RICH assembly, installation and commissioning

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RICH: Assembly and Installation

- **Assembly and Installation procedures have been discussed and revised several times and approved by JLab engineers**

- **The RICH mechanic structure is made by aluminum and Carbon fiber**

It has been constructed in Italy by "Tecnologie Avanzate srl"
A full assembly test has been performed (is being performed) before shipping
All the material will be packed and delivered to JLab in separate boxes by the summer and stored before the start of the assebly

- **The inner components are produced by companies worldwide**

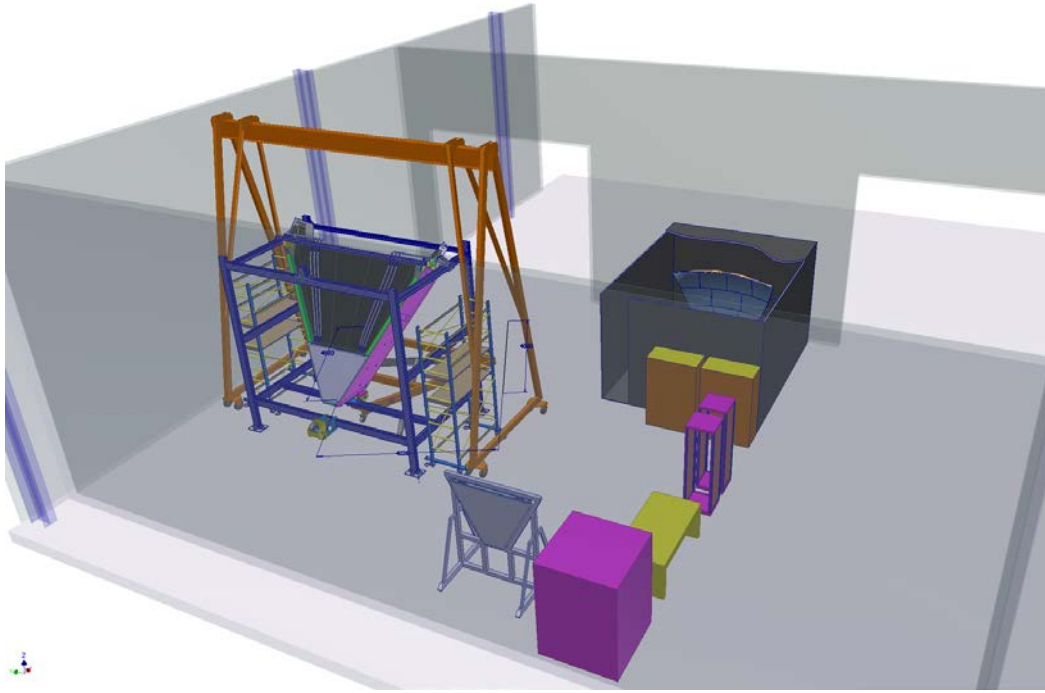
- **Planar mirrors in Italy**
- **Spherical mirrors in USA**
- **Aerogel in Russia**
- **MAPMTs in Japan**
- **Electronics in France**

All the elements are shipped to JLab and tested for acceptance, then fully characterized.

RICH assembly effort

The job is performed in the EEL-124 clean room starting in October 2016

1. **RICH assembly structure**
   - **anchoring to the floor**
   - **verify alignment**
2. **RICH mechanics structure**
   - **verify positions with laser tracker**
   - **compare with assembly test data**
3. **Inner elements**
   - **planar mirrors**
   - **electronic panel**
   - **aerogel**
   - **closing panels**
4. **Parallel works**
   - **assembly of the electronics and tests, including services**
   - **alignment of the mirrors**
   - **assembly of the aerogel wall**



Completion of the assembly by summer 2017

Job performed by INFN personnel with support from JLab for handling gantry-crane and lifting tools

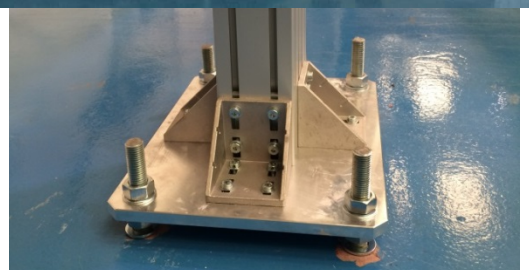
Operation Procedure documents will be produced before starting the jobs

RICH assembly structure

Rotation tools

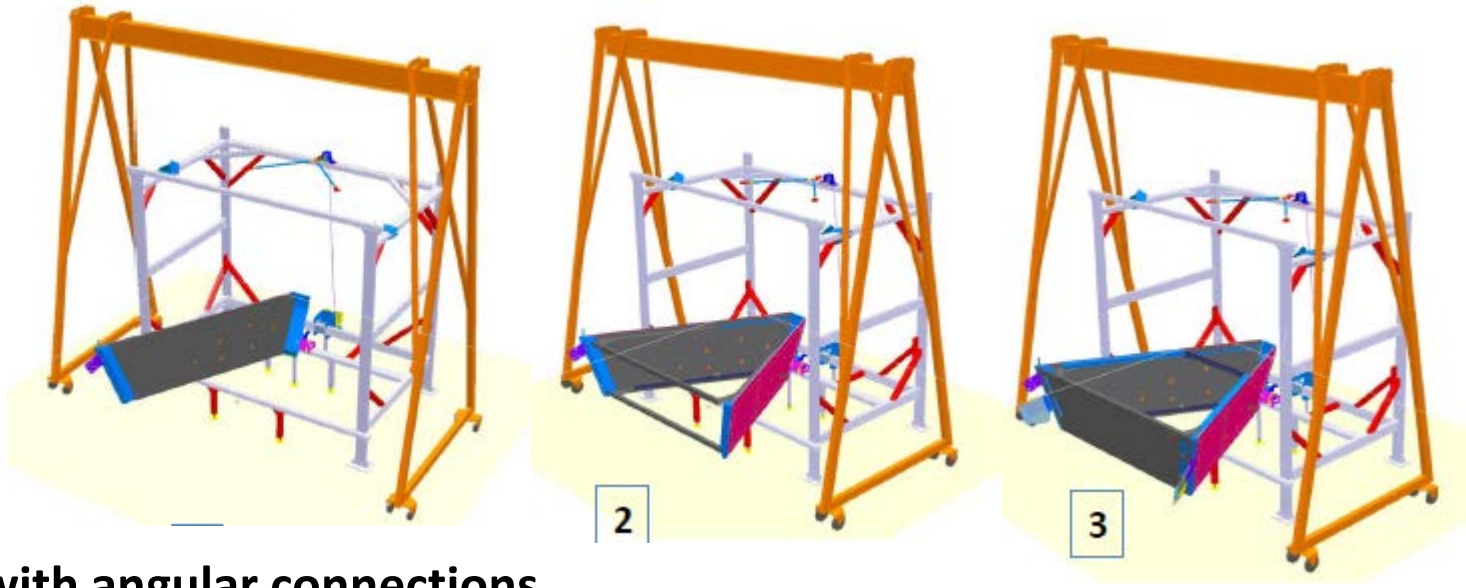
FEA calculations to dimension the structure
Assembly and alignment performed by INFN personnel
Support from JLab for handling of the components

