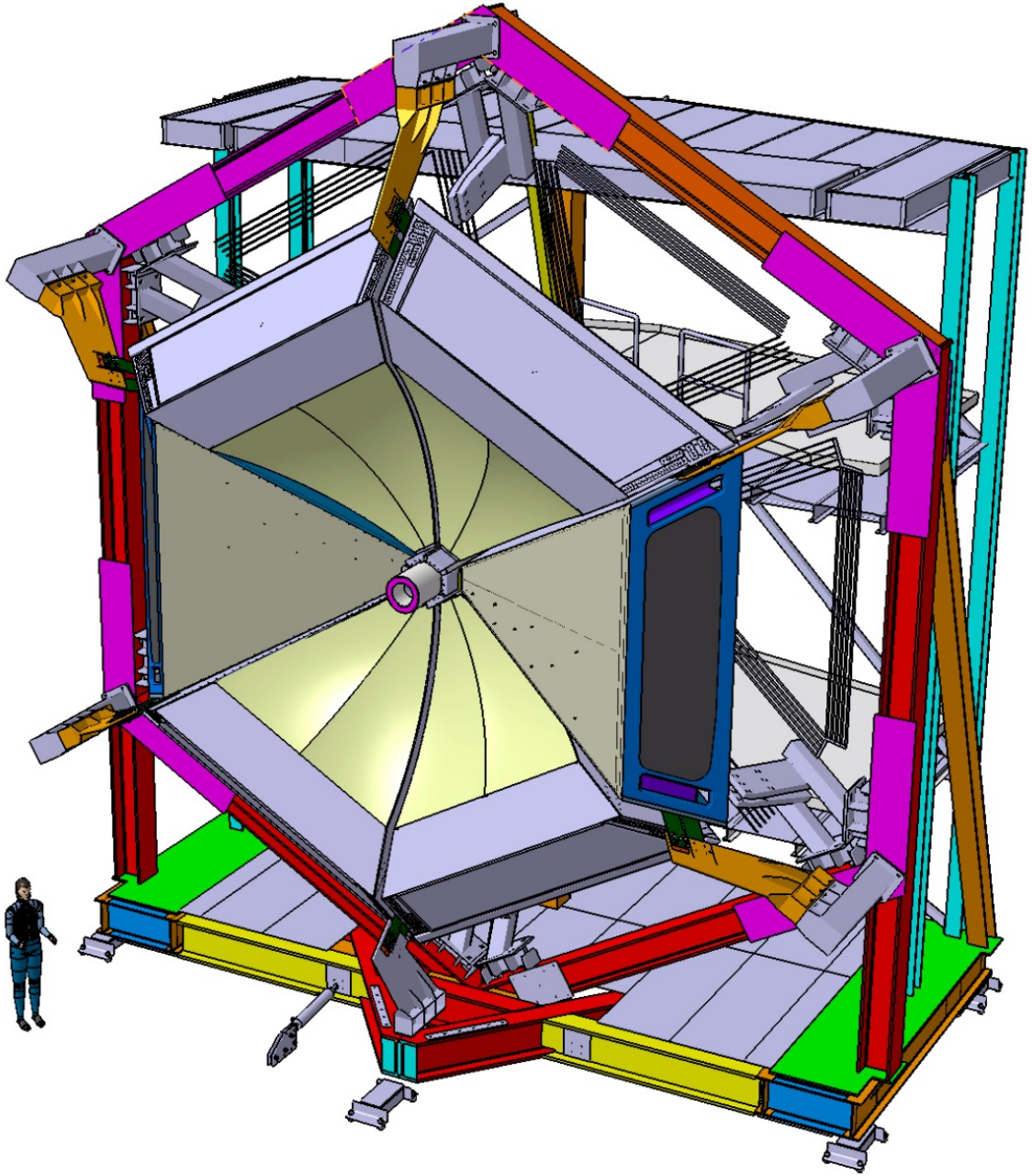
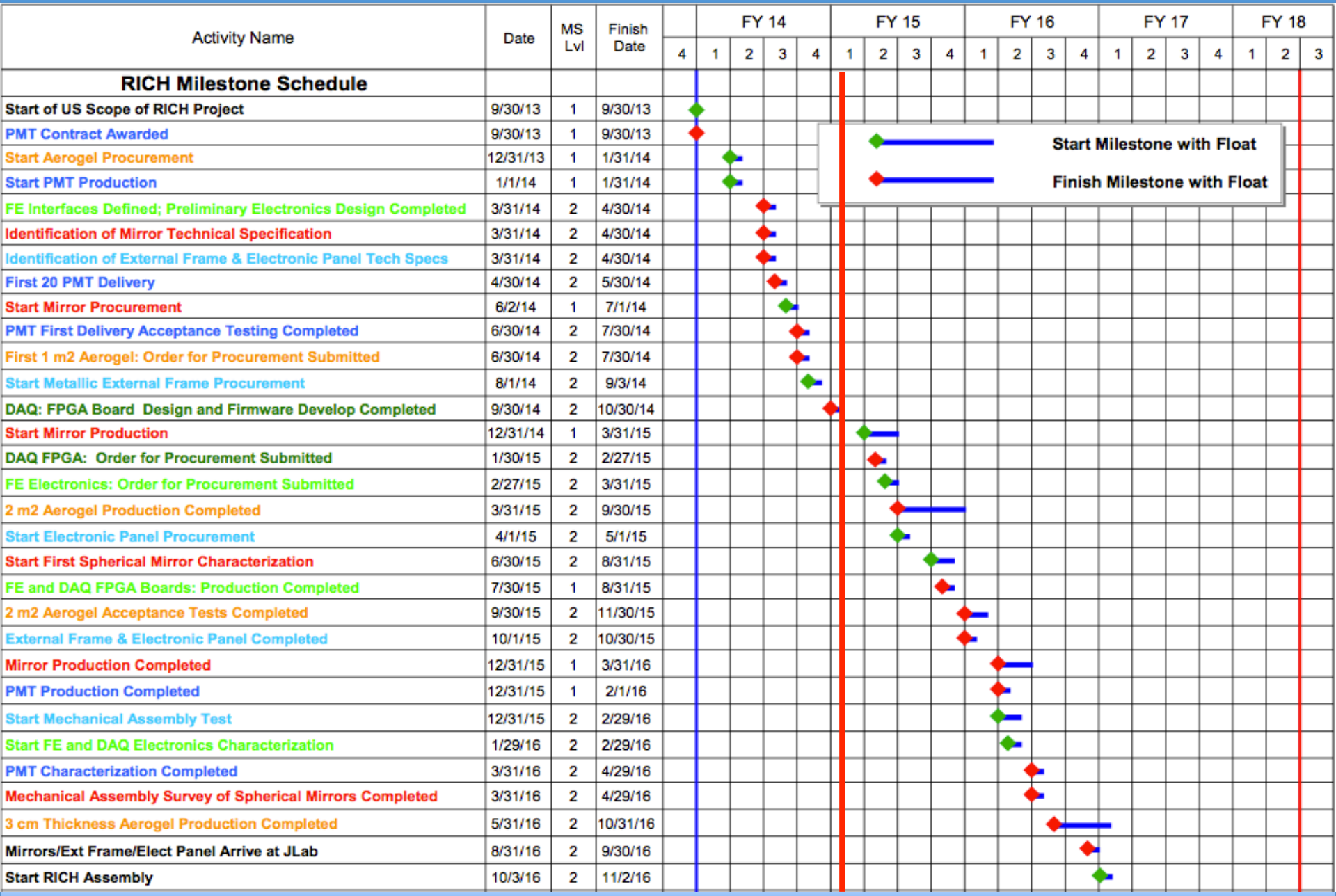


