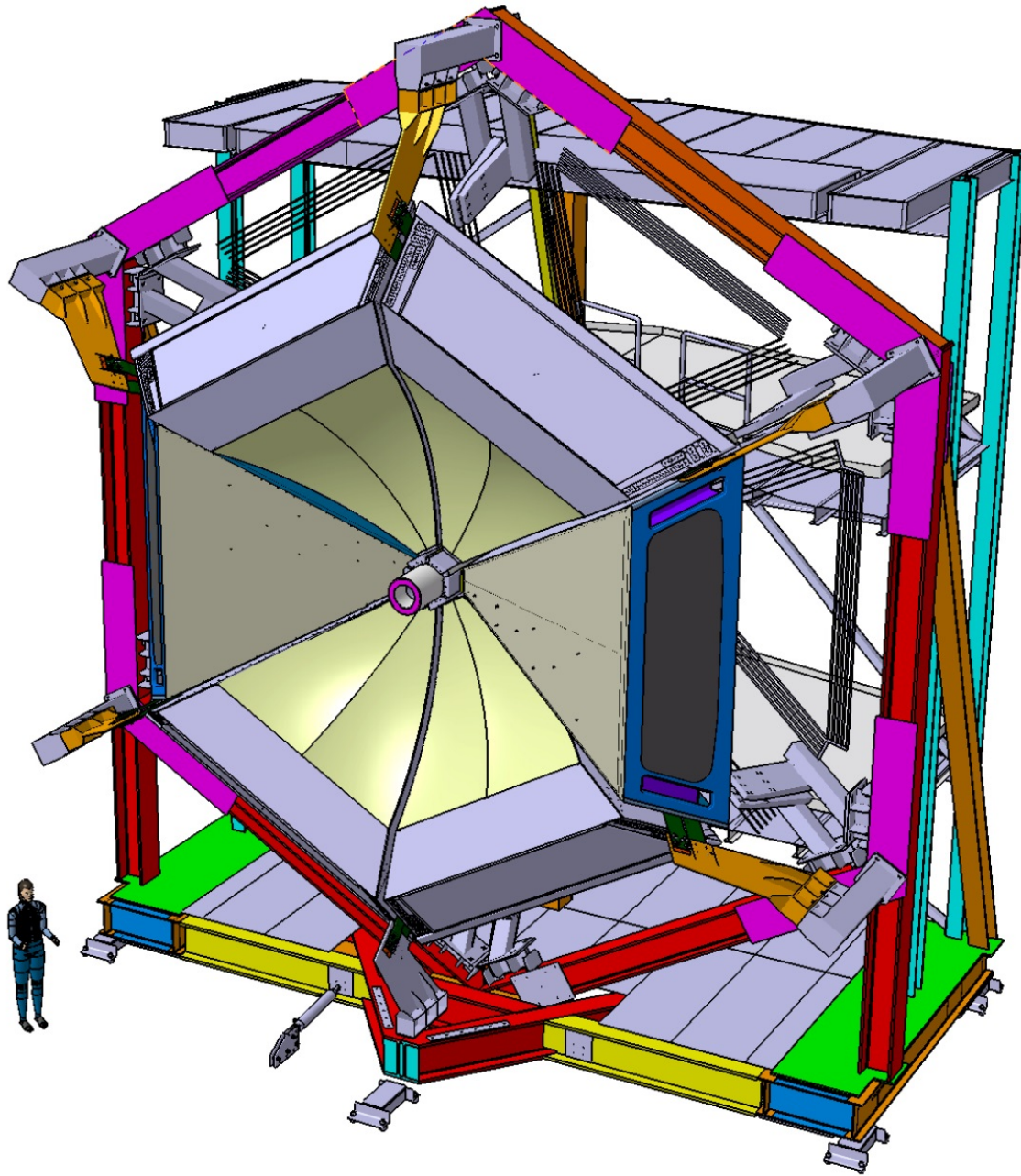
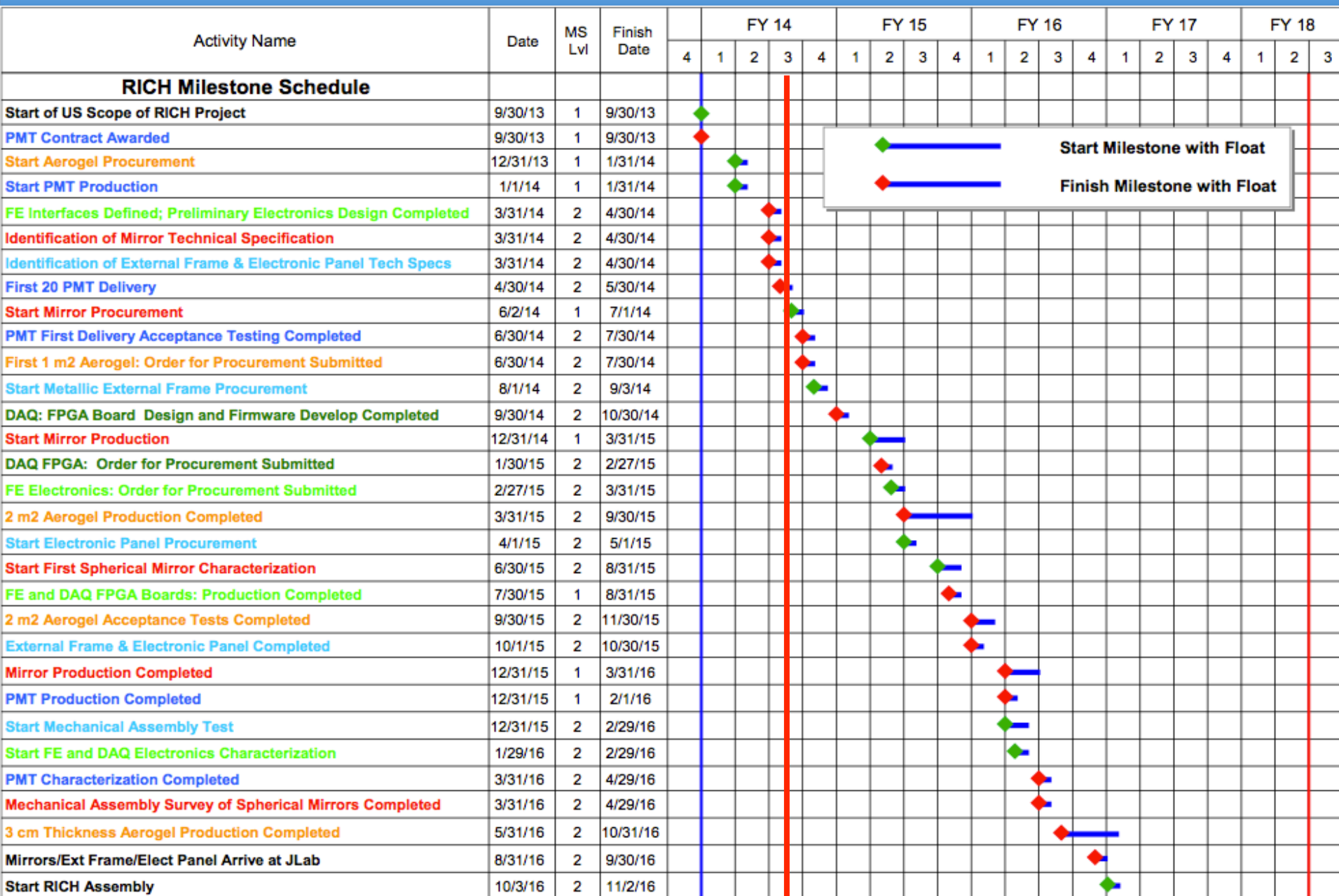