Anchoring platform with bolts



RICH assembly - 1

Start of assembly operation in horizontal position



1. Bottom plate
2. Lateral panels with angular connections
3. Top panel
4. Stiffening ribs

Gantry crane and lifting tools to handle the components

- total weight ~600 kg
- heaviest components: lateral panels (~120 kg)

After completion the RICH is rotated in vertical position

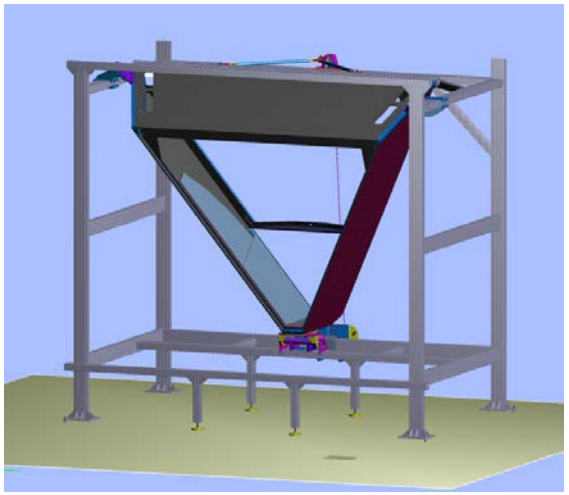
A first geometric survey can be performed using laset tracker targets placed on the RICH box

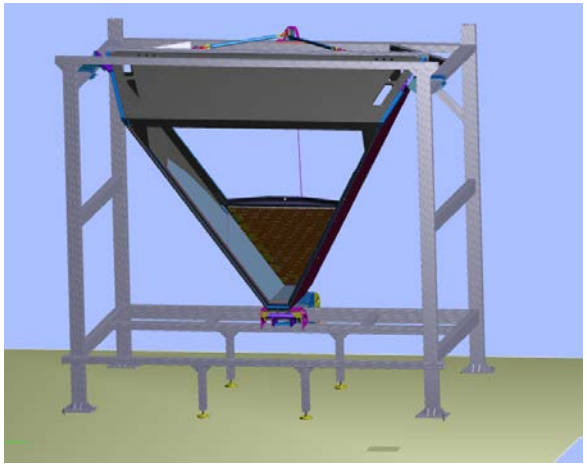
RICH assembly - 2

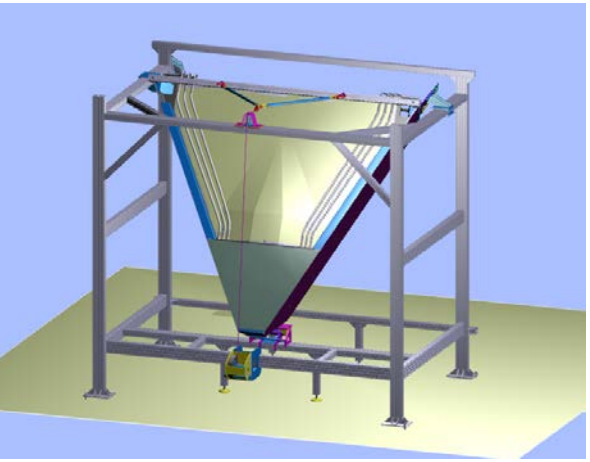
RICH in vertical position

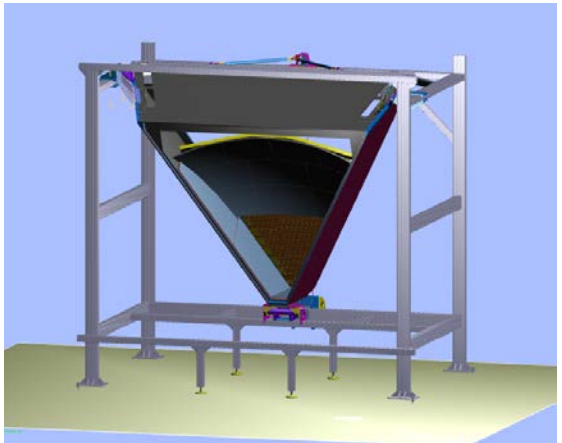
1. **Bottom and lateral mirrors**
2. **Electronics panel, cabling**
3. **Spherical mirror**
4. **Frontal panel with flat mirrors and aerogel**
5. **Backward panel**
6. **Survey of the module**

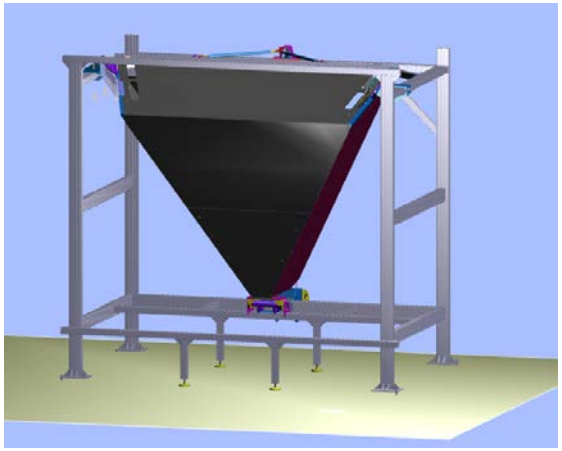
INFN responsibility with JLab support for handling of the components and for survey











Parallel assembly: aerogel

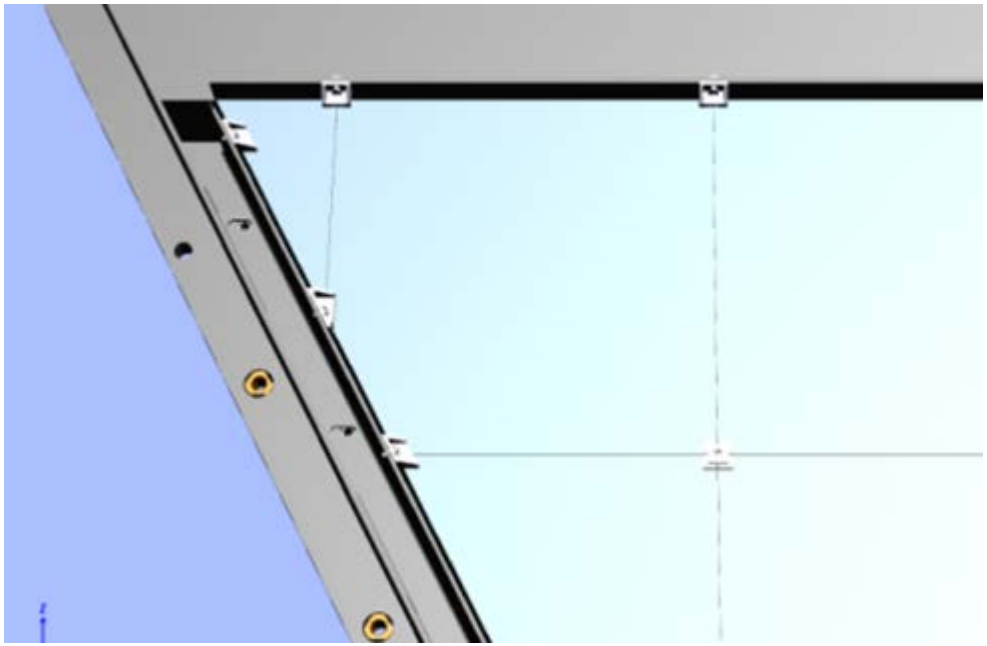
Last assembly job to be completed before RICH sealing