CLAS12-RICH Status-Report

November 12th 2014

RICH Project Milestones

Activity Name	Date	MS Lvl	Finish Date
RICH Milestone Schedule			
Start of US Scope of RICH Project	9/30/13	1	9/30/13
PMT Contract Awarded	9/30/13	1	9/30/13
Start Aerogel Procurement	12/31/13	1	1/31/14
Start PMT Production	1/1/14	1	1/31/14
FE Interfaces Defined; Preliminary Electronics Design Completed	3/31/14	2	4/30/14
Identification of Mirror Technical Specification	3/31/14	2	4/30/14
Identification of External Frame & Electronic Panel Tech Specs	3/31/14	2	4/30/14
First 20 PMT Delivery	4/30/14	2	5/30/14
Start Mirror Procurement	6/2/14	1	7/1/14
PMT First Delivery Acceptance Testing Completed	6/30/14	2	7/30/14
First 1 m2 Aerogel: Order for Procurement Submitted	6/30/14	2	7/30/14
Start Metallic External Frame Procurement	8/1/14	2	9/3/14
DAQ: FPGA Board Design and Firmware Develop Completed	9/30/14	2	10/30/14
Start Mirror Production	12/31/14	1	3/31/15
DAQ FPGA: Order for Procurement Submitted	1/30/15	2	2/27/15
FE Electronics: Order for Procurement Submitted	2/27/15	2	3/31/15
2 m2 Aerogel Production Completed	3/31/15	2	9/30/15
Start Electronic Panel Procurement	4/1/15	2	5/1/15
Start First Spherical Mirror Characterization	6/30/15	2	8/31/15
FE and DAQ FPGA Boards: Production Completed	7/30/15	1	8/31/15
2 m2 Aerogel Acceptance Tests Completed	9/30/15	2	11/30/15
External Frame & Electronic Panel Completed	10/1/15	2	10/30/15
Mirror Production Completed	12/31/15	1	3/31/16
PMT Production Completed	12/31/15	1	2/1/16
Start Mechanical Assembly Test	12/31/15	2	2/29/16
Start FE and DAQ Electronics Characterization	1/29/16	2	2/29/16
PMT Characterization Completed	3/31/16	2	4/29/16
Mechanical Assembly Survey of Spherical Mirrors Completed	3/31/16	2	4/29/16
3 cm Thickness Aerogel Production Completed	5/31/16	2	10/31/16
Mirrors/Ext Frame/Elect Panel Arrive at JLab	8/31/16	2	9/30/16
Start RICH Assembly	10/3/16	2	11/2/16



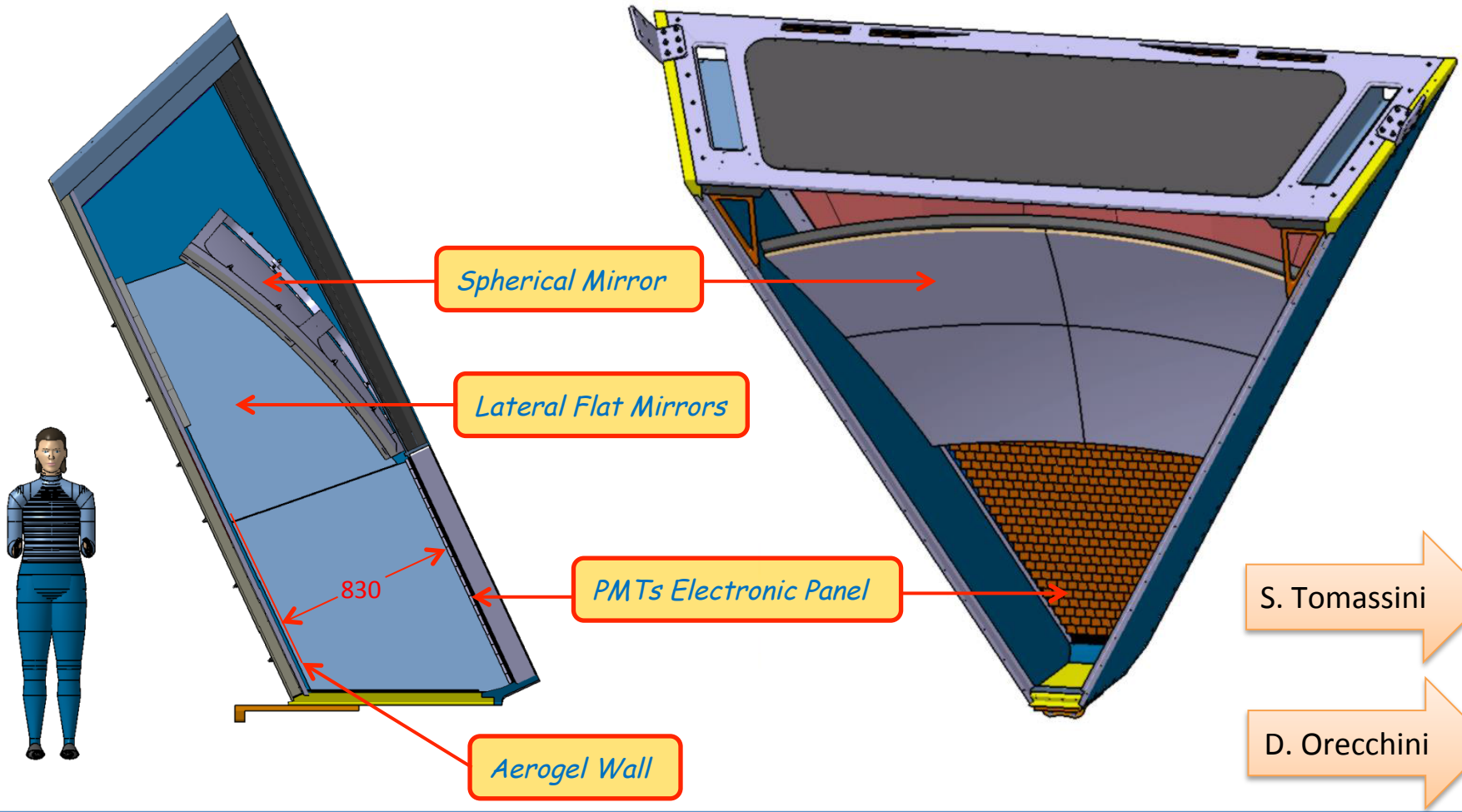
External Frame & Electronic Panel

Milestone L2: Start Metallic External Frame Procurement (8/1/14) **foreseen (11/20/14)**

