FDIRC prototype status
and
an update on tasks & schedule

J. Va'vra

SuperB Workshop at Elba, 2011

Content

- **Status of optics.**
  - **- FBLOCK & New Wedge**
  - **- Update on glue tests**
  - **- Update on the FBLOCK laser calibration scheme.**
- **Status of detector preparation.**
  - **- Update on the detector support in the FDIRC prototype.**
  - **- Results from the SLAC scanning setup measurement of 14 H-8500 tubes.**
- **Status of Fbox & CRT mechanics** (separate talks by Massimo Benettoni & Nicola Mazziotta)
- **Update on FDIRC R&D tasks & schedule**

FBLOCK and New Wedge

J. Va'vra

- **Photon camera out of solid piece of radiation-hard quartz:**
  - 10x smaller than the SOB in BaBar

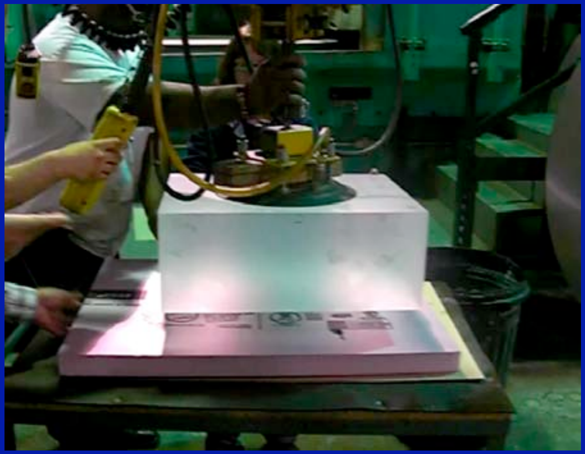
- **A basic question : Is it doable ?**

FBLOCK and New Wedge

J. Va'vra

Saw to make a raw cut on the block:

Lifting of the raw block:



FBLOCK after a raw saw cut:

New wedge after a raw saw cut:

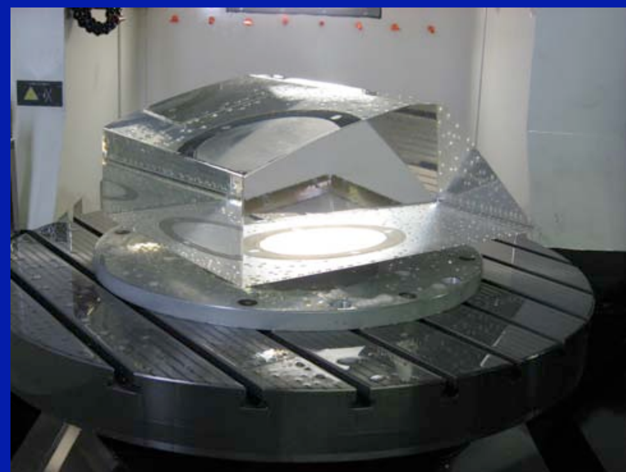
- **Pictures show parts after a raw cut by the saw.**

FBLOCK and New Wedge

J. Va'vra

NC machine:

FBLOCK on the machine:



- **Precise grinding was done on a 5-axis NC machine (magnetically floating bearings). Machine costs: $750k.**

FBLOCK and New Wedge

J. Va'vra

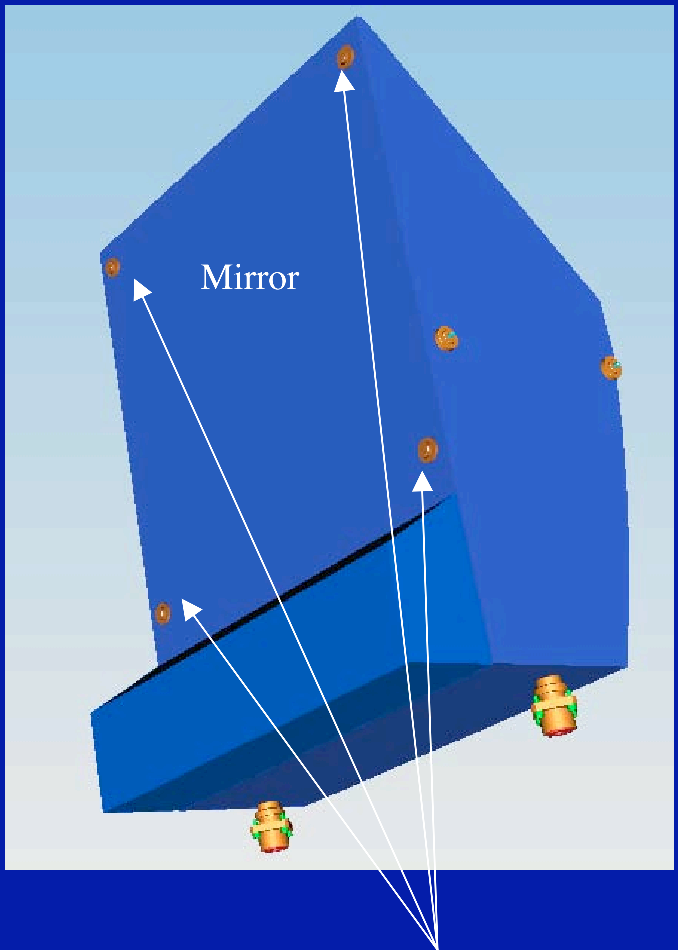
Cosmo company, NY:

Polishing machine on which they will polish FBLOCK:

- **They did wedges for the BaBar DIRC.**
- **Discussed many issues: handling, cleaning, plating, buttons, etc.**

Support of mirrorized surface

J. Va'vra



Worry mainly about these buttons

Damage protection:

- Mirror plating process:

- Coat with aluminum first.

- Overcoat it with Al_2O_3.

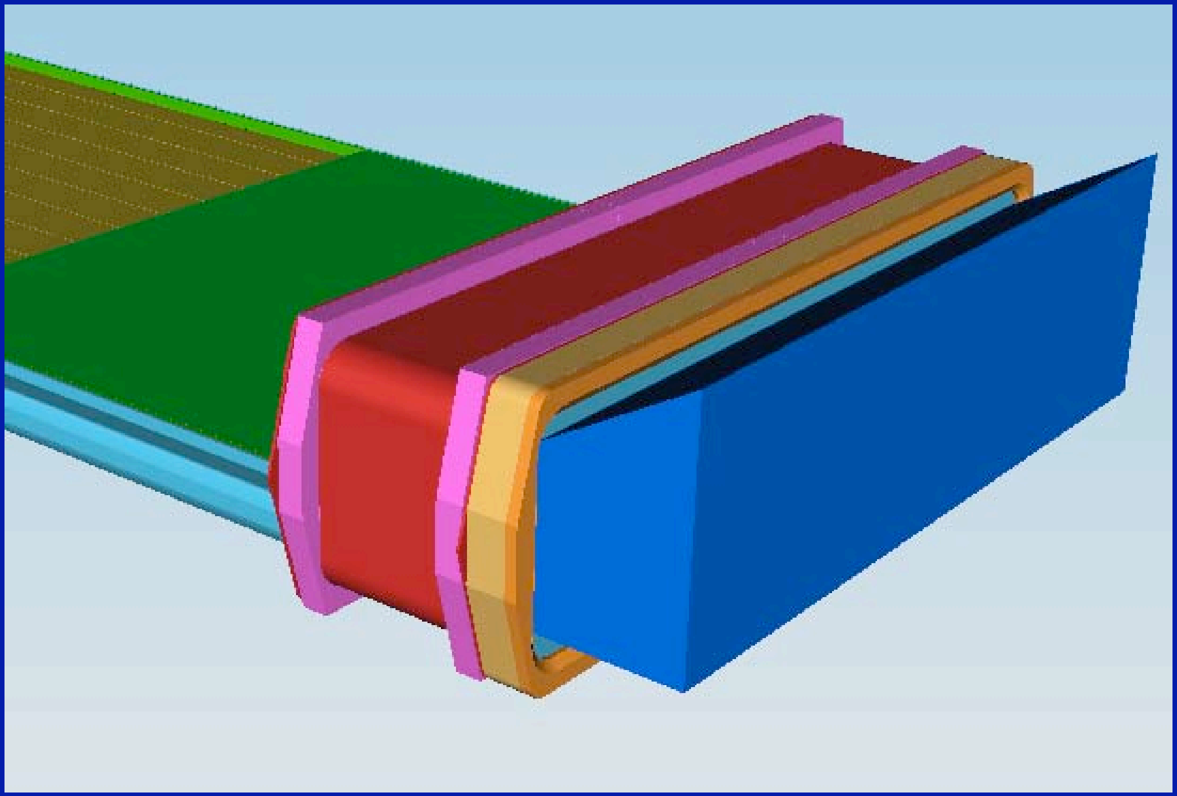
- Overcoat it with Inconel.

