FDIRC prototype status and an update on tasks & schedule

J. Va'vra

SuperB collaboration meeting in Frascatti, Dec.2011

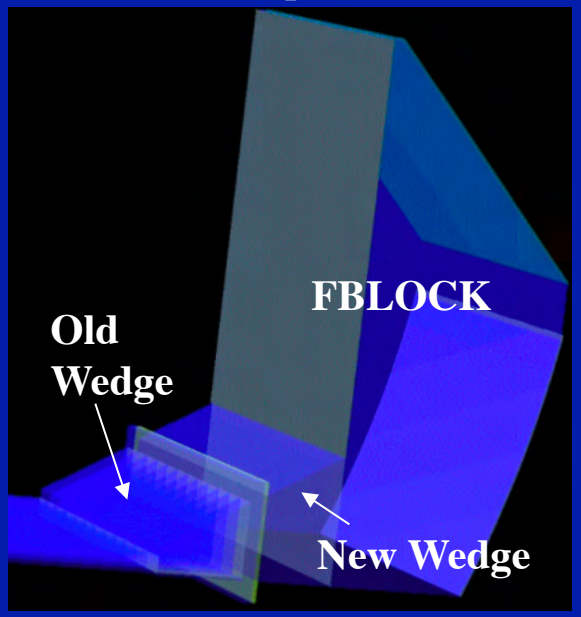
Content

- **Status of optics.**
- **Status of Fbox & CRT mechanics.**
- **Comments on background & shielding.**

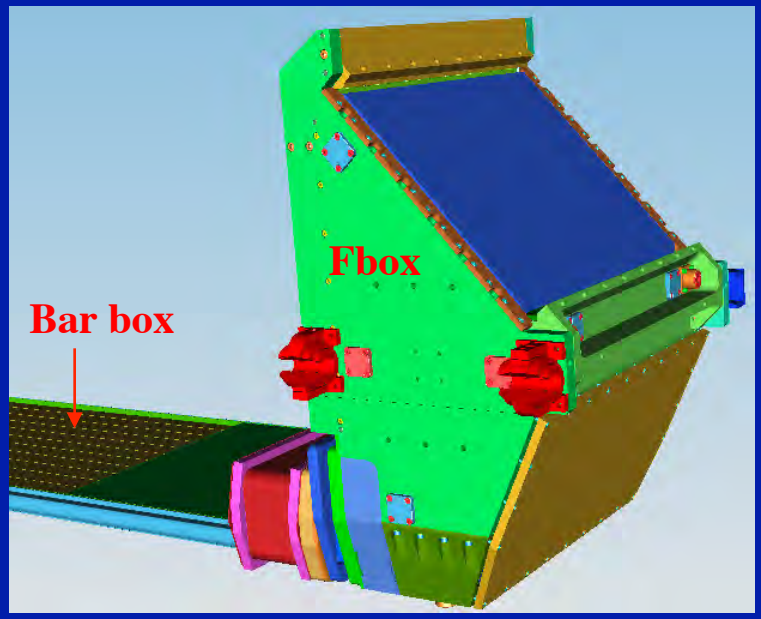
FDIRC: Definitions of names

(For newcomers)

Photon camera optics:

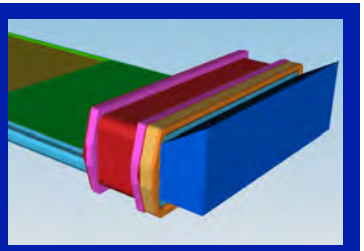


Photon camera mechanics:

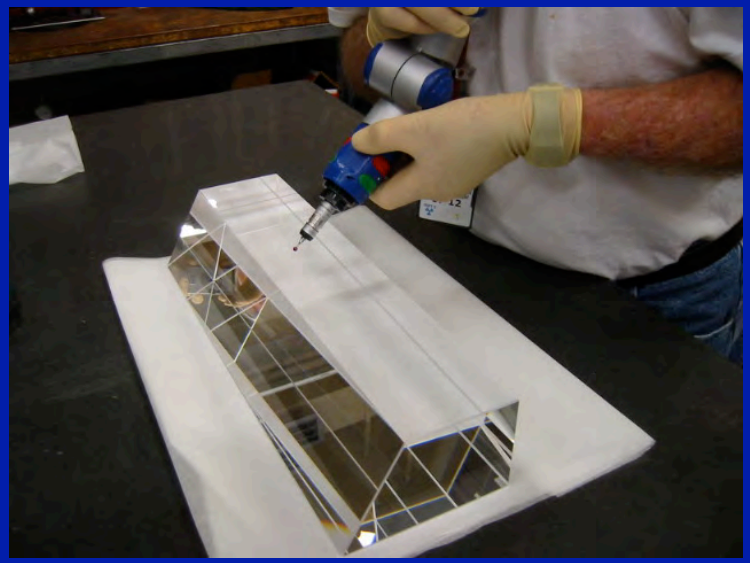


QC of the New Wedge

Alignment people, J. Va'vra and M. McCulloch

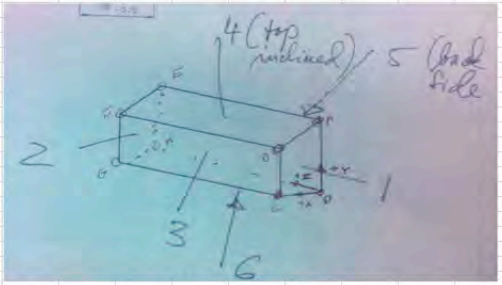


Use a digital arm to measure coordinates of points:



Corners	Z (mm)	X (mm)	Y (mm)		
Corner_A	0.015	0.060	130.684		
Corner_B	0.030	78.513	85.331		
Corner_C	0.020	78.438	0.000		
Corner_D	0.000	0.000	0.000		
Corner_E	418.399	0.060	130.710		
Corner_F	418.406	78.449	85.394		
Corner_G	418.413	78.375	0.000		
Corner_H	418.409	0.000	0.000		
Planes	STDev (mm)	Max (mm)	Min (mm)		
Plane_1	0.004	0.008	-0.008		
Plane_2	0.003	0.008	-0.006		
Plane_3	0.002	0.007	-0.006		
Plane_4	0.003	0.011	-0.009		
Plane_5	0.003	0.007	-0.008		
Plane_6	0.003	0.006	-0.006		
Corners	Distance	Ideal	Plus	Minus	Diff
C-D	78.438	78.000	0.000	-0.500	0.438
G-H	78.375	78.000	0.000	-0.500	0.375
A-D	130.684	130.000	0.100	0.100	0.684
E-H	130.710	130.000	0.100	0.100	0.710
B-C	85.331	85.000			0.331
F-G	85.394	85.000			0.394
A-E	418.384	418.000	0.500	0.500	0.384
B-F	418.376	418.000	0.500	0.500	0.376
C-G	418.393	418.000	0.500	0.500	0.393
D-H	418.409	418.000	0.500	0.500	0.409
Plane	Angle	Ideal	Plus	Minus	Diff
5-6	89.97356	90.00000			-0.02644
4-5	59.99433	60.00000	0.01700	0.01700	-0.00567

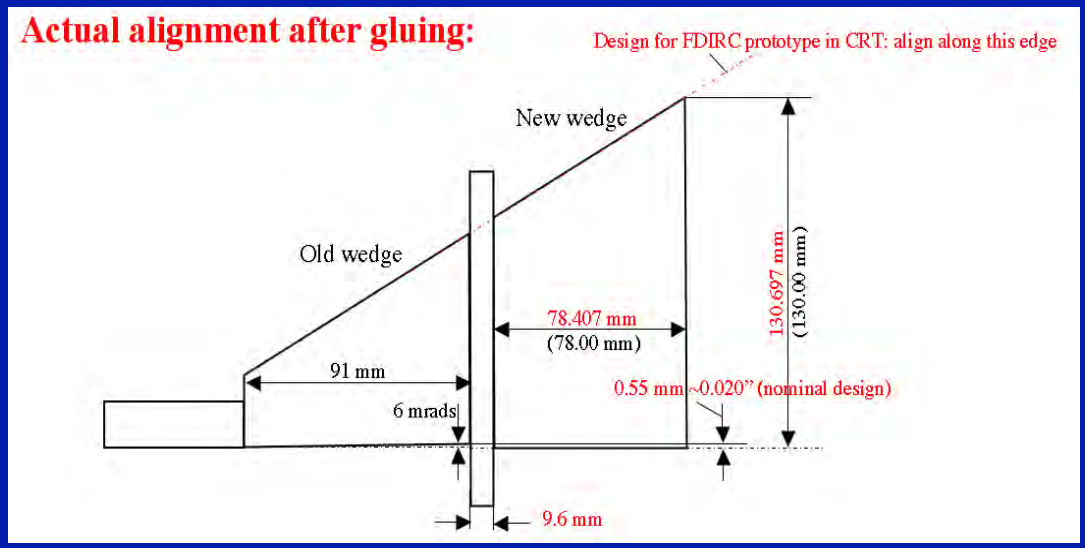
Coordinate system origin is corner D. The direction from corner D to corner H defines the Z axis.
Plane 6 is Y = 0, Roll = 0 . The X axis is from corner D toward corner C in plane 6.
The Y axis is from corner D toward corner A



- **Measure ~20 points on each surface.**
- **Determine angles between surfaces and rms deviation of each point from a given surface, distance between surfaces.**
- **Generally found the alignment acceptable.**

Alignment before gluing

J. Va'vra and M. McCulloch



- **Find that both new Wedge and the window are flat to ~1 mil (~25 microns).**

Bar box – New Wedge glued together

M. McCulloch and J. Va' vra

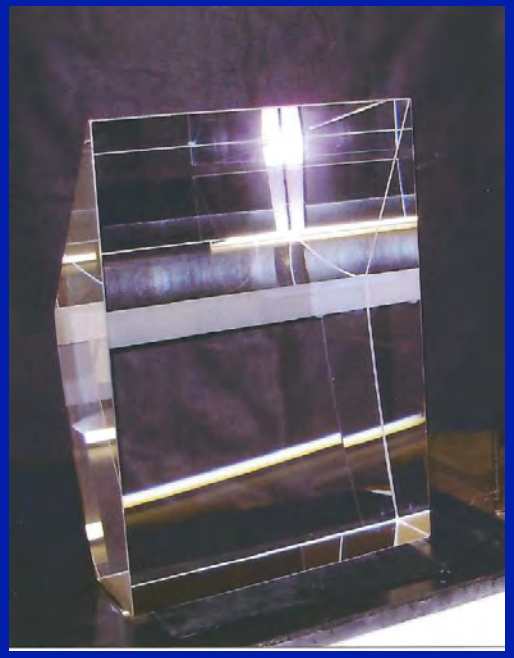
Bar box with a New Wedge:

- **The gap was set to 3 mils (75 microns) with shims. Once the glue was in, shims were removed. Capillary forces squeezed the gap to 1-2 mils (25-50 microns). Optical joint looks perfect. No bubbles.**
- **Use Epotek 301-2 epoxy for this coupling.**
- **The New Wedge adds ~10kg to the bar box weight near the window.**
- **Plan to move the bar box to CRT when Fbox with the FBLOCK is ready.**

FBLOCK: we have a proof that it is doable !!

Cosmo Optics, Middletown, N.Y.

FBLOCK after polishing:

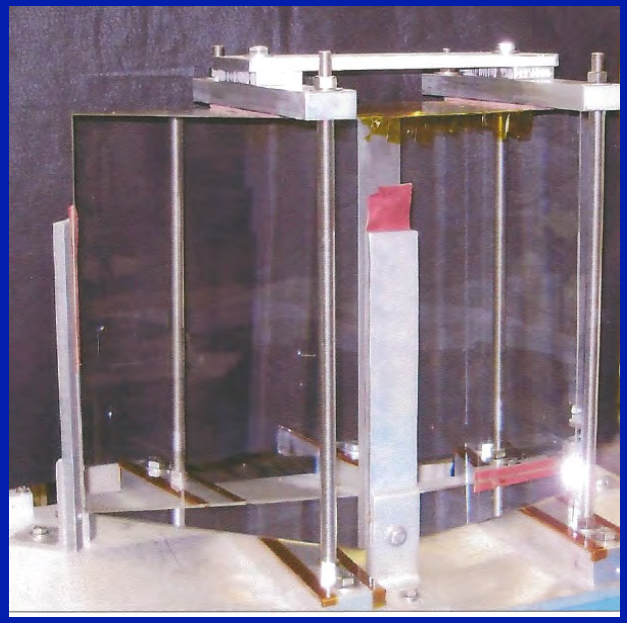


- **Polishing is finished.**
- **People at the optical shop were so excited that it finished successfully that they asked me to write a popular article to their local newspaper in Middletown, N.Y.**

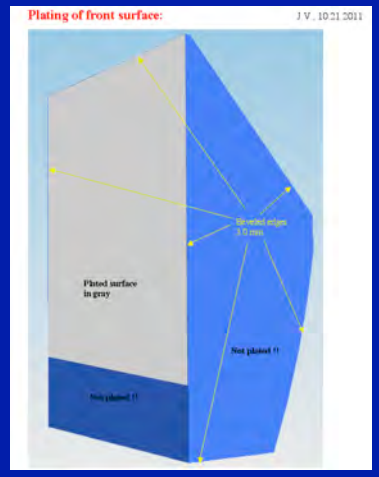
FBLOCK: plating

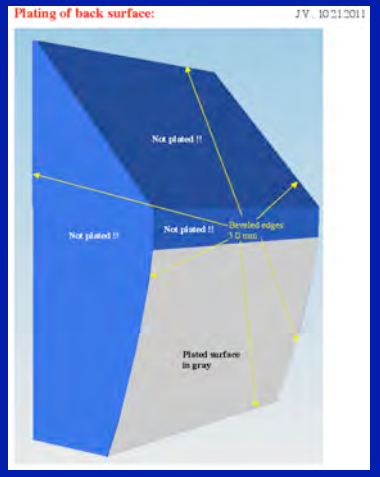
EMF, Ithaca, N.Y.

FBLOCK on side in the plating vessel:



Two mirror surfaces:





- **We went through three plating companies candidates.**
- **Plating will be done this week by EMF, Ithaca, N.Y.**
- **Plating method of two mirror surfaces: Aluminum protected by a SiO_2 layer.**
- **Once FBLOCK is on a rotatable plating table, above brackets will be removed, and two surfaces will be plated in horizontal direction.**
- **Discussing now how to ship it. Decided to postpone it until after Christmas.**

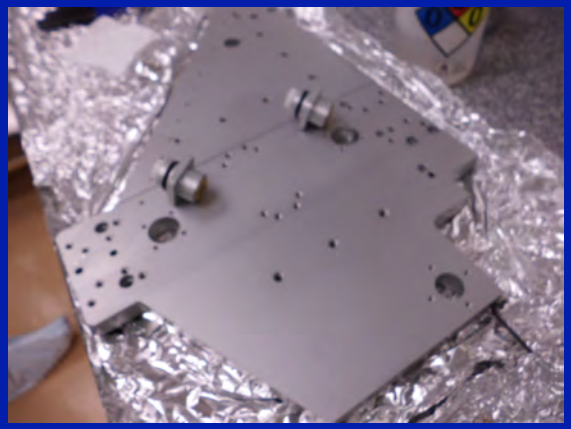
Fbox preparation

Dismantling Fbox

M. McCulloch and J. Va'vra

step-by-step:

Parts in clean room:

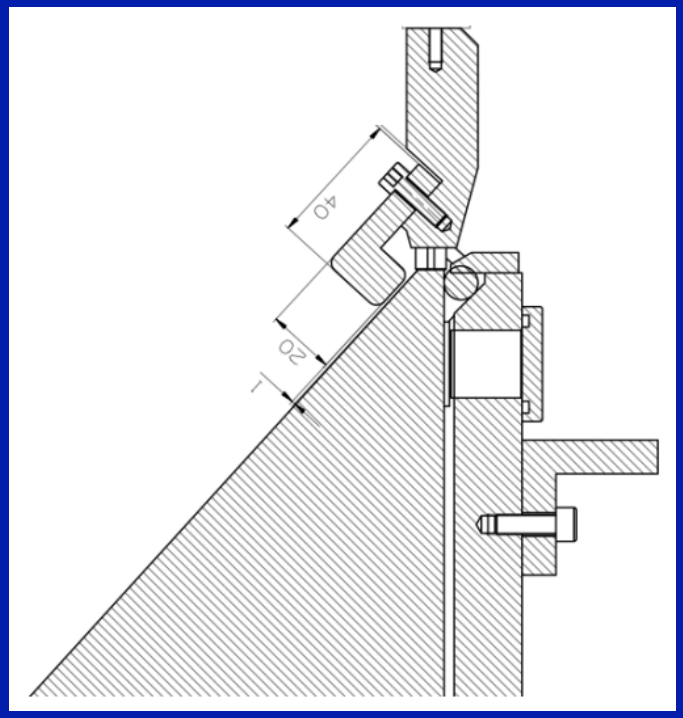


- **Dismantle Fbox step-by-step, record every step in a log book.**
- **Clean all parts. General comment: mostly clean, but some springs had a liquid oil in them, which contaminated nearby parts. Something to watch in future.**
- **Put Fbox sections back together. Now it is all ready the assembly with FBLOCK.**

O-ring solution

M. McCulloch, J. Va' vra

O-ring in FBLOCK:

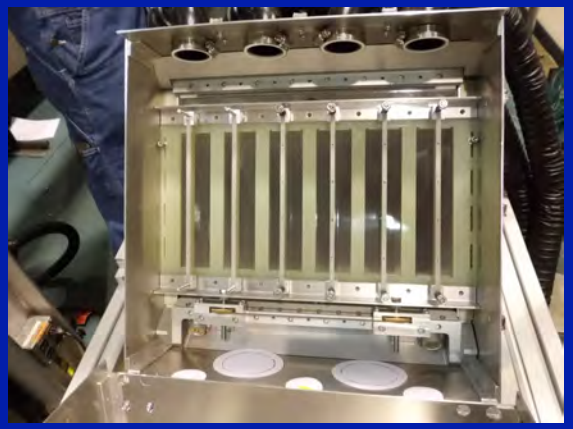


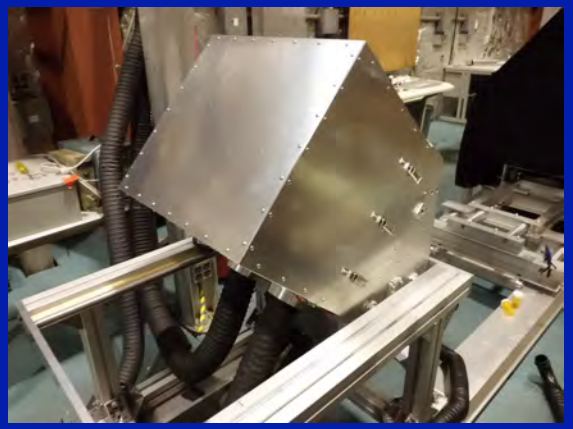
O-ring made of Viton tube & Gore Teflon tape:

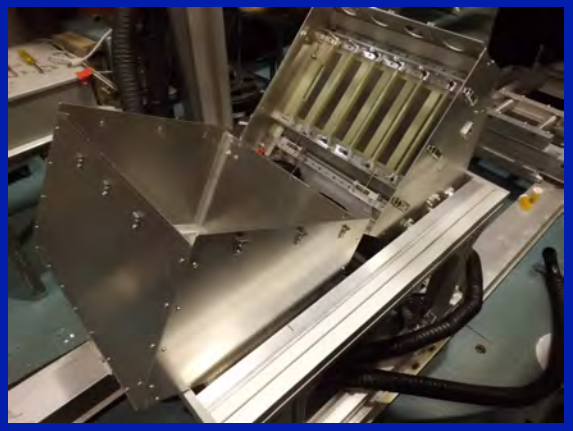
- **Want seal but not create a huge pressure on the FBLOCK tip.**
- **After many iterations, a combination of the Viton O-ring tube and Gore Teflon tape was chosen. It nicely fills complicated surfaces. A final choice will be made after we see the FBLOCK inside Fbox.**

