Plans for FDIRC tests in CRT

J. Va'vra, SLAC

FDIRC progress

(SLAC, Maryland, Hawaii, Orsay, Padova)

- **Raw quartz for FDIRC optics ordered** (Delivery in the middle of Nov.)
- **Final bids for machining the FBLOCK optics launched** (6 companies).
- **FDIRC mechanical design for CRT tests in progress.**
- **H-8500 photon detectors** (at the moment we will have at least 14 detectors in FDIRC).
- **Concepts how to couple the detectors to electronics discussed.**
- **Concrete R&D ahead of us:** Glue tests, grease tests for detector coupling to quartz, etc.
- **Electronics** (LAL TDC/ADC development + Hawaii BLAB3 electronics).
- **Laser calibration** (MC simulation in progress, ideas how to do it exist).
- **Start time resolution in CRT** (the timing resolution in CRT being analyzed).
- **Gas flow & sealing on the FBLOCK** (initial discussion has started).
- **CRT DAQ system** (would like to unify the DAQ system).
- **Approximate start of the CRT tests with FDIRC: May - June, 2011**

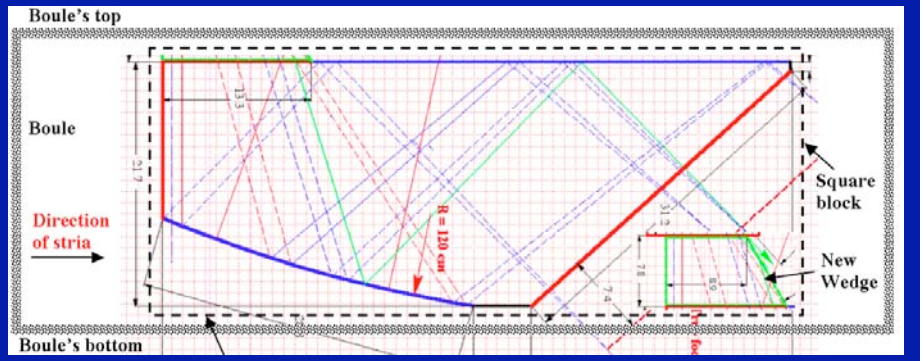
- **I would like to say a few things now in more detail.**

Corning raw quartz material

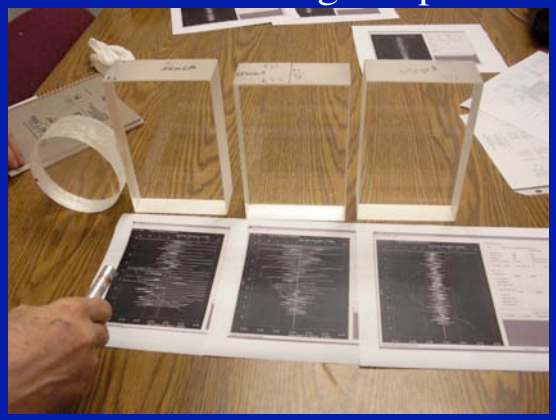
J. Va'vra visited Corning Co.

At the end we will have 3 FBLOCKs out of a single boule like this:

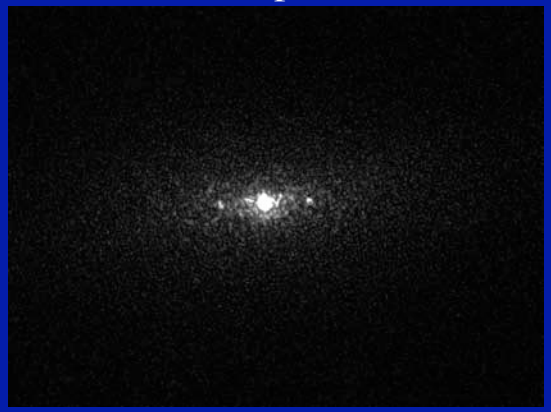
Orientation of FBLOCKs within the boule:



SLAC & 3 Corning samples:



SLAC sample I took with me and its diffraction pattern:

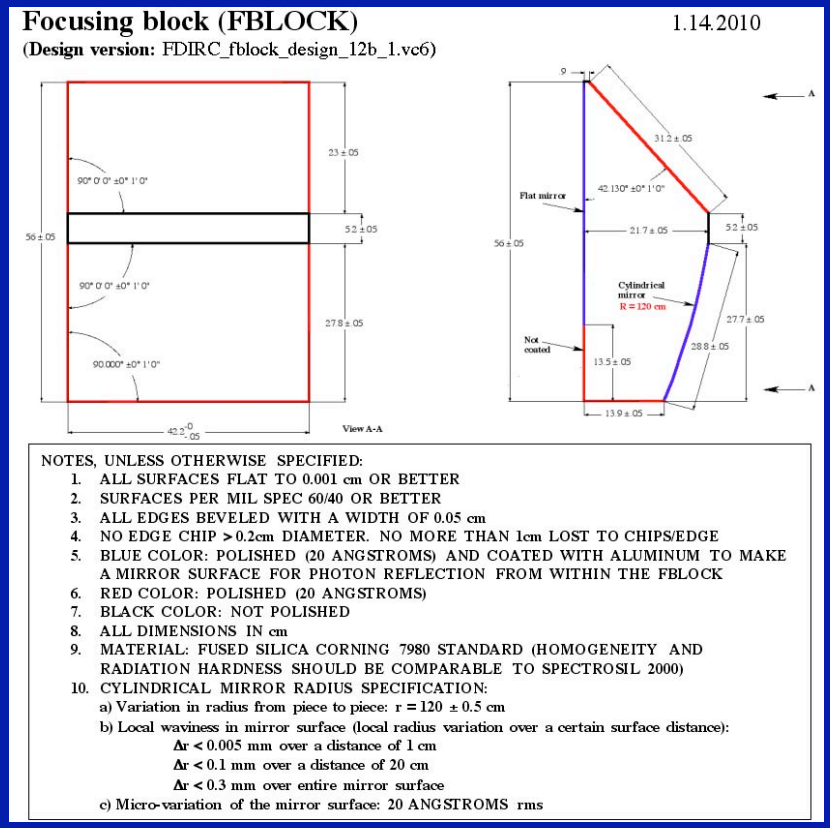


- **None of the Corning samples exhibited the diffraction pattern with a laser.**
- **The raw material has been ordered. The expected delivery in middle of November.**

Bids to machine the FBLOCK launched

J. Va'vra

Pictures & specs from the preliminary bids:

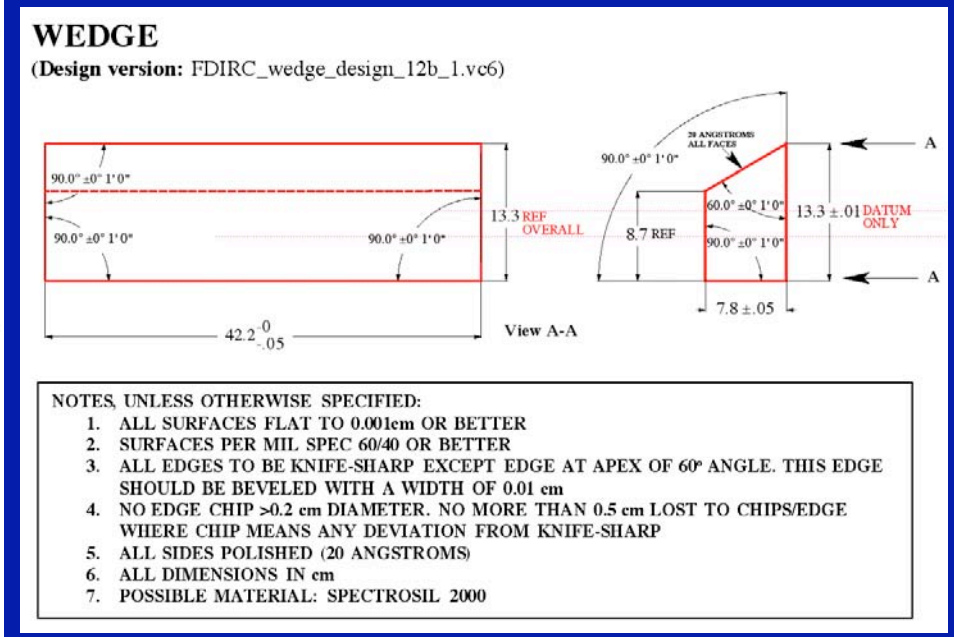


Focusing block (FBLOCK) 1.14.2010

(Design version: FDIRC_fblock_design_12b_1.vc6)