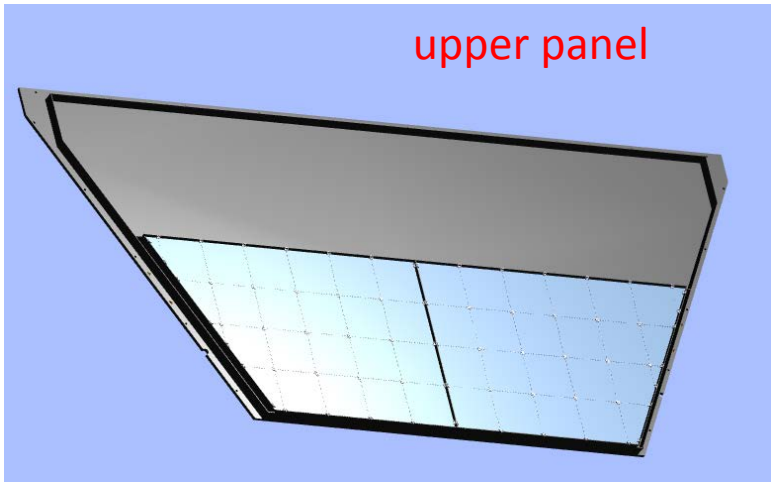
- **3+3 cm in the upper part**
- **2 cm in the lower part onto the planar mirrors**

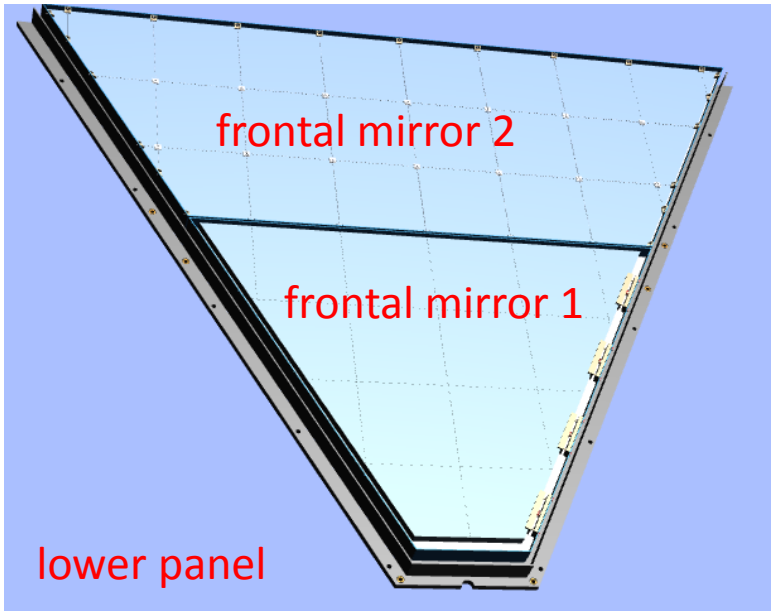
Assembly performed by INFN

The RICH handling must avoid to have the aerogel hanging down

A double system of wires and pushers has been designed



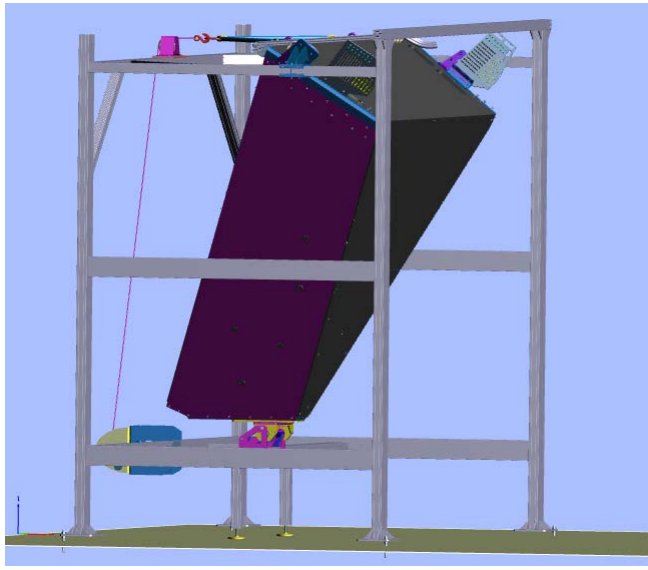


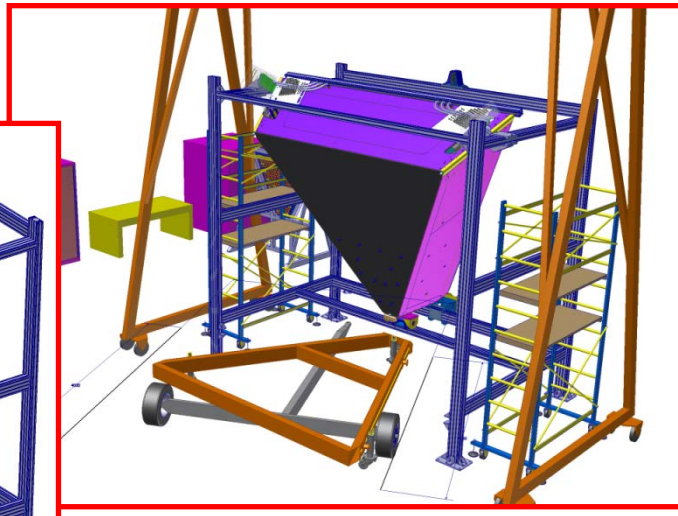


Preparation for installation

1. Remove the horizontal bar
2. Enter the trolley
3. Rotate the RICH
4. Release the RICH from the structure and secure it on the trolley