Technical review with JLab engineers 20 June 2014

Engineers now at JLab to answer reviews remarks and fix last details

Not critical: delay to join external frame with electronic, front and back panels manufacture



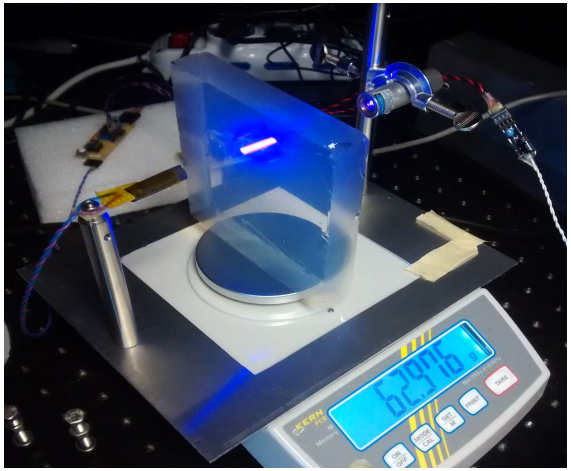
Aerogel

Purchasing order for the first 2 m^2 from the Russian vendor has been submitted

Dry box for aerogel characterization and storage commissioned

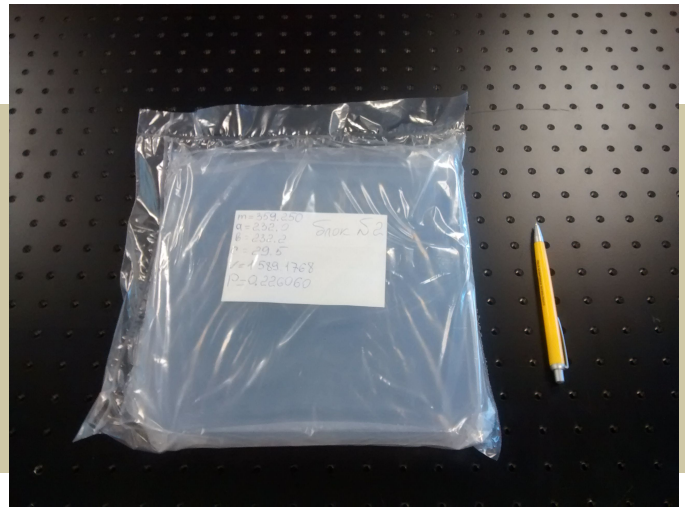
Long term stability tests ongoing

Systematic study of aerogel uniformity ongoing

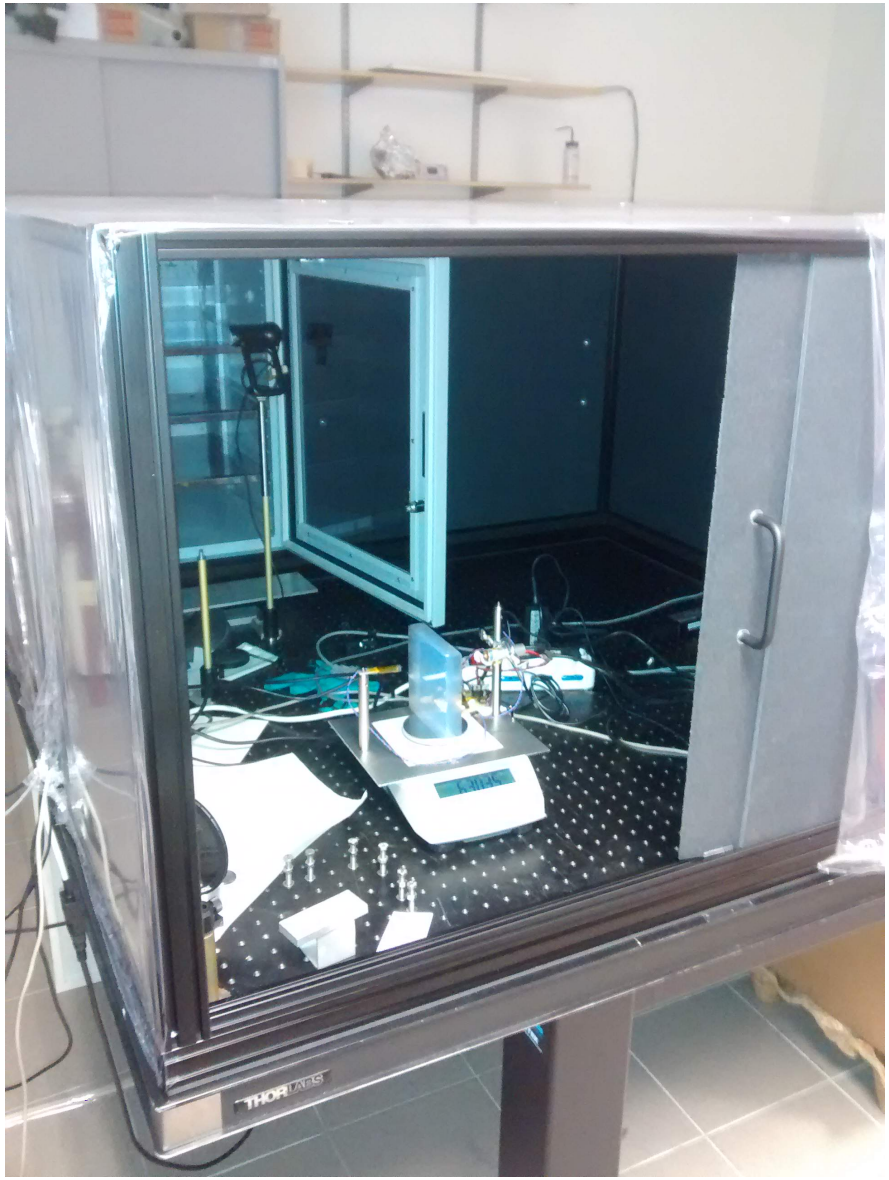


Aerogel Radiator

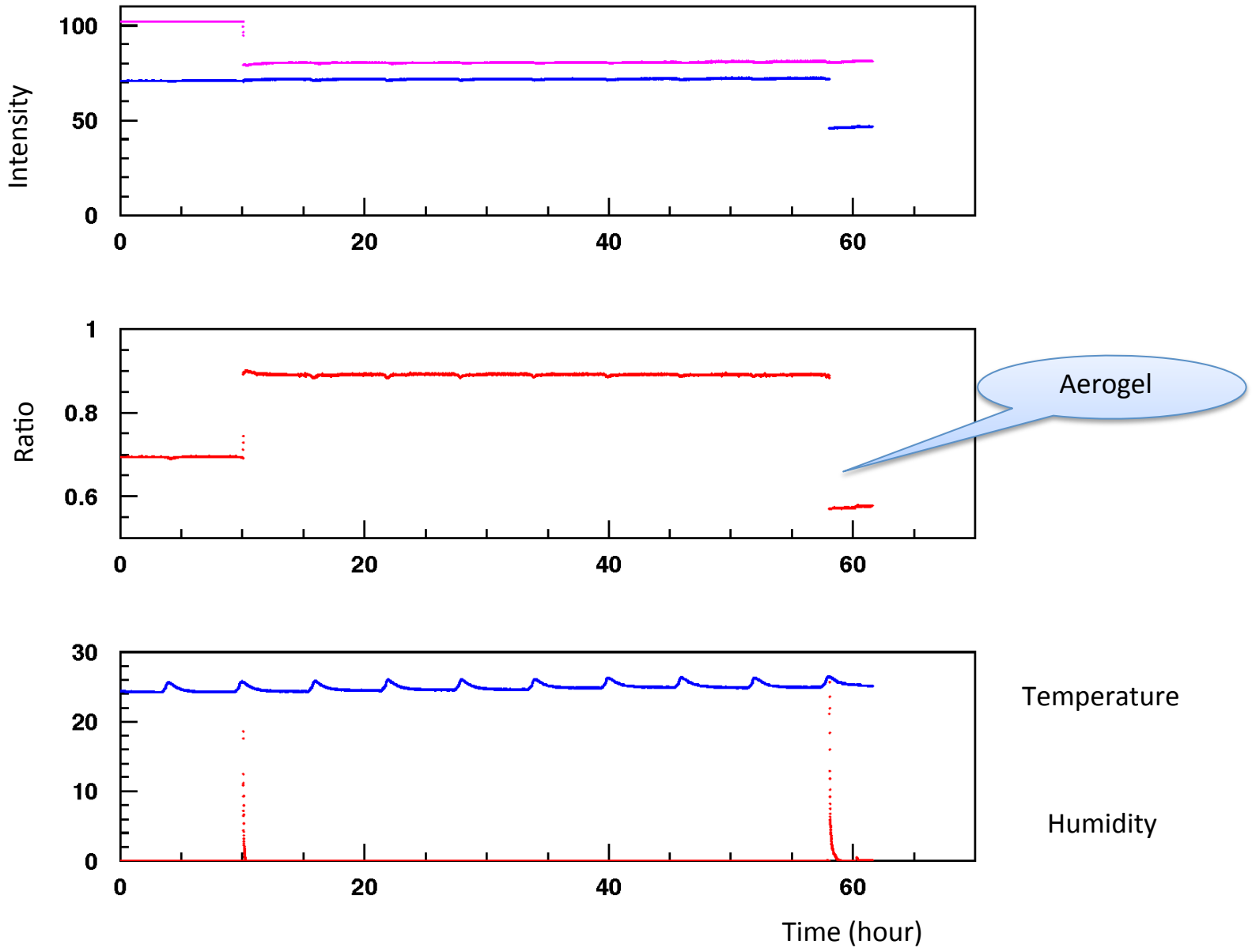
Rafractive index: 1.05
Area: 20x20 cm^2
Thickness: 3 cm
Scattering Length: greater than 50 mm



