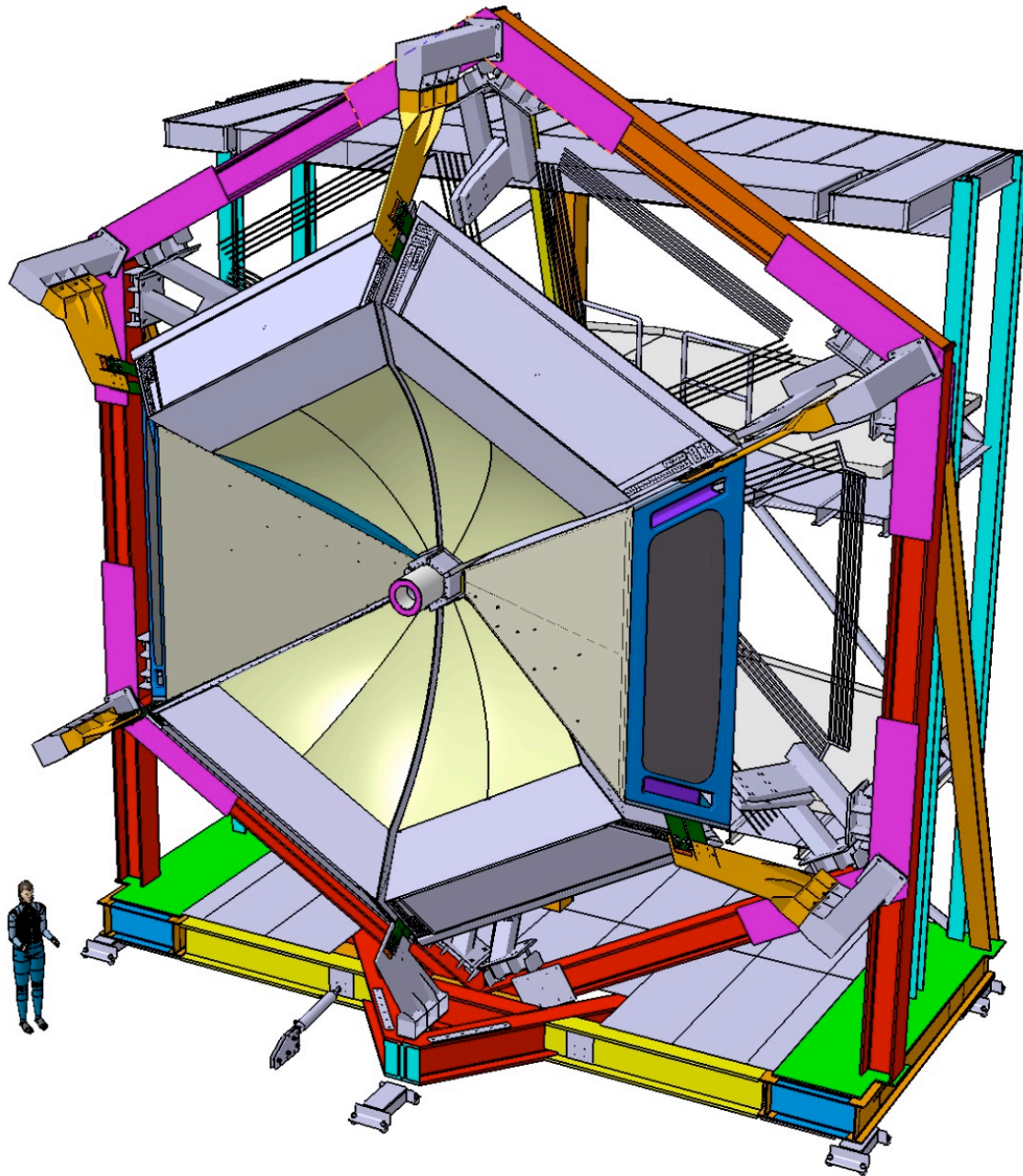


CLAS12-RICH Status-Report

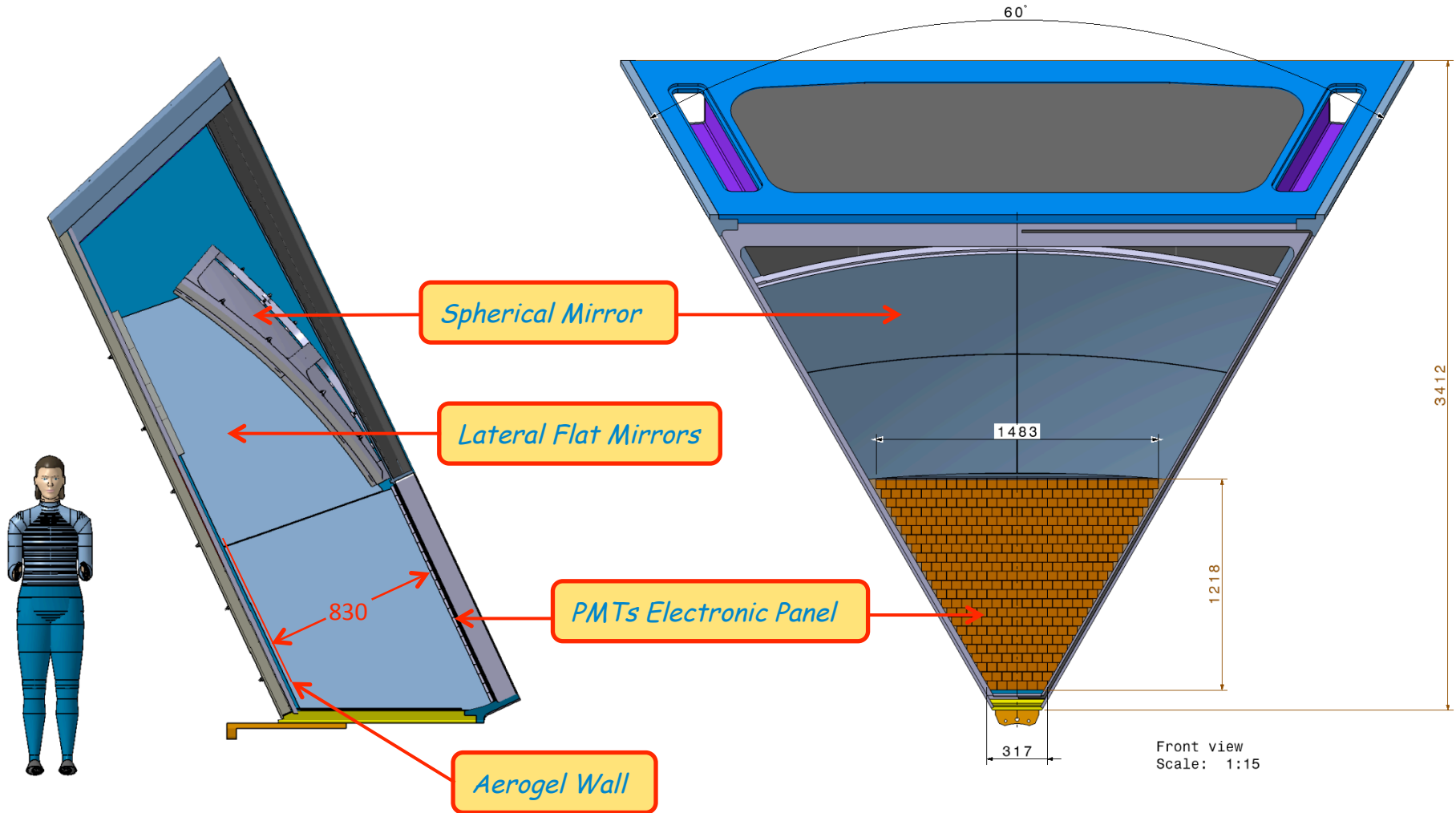
Marco 4th 2014



External Frame & Electronic Panel

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

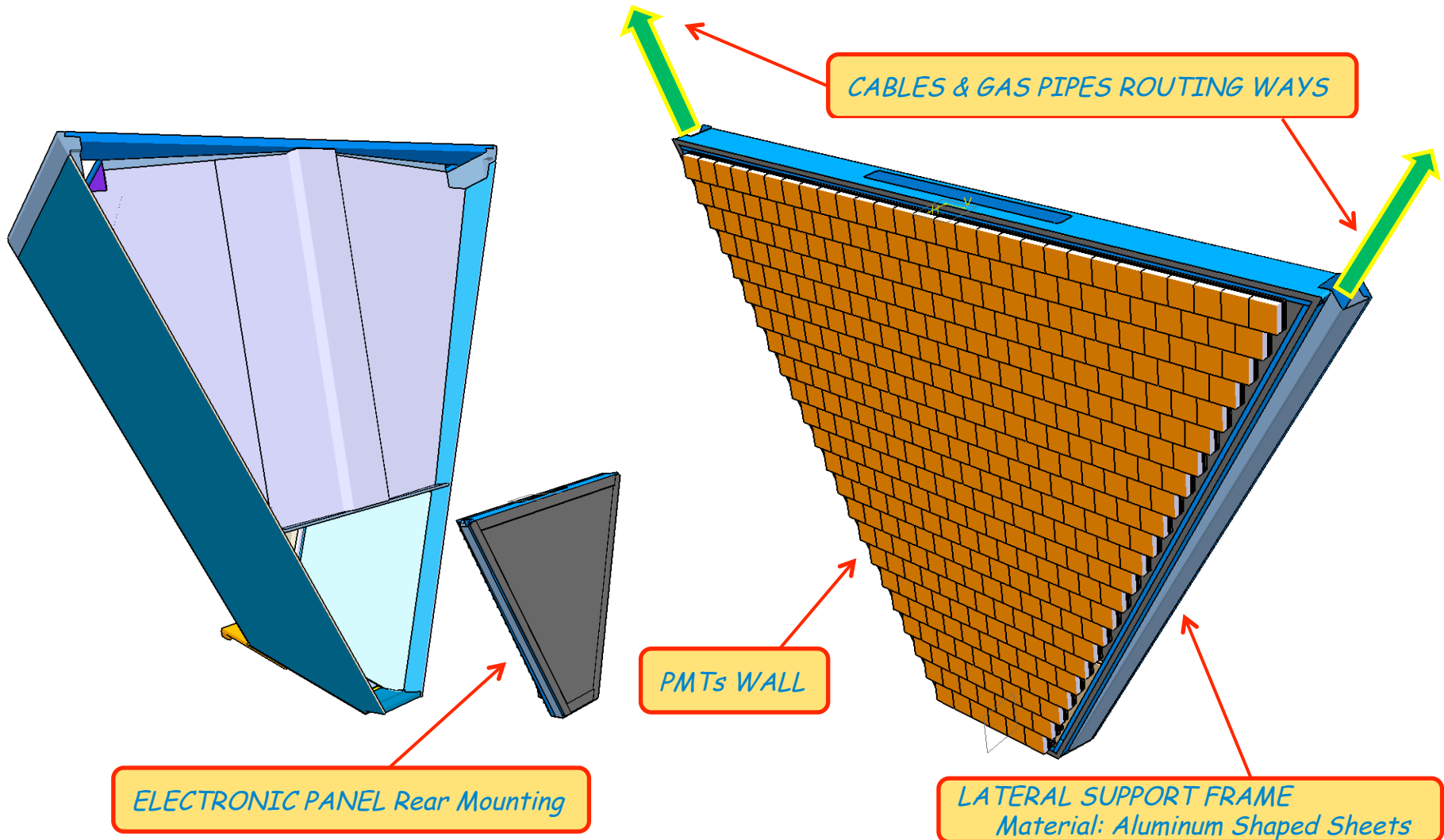
RICH module designed to be as much as possible close to the existing LTCC sector layout



External Frame & Electronic Panel

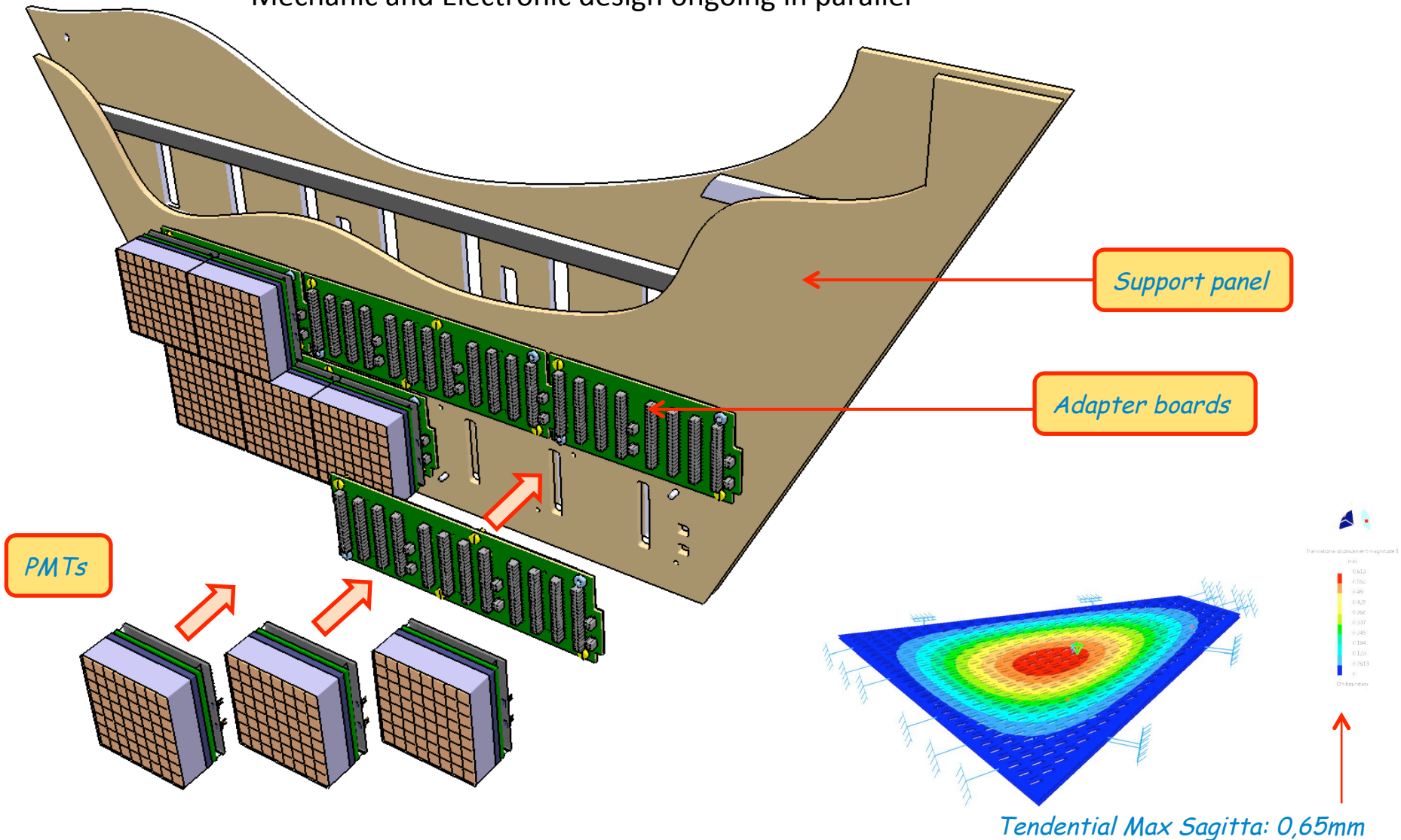
Milestone: Identification of External Frame & Electronic Panel Tech. Specs. (3/31/14)

Electronic panel designed as self supporting element to allow external PMT assembling



Electronic Panel Assembling

The panel should host PMTs and electronics and be light and gas tight to divide the inner dry N_2 volume from the electronics cooled in controlled atmosphere
Mechanic and Electronic design ongoing in parallel