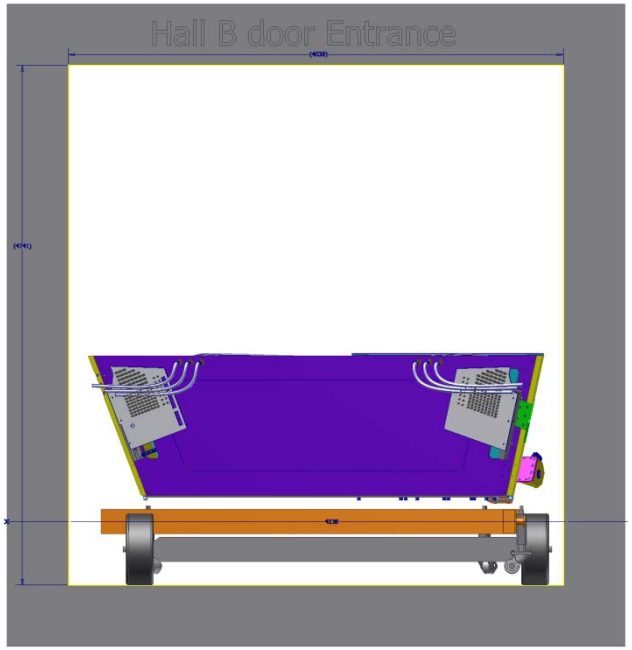
INFN responsibility with JLab support

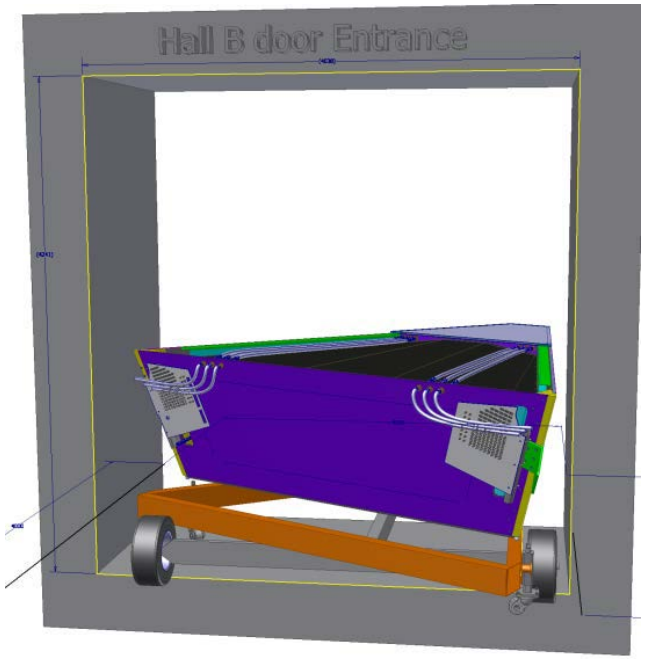




Transportation in Hall-B

Special trolley designed for the RICH transportation
Pulled by electric tractor
Asymmetric wheel position to fit through the Hall-B door

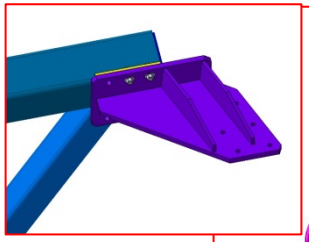


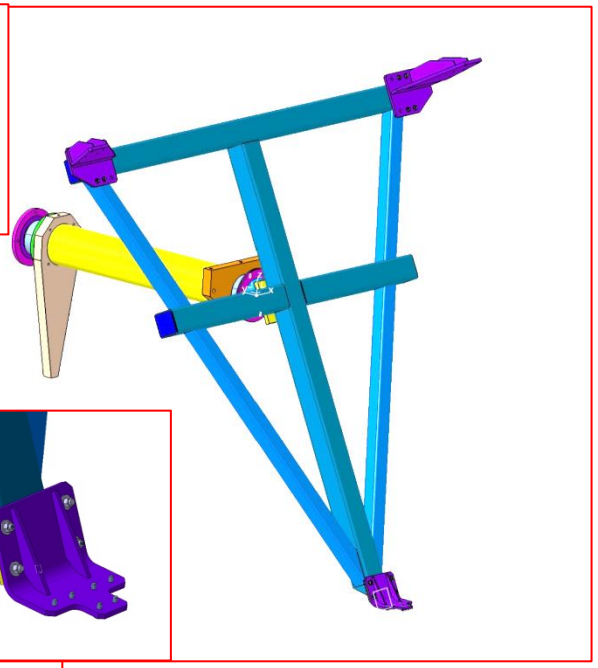


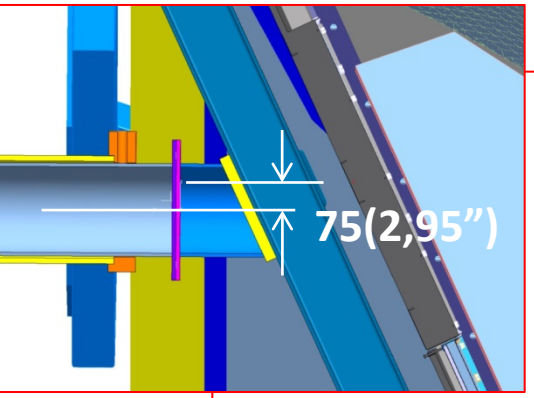
Installation tools

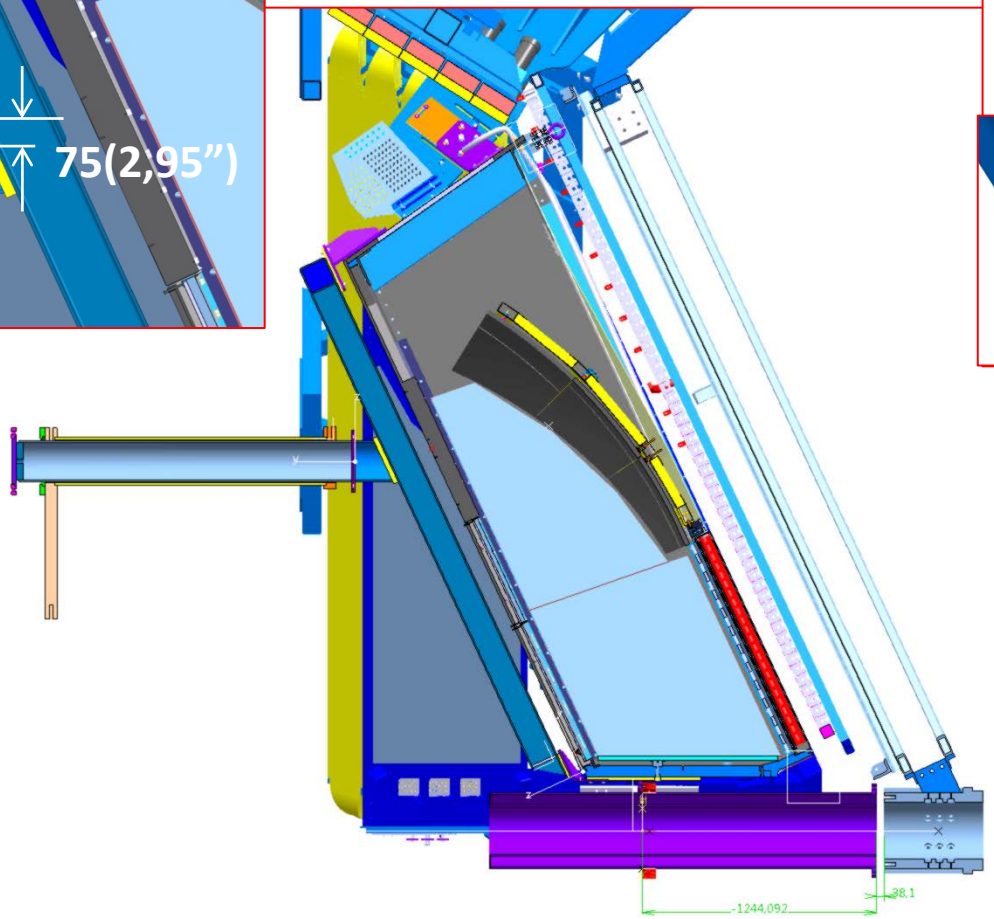
Installation using the LTCC strong-back with modified attaching points