CLAS12-RICH Status-Report

May 5th 2014



RICH Project Milestones



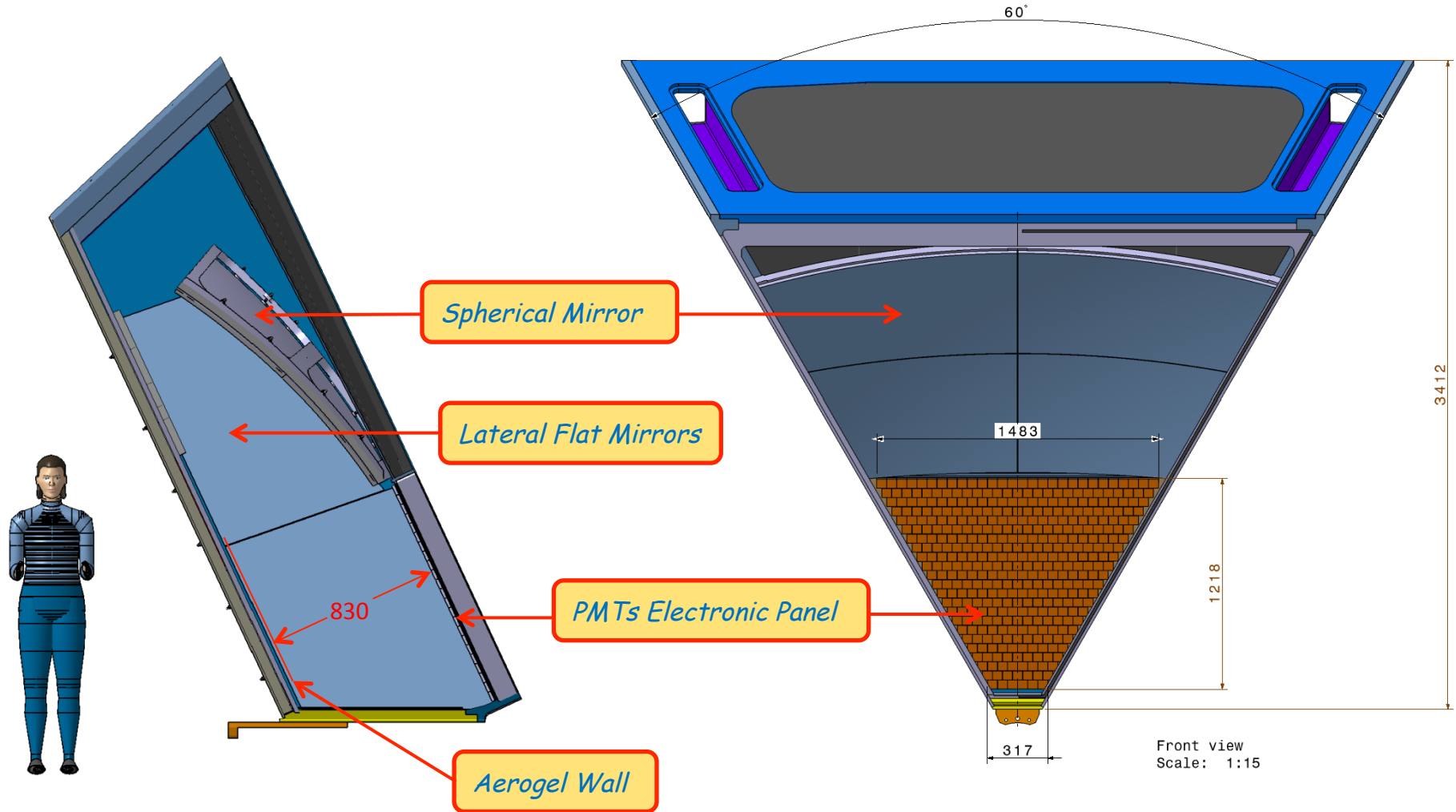
◆ — Start Milestone with Float
◆ — Finish Milestone with Float

External Frame & Electronic Panel

Milestone: Identification of External Frame & Electronic Panel Tech. Specs. (3/31/14) achieved (2/28/14)

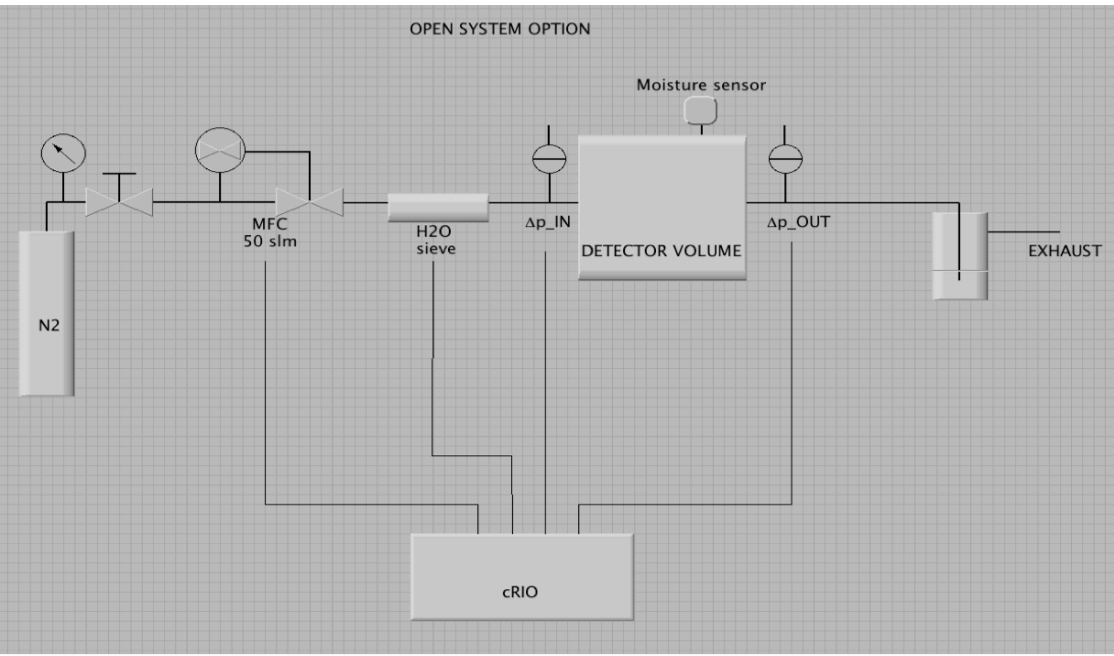
RICH module designed to be as much as possible close to the existing LTCC sector layout

Technical review with JLab engineers 20 June 2014.

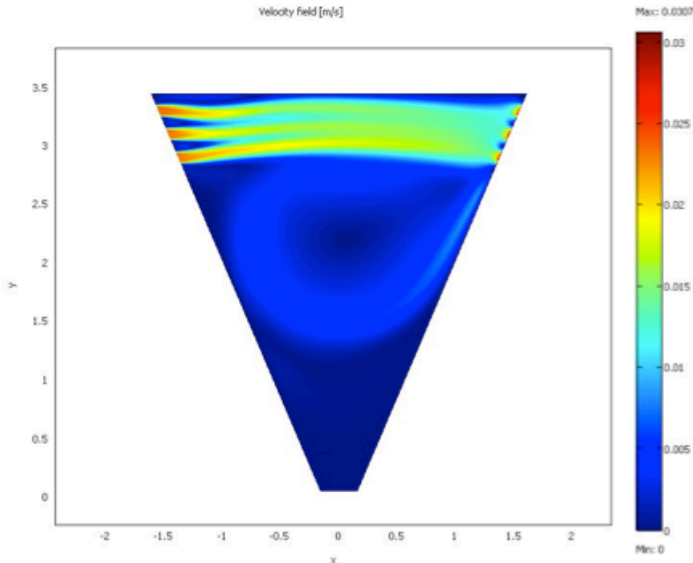


Gas System

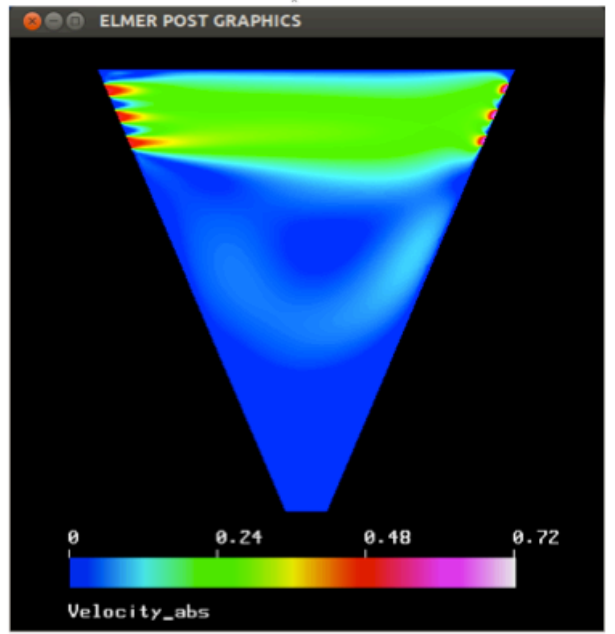
Moving from preliminary design to detailed 3D simulations