- Overcoat it with SiO_2.

- Polypropylene tape between button and mirror

Additional steps to protect plating

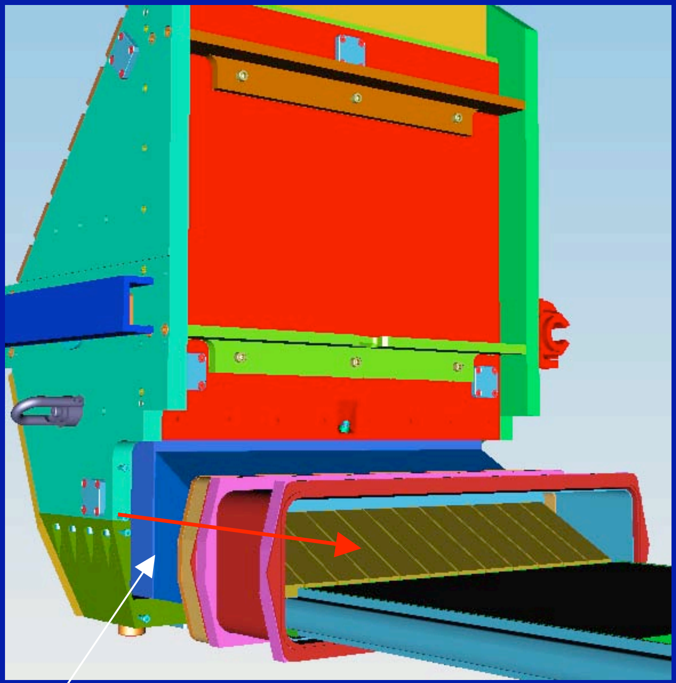
Wedge to bar box gluing



- It will be done with Epotek 301-2 epoxy.
- It will be done in the clean room.
- Matt prepared a fixture for gluing.

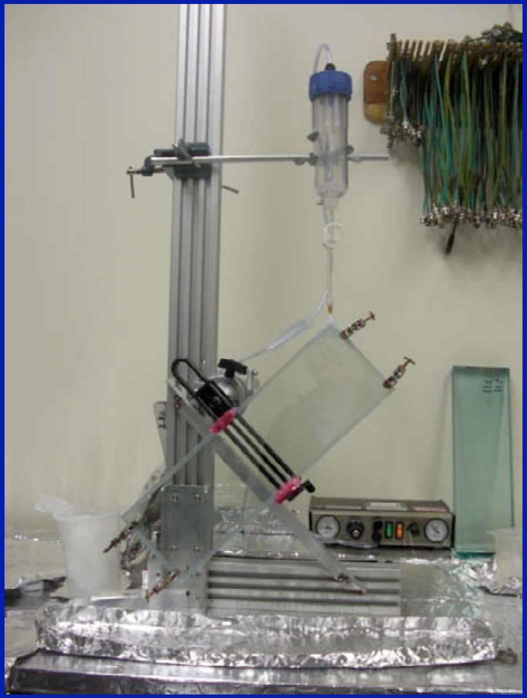
RTV coupling

M.McCulloch and J. Va'vra



RTV

The gluing setup is now perfected:



Cutting RTV with a special wire:

- **Made successfully a large area 1mm-thick RTV coupling either with Shin-Etsu 403 or Rhodorsil 141 for all bar box angular orientation.**
- **We have also demonstrated that the RTV coupling can also be cut, and therefore one can separate the FBLOCK from the New Wedge, if necessary. Surfaces can be cleaned and one can glue it again. This is a very important point !**

Test of the strength of RTV coupling

M.McCulloch and J. Va'vra

Peel test #3:

Shin-Etsu 403 RTV, 1mm thick:

Breaks at 1152 lbs:

Appearance after the breakage:

Glue appearance after separation: rough, breaks in the middle of glue

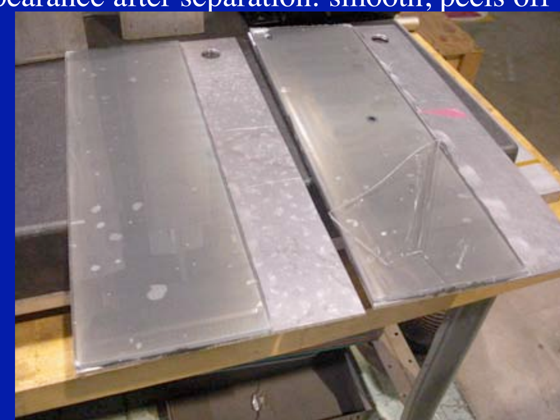
Sheer test #3:

Rhodorsil 141 RTV, 1 mm, vertical inclined joint

Breaks at 1144 lbs:

Appearance after the breakage:

Glue appearance after separation: smooth, peels off the glass



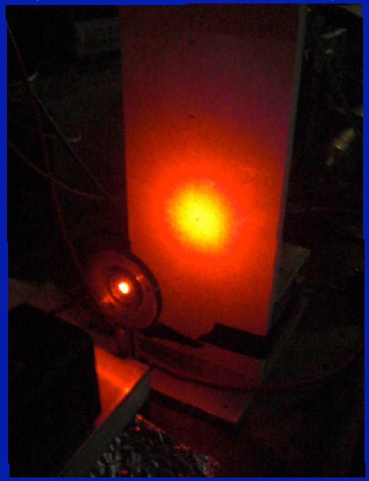
- **The glue would break after ~ 0.5 ton of load, if glass surfaces are <u>properly cleaned</u> !!**

Search for the best diffuser

J. Va'vra

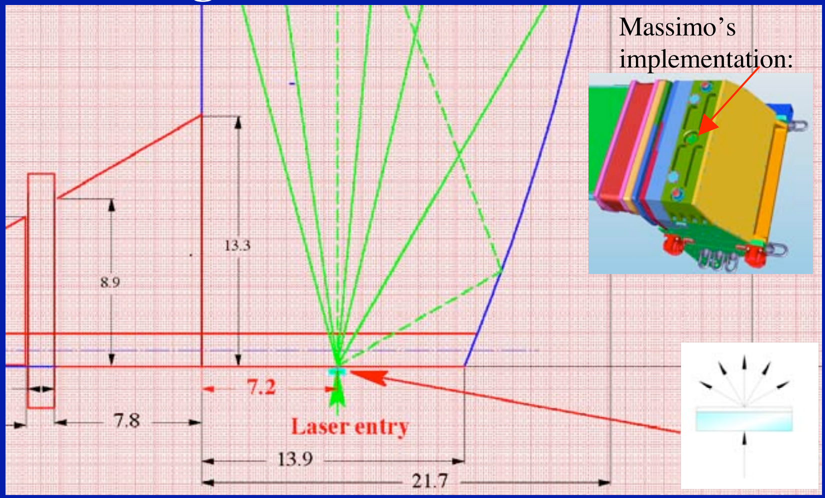
Opal Diffusing Glass:

120 Grit Ground Glass:
(Soda Lime Float Glass)



(Screen is 10 cm away; ~3" dia. spot)

New design with a diffuser:



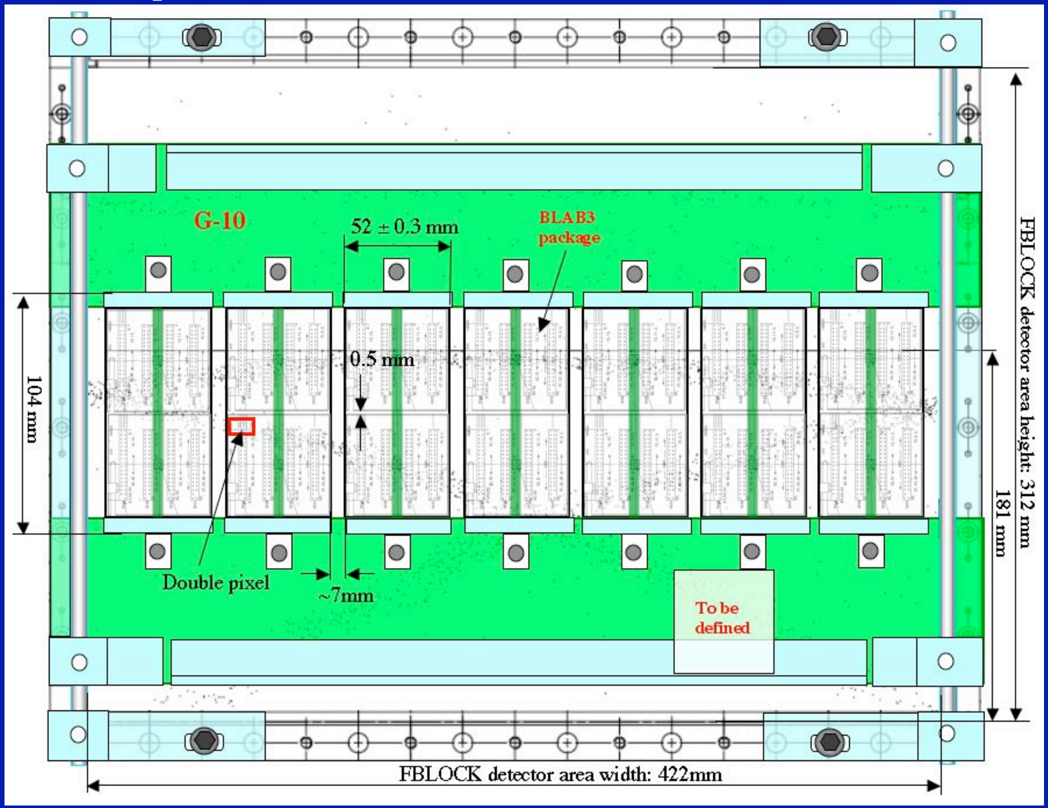
Diffuser

- **Switch from the ground glass diffuser to the <u>OPAL diffusing glass.</u>**
- **OPAL diffuser: (a) more uniform, (b) photons scattered up to $\Theta_{scattered} < 45^o$.**
- **Sand blasted glass: (b) very non-uniform distribution, (b) $\Theta_{scattered} < 30^o$.**
- **The diffuser will be glued to FBLOCK in the clean room when assembling Fbox.**
- **Want to have a very small footprint not to lose real Cherenkov photons (5mm dia.).**
- **For the CRT test we will choose the OPAL diffuser. For SuperB, we will have to check a radiation damage of the diffuser's glass.**

FDIRC prototype detector layout

J.Va'vra with input from G. Varner, D. Roberts, M. Benettoni and M. McCulloch

Proposed initial BLAB3 layout:



- **Initial design assumes seven BLAB3 double-packages right now (14 detectors).**
- **BLAB3 electronics will read every pixel. LAL-Orsay electronics will combine two pixels horizontally, as is planned for the FDIRC at SuperB. One empty extra slot for a tube to monitor the CRT events & laser pulses, or a place for G-APD array ?**
- **It will be modified as we will have more H-8500 MaPMTs.**

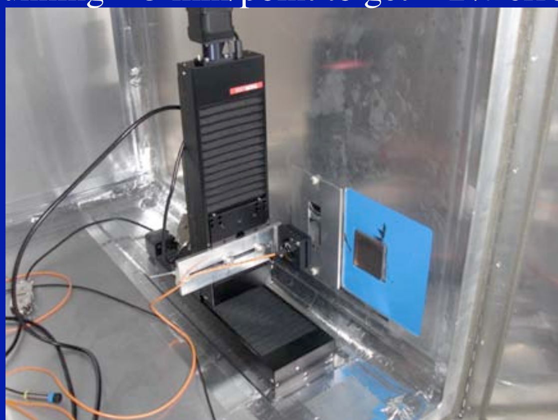
Is H-8500 a good choice ?

- **14 tubes scanned. Questions to ask:**
  - Are these tubes working well enough for our needs ?
  - What is a 2D efficiency response ?
  - What is the gain uniformity of these tubes ?
  - At what voltage do we want to run the prototype tubes ?
  - Are there some "bad effects" at the highest allowed voltage ?
- **A question to Hamamatsu:** Are these tubes actually available in a quantity of 600 (with a delivery profile: starting in 2012, large quantity in 2013 & 2014, and ending in 2015).
- Hamamatsu replied after ~4 weeks: **Yes, we can do it.**

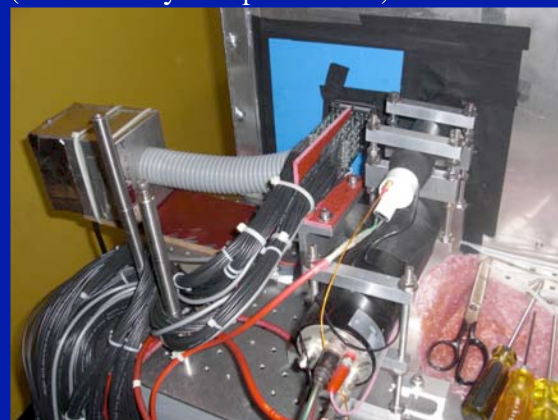
Restart of SLAC scanning setup

J. Benitez, K. Nishimura, D. Aston, J. Va'vra, M. McCulloch

New stage controlled by Windows:
(running ~ 5 min/point to get ~2% error)



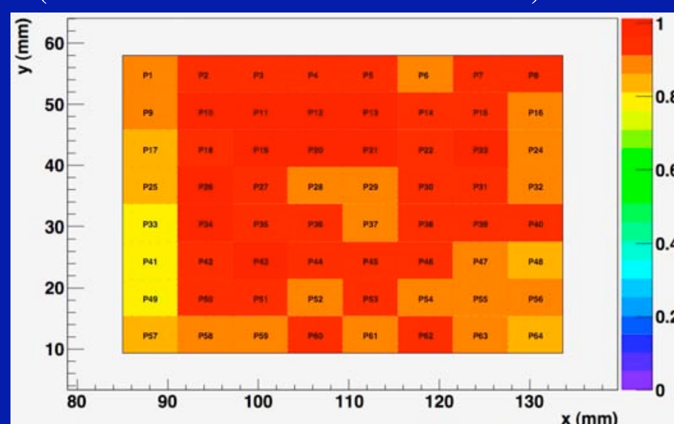
New amplifiers (a gain of ~40x):
(SLAC/Maryland production)



PiLas laser (407nm):
(set the probability to 5-10%)

The new UNIX μ-PCi computer:
(with fiber interface for BLAB3 electronics)

Scan of the Tube #1 at 1.0kV:
(normalized to Photonis XP2020 PMT)



Present electronics:

- **SLAC/Maryland ~40x amplifiers (original SLAC amplifier used Elantek 2075, we switched to THS 4340)**
- **LeCroy Disc 4413/ TDC 3377**
- **Disc. threshold ~25mV**
- **No ADC**
- **PiLas laser diode**
- **Reference tube: Photonis XP2020**

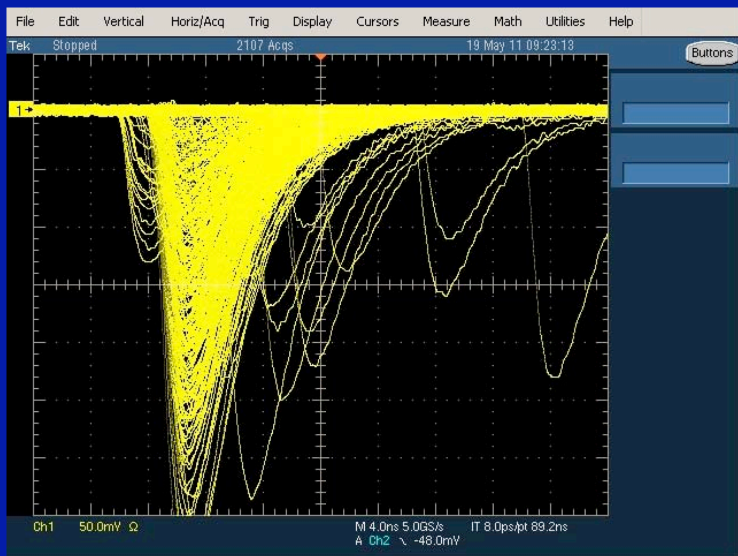
Next step (in July):