- **compatible COG**
- **deformations within tolerance**
- **counterweight computed**



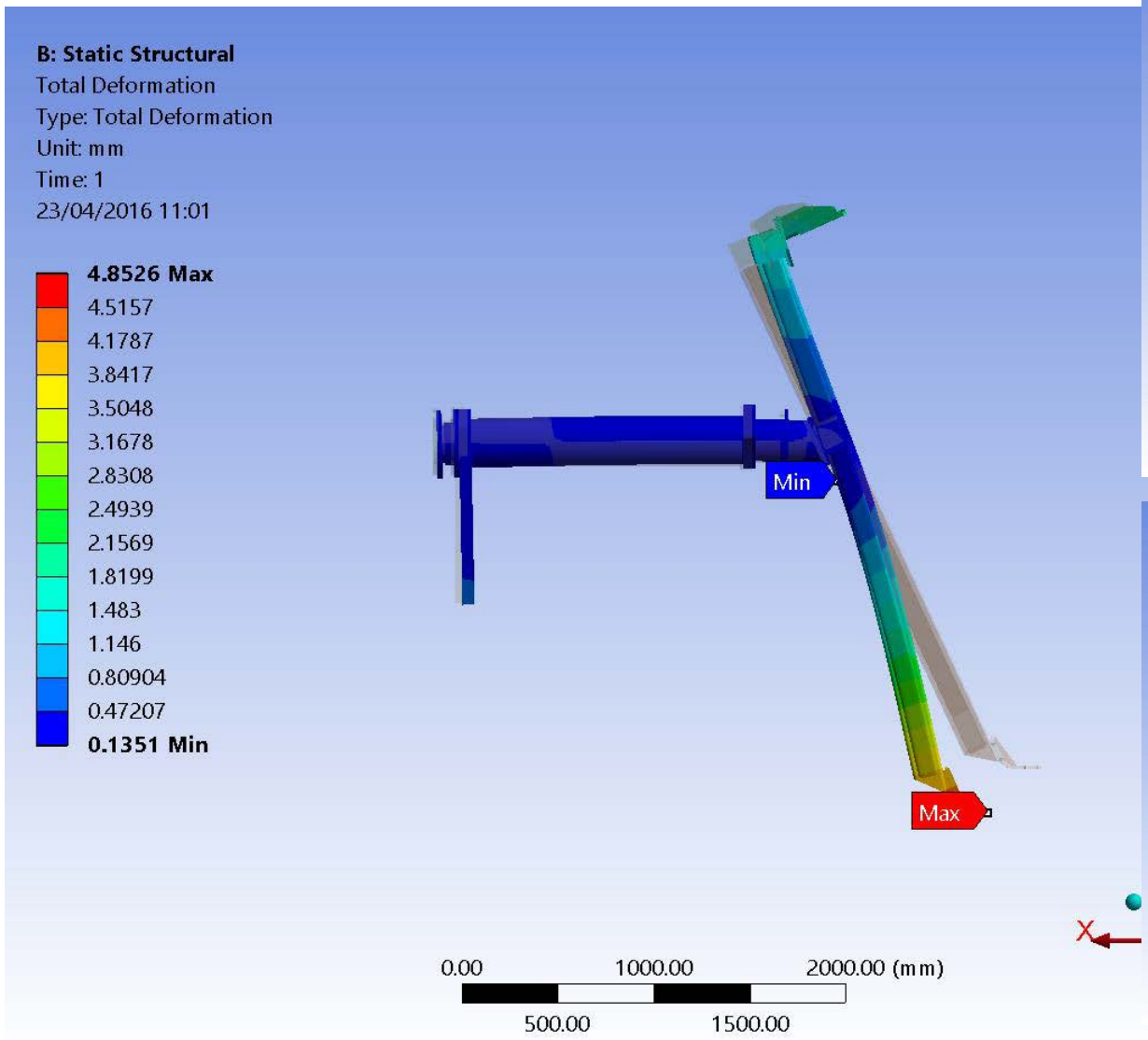


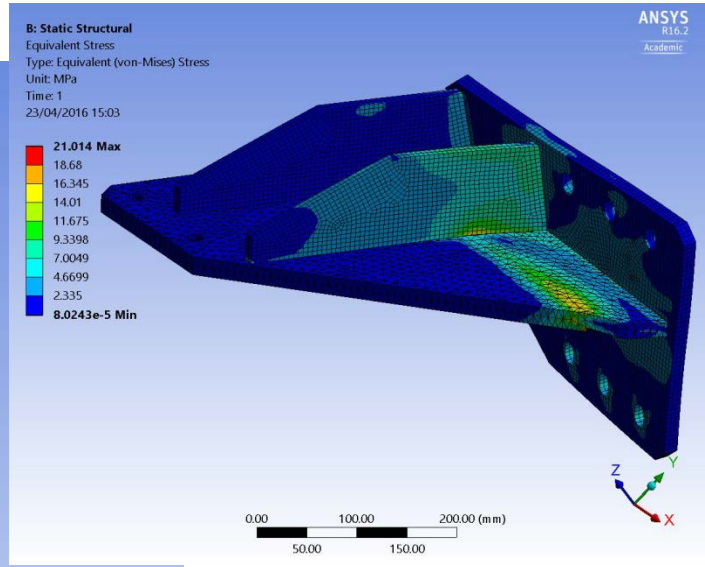


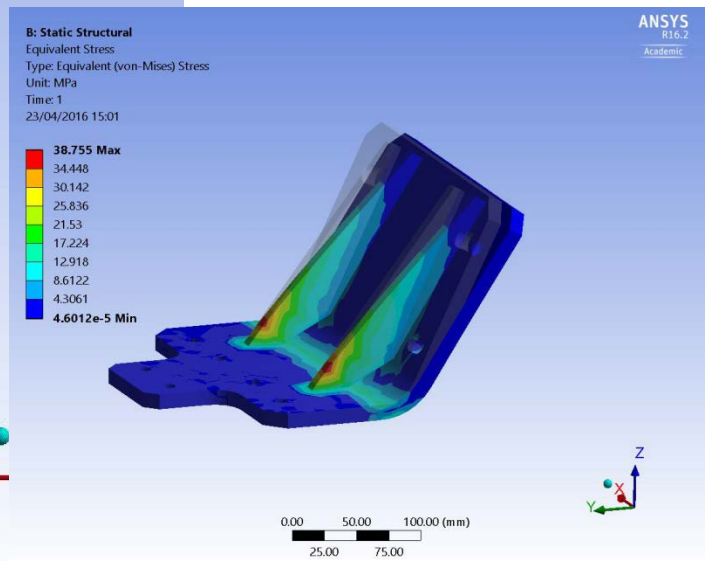


Design approved by B. Miller and S. Mandal April/May 2016

Deformation calculations

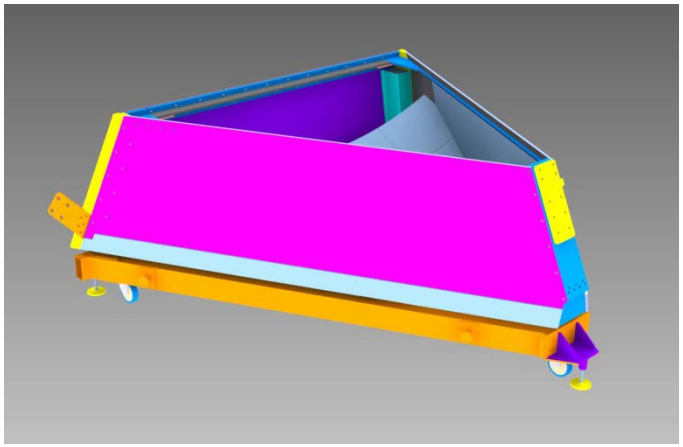


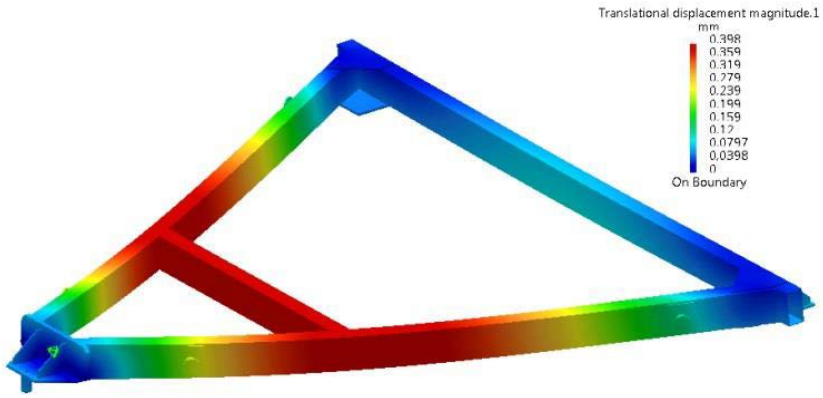




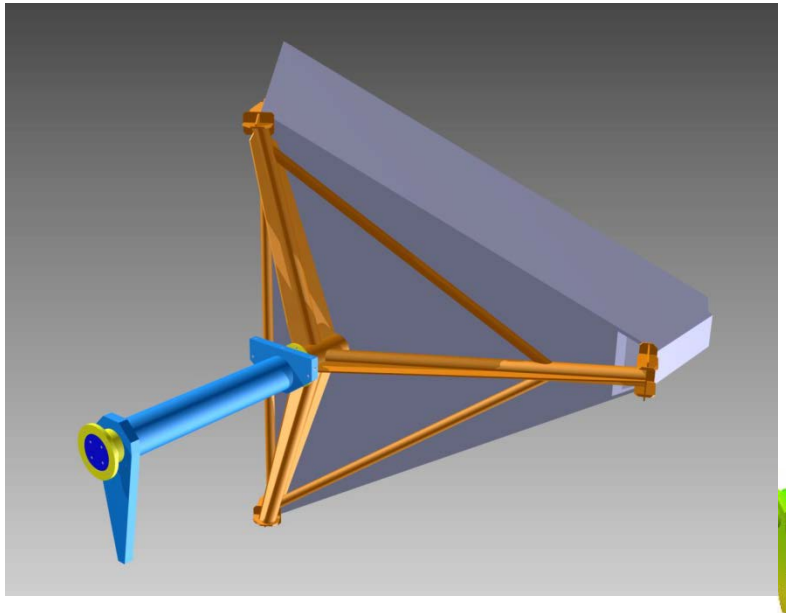
Deformation calculations

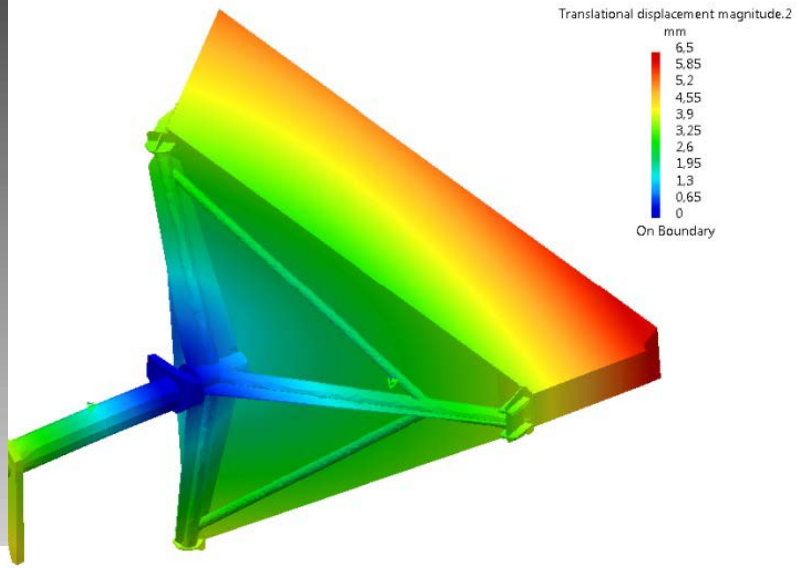
On the trolley