COMSOL MULTIPHYSICS
commercial



ELMER
open source



Aerogel

The Manufacture Engineering Phase by the Russian vendors at Novosibirsk to improve and stabilize large tiles production yield has been completed:

- large tiles yield acceptable for mass production has been achieved
- new tiles with optical improved surface delivered for test
- visit of the manufactures from Novosibirsk in Ferrara: March 17-23, 2014

Aerogel Radiator

Refractive index: 1.05

Area: 20x20 cm²

Thickness: 3 cm

Scattering Length: greater than 50 mm



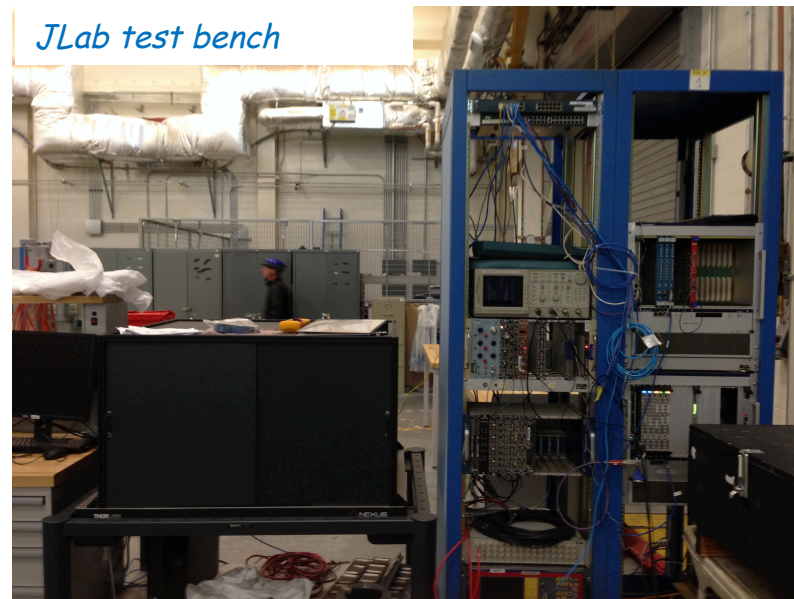
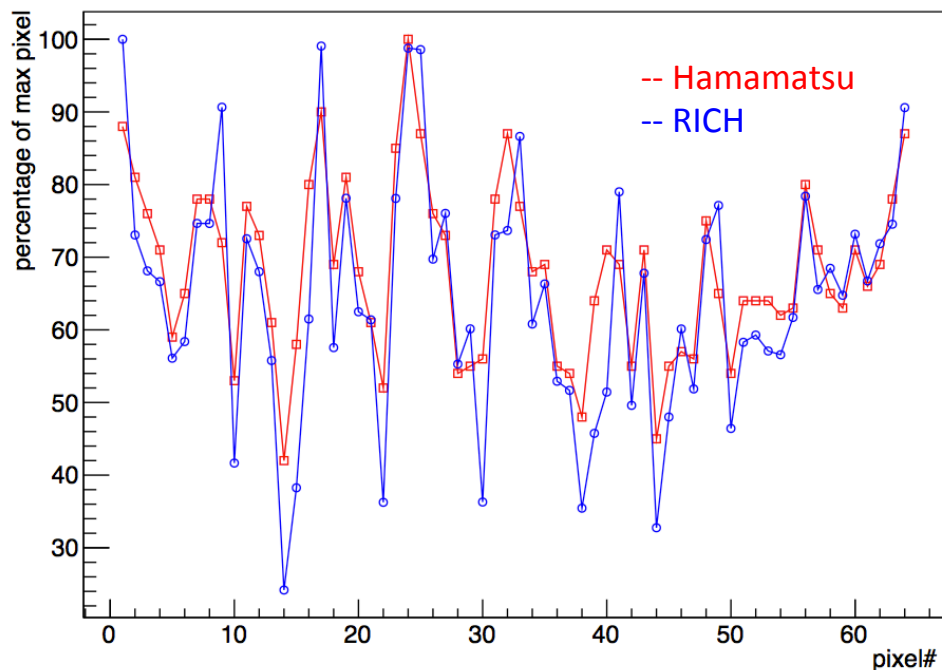
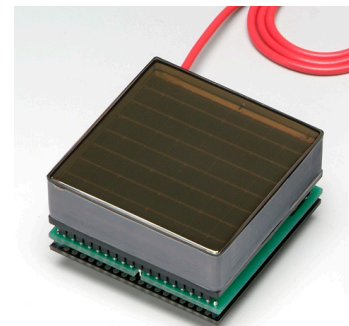
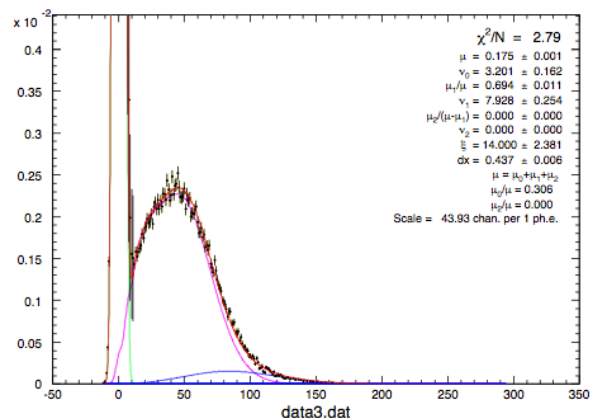
MA-PMT Photon Detector

20 MA-PMTs delivered at Jlab on March 27

- 1 month in advance versus plan
- 2 rejected due to anode dark current > 5 nA

30 MA-PMTs delivered at Jlab on April 29

Acceptance test bench ongoing at Jlab



We have started discussion with procurement and Hamamatsu how to integrate H12700 in the Phase II and Phase III of the contract

Read-Out Electronics

Milestone: FE Interfaces Defined; Preliminary Electronics Design Completed (3/31/14)

achieved

Work done in parallel to finalize executive design of

Adapter board (Genova)

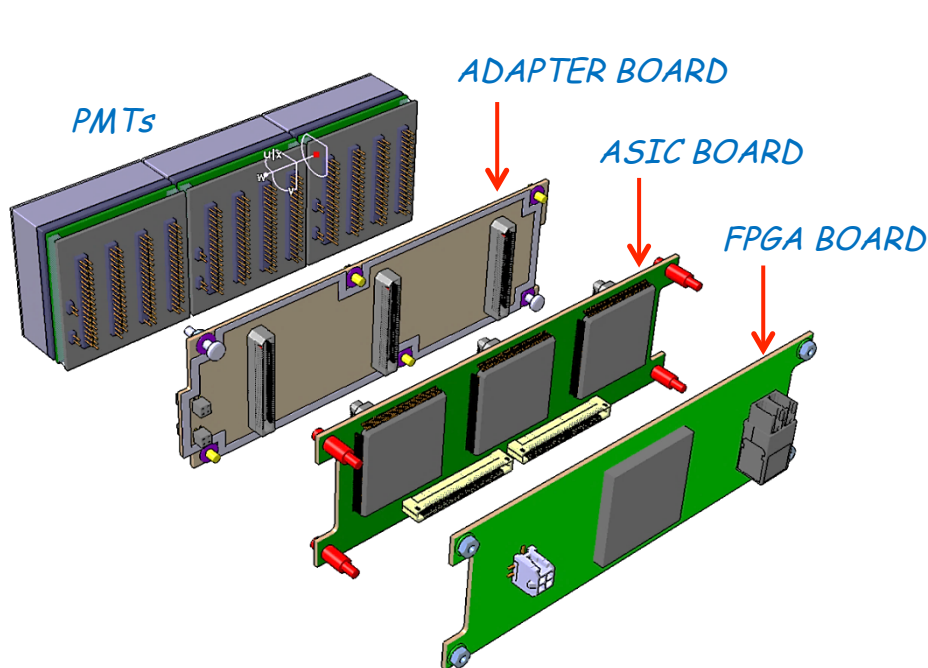
ASICs boards (Ferrara)