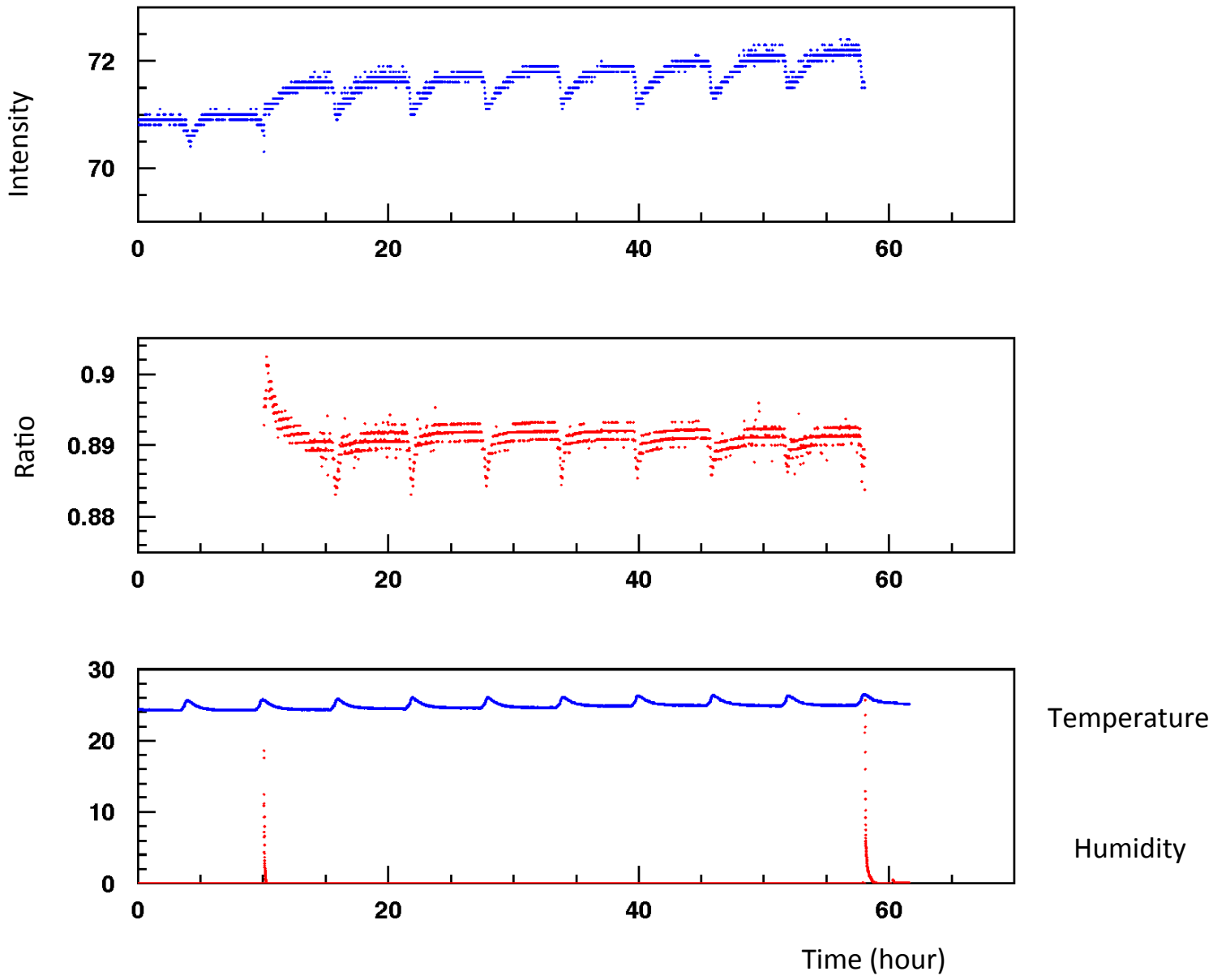
Aerogel: Black & Dry Box



Aerogel: Transparency Monitor



Aerogel: Transparency Monitor

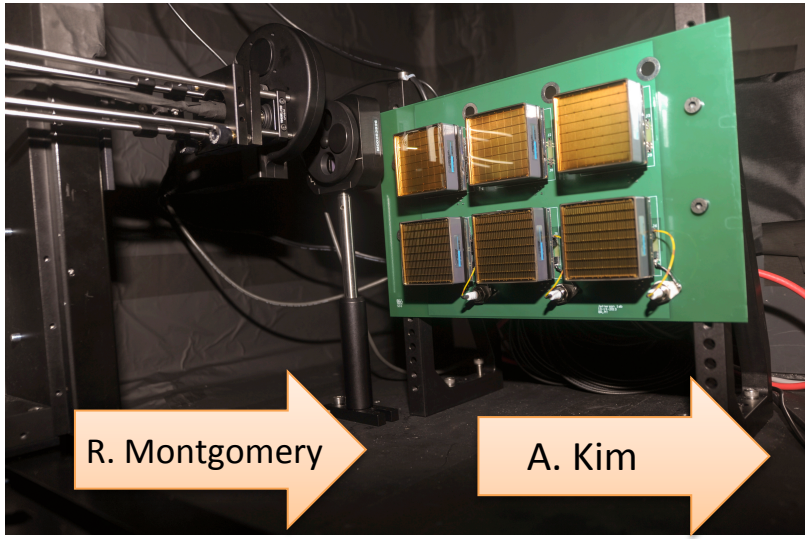


MA-PMT Photon Detector

110 Hamamatsu MAPMT out of 430 delivered and tested at JLab

- 80 H8500
- 30 H12700 with enhanced SPE spectrum

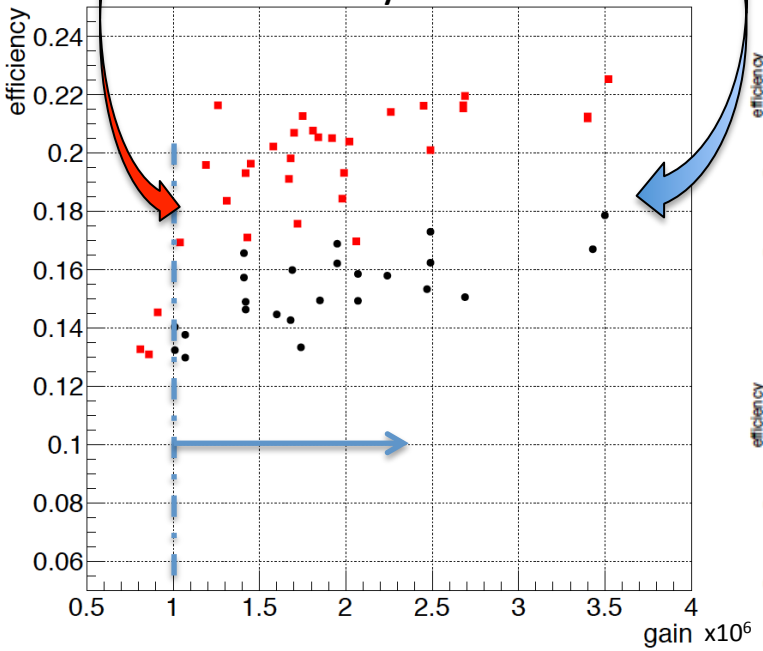