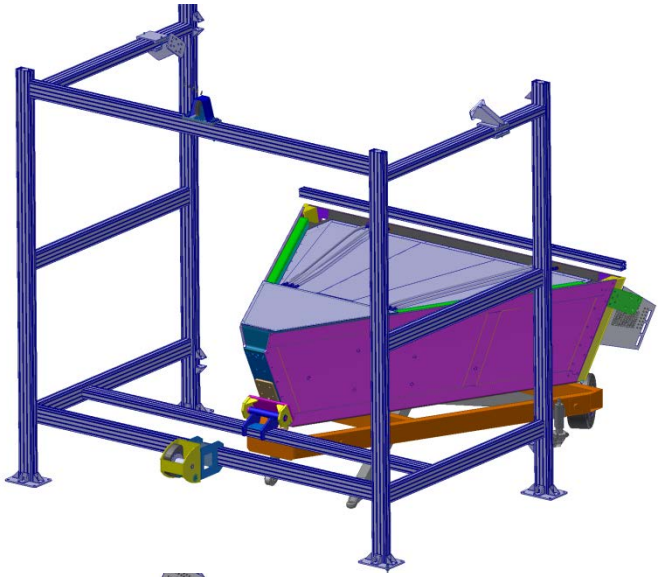
On the crane

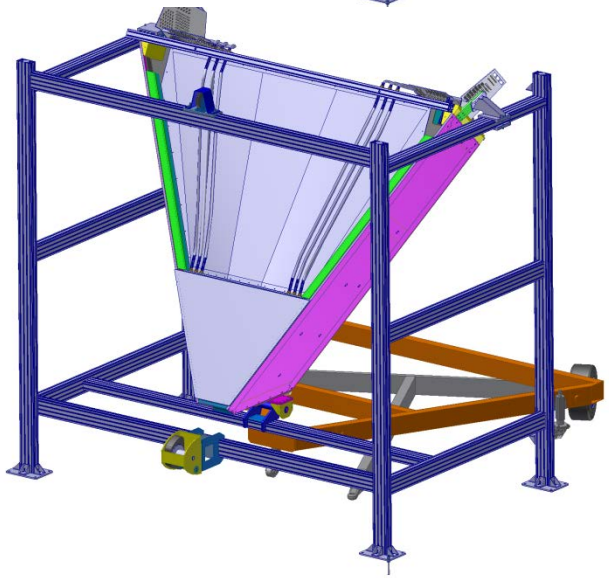




Max deformations few mm
- always well within the elastic regime limits

Installation procedure - 1



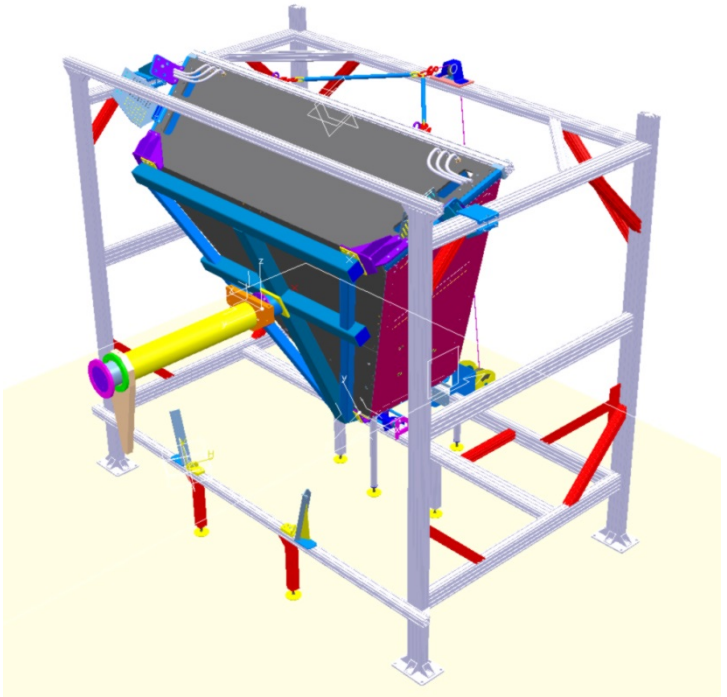


- **Installation in CLAS12 will start in September 2017**

Procedure defined during the RICH Mid-Term review (Oct 2015) and revised in Apr 2016

- **install the assembly structure in Hall-B**
- **transfer the RICH from the trolley to the structure**
- **connect the LTCC strong-back**