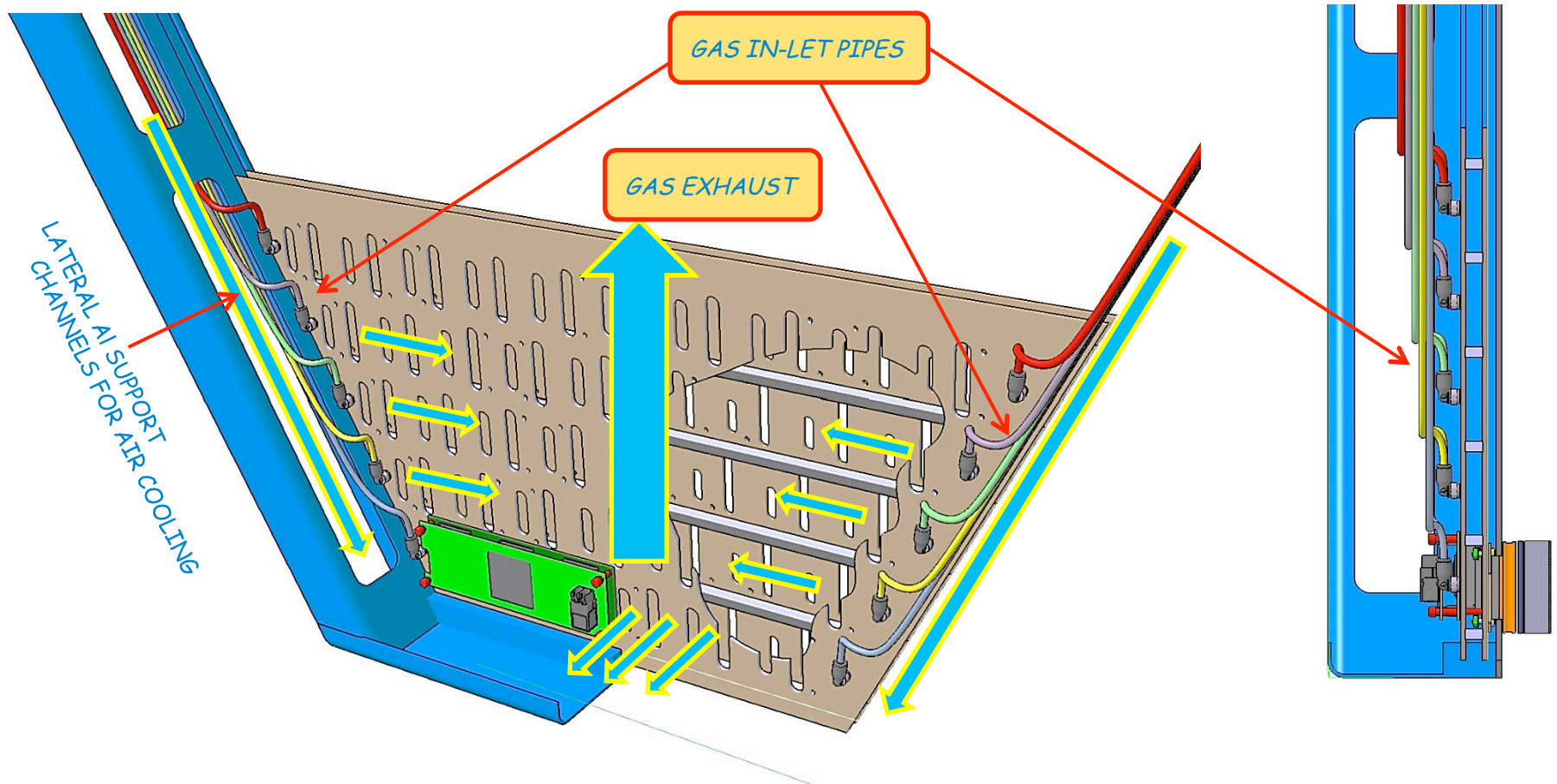


Gas system & Electronics Cooling

Milestone: Gas System: (Preliminary) Design Completed (3/31/14)

Needed to identify requirements for the mechanical structure

Experienced manpower (INFN-Bari) assigned to this task

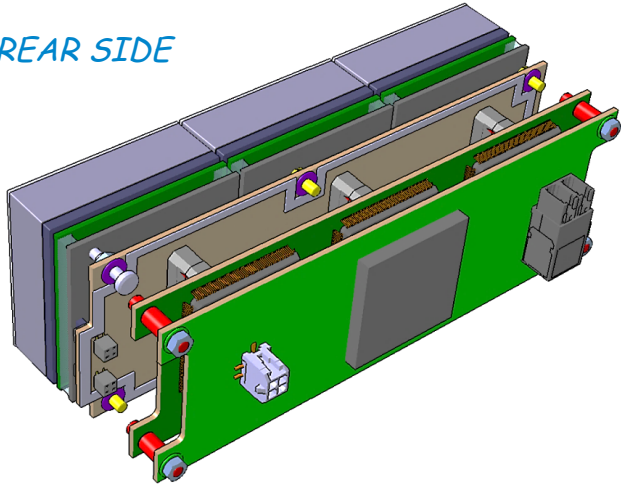


Read-Out Electronics

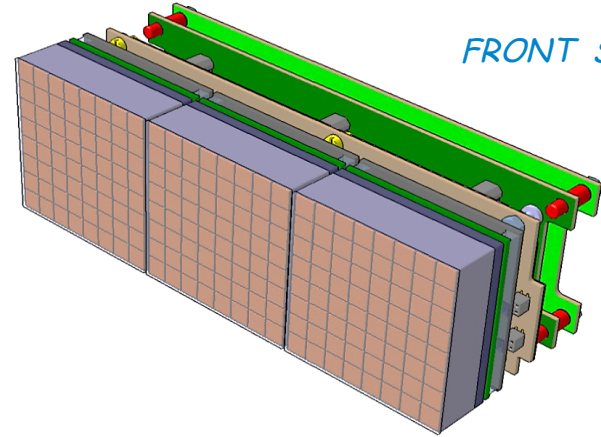
Milestone: FE Interfaces Defined; Preliminary Electronics Design Completed (3/31/14)

Readout boards serve groups of 2 or 3 PMTs

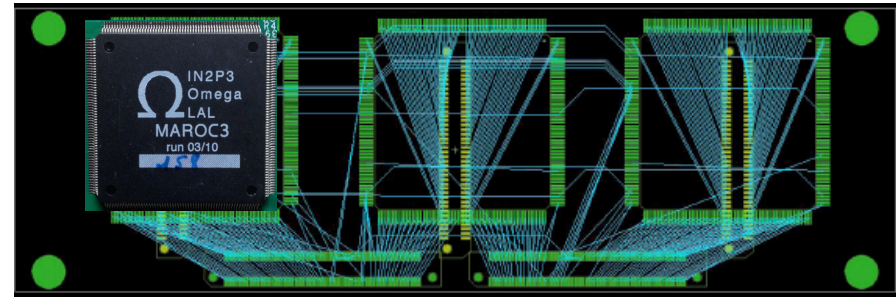
REAR SIDE



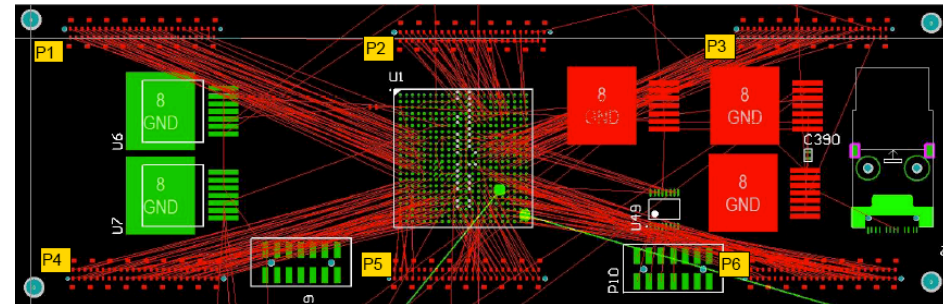
FRONT SIDE



Preliminary ASIC BOARD routing and pin assignment (INFN)



Preliminary FPGA BOARD 2D layout (JLab)