Procurement secured for new H12700 PMTs



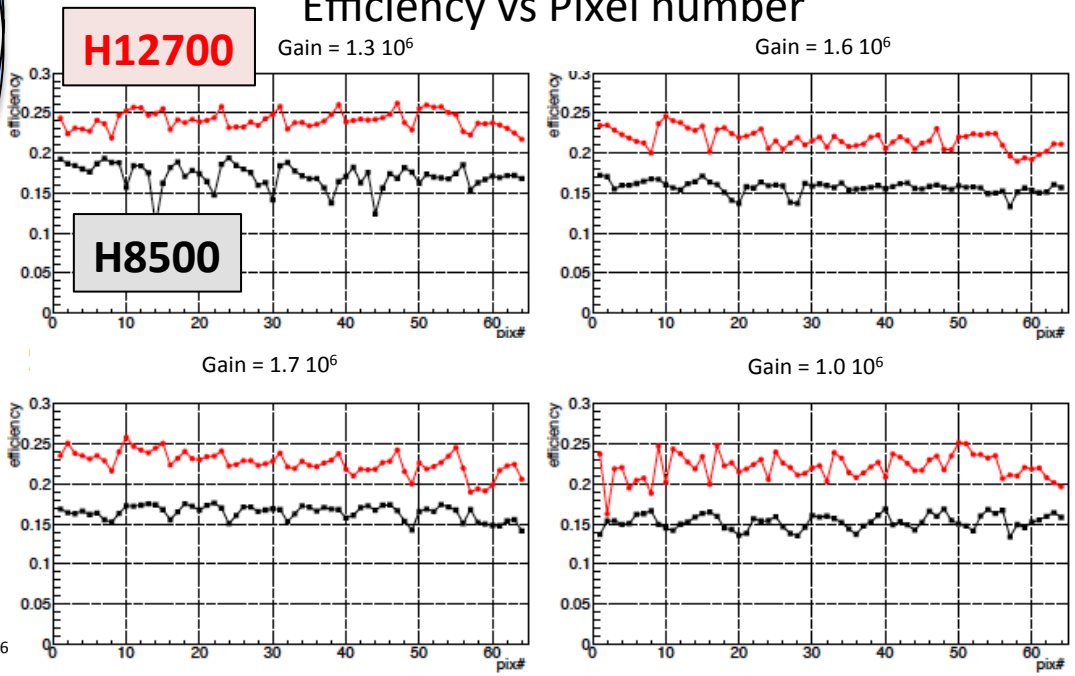
PMT Efficiency Comparison:

H12700 ⟷ **H8500**

Efficiency vs Gain



Efficiency vs Pixel number



Read-Out Electronics

Milestone L2: DAQ: FPGA Board Design and Firmware Completed (9/30/14) **achieved (10/31/14)**

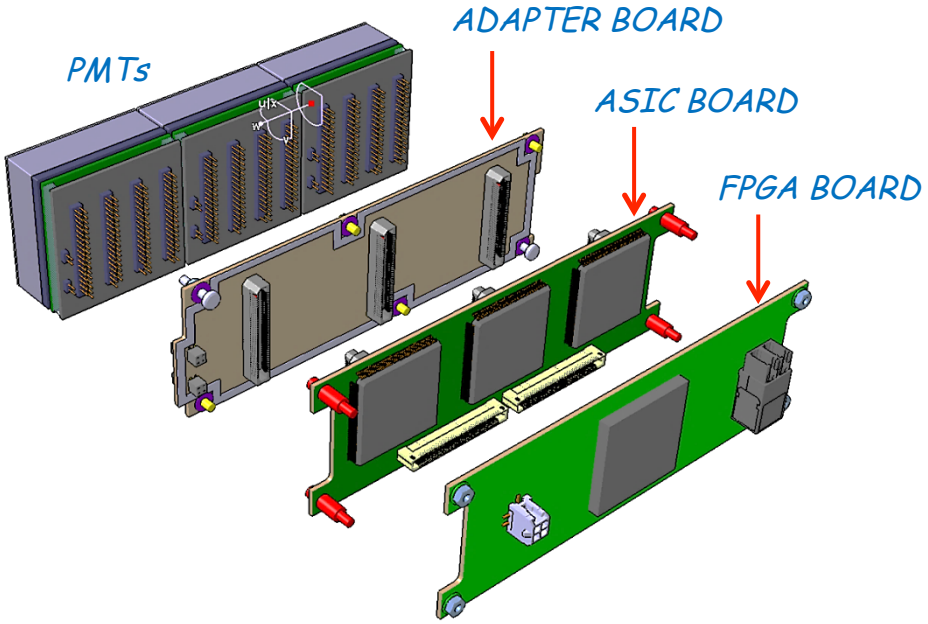
Prototype board production completed:

- Adapter board (Genova)
- ASICs boards (Ferrara)
- DAQ boards (JLab)

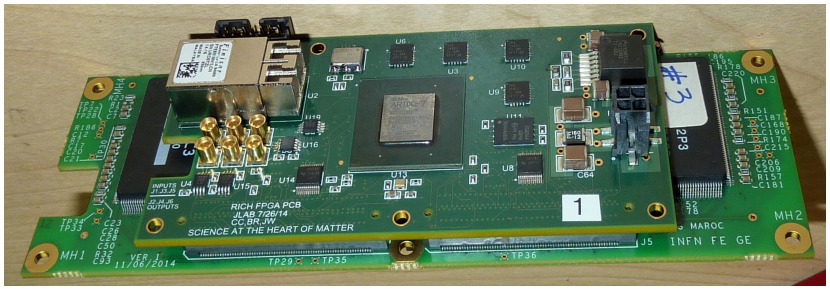
M. Turisini

Italian experts on site for commissioning of a joined test stand

A second test stand will become operative in Italy by the end of the year



3 x ASIC BOARD (INFN) matching the



Universal FPGA BOARD (JLab)

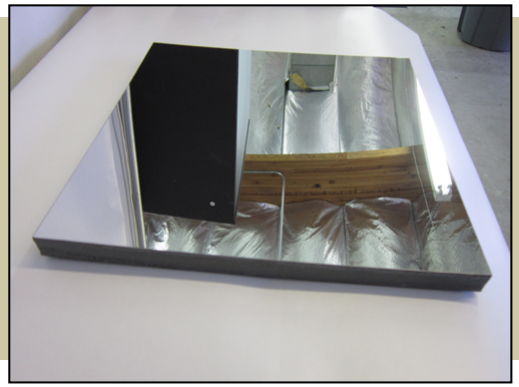
Mirrors

Milestone-1: Start Mirror Procurement (6/2/14) **achieved**

Invitation to tender for spherical mandrel in preparation (2014 funds secured)
First spherical and planar demonstrators under test
Second-stage final demonstrators foreseen by beginning of 2015

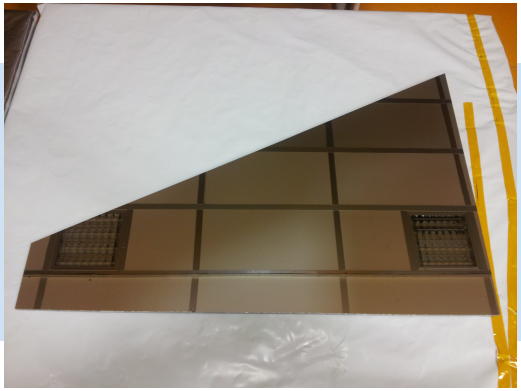
CFRP SPHERICAL Mirror

Radius tolerance <= 1%
Surface accuracy: 5 µm RMS
Surface Quality: 3 nm RMS
D0 < 5 mm
Reflectivity > 90%



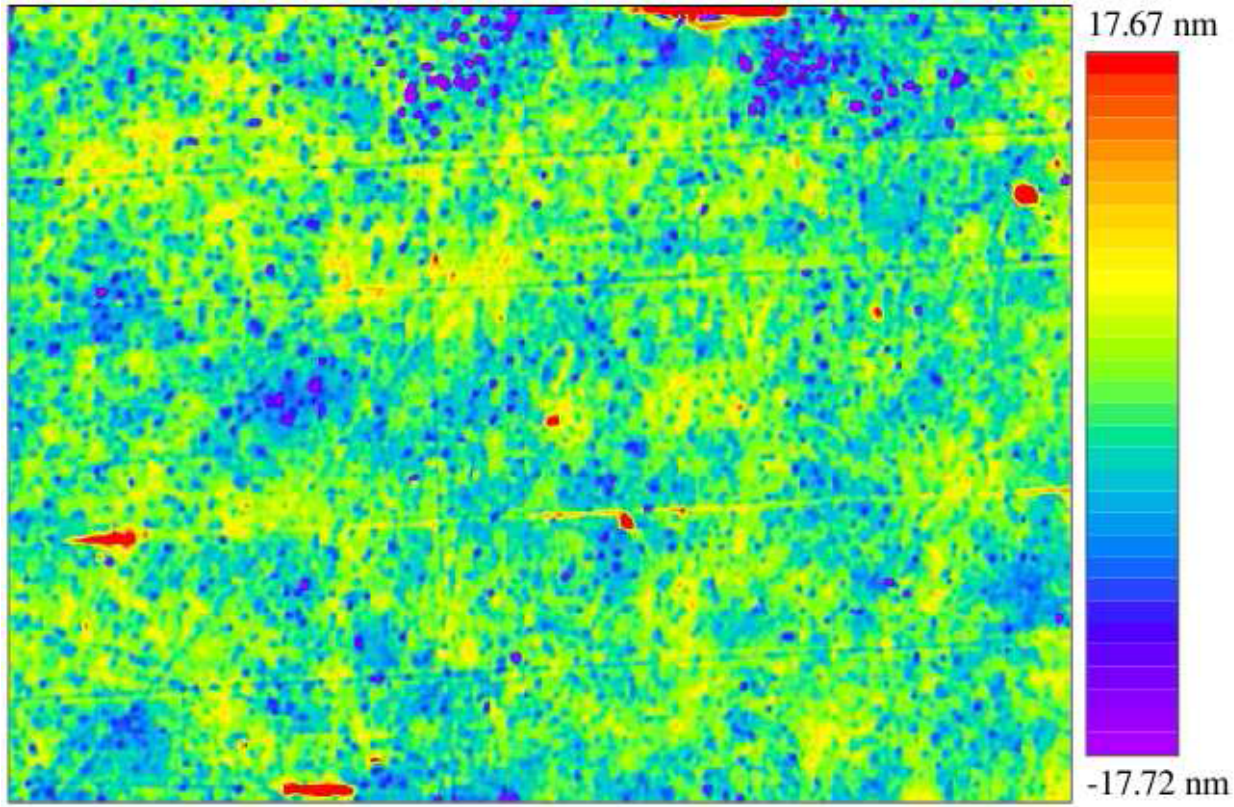
Planar Glass Mirror

Planarity tolerance <= 0.1 mm
Surface accuracy: 5 µm RMS
Surface Quality: 3 nm RMS
Reflectivity > 90%