NOTES, UNLESS OTHERWISE SPECIFIED:

1. ALL SURFACES FLAT TO 0.001 cm OR BETTER
2. SURFACES PER MIL SPEC 60/40 OR BETTER
3. ALL EDGES BEVELED WITH A WIDTH OF 0.05 cm
4. NO EDGE CHIP > 0.2cm DIAMETER. NO MORE THAN 1cm LOST TO CHIPS/EDGE
5. BLUE COLOR: POLISHED (20 ANGSTROMS) AND COATED WITH ALUMINUM TO MAKE A MIRROR SURFACE FOR PHOTON REFLECTION FROM WITHIN THE FBLOCK
6. RED COLOR: POLISHED (20 ANGSTROMS)
7. BLACK COLOR: NOT POLISHED
8. ALL DIMENSIONS IN cm
9. MATERIAL: FUSED SILICA CORNING 7980 STANDARD (HOMOGENEITY AND RADIATION HARDNESS SHOULD BE COMPARABLE TO SPECTROSIL 2000)
10. CYLINDRICAL MIRROR RADIUS SPECIFICATION:
    a) Variation in radius from piece to piece: r = 120 ± 0.5 cm
    b) Local waviness in mirror surface (local radius variation over a certain surface distance):
    $\Delta r < 0.005$ mm over a distance of 1 cm
    $\Delta r < 0.1$ mm over a distance of 20 cm
    $\Delta r < 0.3$ mm over entire mirror surface
    c) Micro-variation of the mirror surface: 20 ANGSTROMS rms



WEDGE

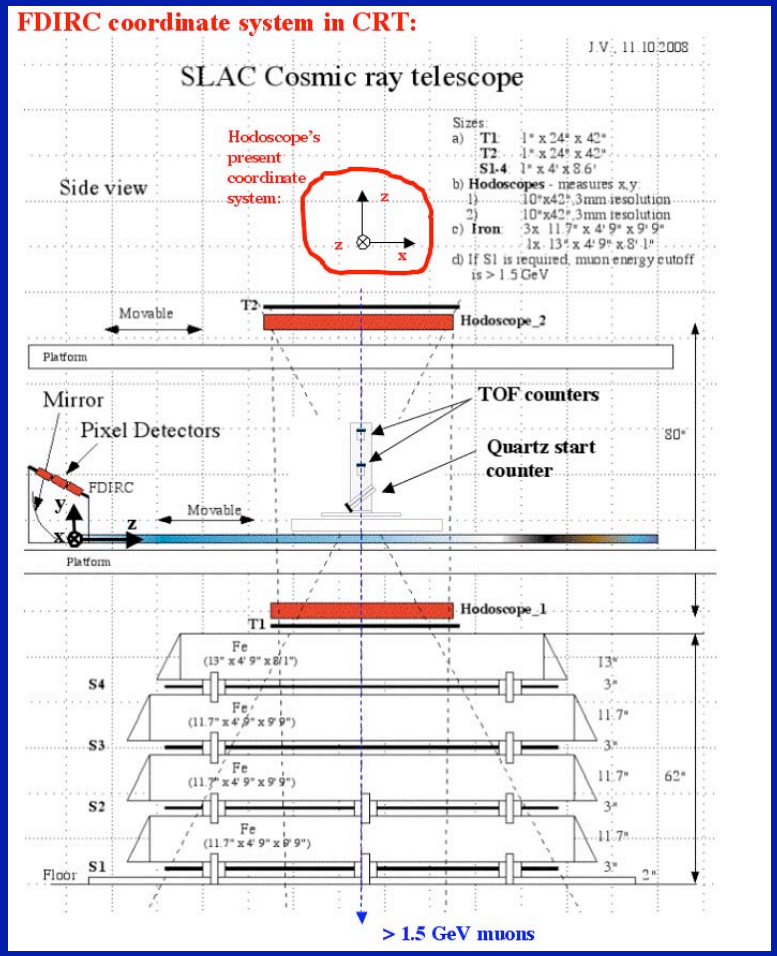
(Design version: FDIRC_wedge_design_12b_1.vc6)

NOTES, UNLESS OTHERWISE SPECIFIED:

1. ALL SURFACES FLAT TO 0.001cm OR BETTER
2. SURFACES PER MIL SPEC 60/40 OR BETTER
3. ALL EDGES TO BE KNIFE-SHARP EXCEPT EDGE AT APEX OF 60° ANGLE. THIS EDGE SHOULD BE BEVELED WITH A WIDTH OF 0.01 cm
4. NO EDGE CHIP >0.2 cm DIAMETER. NO MORE THAN 0.5 cm LOST TO CHIPS/EDGE WHERE CHIP MEANS ANY DEVIATION FROM KNIFE-SHARP
5. ALL SIDES POLISHED (20 ANGSTROMS)
6. ALL DIMENSIONS IN cm
7. POSSIBLE MATERIAL: SPECTROSIL 2000

- **The final bid included Massimo's engineering drawings.**
- **The final bid asks to send it to 6 companies.**

CRT test setup at SLAC

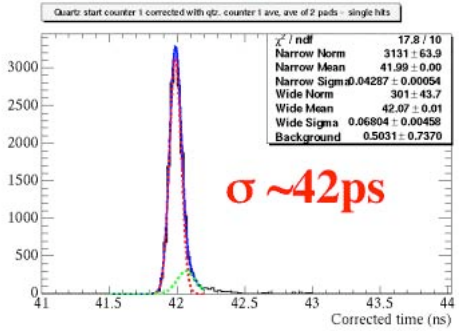


- **A muon passing through the entire stack has E >1.5 GeV.**
- **At present, have ~35" of steel. Would like to add some lead to increase this cutoff energy.**

Start counter: ESA test beam vs. CRT

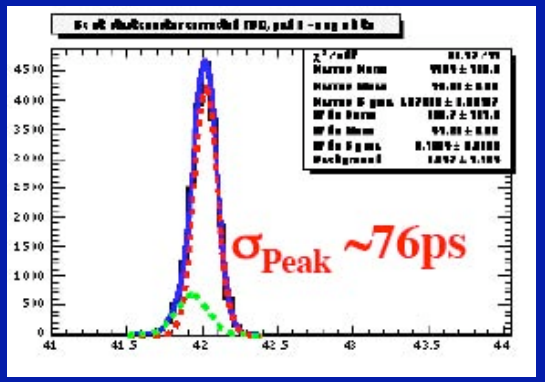
Beam test (Start: Accelerator RF pulse):

Average of 4 pads:



4-pad Burle MCP-PMT:

Pad 3 alone in test beam:



CRT start time:

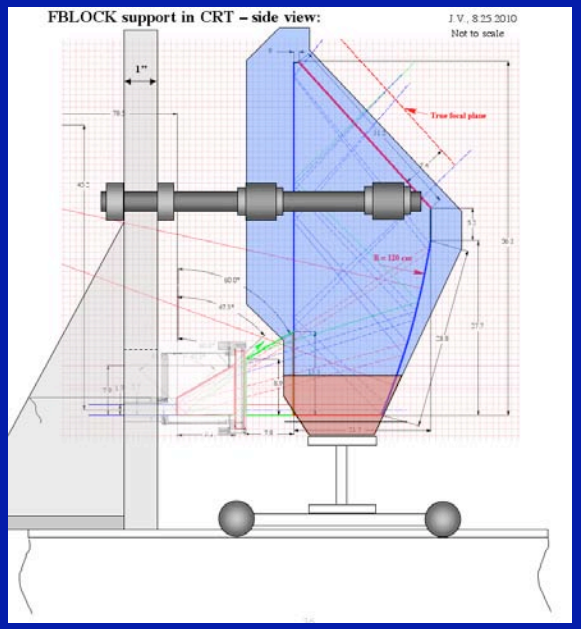
- MCP-PMT has 4 pads
- Pad 3 is used as a start of the entire system. It is processed through a CFD to correct PH in hardware.
- To see if we can achieve a 200 ps resolution per photon, we have taken some data with a single H-8500 pixel coupled to the WaveCatcher, and will try to do a 3D track correction to timing.
- Based on results with TOF counters, we should be able to achieve it even in CRT.