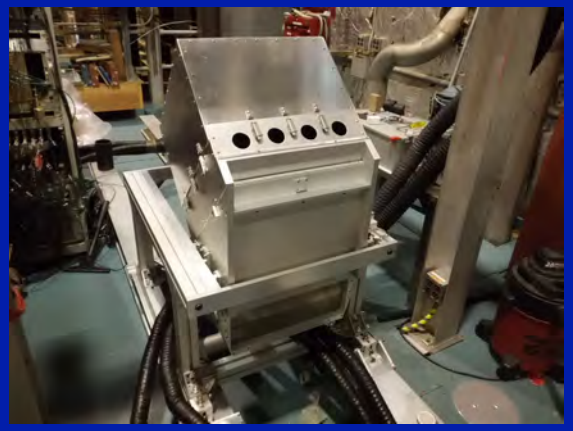
Mechanical trial test of Fbox in CRT

M. McCulloch and J. Va' vra









- **Fbox and its support was successfully trial fitted into the CRT stand.**
- **Right now we working detector holder, electronics shield, air cooling, cable entry.**
- **A thermal test: A 300W heat lamp will heat the enclosed area to ~70-80^{0}C in 20 min if cooling fails. Need a hardware protection using thermal switches.**

FDIRC prototype detector layout

M. McCulloch, J.Va' vra

G-10 holder:

- **Spacing is governed by the size of Hawaii packages.**
- **This will take care of 6 Hawaii double-packages and up to 12 LAL packages.**
- **This hardware was already built.**

Log book of critical dimensions

J.Va' vra

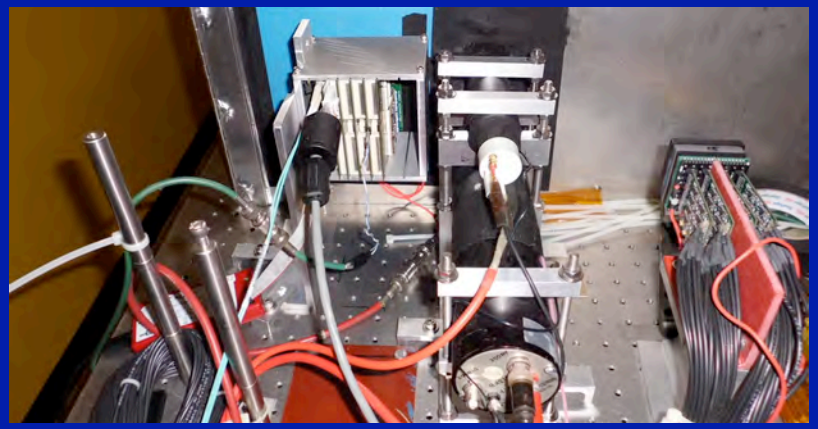
- **Maintain a file of "as-built" critical dimensions for FDIRC prototype:**
  - The current version: "Critical_dimensions_v2.pdf".

  - It has "as-built" dimensions of individual optical components, pixel locations, etc.
  - The file will be maintained throughout the project.

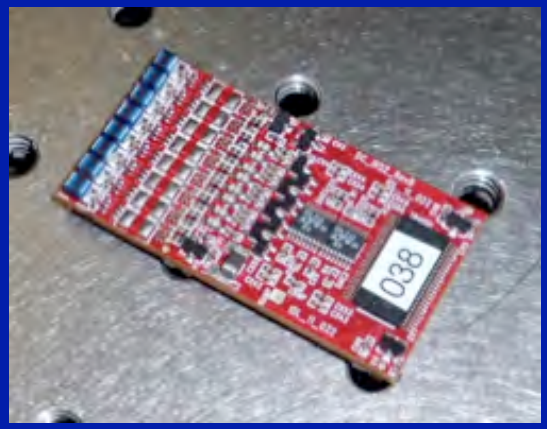
Electronics status – a problem

G. Varner, K. Nishimura

Hawaii IRS-2 digitizer in the SLAC scanning setup:



Avago ~2.5GHz BW amplifier:



- **Hawaii BLAB3 electronics had an amplifier built in. Unfortunately, this electronics does not work at the moment. The amplifier has a digital clock noise.**
- **Gary has switched to previously used IRS-2 waveform digitizer, which has to have an external amplifier. He chose the Avago ~2.5GHz BW amplifier with 10x gain. They added a ~0.4 GHz BW low pass filter to reduce the noise. It is a match to the SL-10 tube, but a poor match to the slower H-8500 tube, giving a poor S/N !! At the end, in this test, nothing worked. We could not even see single pe pulses.**
- **So, I have decided to go back to our old SLAC amplifier. It is not a trivial decision. We need: (a) 48 PC boards, (b) load them, (c) mate them to IRS-2, and (d) test them.**
- **This is a lot of extra work, and it will delay us by at least 1-2 months.**

Remaining major FDIRC prototype items

- **QC the FBLOCK in January.**
- **Assemble Fbox around the FBLOCK in January.**
- **Install the Barbox and Fbox into CRT at the end of January.**
- **Glue the New Wedge to FBLOCK in CRT using the RTV glue.**
- **Create "pixel constants" for FDIRC prototype with MC program.**
- **As a consequence of BLAB3 not working we have to:**
  - switch to IRS-2 waveform digitizer , which, however, requires adding amplifiers
  - produce 48 SLAC amplifier PC boards and components, and load components on PC boards.
  - test new amplifiers with IRS-2 digitizer in the scanning setup.
- **We may even put back in our seven BLAB2 packages.**
- **Install detectors and electronics, cooling, cables, laser calibration, etc.**
- **Start running in CRT sometimes in February-March ?**