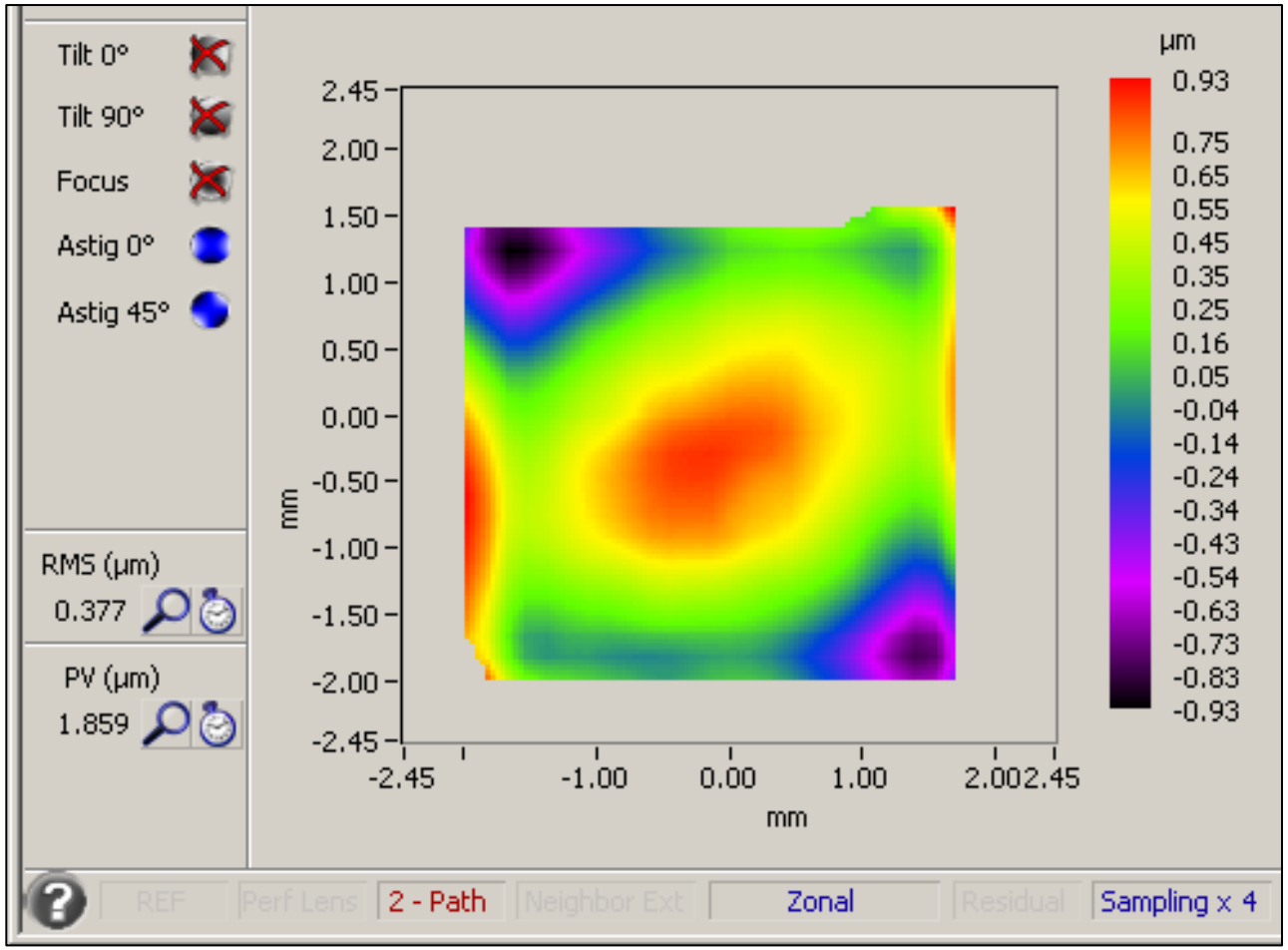
CFRP Spherical Mirror: Shape

Measured in September in Italy
(by LNF and Media-Lario):
Roughness rms ~ 3 nm
Fulfills CLAS12 RICH specifications



Wavefront Data

Surface Shack-Hartmann map of the CFRP mirror shows errors of 1.86μm p-v surface, below the 2.5 μm p-v surface requirement.

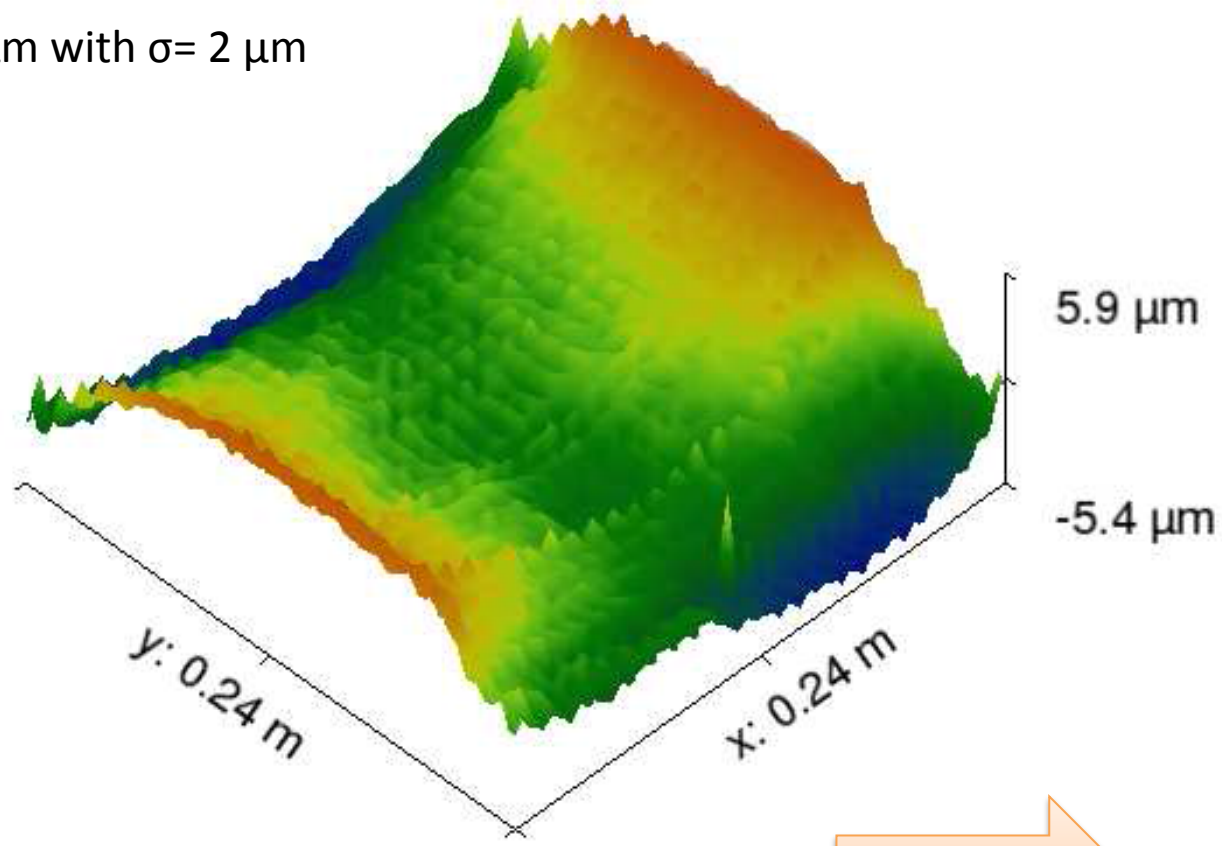


Surface Map of the full aperture of the CFRP mirror. Only tip, tilt and focus removed.