- **This setup will be modified for the BLAB3 electronics in July**

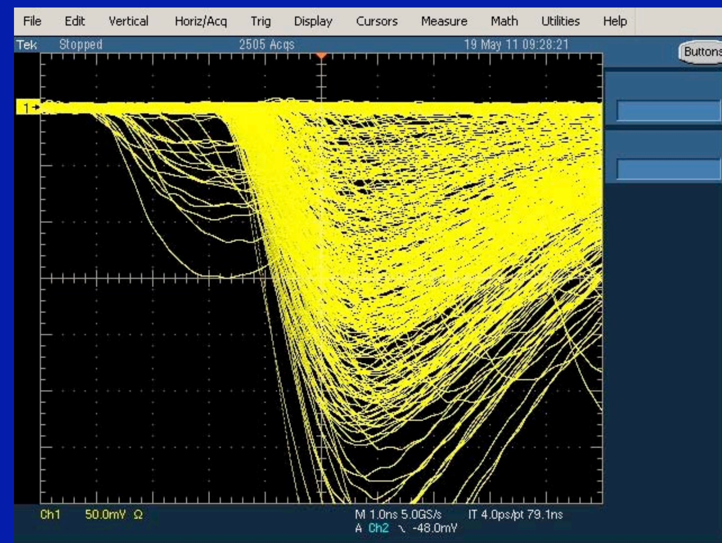
Example of H-8500 single pe$^-$ pulses

J.Va'vra

Tube #6, 1.0kV, 50mV/div, 4ns/div:



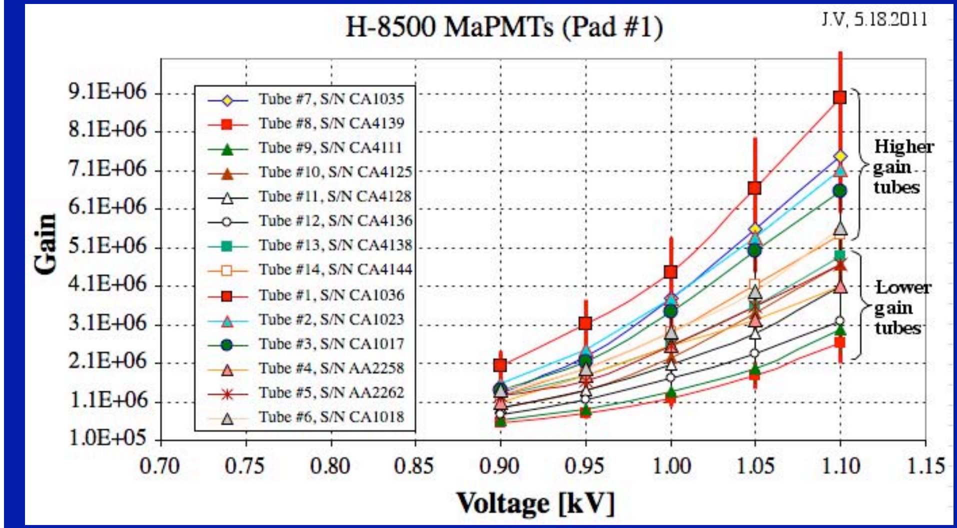
Tube #6, 1.0kV, 50mV/div, 1ns/div:

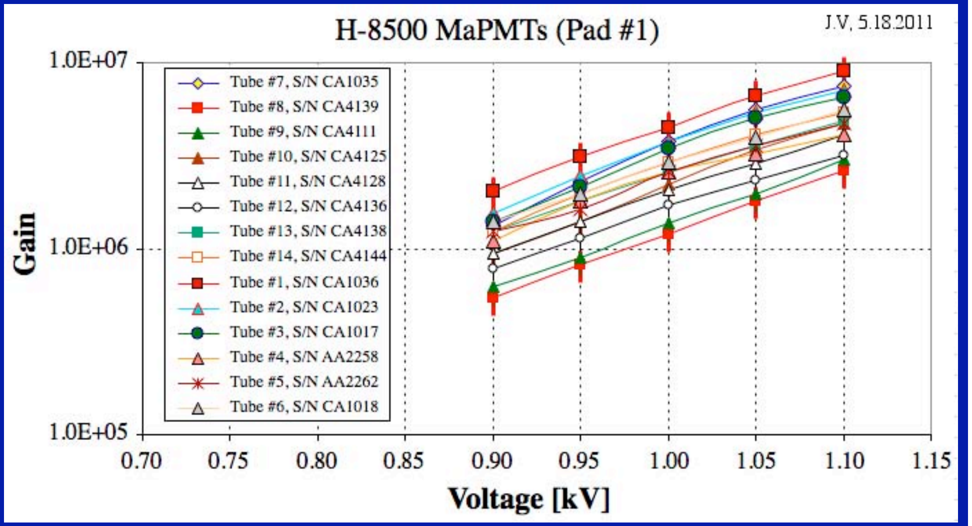


- **Cannot measure the rate of after-pulses in this setup as the laser diode itself has a long tail as well.**
- **Observe "pre-pulses" due to photon converted on the 1-st dynode. These pulses have 2-3x lower amplitude.**

H-8500 gain (measured on pad #1)

J. Va'vra





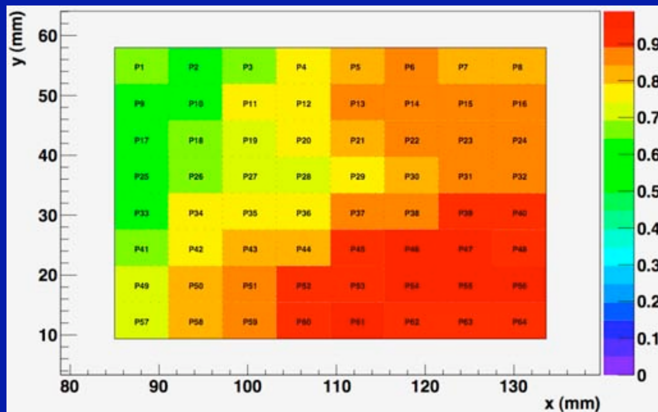
- **Quite a variation of gains among our 14 tubes.**
- **Amplifier has a ~ 40x gain in these tests. Do we need to boost it to ~ 60x ?**
- **The tubes belong to two groups as far as the gain value. It seems a batch dependent. Tubes, starting with a #1035 (tubes #1,2,3,4,5,6,7), have higher gain; tubes, starting with a #4111 (tubes #8,9,10,11,12,13,14), have 2-3 lower gain !**
- **Hamamatsu quotes a total gain at 1.0 kV as a ratio of total cathode & anode currents. Measuring total anode current includes after-pulsing, etc.**
- **My measurement measures a most probable single-electron charge with a scope.**

Compare our 2D efficiency with Hamamatsu

Our scan of tube #11 at 1.0kV:

D. Aston and J. Va'vra

SLAC:



Efficiencies at -1.0 kV relative to Quantacon 2" dia. PMT
(typical error ~2% on a pixel, and ~1% on normalization)

	1	2	3	4	5	6	7	8
1	0.6346	0.6147	0.6664	0.7564	0.8354	0.8311	0.776	0.7878
9	0.5534	0.6145	0.7334	0.775	0.8599	0.8213	0.8447	0.8464
17	0.6234	0.6652	0.7192	0.7413	0.791	0.8236	0.8551	0.8459
25	0.5878	0.6856	0.6969	0.7127	0.7802	0.7951	0.8489	0.8484
33	0.6374	0.7376	0.7468	0.77	0.8326	0.8403	0.9025	0.888
41	0.679	0.7699	0.8188	0.8139	0.8801	0.9282	0.9282	0.9274
49	0.8904	0.7458	0.8113	0.8509	0.8948	0.903	0.9189	0.9644
57	0.7377	0.8299	0.843	0.8843	0.9365	0.9202	0.9136	0.9073
Ave.:	0.668	0.708	0.754	0.788	0.851	0.858	0.873	0.877
Overall average:	0.797							

±0.02

Hamamatsu information about tube #11 at 1.0kV:

Serial No. : CA4128

Ratio of Anode Output = 1 : 2.0

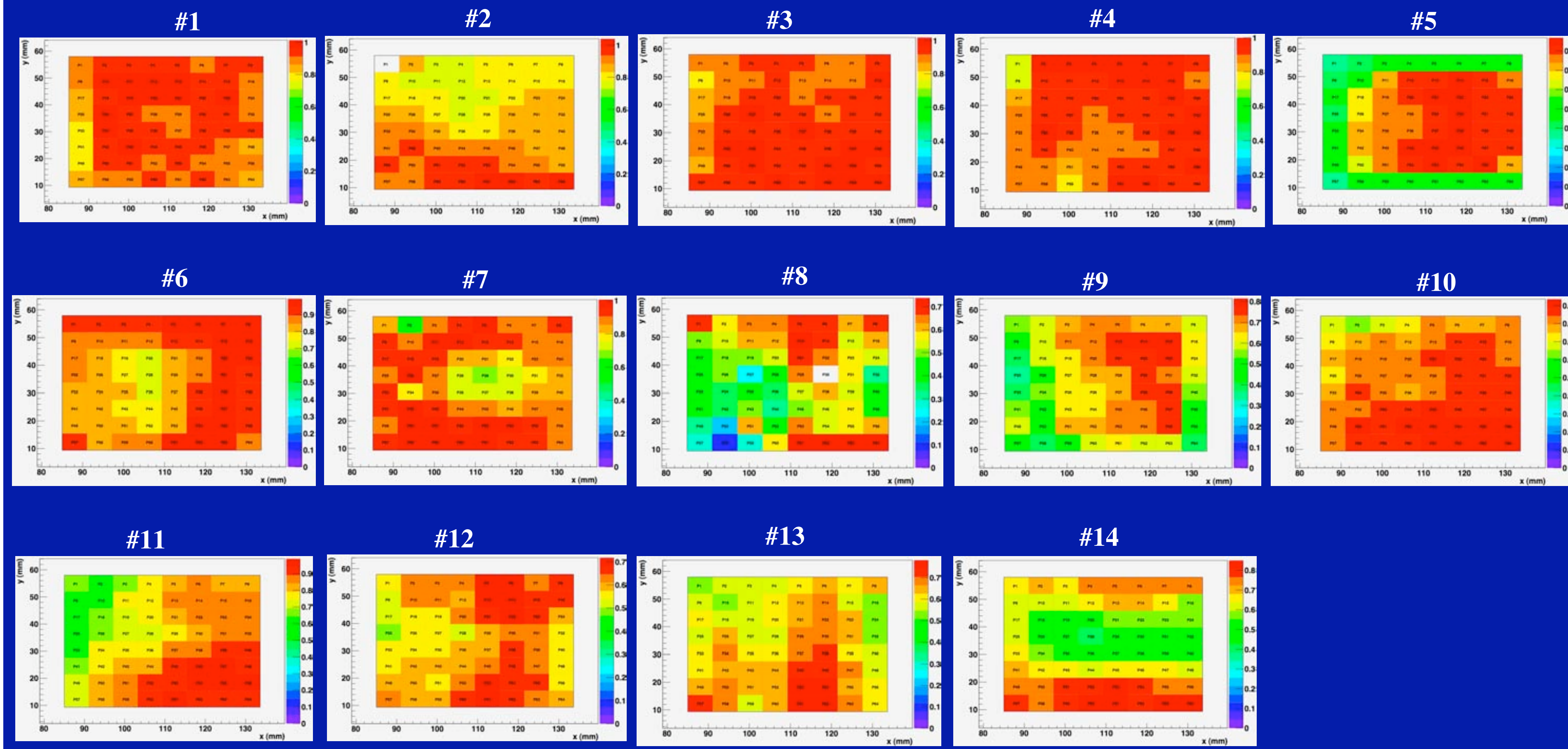
P1 50	P2 56	P3 65	P4 77	P5 82	P6 80	P7 74	P8 67
P9 53	P10 58	P11 71	P12 83	P13 88	P14 85	P15 83	P16 74
P17 56	P18 62	P19 71	P20 77	P21 80	P22 84	P23 84	P24 76
P25 56	P26 65	P27 71	P28 73	P29 77	P30 82	P31 82	P32 76
P33 59	P34 69	P35 77	P36 81	P37 84	P38 91	P39 87	P40 80
P41 63	P42 72	P43 86	P44 89	P45 94	P46 97	P47 92	P48 82
P49 72	P50 79	P51 87	P52 98	P53 100	P54 99	P55 96	P56 87
P57 68	P58 79	P59 82	P60 92	P61 93	P62 95	P63 90	P64 76

Top View

- **We measure a 2D efficiency profile by counting single photoelectrons, normalizing it to the Phillips XP 2020 Quantacon 2" dia. PMT.**
- **Hamamatsu is determining a 2D efficiency profile by measuring the anode current, by placing a 6mm x 6mm baffle over each pad, and normalizes it to the highest efficiency pad. Generally, there seems to be a reasonable degree of agreement.**

Scans of 14 H-8500 MaPMTs at 1.0 kV

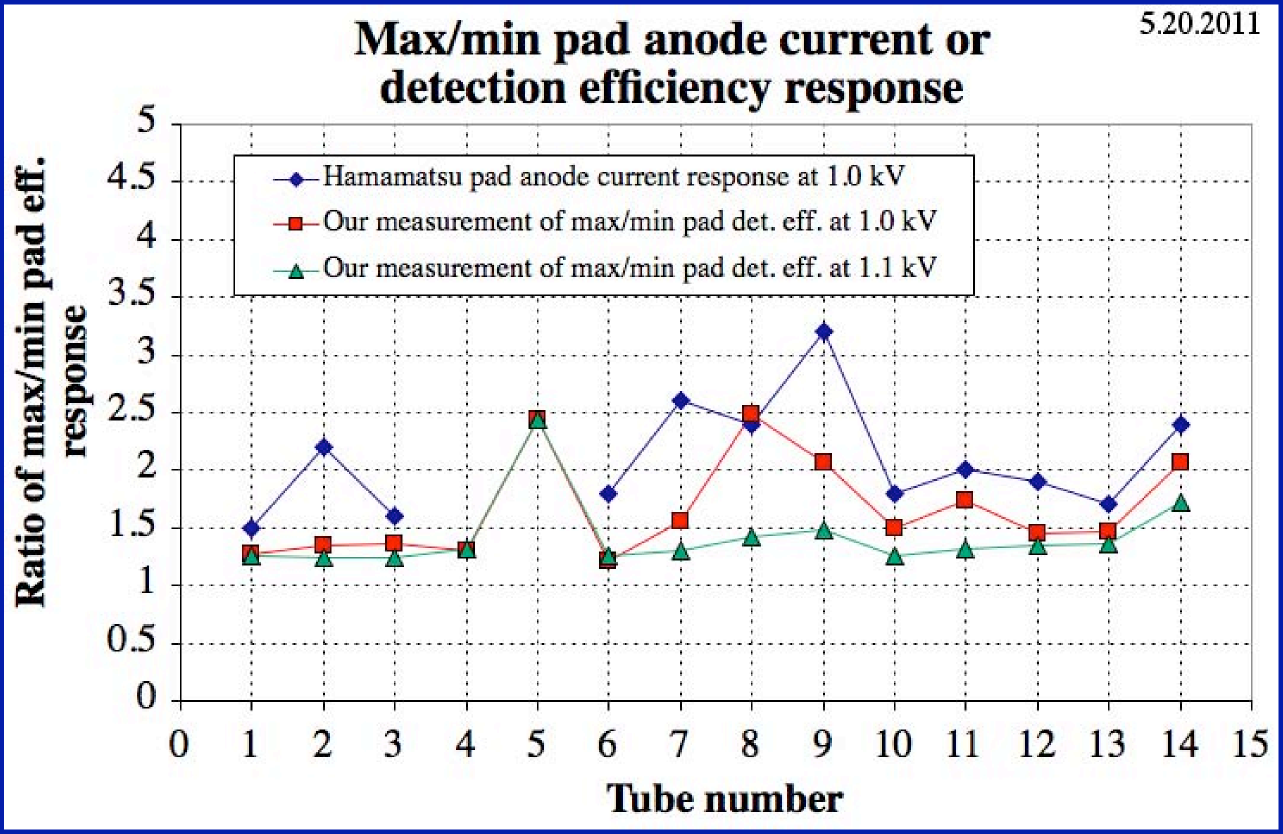
D. Aston and J. Va'vra



- **Typically, a "min-max non-uniformity" is at a level 1:1.5 (a few tubes reach 1:2.5).**
- **Worst pads have a relative efficiency to XP 2020 Quantacon PMT at a ~40-50% level, the best pads at a 80-90% level.**

Max/Min pad non-uniformity = f(tube, voltage)

