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### 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 pro	gram			

### 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.

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The T-Track	ker			



## The T-Tracker

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

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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

- Bottom staves modeled as one beam.
- Load p: linear distribution of Tracker's and frame's weight.

• Vertical displacement: 
$$\delta_y = \frac{5}{384} \frac{pL_{block}^4}{E_{Al}J_x}$$
.

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FEM analysis				
	A: Static Structural Deformazione y Type: Directional Deformation(Y Axis) Unit: mm Global Coordinate System Time: 1 9/5/2014 5-47 PM	A: Static Structural Deformazione X Type: Directional Deformation(X Axis) Unit: mm Characteristic System Time: 1 9/5/2014 5:49 PM		

0.0085 Max

0.0019

-0.0014

-0.004

-0.008

-0.011

-0.015

-0.018

-0.021

-0.025

-0.028

-0.034 -0.038 Mir



- Simplified geometry of stations.
- Frame made from Aluminum.

0 Max

-0.023

-0.031

-0.039

-0.046

-0.054

-0.062

-0.069

-0.077

-0.085

-0.093 -0.1 -0.11 Min

-0.0077

• Maximum vertical displacement:  $\delta_y = 110 \,\mu\text{m}$ .



### 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.

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## Upstream ring



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## Downstream ring 1



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## Downstream ring 2



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## Top stave



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## Bottom stave right



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## Bottom stave left



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### 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.

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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.