



FERMI NATIONAL ACCELERATOR LABORATORY  
Mu2e: muon-to-electron conversion experiment  
*14 august 2014*

## Optimization of the T-Tracker Detector Mechanical Structure for Mu2e

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# Training program

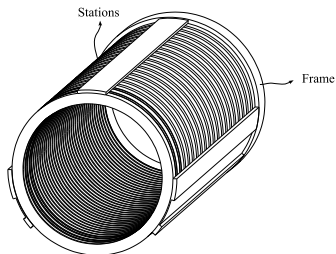
## Training program

- Assist with the optimization of the panel design of the T-tracker.
- Support the advanced design of the T-tracker structure.
- Assist in the development of conceptual designs related to the panel installation activities.

## Specifications

- The maximum vertical displacement of the T-tracker frame,  $\delta_y$ , should be less than 1.00 mm.

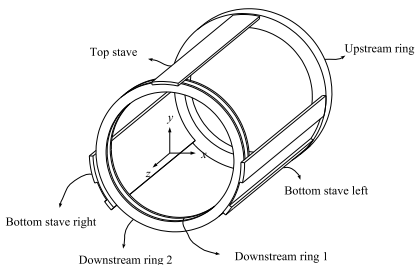
# The T-Tracker



## The T-Tracker

- Part of the Mu2e experiment.
- Tracker composed by 20 stations.
- The stations have to be supported by a frame.

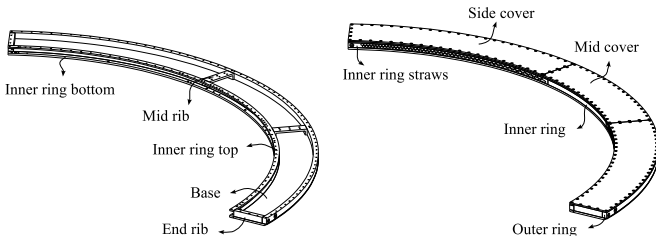
# The frame



## The frame

- Only load: stations weight.
- Supports: four bearing blocks on rings.
- Frame composed by six different parts.

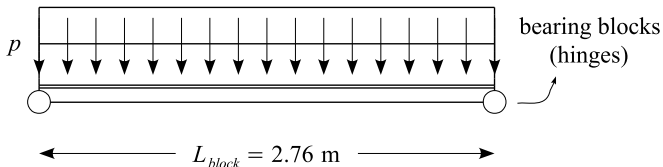
# Load analysis



## The weight

- Every station is composed by 12 panels.
- Weight of a panel:  $m_{panel} = 6.7 \text{ kg}$ .
- Weight of the whole Tracker:  $m_{tot} = 1.74 \cdot 10^3 \text{ kg}$ .

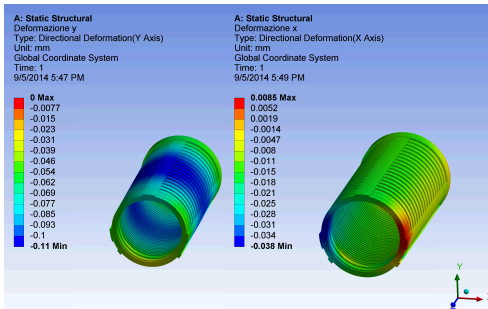
# Analytical model



## Analytical model

- Bottom staves modeled as one beam.
- Load  $p$ : linear distribution of Tracker's and frame's weight.
- Vertical displacement:  $\delta_y = \frac{5}{384} \frac{pL_{block}^4}{E_{AI}J_x}$ .

# FEM analysis

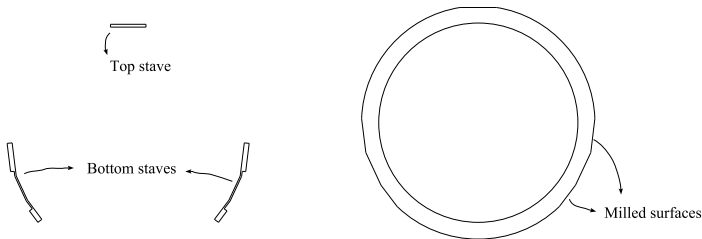


## FEM analysis

- Simplified geometry of stations.
- Frame made from Aluminum.
- Maximum vertical displacement:  $\delta_y = 110 \mu\text{m}$ .