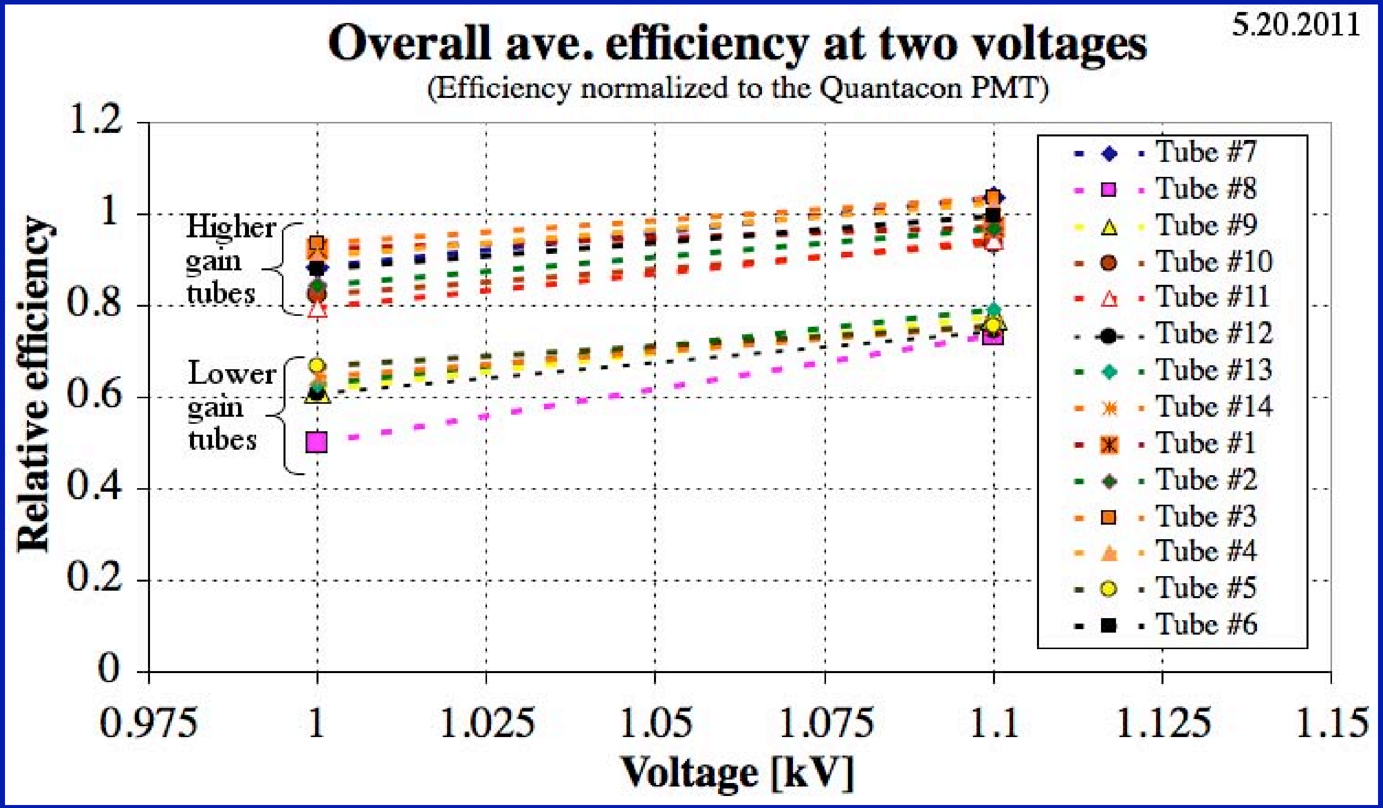
D. Aston and J. Va'vra



- **Typically, a "max-min non-uniformity" is at a level 1:1.5 (a few tubes reach 1:2.5).**
- **Hamamatsu anode pad current response at 1.0kV tracks our single pe$^-$ detection efficiency response at 1.0 kV.**
- **Uniformity improves somewhat as one increases the voltage to 1.1 kV.**

Average pixel efficiency = f(Voltage)

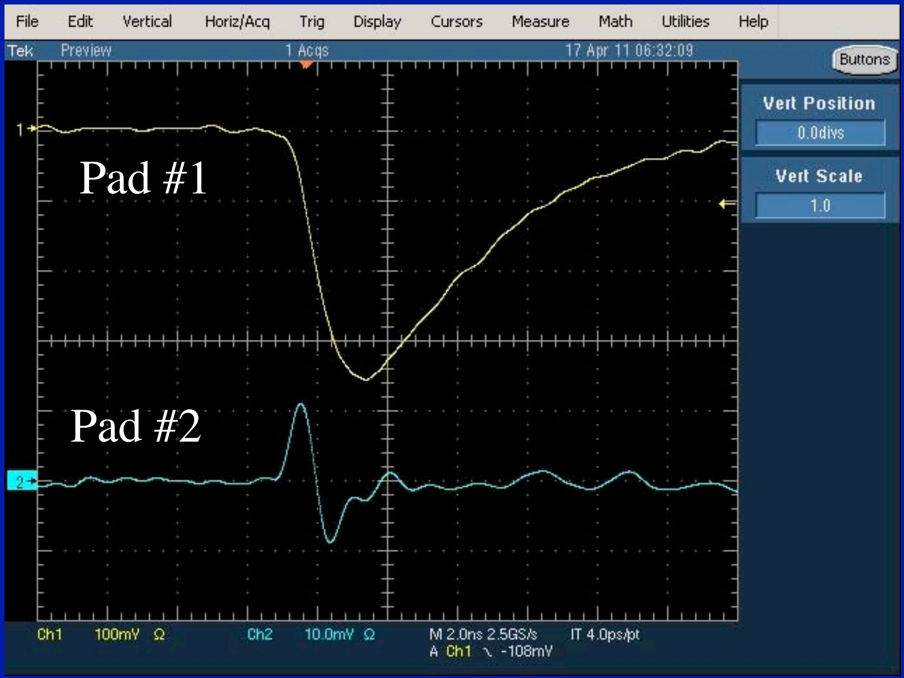
D. Aston and J. Va'vra



- **The efficiency is averaged over all pads and normalized to 2" dia. Phillips XP2020 Quantacon PMT.**
- **We cannot really run at 1.1kV in practice in the final FDIRC at SuperB as we would run out of headroom.**

Cross-talk

J. Va'vra



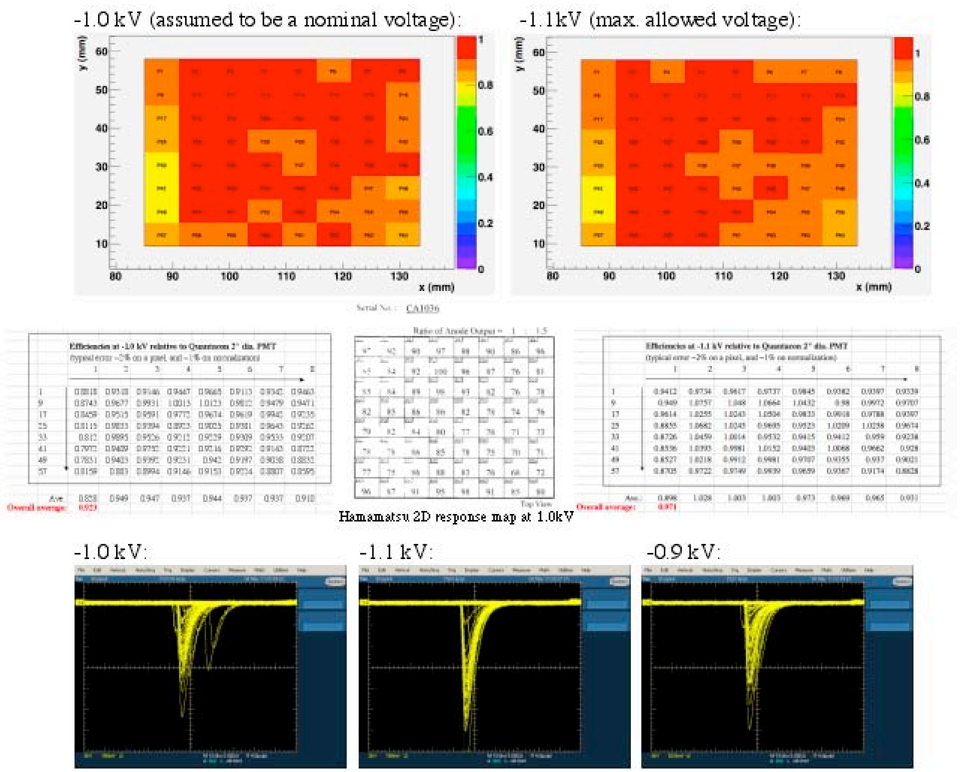
- **Laser light at the center of the pad #1.**
- **Amplitude of the cross-talk (Pad #1 --> Pad #2): ~3%. The cross-talk pulse is differentiated.**
- **Hamamatsu data sheets on H-8500 cross-talk: ~3%.**
- **However, this it is not done with the final electronics !!**