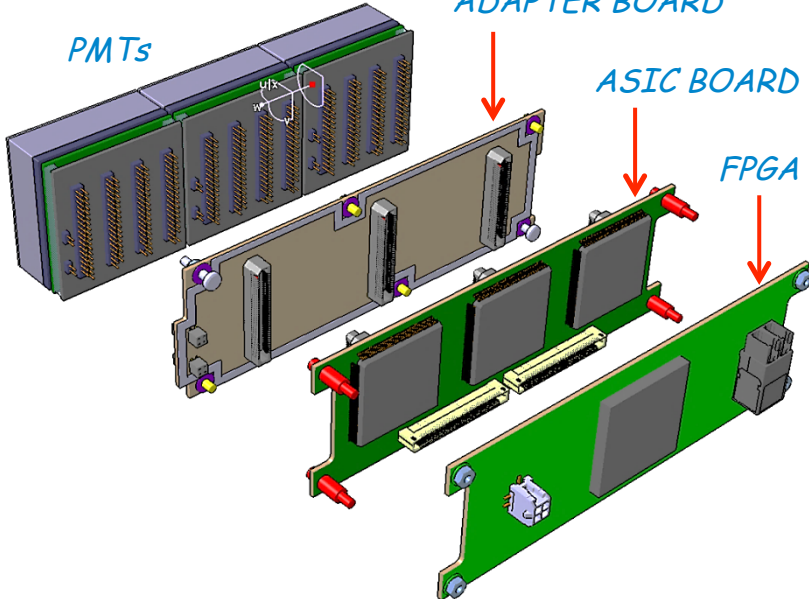


PMTs

ADAPTER BOARD

ASIC BOARD

FPGA BOARD



Read-Out Electronics

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

FE interface pin assignment defined

ERF5	Name	J	ID	C	asic	mrc
1	GND	6	2	1	0	none
2	GND	6	2	2	0	none
3	OUT_1_62	6	43	1	119	
4	OUT_1_63	6	40	1	118	
5	OUT_1_60	6	49	1	121	
6	OUT_1_61	6	46	1	120	
7	OUT_1_58	6	55	1	123	
8	OUT_1_59	6	52	1	122	
9	OUT_1_56	6	61	1	125	
10	OUT_1_57	6	58	1	124	
11	OUT_1_54	6	67	1	127	
12	OUT_1_55	6	64	1	126	
13	OUT_1_52	6	73	1	129	
14	OUT_1_53	6	70	1	128	
15	OUT_1_50	6	79	1	131	
16	OUT_1_51	6	76	1	130	
17	OUT_1_48	6	85	1	133	
18	OUT_1_49	6	82	1	132	
19	GND	6	2	3	0	none
20	GND	6	2	4	0	none
21	OUT_1_46	6	91	1	135	
22	OUT_1_47	6	88	1	134	
23	OUT_1_44	6	97	1	137	
24	OUT_1_45	6	94	1	136	
25	OUT_1_43	6	103	1	139	
26	OUT_1_42	6	100	1	138	
27	OUT_1_40	6	109	1	141	
28	OUT_1_41	6	106	1	140	
29	OUT_1_38	6	115	1	143	
30	OUT_1_39	6	112	1	142	
31	OUT_1_36	6	121	1	145	
32	OUT_1_37	6	118	1	144	
33	OUT_1_34	6	127	1	147	
34	OUT_1_35	6	124	1	146	
35	OUT_1_32	6	133	1	149	
36	OUT_1_33	6	130	1	148	
37	GND	6	2	5	0	none
38	GND	6	2	6	0	none
39	OUT_1_30	6	139	1	152	
40	OUT_1_31	6	136	1	151	
41	OUT_1_28	6	145	1	154	
42	OUT_1_29	6	142	1	153	
43	OUT_1_26	6	151	1	156	
44	OUT_1_27	6	148	1	155	
45	OUT_1_24	6	157	1	158	
46	OUT_1_25	6	154	1	157	
47	OUT_1_22	6	163	1	160	
48	OUT_1_23	6	160	1	159	
49	OUT_1_20	6	169	1	162	
50	OUT_1_21	6	166	1	161	
51	OUT_1_18	6	175	1	164	
52	OUT_1_19	6	172	1	163	
53	OUT_1_16	6	181	1	166	
54	OUT_1_17	6	178	1	165	
55	GND	6	2	7	0	none
56	GND	6	2	8	0	none
57	OUT_1_14	6	187	1	168	
58	OUT_1_15	6	184	1	167	
59	OUT_1_12	6	193	1	170	
60	OUT_1_13	6	190	1	169	
61	OUT_1_10	6	199	1	172	
62	OUT_1_11	6	196	1	171	
63	OUT_1_8	6	205	1	174	
64	OUT_1_9	6	202	1	173	
65	OUT_1_6	6	211	1	176	
66	OUT_1_7	6	208	1	175	
67	OUT_1_4	6	217	1	178	
68	OUT_1_5	6	214	1	177	
69	OUT_1_2	6	223	1	180	
70	OUT_1_3	6	220	1	179	

ERF5	Name	J	ID	C	asic	mrc
1	GND	5	2	1	0	none
2	GND	5	2	2	0	none
3	OUT_2_30	5	140	2	152	
4	OUT_2_31	5	137	2	151	
5	OUT_2_28	5	146	2	154	
6	OUT_2_29	5	143	2	153	
7	OUT_2_26	5	152	2	155	
8	OUT_2_27	5	149	2	155	
9	OUT_2_24	5	158	2	158	
10	OUT_2_25	5	155	2	157	
11	OUT_2_22	5	164	2	160	
12	OUT_2_23	5	161	2	159	
13	OUT_2_20	5	170	2	162	
14	OUT_2_21	5	167	2	161	
15	OUT_2_18	5	176	2	164	
16	OUT_2_19	5	173	2	163	
17	OUT_2_16	5	182	2	166	
18	OUT_2_17	5	179	2	165	
19	GND	5	2	3	0	none
20	GND	5	2	4	0	none
21	OUT_2_14	5	188	2	167	
22	OUT_2_15	5	185	2	167	
23	OUT_2_12	5	194	2	170	
24	OUT_2_13	5	191	2	169	
25	OUT_2_10	5	200	2	172	
26	OUT_2_11	5	197	2	171	
27	OUT_2_8	5	206	2	174	
28	OUT_2_9	5	203	2	173	
29	OUT_2_6	5	212	2	175	
30	OUT_2_7	5	209	2	175	
31	OUT_2_4	5	218	2	178	
32	OUT_2_5	5	215	2	177	
33	OUT_2_2	5	224	2	180	
34	OUT_2_3	5	221	2	179	
35	OUT_2_0	5	230	2	182	
36	OUT_2_1	5	227	2	181	
37	GND	5	2	5	0	none
38	GND	5	2	6	0	none
39	TrasmiON_3	6	24	3	114	
40	OR_2_0	5	35	2	191	
41	Qbuf_R_2	5	11	2	76	
42	OR_2_1	5	38	2	192	
43	Qbuf_R_3	5	12	3	76	
44	EN_otag_fromFpga	5	32	4	213	
45	Hold1	5	8	4	79	
46	EN_EXT_ADD	5	3	4	none	
47	Hold2	5	9	4	81	
48	CK_EXT_ADD	5	4	4	none	
49	RStb_R	5	14	4	80	
50	Qbuf_BC_3	5	20	3	199	
51	CK_R	5	13	4	78	
52	DOUT_EXT_ADD_2	5	6	2	none	
53	OUT_ADD_3	5	27	3	115	
54	DOUT_EXT_ADD_3	5	7	3	none	
55	GND	5	2	7	0	none
56	VDD	5	1	1	0	none
57	GND	5	2	8	0	none
58	VDD	5	1	2	0	none
59	GND	5	2	9	0	none
60	VDD	5	1	3	0	none
61	Ctest	5	33	4	234	
62	VDD	5	1	4	0	none
63	GND	5	2	10	0	none
64	VDD	5	1	5	0	none
65	OR_3_0	5	36	3	191	
66	OR_3_1	5	39	3	192	
67	GND	5	2	11	0	none
68	GND	5	2	12	0	none
69	OUT_3_62	5	45	3	119	
70	OUT_3_63	5	42	3	118	