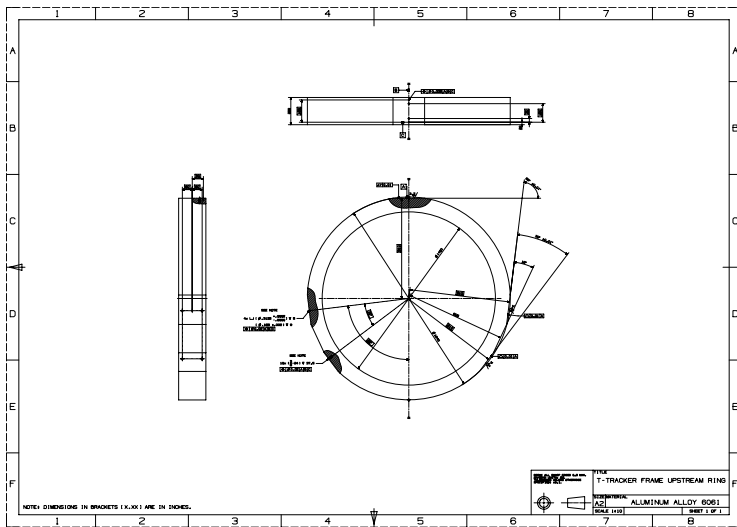
# Frame section



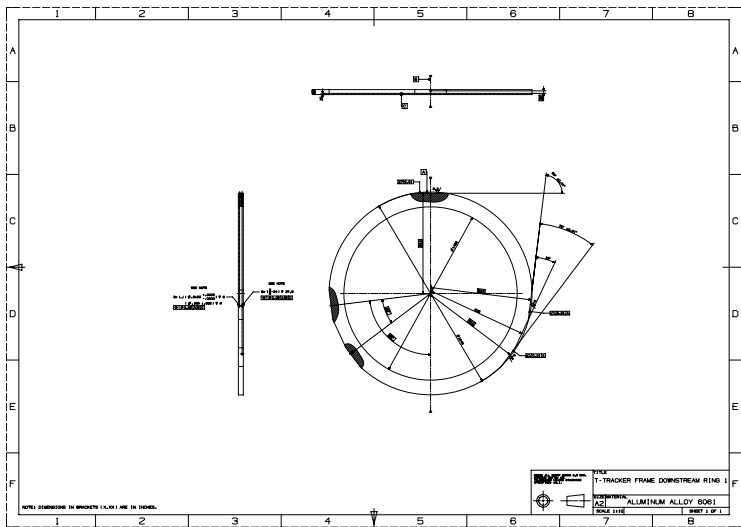
## FEM analysis

- New geometry in order to have less costs of production.
- Milled surfaces on the rings used as references surfaces.
- Mechanical drawings given to machine shops to have an estimate of costs.