DAQ boards (JLab)

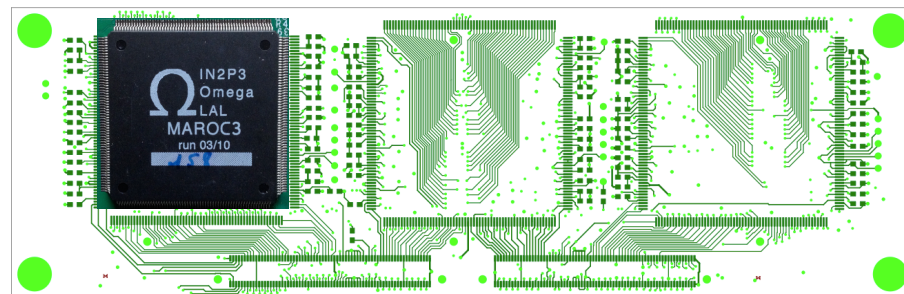
Meetings ongoing to fix details interfering with mechanics

board holding details

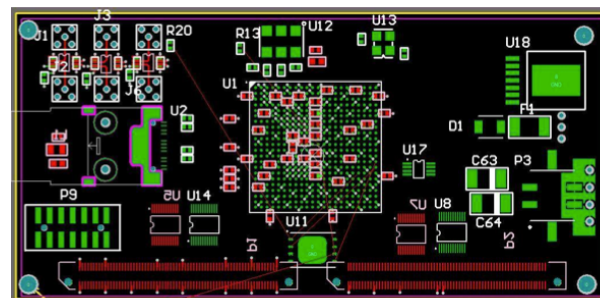
LV and readout transceiver orientation and cable routing



ASIC BOARD routing (INFN)



Universal FPGA BOARD 2D layout (JLab)



Mirrors

Milestone: Identification of Mirror Technical Specification (3/31/14)

achieved (2/28/14)

Manufacture Engineering Phase ongoing with companies in Italy and USA
In contact with CERN laboratory for mirror characterization

CFRP SPHERICAL Mirror

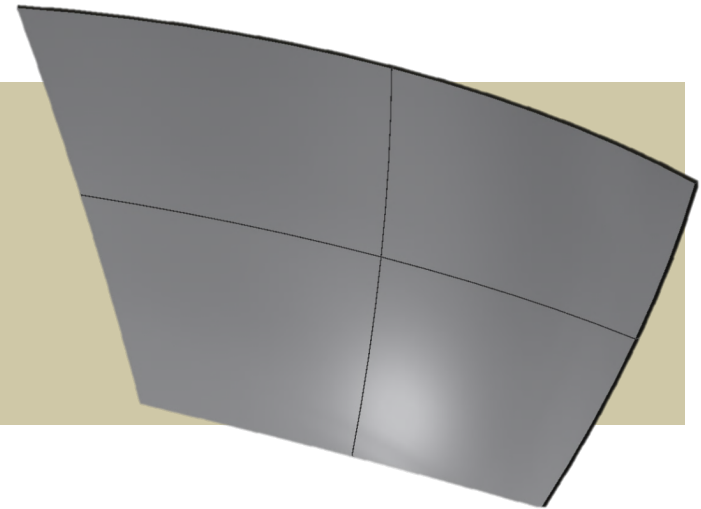
Radius tolerance $\leq 1\%$

Surface accuracy: $5 \mu\text{m RMS}$

Surface Quality: 3 nm RMS

$D0 < 5 \text{ mm}$

Reflectivity $> 90\%$



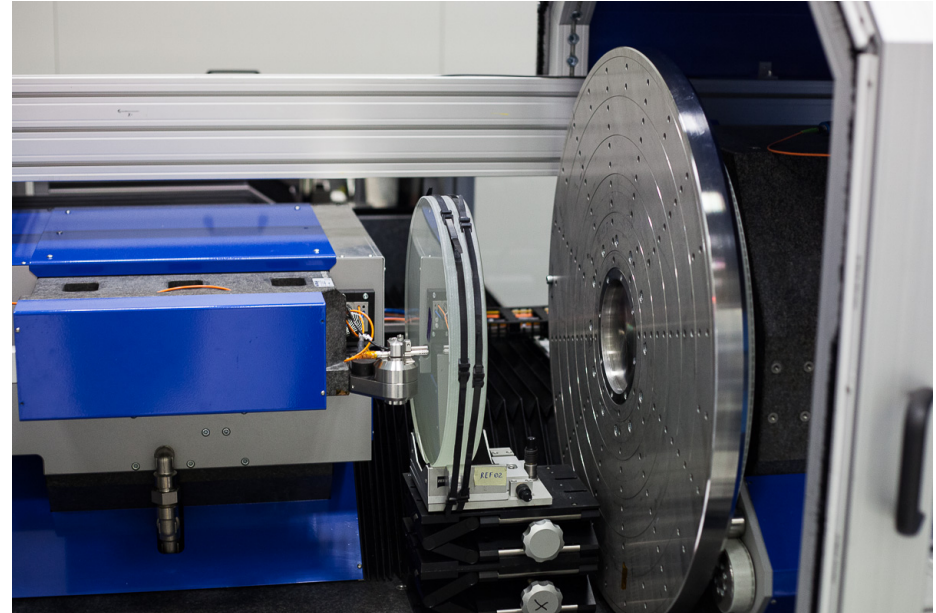
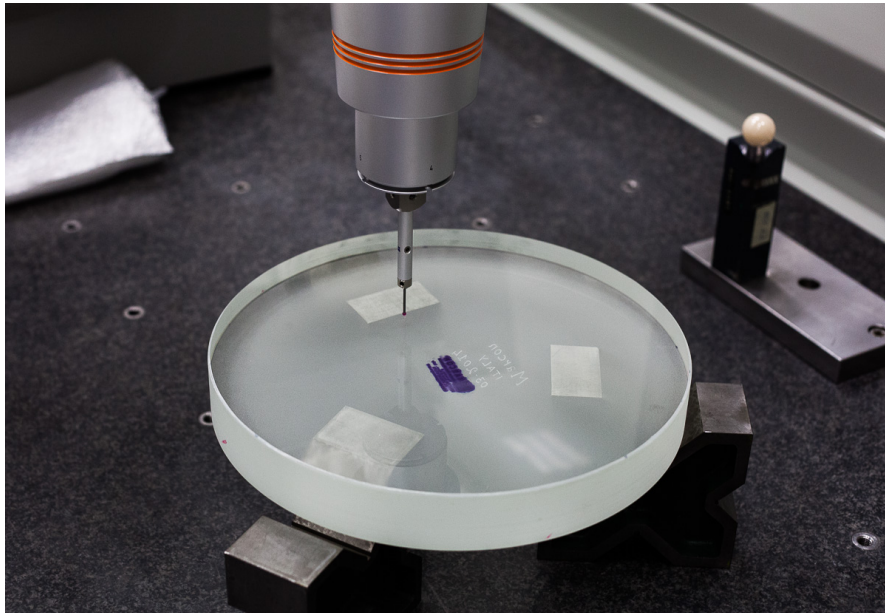
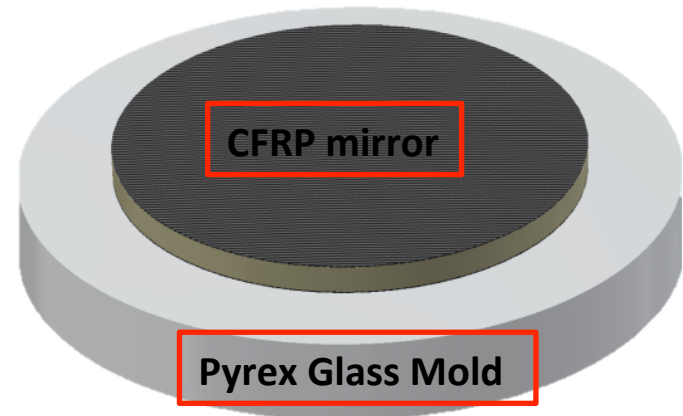
CFRP Spherical Mirror: Mandrel Demo

