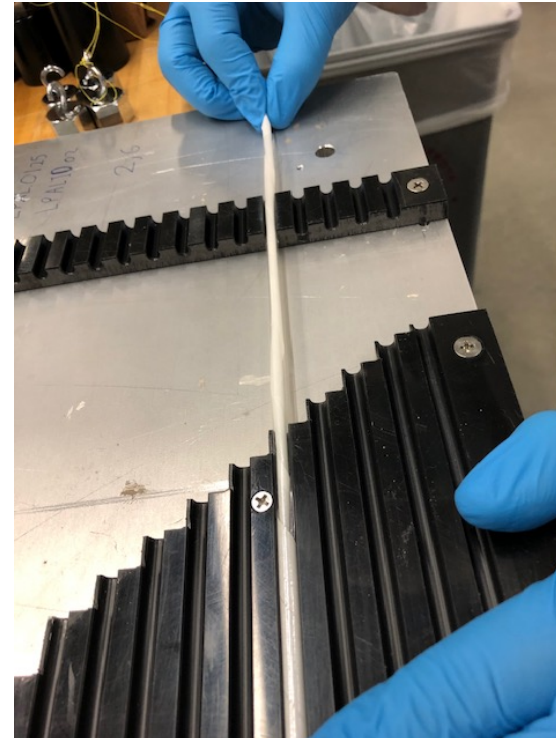
It has only felt safe to handle the 8 μm straws with internal outward force:

- Paper is inside
- Straws are inflated

Without either they collapse under own weight or static.

Almost no compression force can be applied which makes installing terminations difficult.

If allowed to be rough with ends (will not be part of detector), sealing terminations can be installed and the straws inflated.



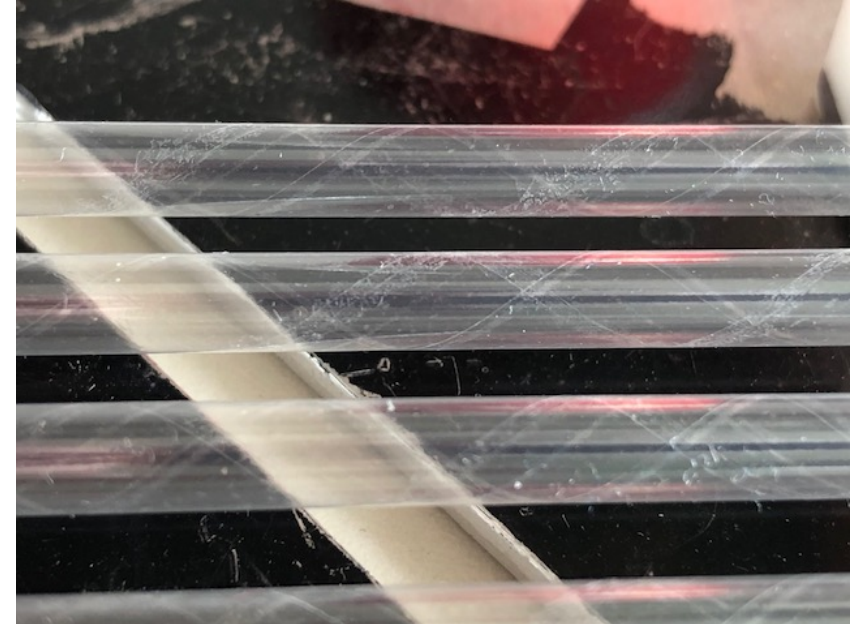
Installing Inflated Straws

With minimal inflation the straws are quite easy to handle.

Leaving straws inflated prior to installation is a good continuous leak test.

I would like to make a prototype, where we:

- Install straws inflated under tension
- Epoxy in place
- Cut off ends
- Install terminations into open straw ends



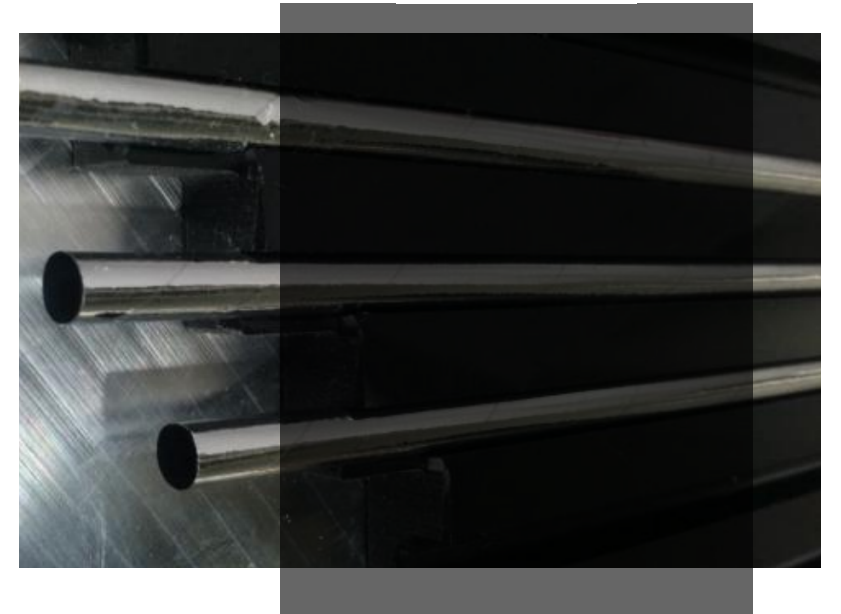
Inflated 8 μm Mylar Straws

Pull Vacuum around straws

If we put a vacuum around the straw we get the straws to be both rigid and have access to the open end to install wires and terminations.

Sealing the vacuum around the straws is the real problem. In order to make the seal, we would probably need to inflate the straw or have the paper inside.