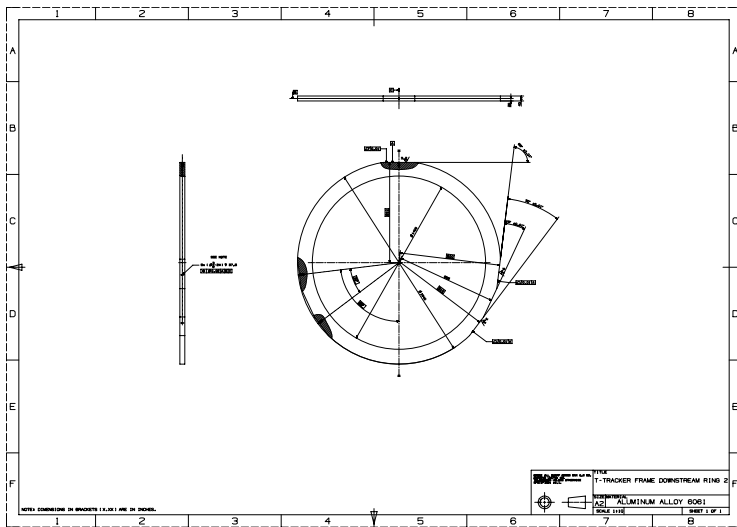
# Upstream ring



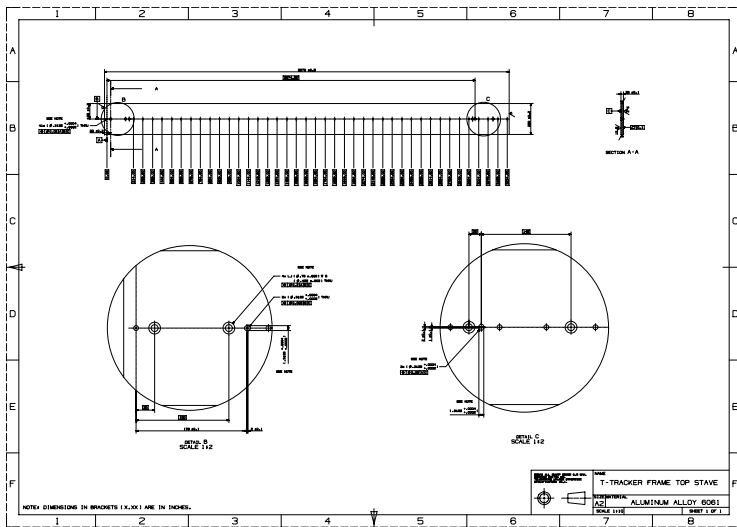
# Downstream ring 1



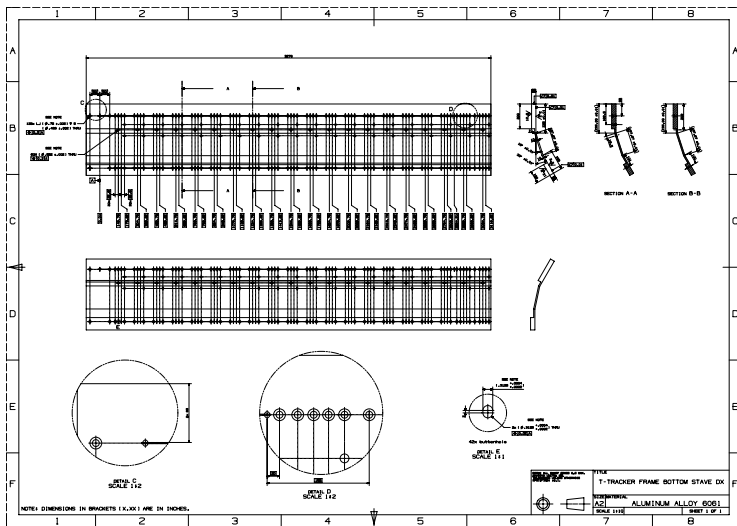
# Downstream ring 2



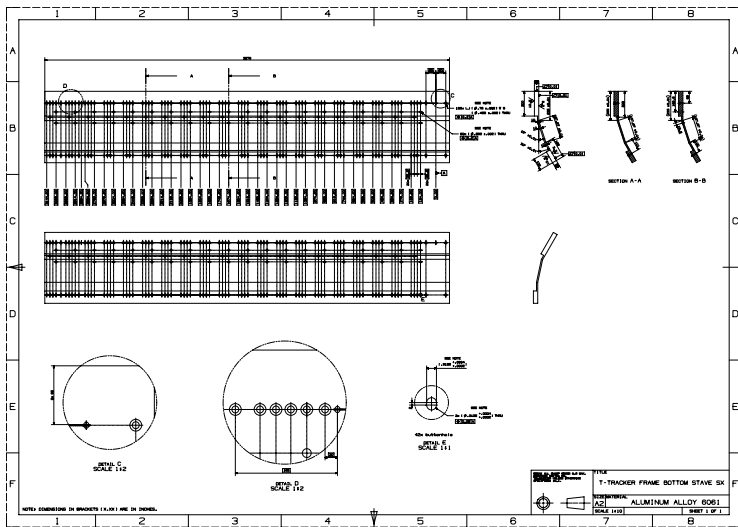
# Top stave



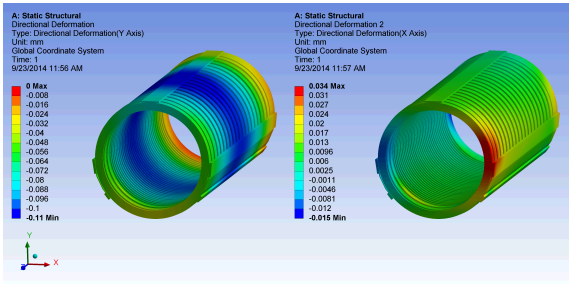
# Bottom stave right



# Bottom stave left



# FEM analysis



## Final FEM analysis

- Maximum vertical displacement:  $\delta_y = 120 \mu\text{m}$ .
- The maximum displacement follows the specification.
- There is still the possibility to reduce the section of the staves.



# Conclusions

## Conclusions and next steps

- Has been realized the structural analysis of the frame.
- Has been studied the technological feasibility of every part of the frame.
- The drawings have been delivered to the machine shop for an estimate of the costs.
- It will be necessary to design of the production of the prototype of the frame.