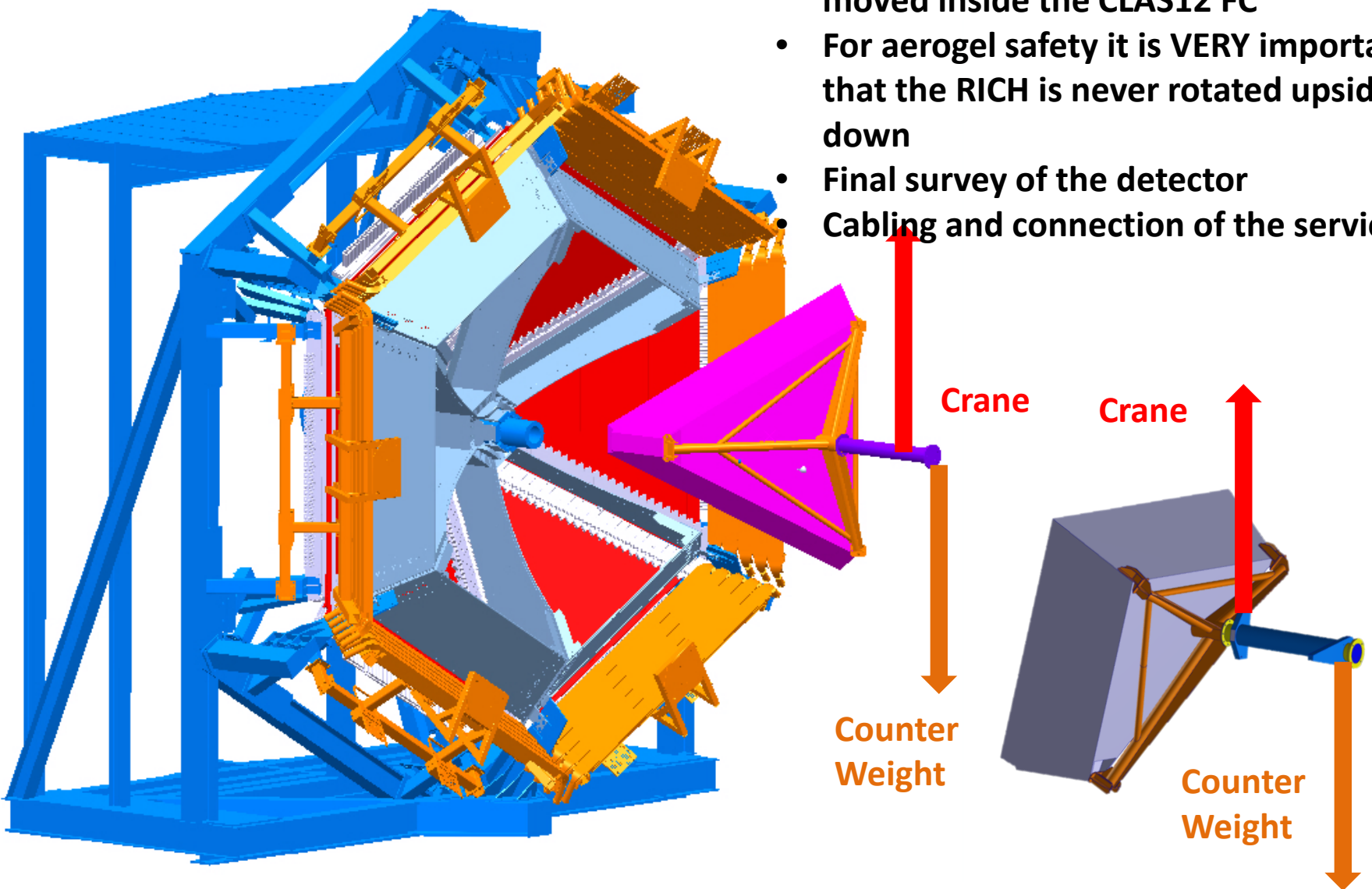
JLab personnel with INFN support



RICH + Strong Back + Lifting Tool: 1681 kg
Counter weight: 2897 kg

Installation procedure - 2

- The RICH is released from the structure, rotated to the Sector 4 position and moved inside the CLAS12 FC
- For aerogel safety it is VERY important that the RICH is never rotated upside down
- Final survey of the detector
- Cabling and connection of the services



Commissioning: calibration runs

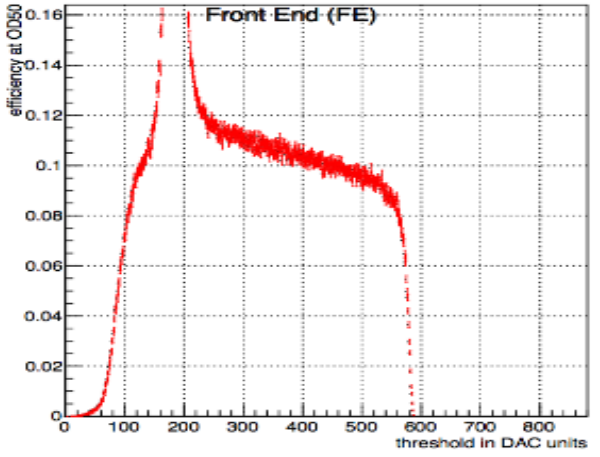
Commissioning of the detector will start in EEL-124 as soon as the electronic panel is fully assembled

- **Pedestal runs**
  - **MAROC thresholds**
- **Charge injector runs**
  - **MAROC calibration, gain equalization, timing, time-over-threshold**
- **Dark noise runs**
  - **dark rate, spe response**

- **Results uploaded in the RICH database**

Services

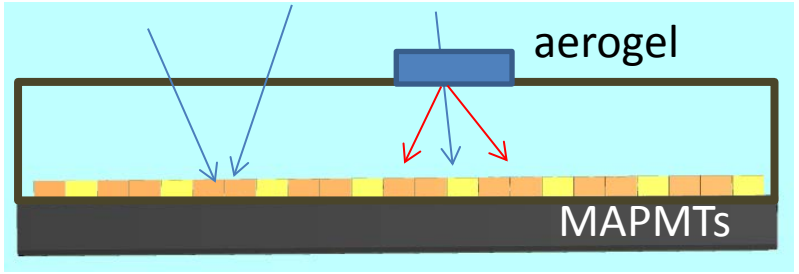
- **cooling, slow controls, interlocks**

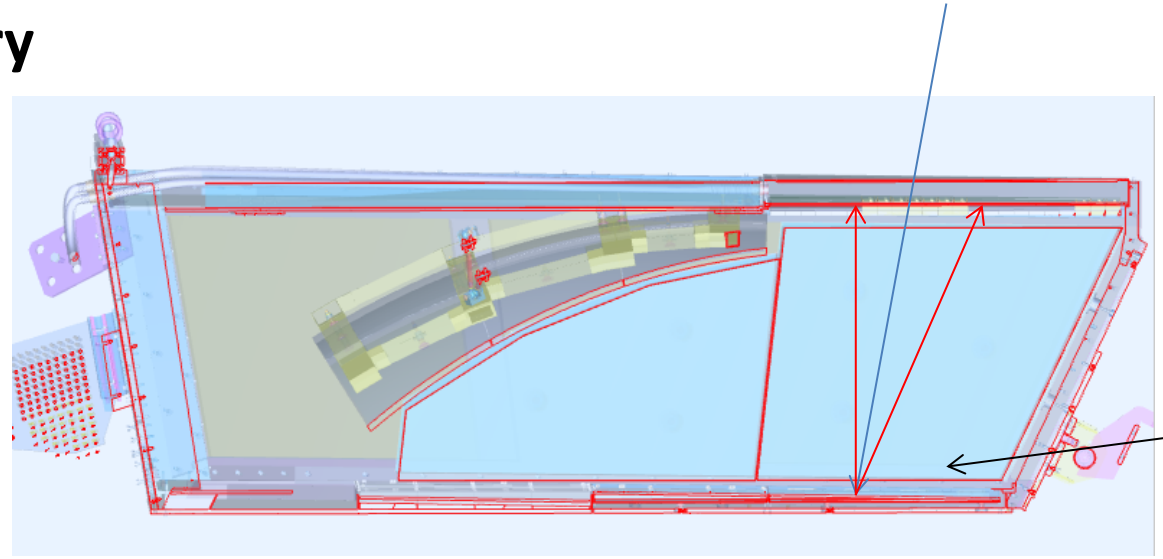


Commissioning: cosmic runs

Runs with cosmics in EEL-124 taken with the electronic panel as a stand-alone system and with the RICH fully assembled
Initial data taking with self-trigger, then with a tracking system

- **light-tightness**
- **DAQ**
- **cooling**
- **slow controls**
- **reconstruction software**
- **geometry**





Commissioning with beam

Test of the RICH at low luminosity
- **verify the channel functionality**
- **test of the DAQ and of the reconstruction software**

Test of the RICH as a function of the luminosity
- **noise level**
- **occupancy**

Use narrow resonances for test PID capabilities
- **K0 for pions**
- **ϕ for kaons**
- **Λ for protons**

Commissioning document of the CLAS12 RICH

M. Mirazita

May 13, 2016

Abstract

This is an integration to the CLAS12 Commissioning Document describing the Commissioning procedure for the RICH detector.

Contents

Summary

RICH assembly and installation procedures have been defined and responsibilities identified
The time schedule will allow to complete the RICH installation by summer 2017

RICH assembly — **starting October 2016**
- **RICH mechanics**
- **Electronic panel**
- **Mirrors**
- **aerogel** — **completion by August 2017**

Tests without beam
- **electronics**
- **cosmic runs** — **completion by July 2017**

Installation — **starting September 2017**
- **installation of the RICH in CLAS12**
- **cabling and test of the detector**