Mandrel demo in preparation at Marcon (Italy) :

- suprema (borosilicate glass) material
- spherical shape, 4 m radius, 35 cm diameter

➡ Delivered at the end of March

Mechanics is fulfilling specs
(from preliminary characterization results)



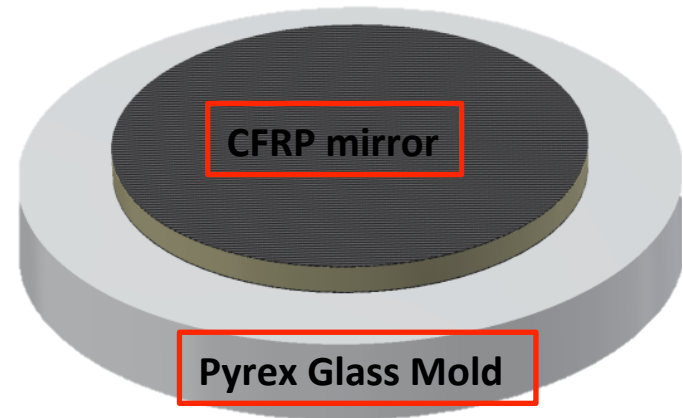
CFRP Spherical Mirror

Two mirrors demo in preparation at CMA (USA) :

- CFRP skin and rohacell core
- spherical shape, 30 cm diameter
- 1st demo: 3.5 m radius, LHCb finish, from a CMA mandrel

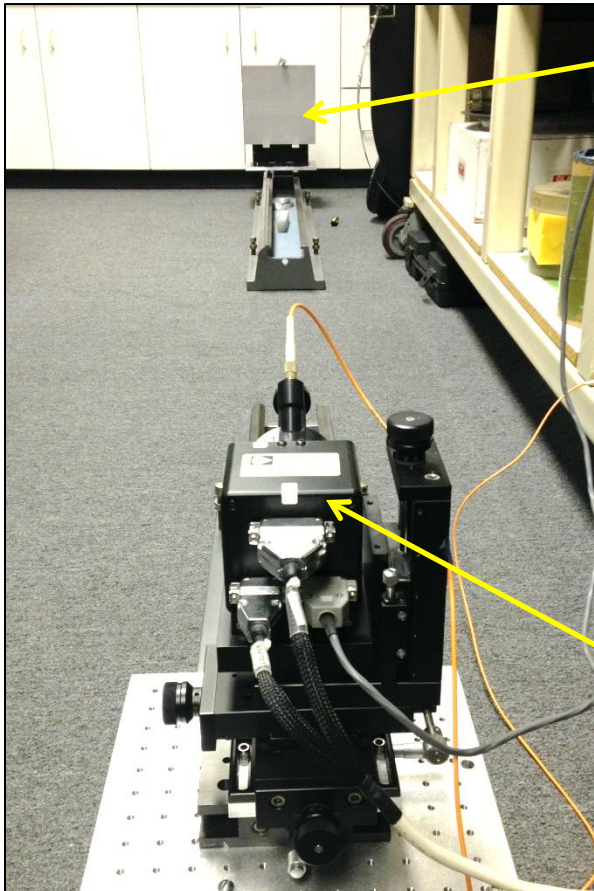
not fulfilling specs. → to be redone by the end of March

- 2nd demo: 4 m radius, CLAS12 finish, from the Marcon mandrel

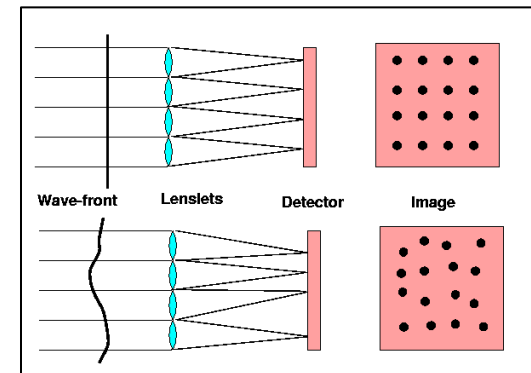
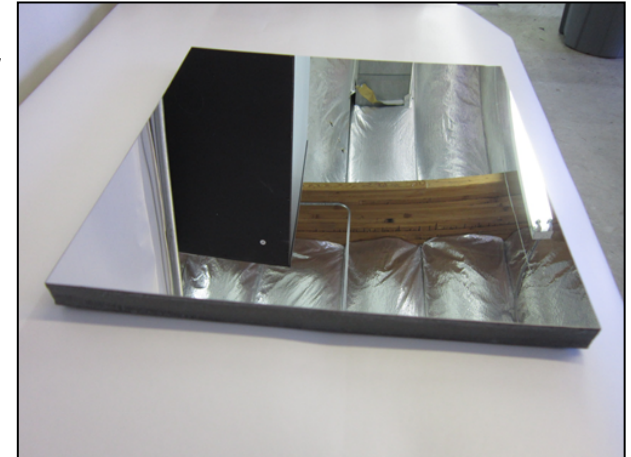


Wavefront Data

The mirror was measured with a Shack-Hartmann wavefront sensor as shown in the image below. The test is a radius of curvature test.