FDIRC background at full luminosity

Method	Person	Rate per double-pixel from the bar box, i.e., from active volume	Rate per double-pixel from the Photon camera if not shielded
Real MC simulation using a proper treatment of optical photons	Alejandro, Doug, Andrea	~ 85 kHz	~ 550 kHz
MC simulation using a simple treatment of optical photons	Riccardo	~ 60 kHz *	~ 400 kHz *
Empirical scaling from Belle-I by quartz volume and as Lumi-term	Jerry	~ 75 kHz *	~ 120 kHz *

* Apply a factor of 2 reduction for a photon loss on optical surfaces

- **Impressive agreement, but may be still completely wrong !**
- **We clearly need to shield the photon camera.**

Lessons from the DIRC shielding battle

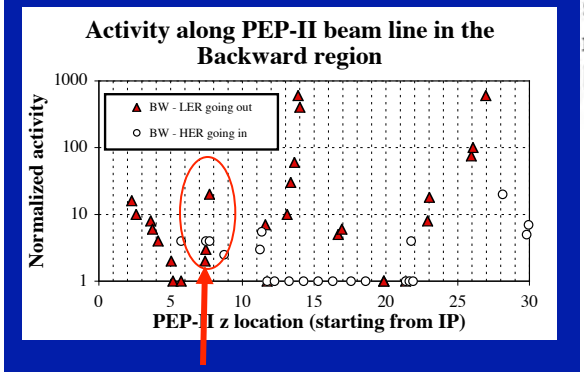
J. Vavra, http://www.slac.stanford.edu/~jjv/activity/Long_manual_bckg_detectors.pdf

1)

Started with no shielding

DIRC Display (1999):

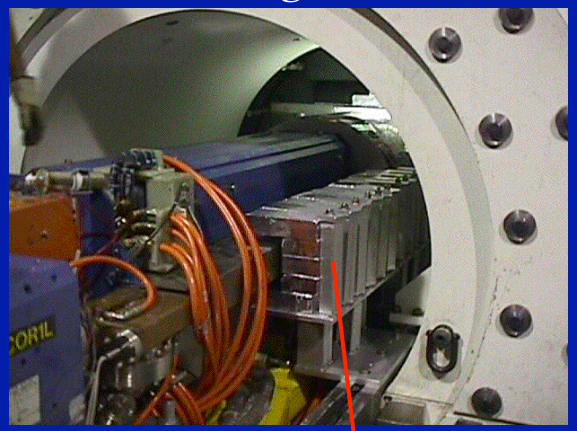
Geiger counter survey (2003):



Located just under DIRC

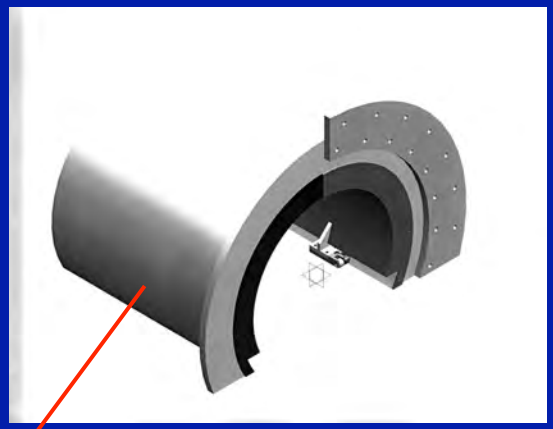
2)

Improvised shielding with lead bricks:

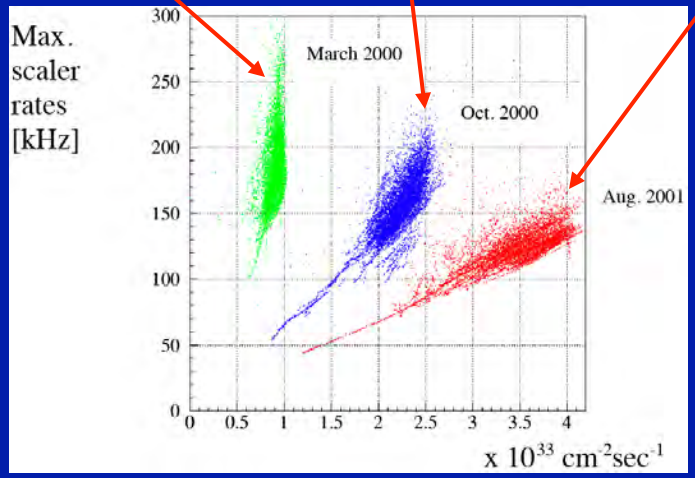


3)

Properly engineered shielding under DIRC SOB (2001):



Improvements in DIRC background = f(time):