Error is 1.86 μm p-v on the surface.

CFRP Spherical Mirror: Shape

Measured in September in Italy
(by INFN and Media-Lario):
peak-to-valley variation ~ 11 µm with σ= 2 µm
Outside specifications



Aging tests onging
Meeting with CMA scheduled on November 10

M. Mirazita

CMA Composite Mirror Appl.

Best explanation for the shape deterioration is rohacell being not stiff enough against moisture and epoxy shrinkage.
→ Demo n.2 with CMA standard core made of CFRP cut tubes

Best explanation for the unexpected weight is glue filling the Rohacell cut pores.
→ Glue only on CFRP tube perimeters and not as a full layer

The mirror replica should have only a few % increase in micro-roughness. A pyrex mandrel can sustain many mirror productions.
→ Increase number of sub-mirrors

The solution with 10 sub-mirrors of is a good compromise to share the mandrel cost and reduce the risk of single mirror failures
→ Take 1 m diagonal as reference.

The mandrel diagonal should be only few centimeters greater than the nirror one. There are companies in Tucson able to supply a low-cost pyrex mandrel of 1 m diagonal.
→ Invite those companies to the tender

CMA Composite Mirror Appl.

CMA produced the mirrors of HERMES, LHCb and AMS.

The mirror was only a layer of CFRP and required several holders to keep the shape in addition to the 3 point supports, a specific alignment by CMA experts plus dedicated software for misalignment corrections
→ To be consider ?

HERMES mirror had 2 mm clearance and the LHCB mirror 1 mm clearance.
→ 3 mm clearance or below is not a problem

HERMES mirror had 3 nylon point supports (inside acceptance) and LHCb 3 stainless steel support (outside acceptance)
→ Go with 3 nylon supports

CFRP mirrors for AMS was coated at ZAOT (Italy)
→ Keep ZAOT as an alternative to ECI

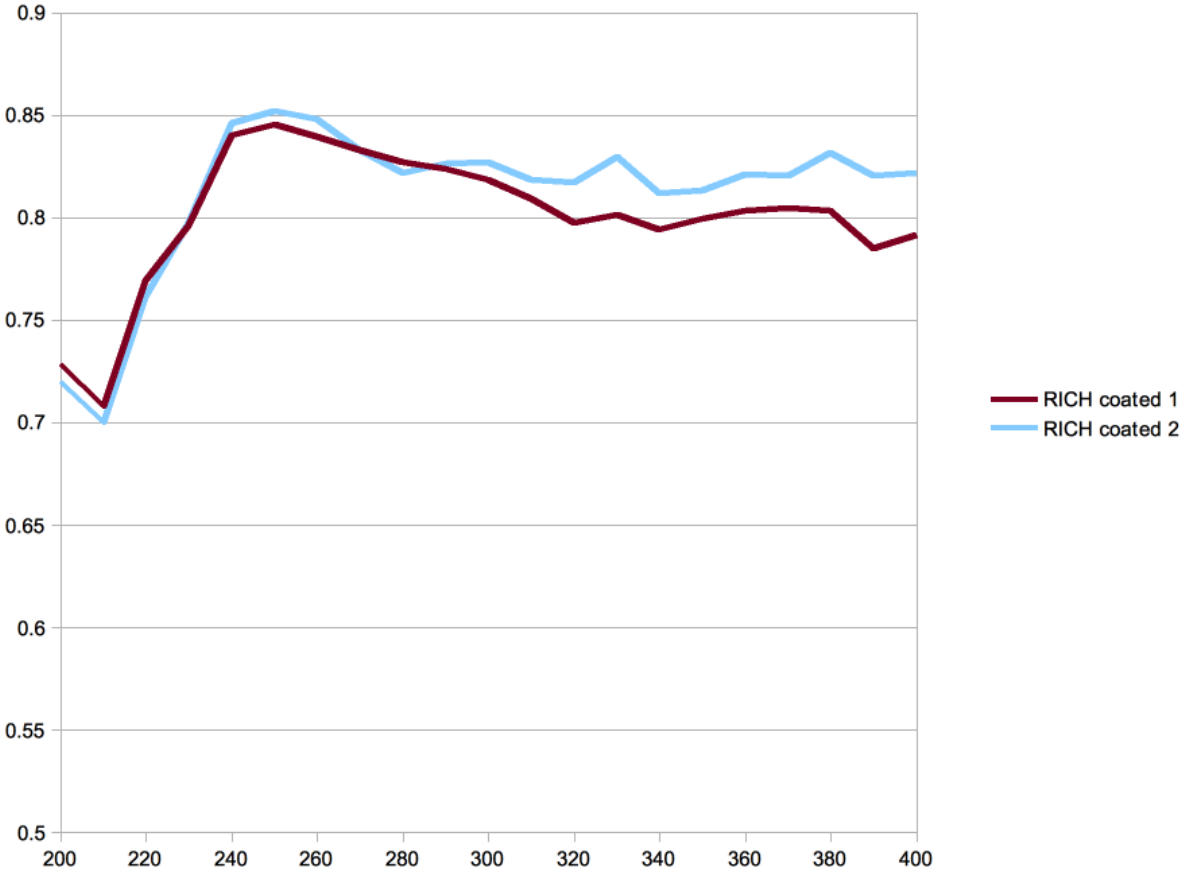
The mandrel diagonal should be only few centimeters greater than the nirror one. There are companies in Tucson able to supply a low-cost pyrex mandrel of 1 m diagonal.
→ Invite those companies to the tender

CFRP Spherical Mirror: Reflectivity

Measured in July at JLab
Reflectivity around 80%
Outside specifications

CMA is not specialized in coatings

Meeting with
ECI Evaporated Coatings
Scheduled on November 11



ECI Evaporating Coating

Already worked with CFRP, although not with CMA

MgF_2 is soft and porous when coated at low temperature (as required by CFRP)

- explain why we spoiled the CMA demo coating while cleaning it
- explain the larger roughness of the CMA coated demo

ECI has its own recipit which is more robust and flat

They can accommodate two 1m diagonal mirrors in one batch and would Prefer to work with groups of 4 mirrors at a time

The are willing to try to re-coat the CMA demo n.1 together with the upcoming demo n.2

They may be interested in radiation hardness tests and roughness measurements of their patented coating