Typical information about each tube

D. Aston and J. Va'vra

One page in a log book like this for each tube:

H-8500 #1, Serial number: CA1036 5.3.2011



Tube #1, Pad #1, H-8500 serial no. CA1036

Hamamatsu info (1.0kV): (a) cathode luminous sensitivity: 57.8 nA/lm, (b) anode luminous sensitivity: 277.0 A/lm, (c) Anode dark current: 7.42 nA, (d) Gain: 4.79x10^6

Gain = f(Voltage):

Photon flux condition (7 Mylar att.)	H-8500 MPMT voltage [kV] (negative)	Pulse width before amplifier (approx.) [ns]	Average measured single pe amplitude [mV]	SLAC/Maryland amplifier gain (approx.)	Average single pe ampl. before amplifier [mV]	Ave. single electron current [nA]	Pulse total charge after amplifier [electrons]	MCP-PMT total gain before amplifier [electrons]
singles	0.90	10.0	130	40	3.3	65	8.1E+07	2.0E+06
singles	0.95	10.5	190	40	4.8	95	1.2E+08	3.1E+06
singles	1	11.0	260	40	6.5	130	1.8E+08	4.5E+06
singles	1.05	11.5	370	40	9.3	185	2.7E+08	6.6E+06
singles	1.1	12.0	480	40	12.0	240	3.6E+08	9.0E+06

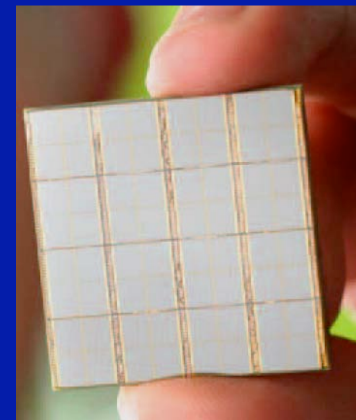
- **For each tube:**
- Gain measurement
- A scope check of single electron pulses at each voltage (check for some “bad” behavior: noise and after-pulsing).
- 2D efficiency scan at two voltages (1.0 & 1.1 kV), normalized to the Photonis Qantacon PMT.
- Compare our scan result with the Hamamatsu information about the 2D response at 1.0 kV.

A few comments on G-APD arrays

J.Va'vra

Hamamatsu digital G-APD array:

Phillips digital G-APD array:



- **Criteria for accepting something like this:**

- **Noise rate** especially after **irradiation**. HPK G-APDs fail after a dose of ~10^{10} n's; Belle-II has dropped it for TOP.
- **Cross-talk & after-pulsing rate**: HPK says that their present G-APDs have up to ~30% of extra output.
- **Optical acceptance:** Photons exit from bar at very large angles => cannot have an intermediate optics to focus light into small pixels as one would loose photons => The G-APD array has to be placed on the FBLOCK directly and it has to have small dead space between pixels and one has to cover a very large area.
- **Cost:** My cost estimate is that "HPK G-APD array option" would cost 4-5x more than a H-8500 solution, presently.

Updated on FDIRC prototype tasks

Comments:

- **Many tasks finished and in progress, but still a way to go to finish the prototype. I estimate ~3 months to go before we can run the FDIRC prototype in CRT.**
- **I started to prepare a list of long-term tasks for SuperB, to be divided by various collaborating institutions. This represents an initial step in the process.**

FDIRC tasks for 2011

1	Tasks for FDIRC prototype test in CRT	Present list of institutions	People	Time to start	Time to finish	Range [days]	Comment	Critical items at present
2	I. FDIRC optics:							
3	**a) Mechanical support structures**							
4	Mechanical design of Fbox	Padova, SLAC, Bari	MB, JV, NM, MMcC	15-Jan-11	5-May-11	110	finished	
5	Machining of Fbox parts	Bari & Padova	MB, NM	5-May-11	5-Jun-11	31	in progress	
6	Mechanical design of Fbox support in CRT	Bari, Padova, SLAC	NM, MB, JV, MMcC	15-Jan-11	5-May-11	110	finished	
7	Machining of Fbox support for CRT	Bari & Padova	MB, NM	5-May-11	30-May-11	25	in progress	
8	3D dummy model of the New wedge & FBLOCK	Bari, Padova, SLAC	MB, NM	1-Mar-11	25-Apr-11	55	in progress	
9	Careful chemical cleaning (etching) of Fbox parts	Bari & Padova	MB, NM	1-Jun-11	10-Jun-11	9		
10	Trial assembly of Fbox & 3D dummy, possible modifications, itterate	Bari & Padova	MB, NM	10-Jun-11	15-Jun-11	5		
11	Sending Fbox, support and 3D dummy model to SLAC	Bari & Padova	MB, NM	15-Jul-11	20-Jul-11	5		
12	Trial assembly of Fbox at SLAC, possible modification, itterate	SLAC	MMcC, JV	25-Jul-11	15-Jul-11	-10		
13	**b) Quartz optics (FBLOCK, New Wedge, coupons)**		MB, NM					
14	Optical design (ray tracing) and verification by MC	SLAC, Maryland	JV, DR		15-Jan-11		finished	
15	Raw quartz material procurement and delivery	SLAC	Corning, JV	15-Oct-10	10-Jan-11	87	finished	
16	Quartz machining & polishing & plating of FBLOCK & New Wedge	SLAC	Cosmo optics, JV	25-Mar-11	15-Aug-11	143	in progress	
17	Delivery of the New Wedge to SLAC	Cosmo	Fedex	5-Jul-11	15-Jul-11	10		
18	QC of New Wedge at SLAC; compare them with Cosmo data	SLAC	QC, MMcC, JV, MC	1-Jul-11	5-Jul-11	4		
19	Glue the New Wedge to bar box	SLAC	MMcC, JV	5-Jul-11	15-Jul-11	10		
20	Delivery of FBLOCK to SLAC	Cosmo	Fedex		15-Aug-11			
21	Mechanical QC of FBLOCK at SLAC; compare them with Cosmo data	SLAC	QC, MMcC, JV, MC	15-Aug-11	20-Aug-11	5		
22	Simple optical tests of FBLOCK with a laser (look for lobes, etc.)	SLAC	JV	20-Aug-11	21-Aug-11	1		
23	Glue laser light diffuser to the bottom of the FBLOCK	SLAC	MMcC, JV	21-Aug-11	22-Aug-11	1		
24	Assembly of Fbox around FBLOCK & New Wedge	SLAC, Bari, Padova	MMcC, JV, MB, NM	22-Aug-11	25-Aug-11	3		
25	FBLOCK & Fbox assembly finished in the clean room	SLAC	MMcC, JV	25-Aug-11	28-Aug-11	3		
26	**c) Final integration in CRT**							
27	Removal of the present FDIRC prototype from CRT	SLAC	MMcC, riggers, JV	15-May-10	17-May-10	2	finished	
28	Installation of bar box support base for the new bar box	SLAC	MMcC, riggers, JV	18-May-10	20-May-10	2	finished	
29	QC the bar box base before bringing the bar box	SLAC	MMcC,alignment, JV	20-May-10	30-May-10	10	finished	
30	Install the bar box #0 on the CRT base	SLAC	MMcC, riggers, JV	16-Jul-10	18-Jul-10	2		
31	Install the Fbox support to the CRT base	SLAC, Bari, Padova	MMcC, JV, MB, NM	15-Jul-10	25-Jul-10	10		
32	Trial fit of Fbox & dummy & bar box in CRT - adjust alignment	SLAC, Padova, Bari	MMcC, MB, JV, NM	20-Jun-11	30-Jun-11	10		
33	Bring Fbox with the real FBLOCK & New Wedge to CRT	SLAC, Padova, Bari	MMcC, riggers, JV, NM	15-Aug-11	25-Aug-11	10		
34	Optical coupling between the FBLOCK & New Wedge (RTV ?)	SLAC, Padova, Bari	MMcC, JV, MB, NM	25-Jul-11	31-Aug-11	37		
35	Gas sealing of Fbox and bar box, install the N2 boil-off gas flow	SLAC	MMcC	1-Aug-11	5-Aug-11	4		
36	Install the N2 boil-off gas flow	SLAC	MMcC	5-Sep-11	7-Sep-11	2		
37	Install the mechanical enclosure and establish the light seal	SLAC	MMcC, JV	10-Sep-11	12-Sep-11	2		
38	Install detectors with their initial electronics - see more later	SLAC, Hawaii	GV, JV, KN	10-Sep-11	25-Sep-11	15		
39	**d) Other tests/actions which need to be done relatively soon**							
40	R&D on optical coupling between large area glass surfaces (Epotek & RTV)	SLAC	MMcC, JV	10-Jan-11	20-Mar-11	69	finished	
41	Make a diffuser for the laser calibration, and test it	SLAC	MMcC, JV	25-Mar-11	1-Apr-11	7	finished	
42	Order mirror coupons from the plating company	SLAC	JV	10-Mar-11	24-Mar-11		finished	
43	Evaluation of mirror coupons for FBLOCK coating - hardness tests	SLAC	MMcC	5-Mar-11	25-Jun-11			
44	Evaluation of mirror coupons for FBLOCK coating - radiation sensitivity	SLAC	JV	20-Feb-11	20-May-11	89		
45	Evaluation of several diffusers for laser calibration	SLAC	JV	15-Mar-11	20-May-11	66	in progress	
46	Find a new place to do optical transmission tests with a spectrophotometer	SLAC	JV		28-Feb-11		finished	
47	Create a glue test samples for "yellowing & radiation" tests	SLAC	MMcC, JV	15-Feb-11	25-Mar-11	38	finished	
48	UV light exposure of glue samples	SLAC	JV	15-Mar-11	15-Apr-11	31	in progress	
49	Radiation tests of glue samples	SLAC	JV	15-Mar-11	15-Apr-11	31	in progress	
50	Tests of optical coupling between detectors and FBLOCK (Grease ? RTV ?)	SLAC, Padova, Bari	MMcC, JV, MB, NM				in progress	
51	Measure refraction index of RTV used for coupling between Wedge & FBLOCK							
52	Optical distortions in RTV coupling between Wedge and FBLOCK							
53	Measure various distortions and errors in the FDIRC prototype	SLAC	alignment, MMcC, JV					