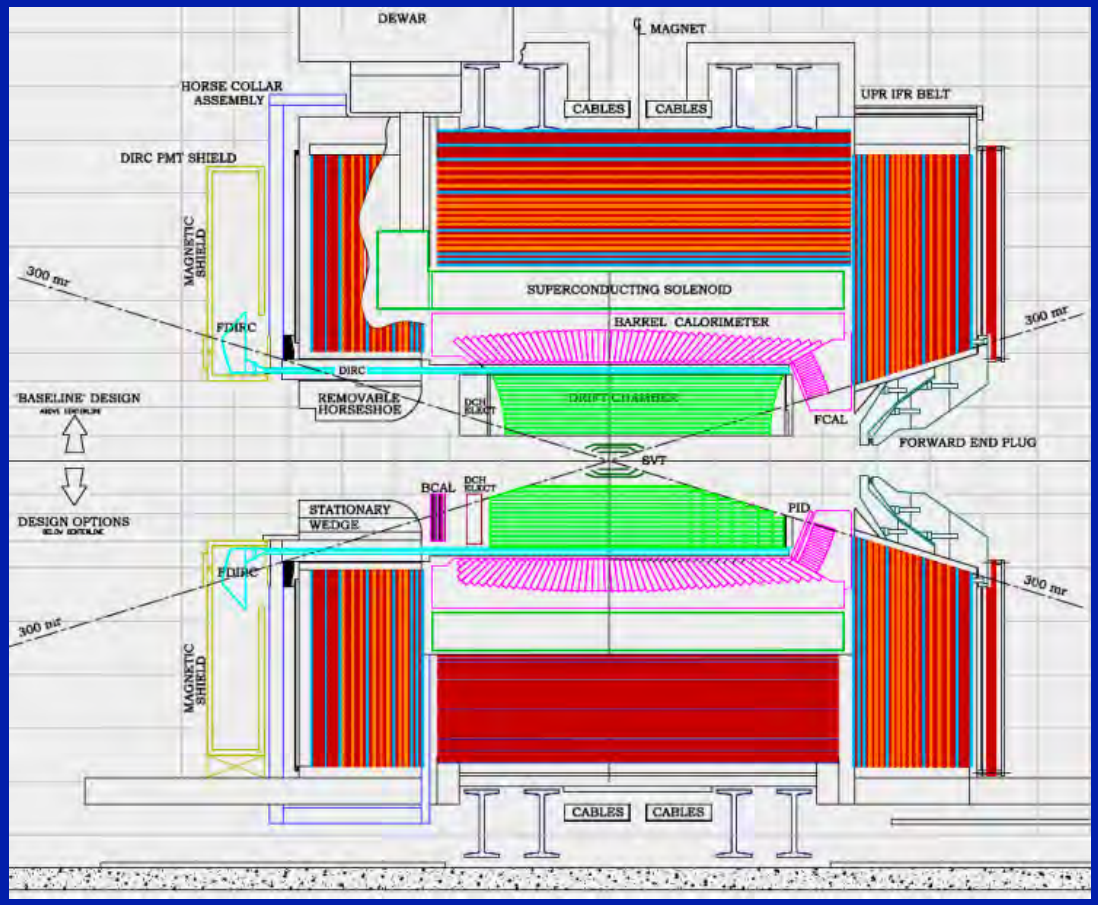
Fight against background:

1) Apply timing cut: ± 8ns
2) Add shielding !!! But where ?
3) Install background detectors
4) Improve machine

Rate was limited by:

Electronics dead time: ~5% at a rate of ~250 kHz/PMT

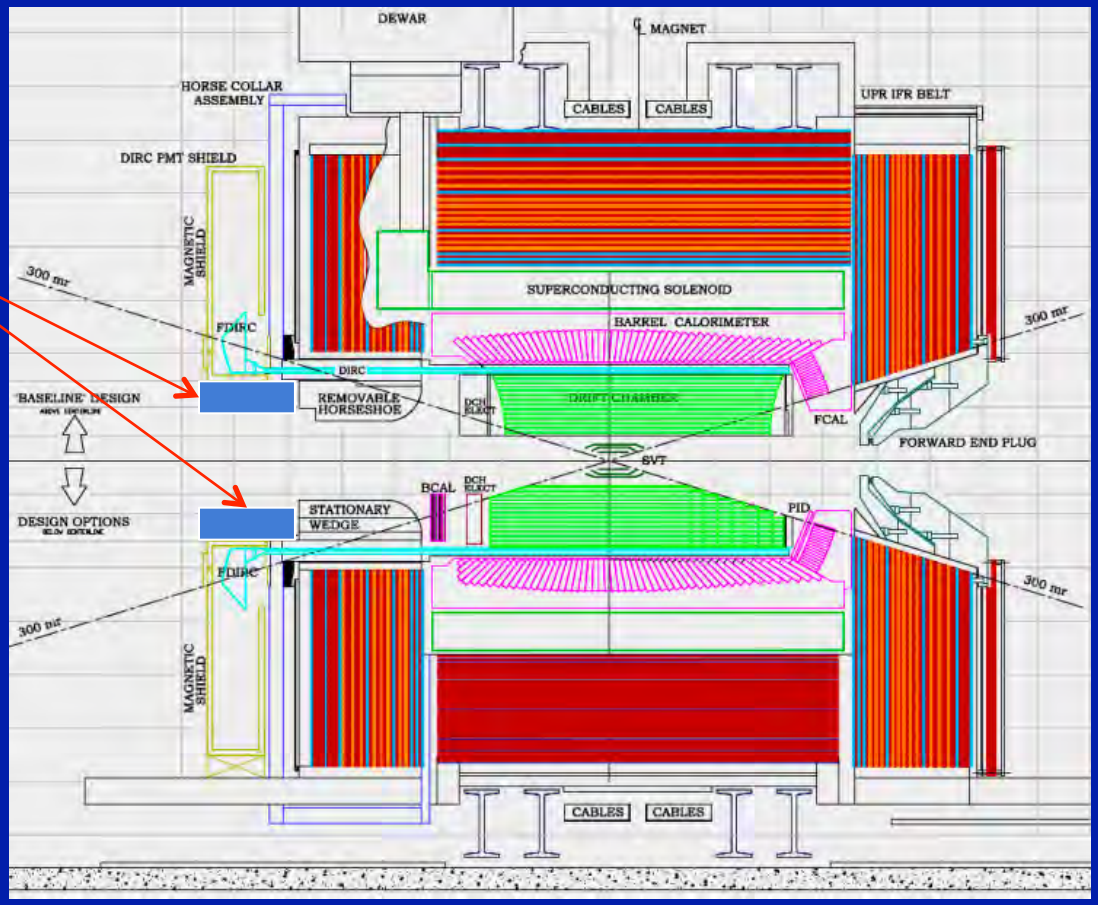
New FDIRC shielding



- **Need to come up with something which will work from several point of views: FDIRC camera background, easy access, cables, etc.**

New FDIRC shielding

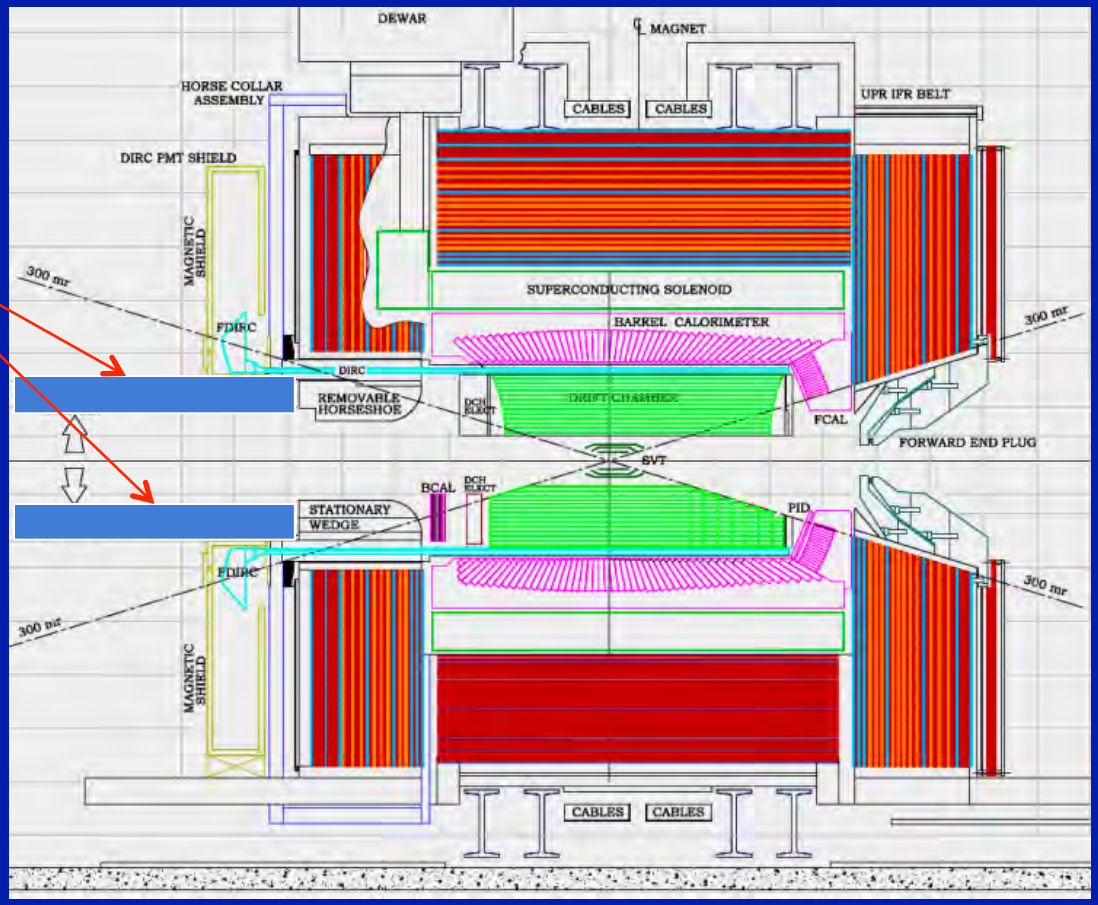
Need shielding:



- **Need to come up with something which will work from several point of views: FDIRC camera background, easy access, cables, etc.**
- **We need to add a shield under the Photon camera.**

New FDIRC shielding

Or this ?



- **Need to come up with something which will work from several point of views: FDIRC camera background, easy access, cables, etc.**
- **May be that all beam line components need to be shielded in a tunnel !!**