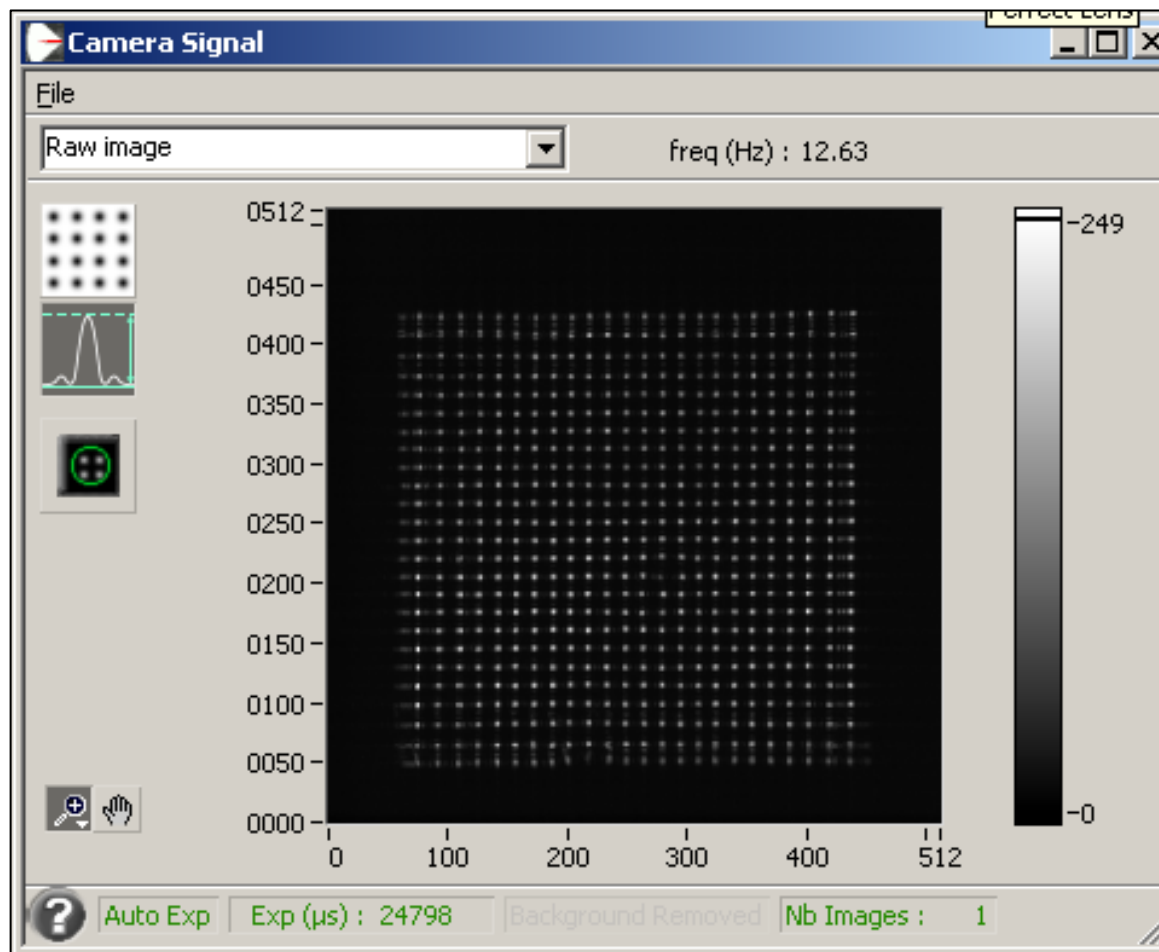


CFRP Coated Mirror



Wavefront Data

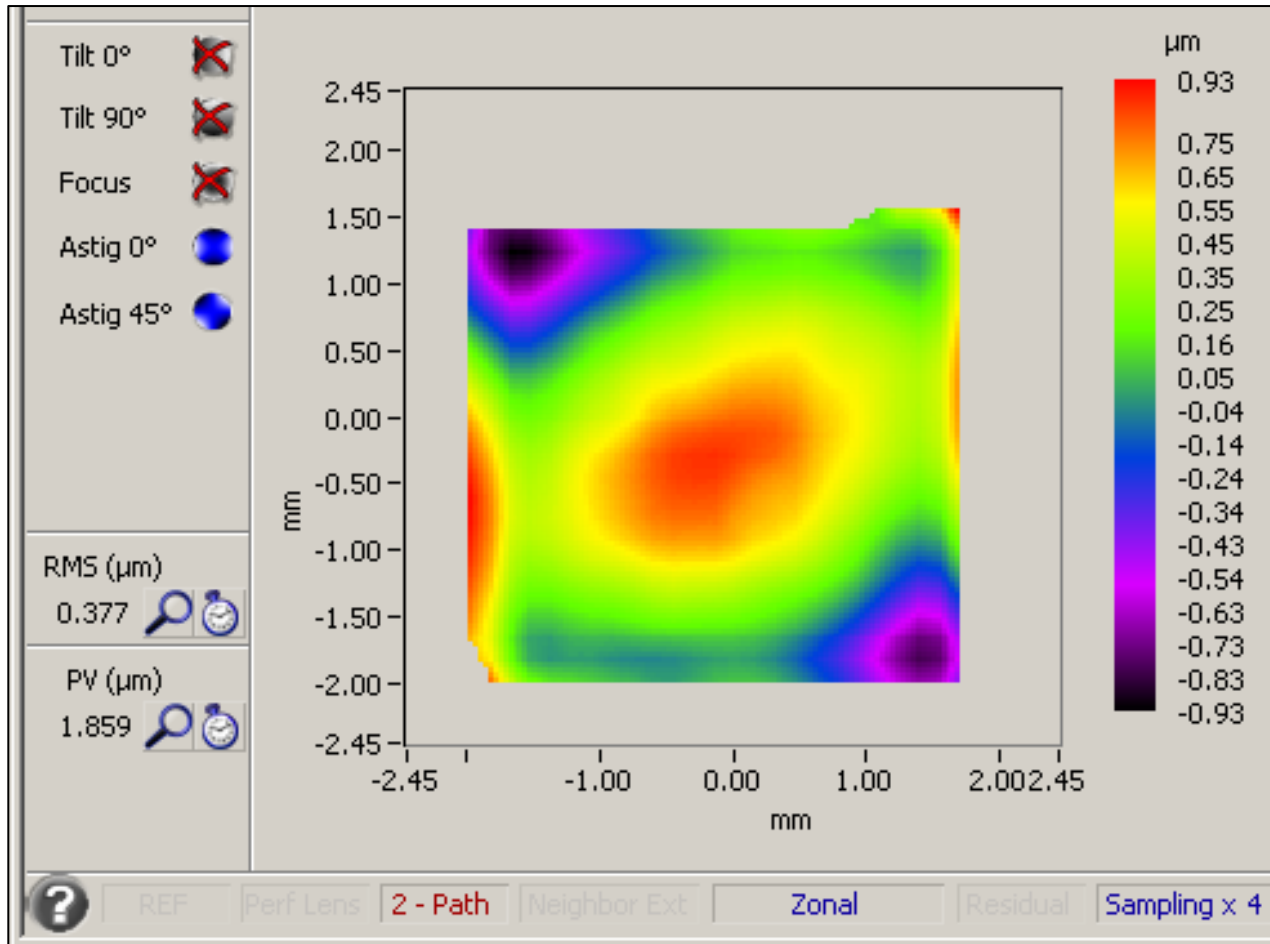
Camera signal showing the microlens array for slope measurements.



Camera Image, Raw data of full aperture of the CFRP mirror.

Wavefront Data

Surface map of the CFRP mirror shows errors of $1.86\mu\text{m}$ p-v surface, below the $2.5\mu\text{m}$ p-v surface requirement.

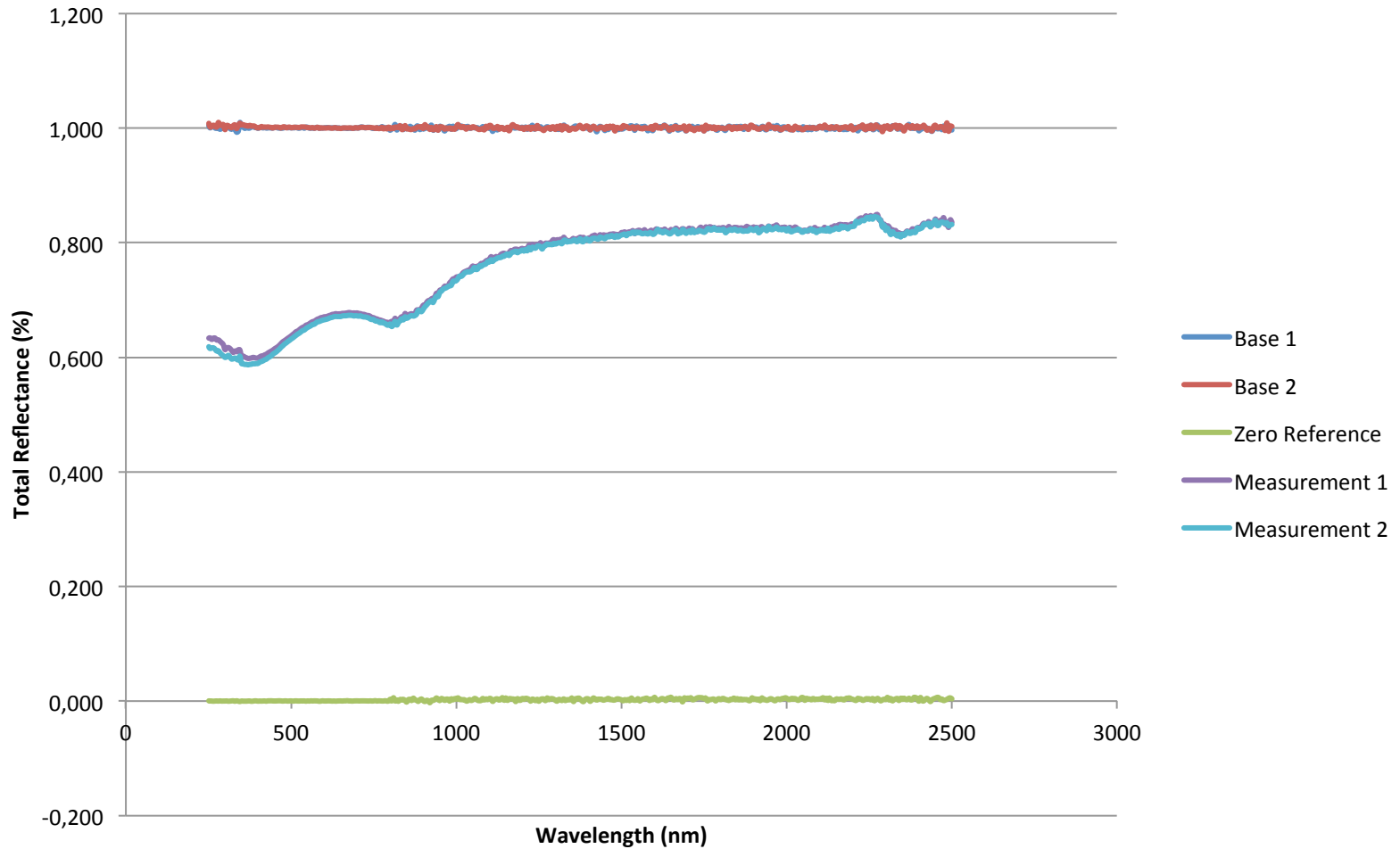


Surface Map of the full aperture of the CFRP mirror. Only tip, tilt and focus removed.