71	OUT_1_0	6	229	1	182	
72	OUT_1_1	6	226	1	181	
73	GND	6	2	9	0	none
74	GND	6	2	10	0	none
75	CK_BC	6	21	4	68	
76	OR_3_2	6	34	1	191	
77	RStb_BC	6	19	4	66	
78	OR_1_1	6	37	1	192	
79	D_BC_1	6	18	1	64	
80	DOUT_EXT_ADD_1	6	5	1	none	
81	GND	6	2	11	0	none
82	VDD	6	1	1	0	none
83	GND	6	2	12	0	none
84	VDD	6	1	2	0	none
85	GND	6	2	13	0	none
86	VDD	6	1	3	0	none
87	GND	6	2	14	0	none
88	VDD	6	1	4	0	none
89	GND	6	2	15	0	none
90	VDD	6	1	5	0	none
91	GND	6	2	16	0	none
92	VDD	6	1	6	0	none
93	D_R	6	15	1	82	
94	TrasmiON_1	6	22	1	114	
95	OUT_ADD_1	6	25	1	115	
96	TrasmiON_2	6	23	2	114	
97	OUT_ADD_2	6	26	2	115	
98	Qbuf_R_1	6	10	1	76	
99	start_ADDcb	6	28	4	116	
100	CK_40M	6	31	4	188	
101	RStb_ADDcb	6	29	4	184	
102	CKb_40M	6	30	4	186	
103	GND	6	2	17	0	none
104	GND	6	2	18	0	none
105	OUT_3_62	6	44	2	119	
106	OUT_3_63	6	41	2	118	
107	OUT_3_60	6	50	2	121	
108	OUT_3_61	6	47	2	120	
109	OUT_3_58	6	56	2	123	
110	OUT_3_59	6	53	2	122	
111	OUT_3_56	6	62	2	125	
112	OUT_3_57	6	59	2	124	
113	OUT_3_54	6	68	2	127	
114	OUT_3_55	6	65	2	126	
115	OUT_3_52	6	74	2	129	
116	OUT_3_53	6	71	2	128	
117	OUT_3_50	6	80	2	131	
118	OUT_3_51	6	77	2	130	
119	OUT_3_48	6	86	2	133	
120	OUT_3_49	6	83	2	132	
121	GND	6	2	19	0	none
122	GND	6	2	20	0	none
123	OUT_3_46	6	92	2	135	
124	OUT_3_47	6	89	2	134	
125	OUT_3_44	6	98	2	137	
126	OUT_3_45	6	95	2	136	
127	OUT_3_42	6	104	2	139	
128	OUT_3_43	6	101	2	138	
129	OUT_3_40	6	110	2	141	
130	OUT_3_41	6	107	2	140	
131	OUT_3_38	6	116	2	143	
132	OUT_3_39	6	113	2	142	
133	OUT_3_36	6	122	2	145	
134	OUT_3_37	6	119	2	144	
135	OUT_3_34	6	128	2	147	
136	OUT_3_35	6	125	2	146	
137	OUT_3_32	6	134	2	149	
138	OUT_3_33	6	131	2	148	
139	GND	6	2	21	0	none
140	GND	6	2	22	0	none

71	OUT_3_60	5	51	3	121	
72	OUT_3_61	5	48	3	120	
73	OUT_3_58	5	57	3	123	
74	OUT_3_59	5	54	3	122	
75	OUT_3_56	5	63	3	125	
76	OUT_3_57	5	60	3	124	
77	OUT_3_54	5	69	3	127	
78	OUT_3_55	5	66	3	126	
79	OUT_3_52	5	75	3	129	
80	OUT_3_53	5	72	3	128	
81	OUT_3_50	5	81	3	131	
82	OUT_3_51	5	78	3	130	
83	OUT_3_48	5	87	3	133	
84	OUT_3_49	5	84	3	132	
85	GND	5	2	13	0	none
86	GND	5	2	14	0	none