Putting the straws under tension and epoxying them would probably accomplish the same thing without building a vacuum container, but doing this before removing the paper could be promising.



Vacuum applied around straws

Stretch Coefficient

Did a rough experiment on inflated straws to get idea of stretch coefficient and elasticity region.

Stretch Coefficient was 4 ± 0.5 (mm/m) at 400 grams.

Consistent with previous Mu2e straws.

At 500 g a clear warping of the straw was observed afterward.

Stretch is very similar to tungsten wire. People have been interested in installing wire before tensioning.



Unexpected behavior as tensioning off axis significantly warped straw

Self-centering Terminations

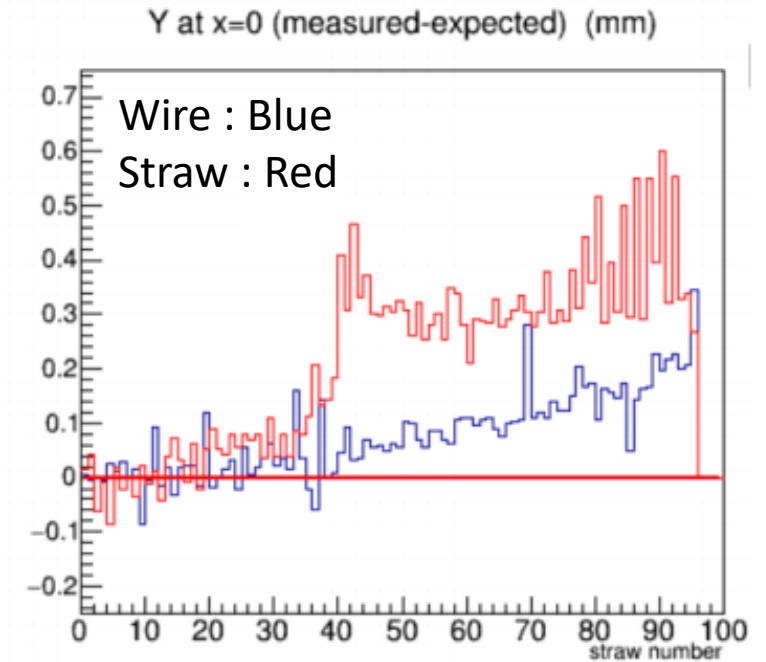
In Mu2e, the alignment of straw and wire centers has been more difficult than initially expected.

Tom Chase designed a termination which would self-center the wire and hold the pin more securely, however it came too late to be implemented for Mu2e.

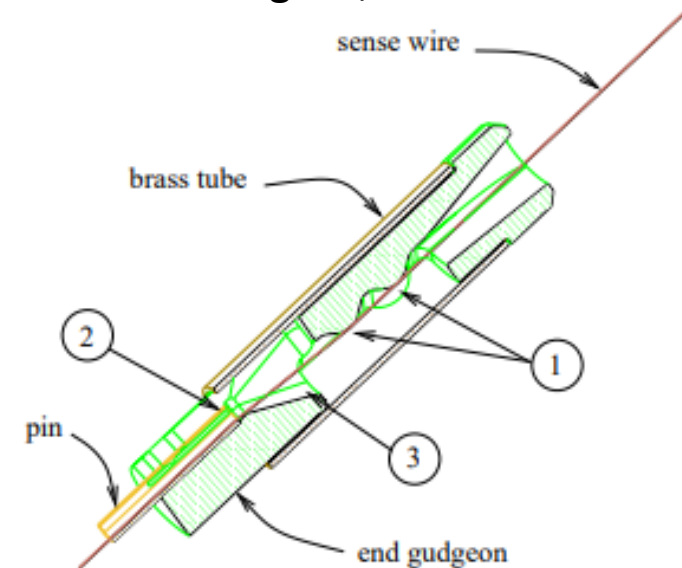
I have heard Atlas also used self-aligning helical terminations. *Couldn't find an image though

Other terminations improvements could include :

- Pin being molded into the termination
- Crimping versus Soldering



Seog Oh, Duke



Tom Chase, UMN

Material Budget

Our main focus on improving resolution has been to reduce the material budget of the detector.

Mylar is our largest component, hence the thinner straws.

Other topics that have been discussed :

- **Removing Gold inside straws**
- **Changing gas**
- **Reducing gas pressure**
- **Different wire material**
- **Optimize straw size**

Component	Key Dimension	Density (g/cm ³)	Cross section (cm ²)	X ₀ (g/cm ²)	L _p /X ₀	Fraction of Total
Mylar	15 μm	1.4	2.36E-03	40.00	1.32E-04	67.1%
Aluminum	1000 Å	2.699	1.57E-05	24.01	2.83E-06	1.4%
Gold	200 Å	19.3	3.14E-06	6.46	1.50E-05	7.6%
W (25μm)	25 μm	19.3	4.91E-06	6.76	2.24E-05	11.4%
Argon	80%	0.00133	1.96E-01	19.55	2.13E-05	10.8%
CO ₂	20%	0.00037	1.96E-01	36.20	3.19E-06	1.6%
Total (one straw)					1.97E-04	

Table 1. Composition of a straw.
From Mu2e Tracker Geometry Docdb#888

The reduced Mylar walls will make construction harder. Other ways of reducing material might not make initial construction harder but further work needs to be done to judge their effect downstream.

Conclusions

- **The thinner straws will be a challenge for construction, one that will hopefully be met with creative ideas.**
- **Some of these ideas should be investigated in the Snowmass preparations, others probably don't need to be looked at until much later in the Mu2e-II process.**

Let's take some time to discuss and open the floor to anyone's ideas.