Error is $1.86\mu\text{m}$ p-v on the surface.

Reflectivity Data

The second measurement indicates just above 60% reflectivity at 450nm



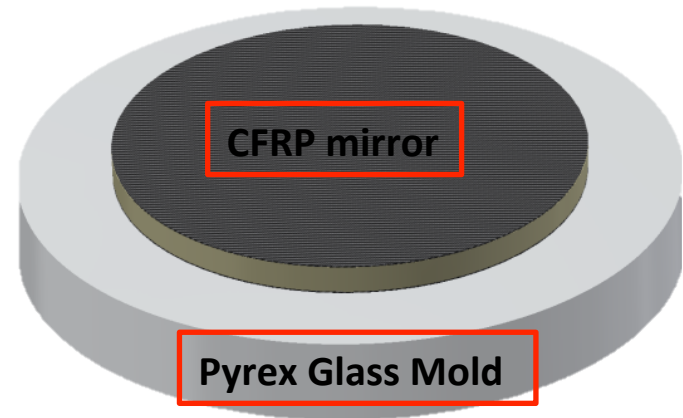
CFRP Spherical Mirror

Two mirrors demo in preparation at CMA (USA) :

- CFRP skin and rohacell core
- spherical shape, 30 cm diameter
- 1st demo: 3.5 m radius, LHCb finish, from a CMA mandrel

mechanics fulfilling specs. but coating process not reliable

- 2nd demo: 4 m radius, CLAS12 finish, from the Marcon mandrel



CMA can do the wanted CFRP substrate but not the coating

CMA has accepted to reproduce demo n.1 without coating by the end of May

For coating we have contacted

- * SESO-Thales (France)
made the coating for LHCb, max allowed mirror diameter 1.8 m
- * Zaot (Italy)
coating the planar mirrors for Media-Lario, max allowed mirror diameter 1.8 m,
in principle able to reach 92-95% reflectivity in the 300-600 nm wavelength range

Mirrors

Milestone: Identification of Mirror Technical Specification (3/31/14)

Manufacture Engineering Phase ongoing with companies in Italy and USA

In contact with CERN laboratory for mirror characterization

CFRP SPHERICAL Mirror

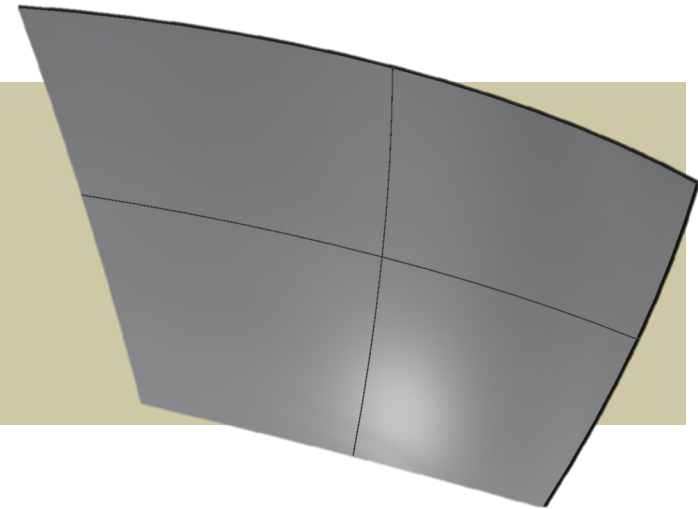
Radius tolerance $\leq 1\%$

Surface accuracy: $5\ \mu\text{m}$ RMS

Surface Quality: $3\ \text{nm}$ RMS

$D0 < 5\ \text{mm}$

Reflectivity $> 90\%$



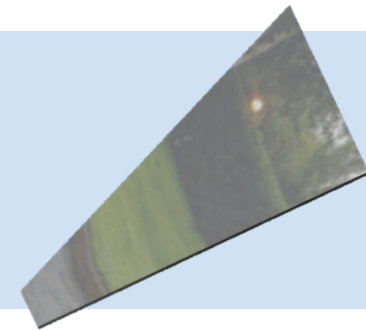
Planar Glass Mirror

Planarity tolerance $\leq 0.1\ \text{mm}$

Surface accuracy: $5\ \mu\text{m}$ RMS

Surface Quality: $3\ \text{nm}$ RMS

Reflectivity $> 90\%$



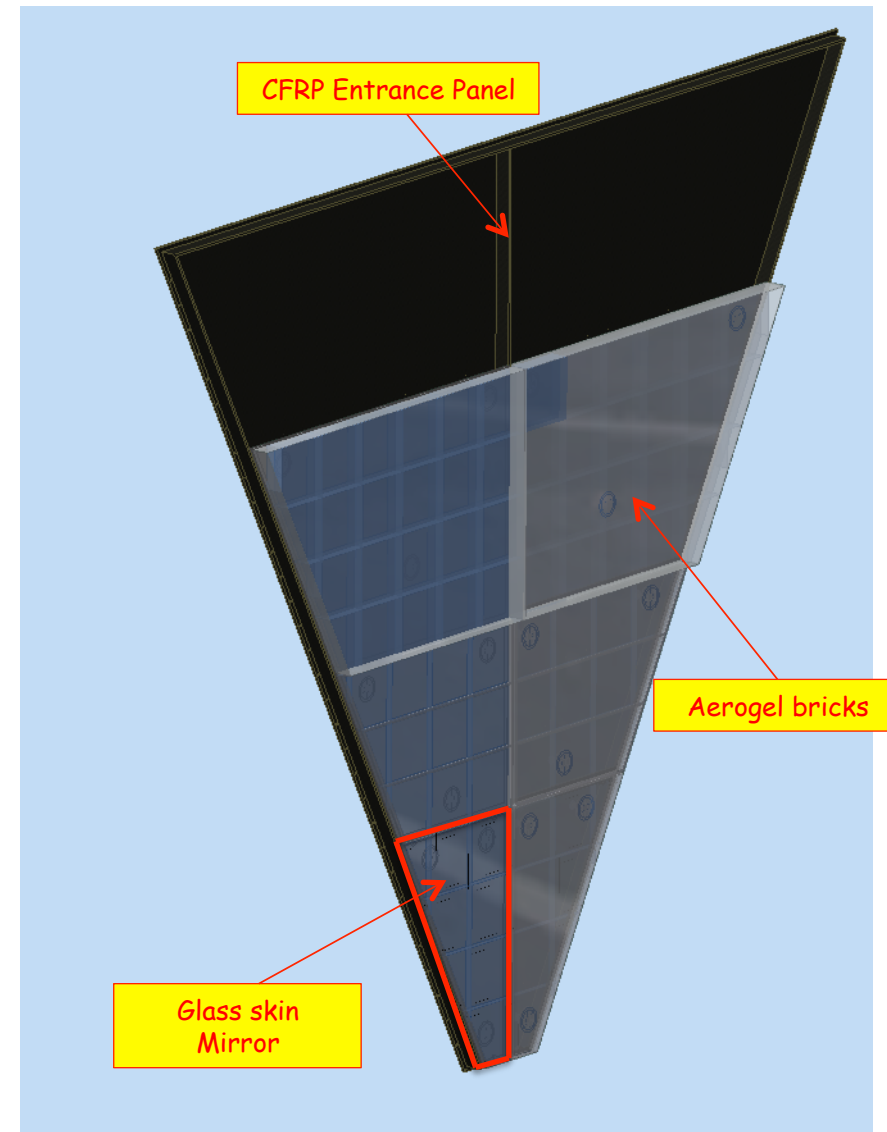
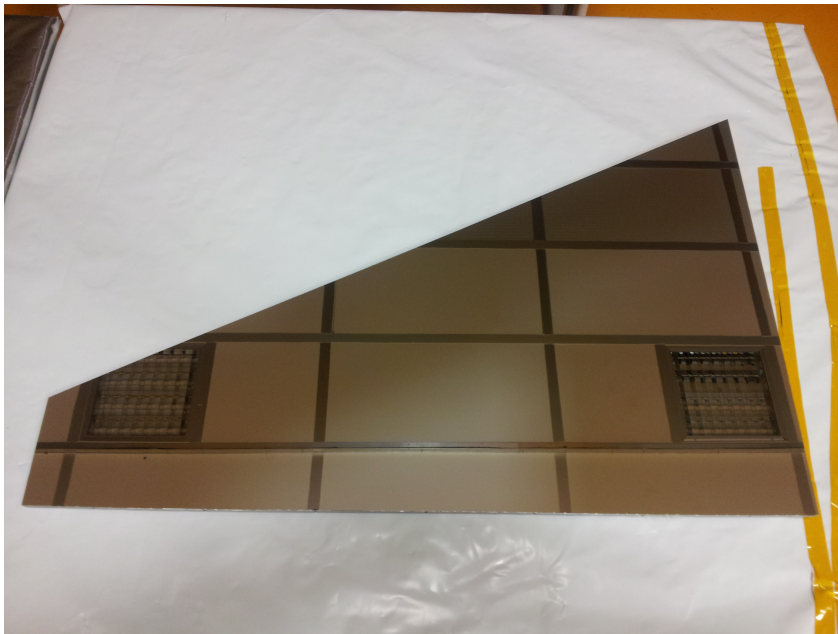
Glass Skin Mirror