The 1-st page from the spreadsheet only.

WBS in White paper

WBS	Item	EDIA mm	Labor mm	M&S kEuro	Rep.Val. kEuro
1.3	**PID**	**116**	**236**	**5820**	**7138**
1.3.1	**DIRC Barrel (Focusing DIRC)**	**116**	**236**	**5820**	**7138**
1.3.1.1	Radiator Support Structure	4	4	10	2516
1.3.1.2	Radiator box/FBLOCK assembly	14	40	2819	4515
1.3.1.3	New Camera mechanical boxes	14	28	305	0
1.3.1.4	Photodetector assembly	18	32	2607	0
1.3.1.5	Calibration System	2	4	59	0
1.3.1.6	Mechanical Utilities	4	8	20	107
1.3.1.7	System Integration	60	120	0	0

- **This has to be updated.**
- **And, one has to include institutions.**

Long-term FDIRC tasks

1	WBS	Item	Present list of institutions	People	EDIA [mm]	Labor [mm]	M&S [kEuro]	Rep.Value [kEuro]
2	1.3	PID			116	236	5820	7138
3	1.3.1	DIRC Barrel (Focusing DIRC)						
4	1.3.1.1.	**FBLOCK and New Wedge optical pieces**						
5	1.3.1.1.1.	Raw quartz material procurement	SLAC, Padova, LAL-Orsay, Trieste					
6	1.3.1.1.2.	Verification of the raw material with a laser (look for lobes, etc.)	SLAC, Padova, LAL-Orsay, Trieste					
7	1.3.1.1.3.	FBLOCK & New Wedge quartz grinding and polishing	SLAC, Padova, LAL-Orsay, Trieste					
8	1.3.1.1.4	QC of finished optics; compare them with the manufacturer's data	SLAC, Padova, LAL-Orsay, Trieste					
9	1.3.1.2.	**Photon Camera Assembly**						
10	1.3.1.2.1.	Mechanical design of Fbox	Padova, Bari, SLAC, Trieste					
11	1.3.1.2.2.	Machining of Fbox parts	Padova, Bari					
12	1.3.1.2.3.	Machining of Fbox supports at SuperB	Padova, Bari					
13	1.3.1.2.4.	Glue the light diffuser to FBLOCK (light calibration)	Padova, Bari, SLAC, Trieste					
14	1.3.1.2.5.	Assemble of Fbox around FBLOCK	Padova, Bari, SLAC, Trieste					
15	1.3.1.2.6.	Installation of PMTs with a final electronics on the Fbox	Padova, Bari, SLAC, Trieste					
16	1.3.1.2.7.	QC of finished optical pieces	Padova, Bari, SLAC, Trieste					
17	1.3.1.2.8.	Detector alignment on each Fbox	Padova, Bari, SLAC, Trieste					
18	1.3.1.3.	**Preparation of bar boxes at SLAC**						
19	1.3.1.3.1.	Optical coupling between bar box window and New Wedge (Epotek)	SLAC					
20	1.3.1.3.2.	Delivery of bar boxes to Italy	SLAC					
21	1.3.1.4.	**Radiator/FBLOCK Mechanical Support Structures**						
22	1.3.1.4.1.	Modification of the bar box design to make it compatible with SuperB	Padova, Bari, SLAC					
23	1.3.1.4.2.	Mechanical design of Fbox support at SuperB	Padova, Bari, SLAC					
24	1.3.1.4.3.	Earthquake analysis	Padova					
25	1.3.1.5.	**Photodetectors**						
26	1.3.1.5.1.	PMT procurement with Hamamatsu	LAL-Orsay, Trieste, Maryland, Bari					
27	1.3.1.5.2.	Build a scanning setup for testing of all 600 tubes	LAL-Orsay, Trieste, Maryland, Bari					
28	1.3.1.5.3.	Scan of all PMTs for the production	LAL-Orsay, Trieste, Maryland, Bari					
29	1.3.1.5.4.	Investigation of special MaPMT effects in other scanning setups	SLAC, Maryland, Bari					
30	1.3.1.5.5.	Design and build the Motherboard holder scheme	LAL-Orsay, SLAC, Maryland, Bari					
31	1.3.1.5.6.	Assemble detectors on Motherboard	LAL-Orsay, Bari					
32	1.3.1.5.7.	Install the Motherboard with detectors on FBLOCK	LAL-Orsay, Bari					
33	1.3.1.5.8.	Rate, aging, noise and magnetic field studies of H-8500 MaPMTs	Novosibirsk, LAL-Orsay, Bari					
34	1.3.1.6.	**High voltage system**						
35	1.3.1.6.1.	Cables, distribution boxes, power supplies, current monitoring	Bari					
36	1.3.1.7.	**Detector protection system**						
37	1.3.1.7.1.	Detector protection system against He leaks						
38	1.3.1.7.2.	Use a common monitor signal from each MaPMT to check its status						
39	1.3.1.7.3.	Detector protection system against beam dumps						
40	1.3.1.7.4.	Background detectors to provide fast feedback to the FDIRC						
41	1.3.1.8.	**Calibration System**						
42	1.3.1.8.1.	Procurement of PiLas lasers	Maryland					
43	1.3.1.8.2.	Installation of fibers and lenses	Maryland					
44	1.3.1.8.3.	A choice of the light diffuser	Maryland					
45	1.3.1.9.	**System Integration in SuperB detector**						
46	1.3.1.9.1.	Installation of bar boxes	SLAC, Padova, Bari					
47	1.3.1.9.2.	Installation of Fbox support	SLAC, Padova, Bari					
48	1.3.1.9.3.	Installation of Fboxes into the SuperB structure	SLAC, Padova, Bari					
49	1.3.1.9.4.	Gluing FBLOCKs to New Wedges in situ	SLAC					
50	1.3.1.9.5.	Alignment check of bar boxes, FBLOCKs and detector positions	SLAC, Padova, Bari					
51	1.3.1.10.	**Analysis & monitoring software development**						
52	1.3.1.10.1.	Laser monitoring software to determine time offsets and drifts						
53	1.3.1.10.2.	MC simulation of Theta_c,kx,ky,kz and TOP pixel constants	Maryland, Padova					
54	1.3.1.10.3.	Background MC studies of FDIRC in FullSim	Bari					
55	1.3.1.10.4.	Implementation of the FDIRC quartz optical model in FullSim	Bari					
56	1.3.1.10.5.	Detector performance monitoring software	Bari					
57	1.3.1.10.6.	Laser calibration software	Maryland					
58	1.3.1.10.7.	Background monitoring software						
59	1.3.1.10.8.	HV control & HV & current monitoring software						

The 1-st attempt to do it. Suggest that various institutions express an interest and together we will try to fill up this table by iterative process.