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

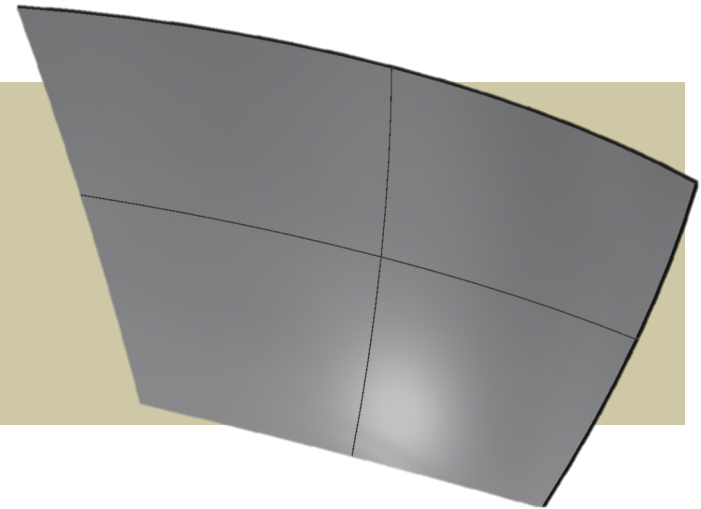
Radius tolerance $\leq 1\%$

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

Surface Quality: 3 nm RMS

$D0 < 5 \text{ mm}$

Reflectivity $> 90\%$



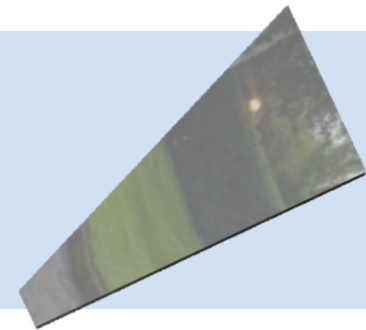
Planar Glass Mirror

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

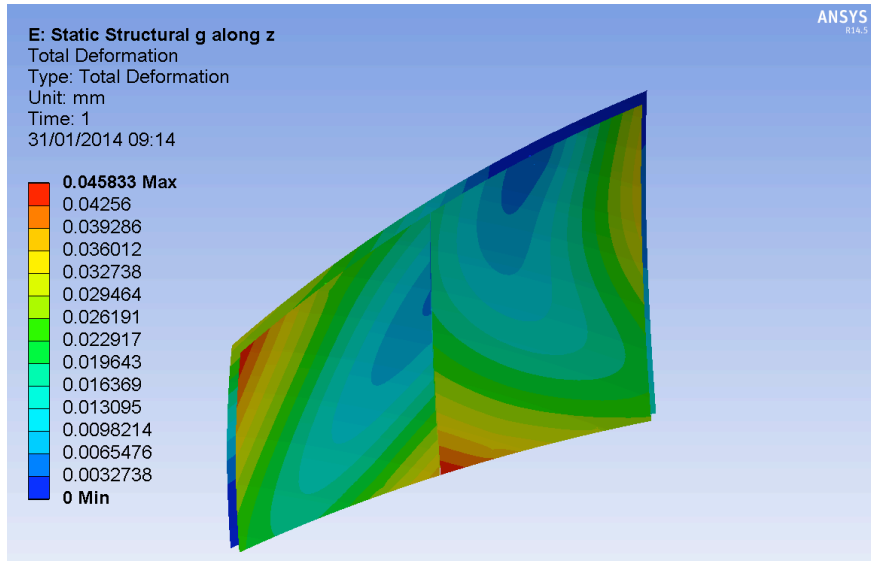
Surface accuracy: $5 \mu\text{m RMS}$

Surface Quality: 3 nm RMS

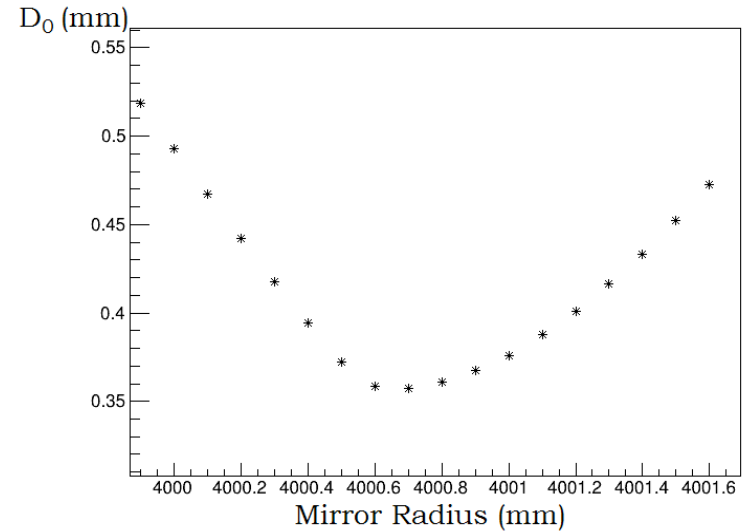
Reflectivity $> 90\%$



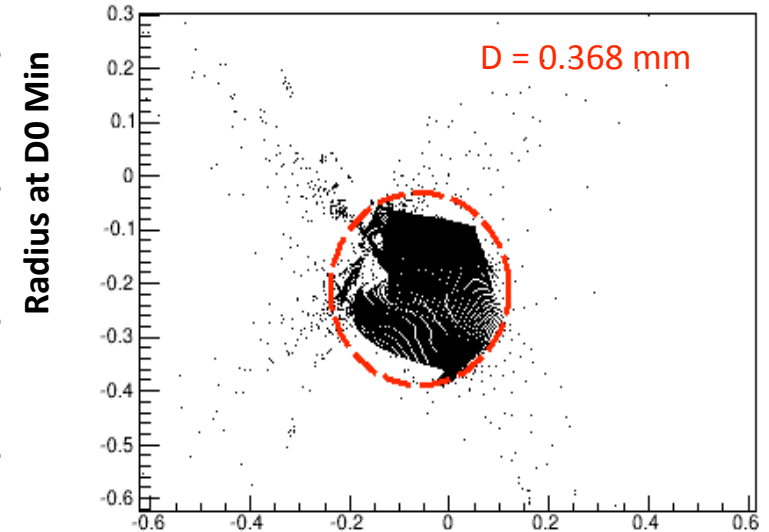
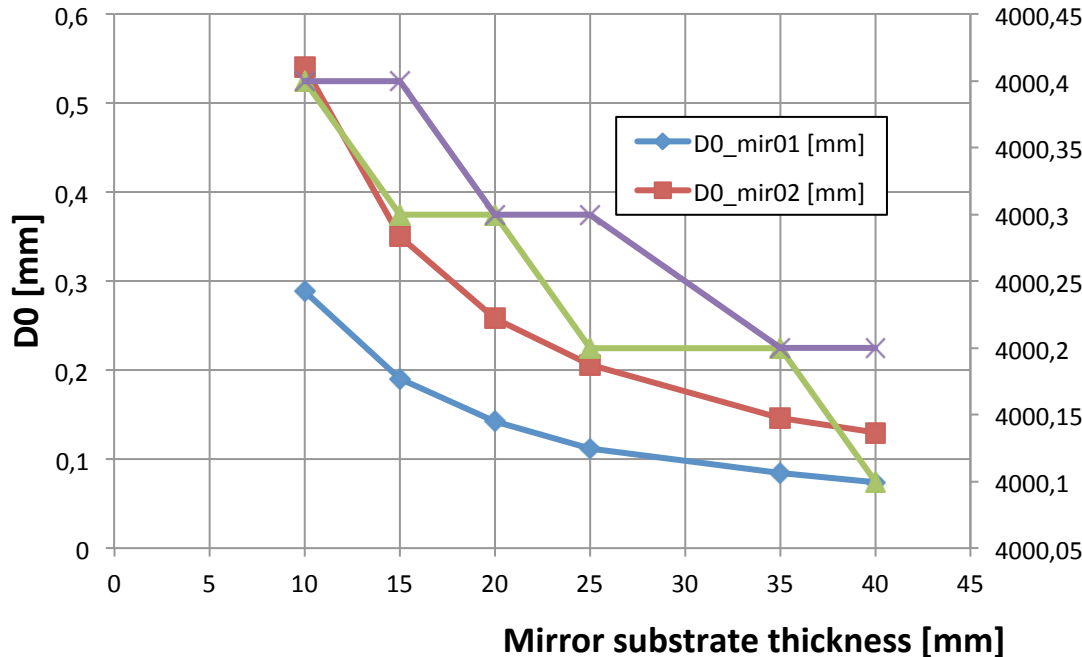
CFRP Spherical Mirror



FEM mechanic analysis is being connected to optical performance evaluation



D0 and radius optimization



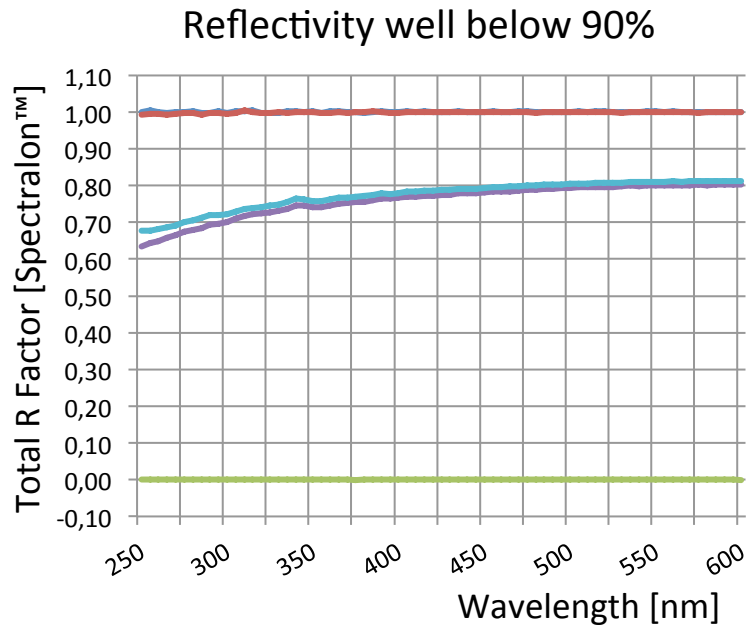
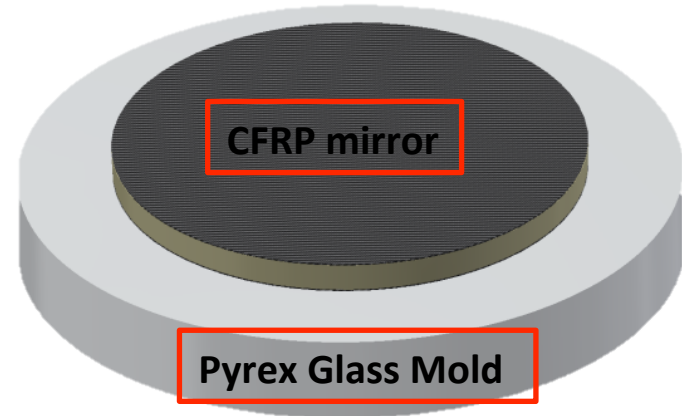
CFRP Spherical Mirror

Two mirrors demo in preparation at CMA (USA) :

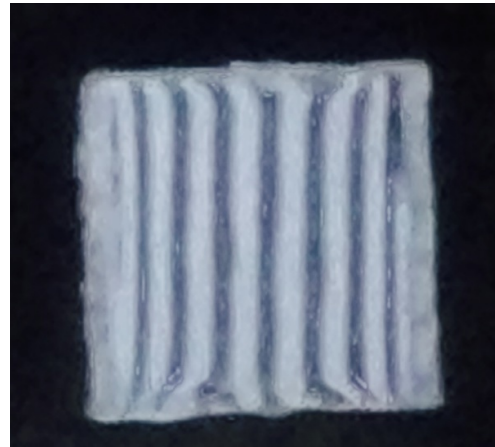
- CFRP skin and rohacell core
- spherical shape, 30 cm diameter
- 1st demo: 3.5 m radius, LHCb finish, from a CMA mandrel