Two demos under preparation at Media-Lario (Italy) :

- soda-line mm glass skin and Al honeycomb core
- reinforced frame for aerogel holder
- 1st demo: 1.6 mm (standard) glass skin thicknesses

➔ **Technical review @ Media-Lario
Delivered**

- 2nd demo: <1 mm (goal) glass skin thicknesses



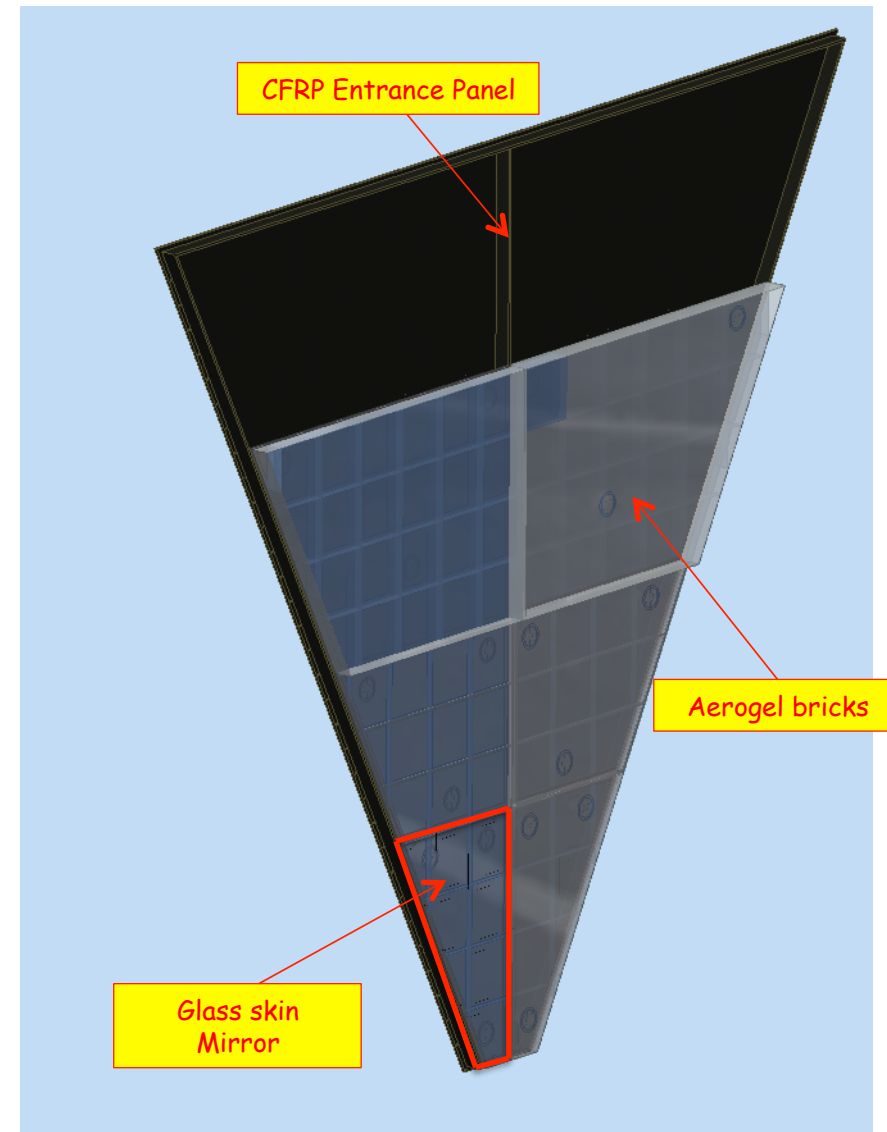
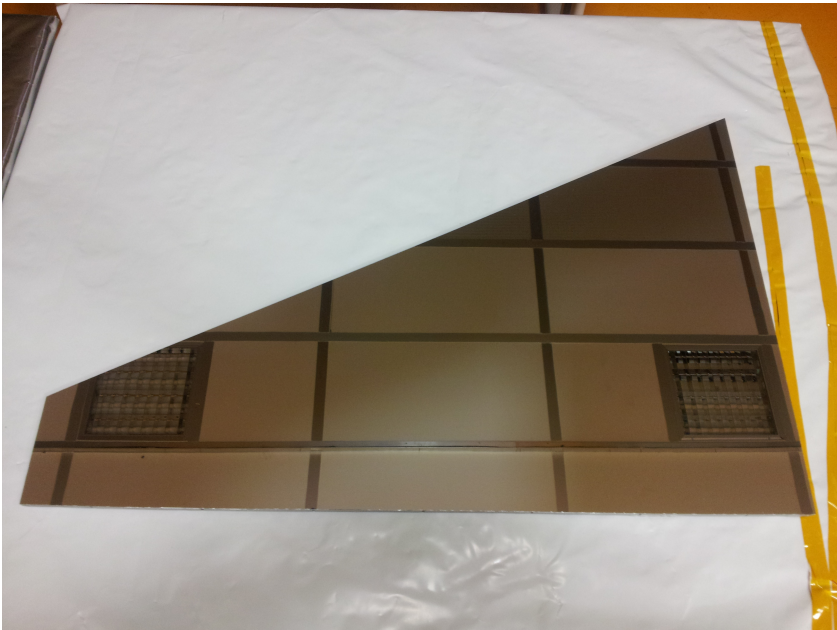
Glass Skin Mirror

Two demos under preparation at Media-Lario (Italy) :

- soda-line mm glass skin and Al honeycomb core
- reinforced frame for aerogel holder
- 1st demo: 1.6 mm (standard) glass skin thicknesses

Surface quality: 40 μm p-v, 8-9 μm rms

- not perfect Al mold (20 μm p-v)
- not optimized vacuum process
- gravity (to be studied by FEM simulation)



Glass Skin Mirror

Suitable coating with room for improvement