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

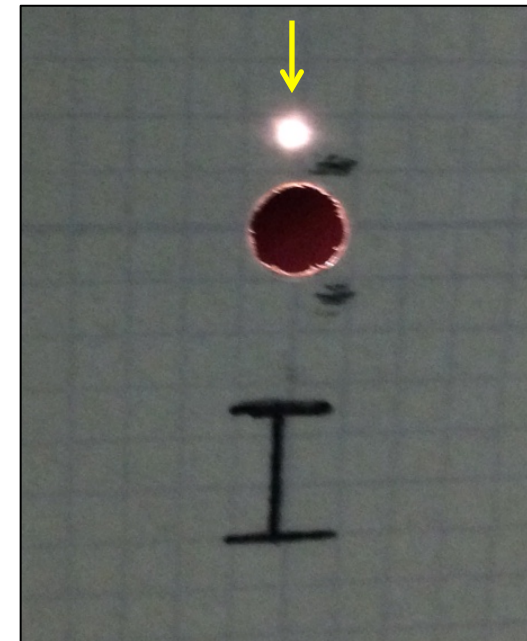
- 2nd demo: 4 m radius, CLAS12 finish, from the Marcon mandrel



Ronchigram indicates edge effect



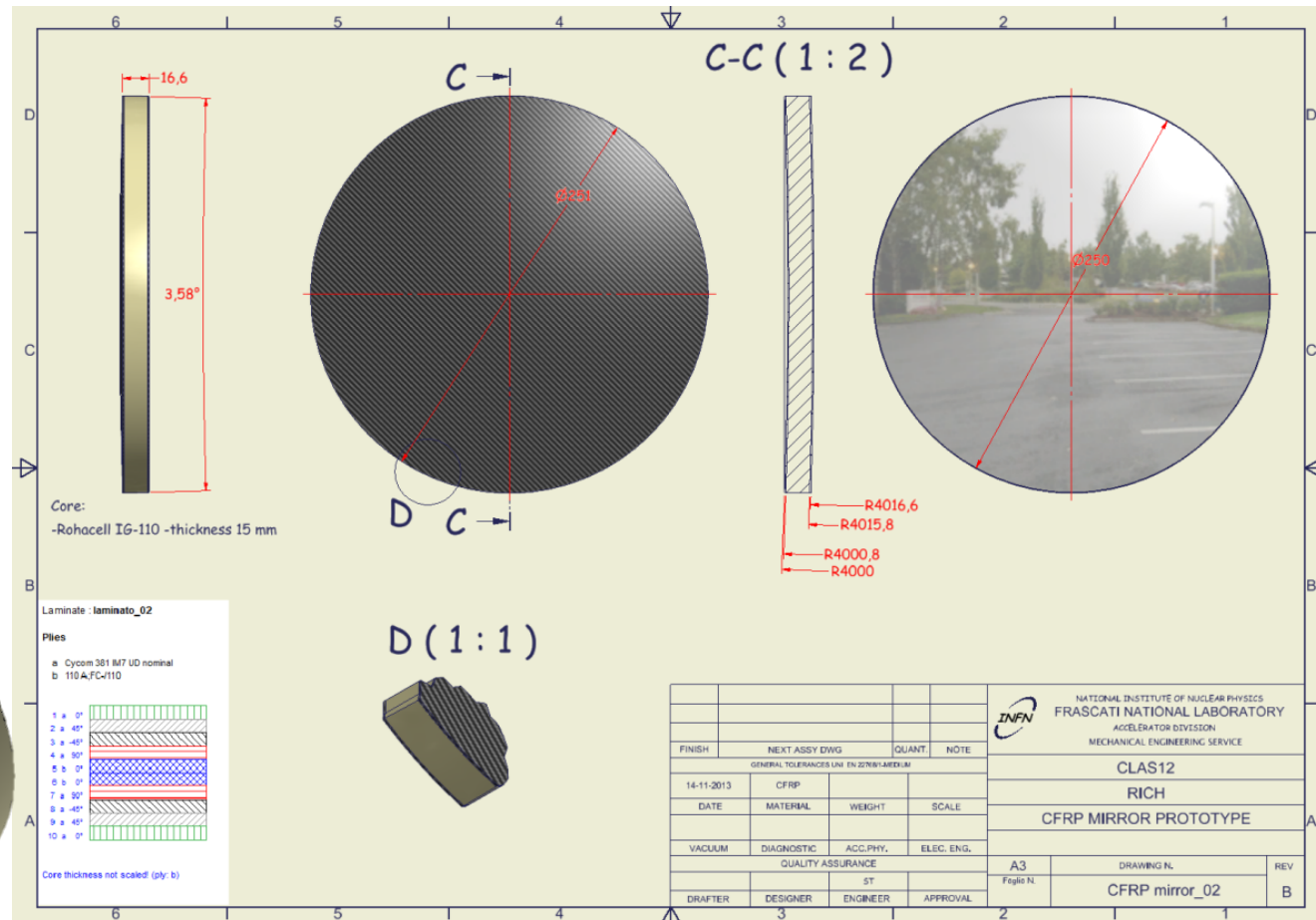
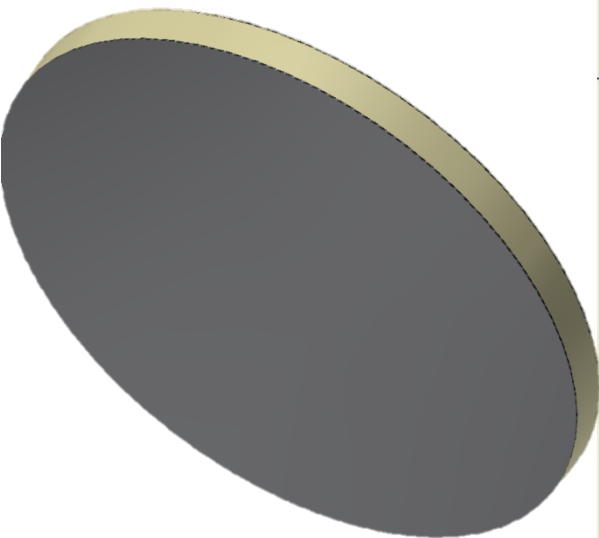
Return spot size = 1.25 mm



CFRP Spherical Mirror: Mandrel Demo

Mandrel demo in preparation at Marcon (Italy) :

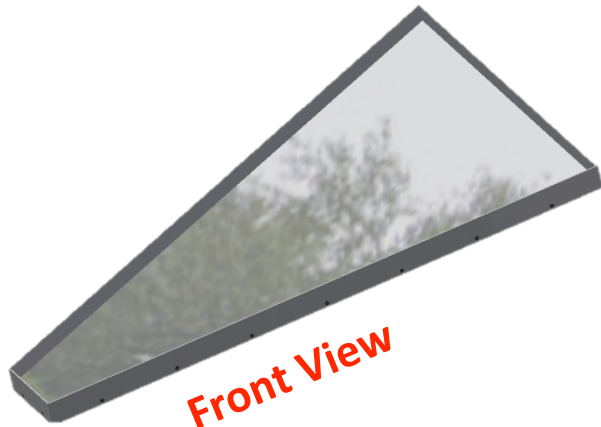
- supremax (borosilicate glass) material
- spherical shape, 4 m radius, 35 cm diameter
- **delivery expected middle of March**



Forward Glass Mirror

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

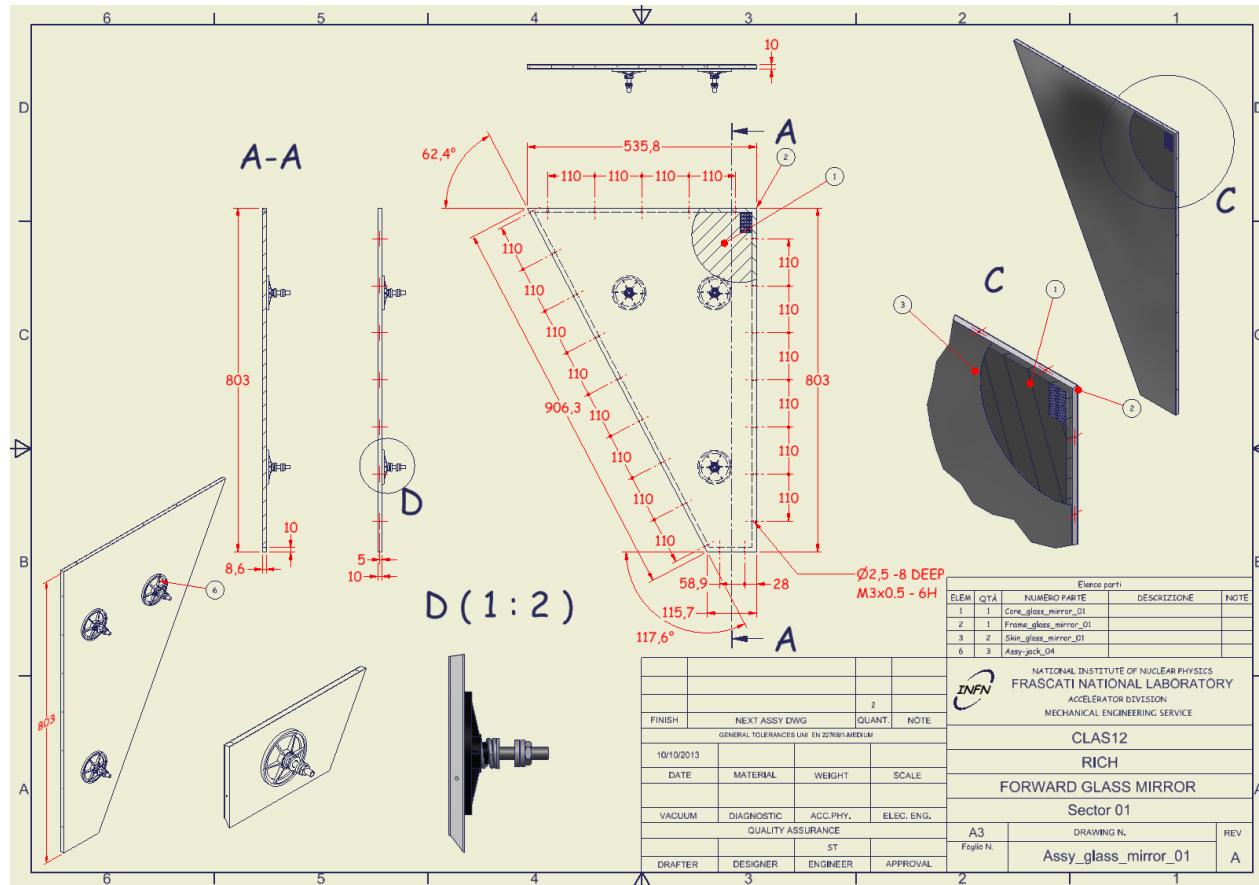
- soda-line mm glass skin and Al honeycomb core
- reinforced frame for aerogel holder
- 1st demo: 1.6 mm (standard) glass skin thicknesses
delivery expected middle of April
- 2nd demo: <1 mm (goal) glass skin thicknesses



Front View



Back View



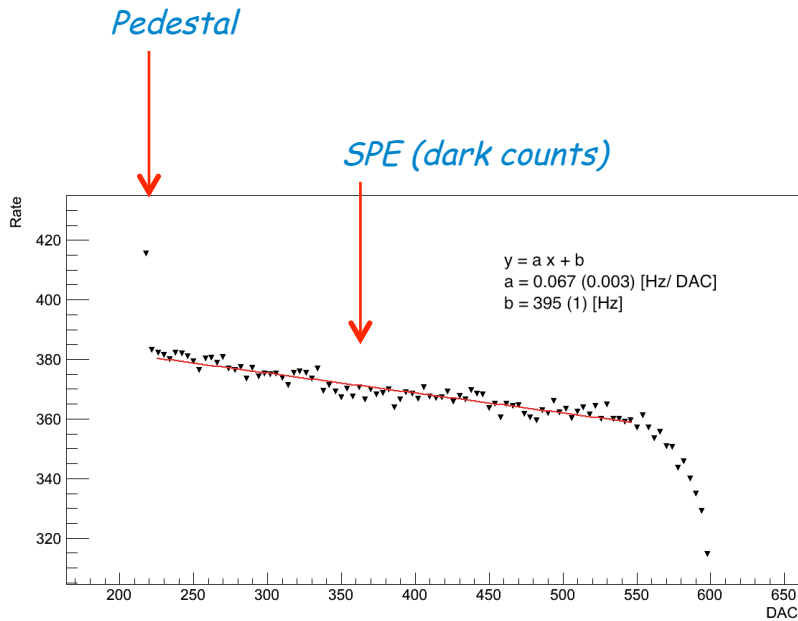
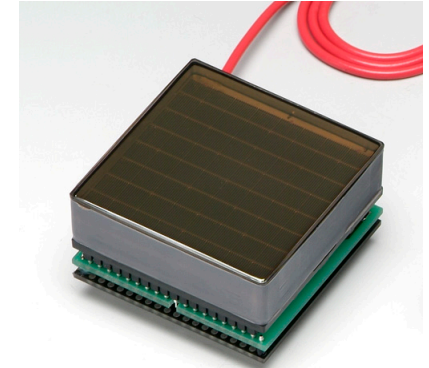
MA-PMTs

Milestone: Start PMT Production (1/1/14)

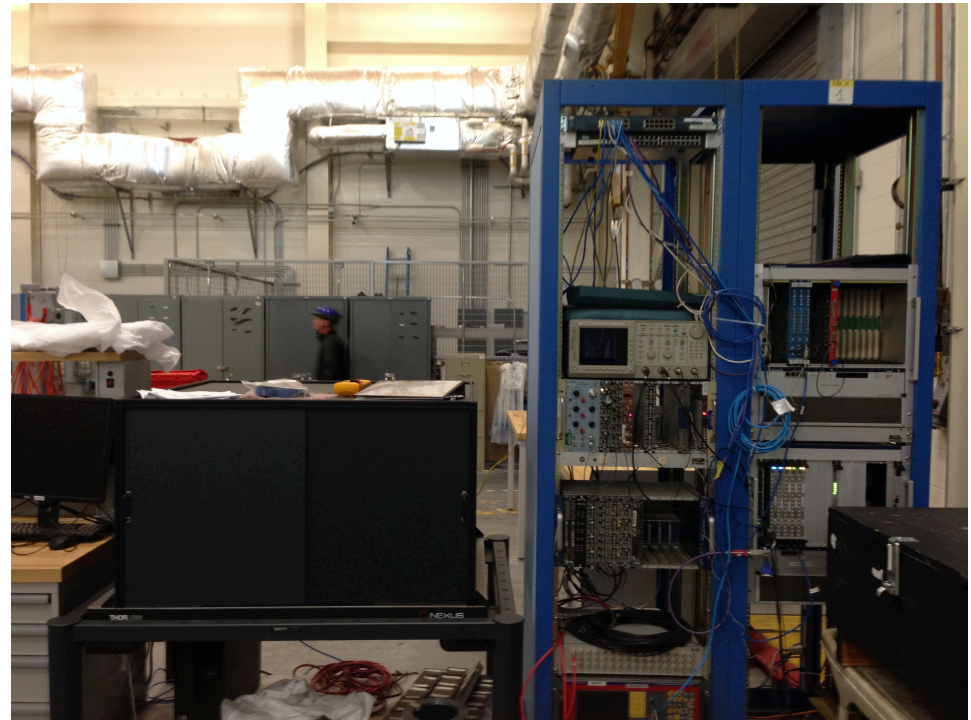
- H8500 chosen for the first 80 PMTs (H12700 not ready)

Milestone: First 20 PMT Delivery (4/30/14)

- acceptance test bench ready at JLab
- characterization with digital readout ongoing
- inter-calibration procedures under development



Threshold scan of dark count digital readout



JLab test bench

Aerogel

Manufacture Engineering Phase ongoing with Novosibirsk to improve and stabilize large tiles production yield and transmission length:

- large tiles yield acceptable for mass production has been achieved
- new tiles with optical improved surface ready for test

Aerogel Radiator

Refractive index: 1.05

Area: 20x20 cm²

Thickness: 3 cm

Scattering Length: greater than 50 mm