Mechanics for the FDIRC in CRT

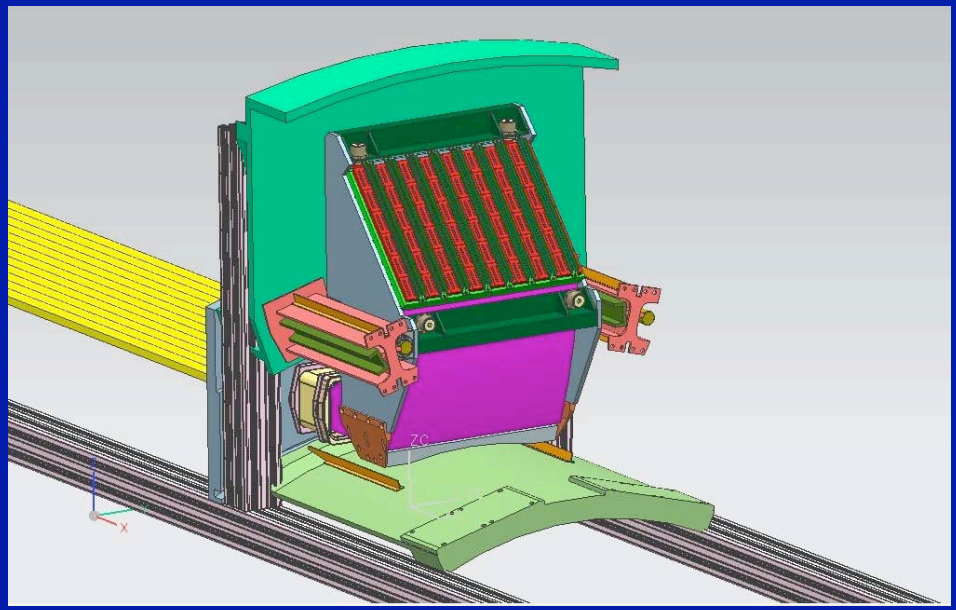
M. Benetonni, J. Va'vra

I sent some initial thoughts to Massimo:

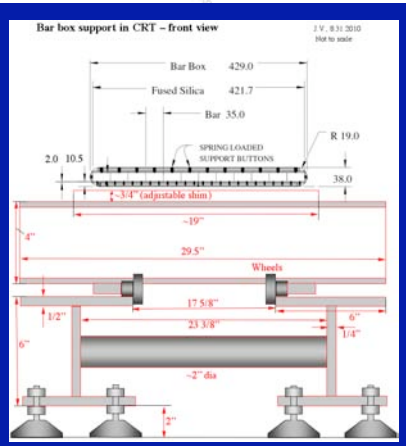
Side view:



Massimo's initial concept for CRT:

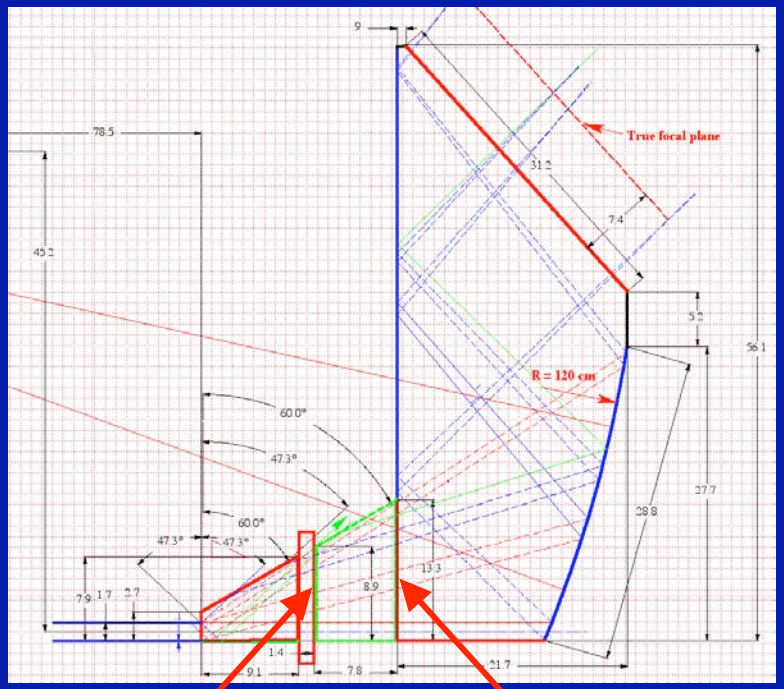


We want to use the existing CRT I-beam support structure:



- **<u>The point here is that the process has started.</u>**
- **A number of details still to be solved.**

Glue joint



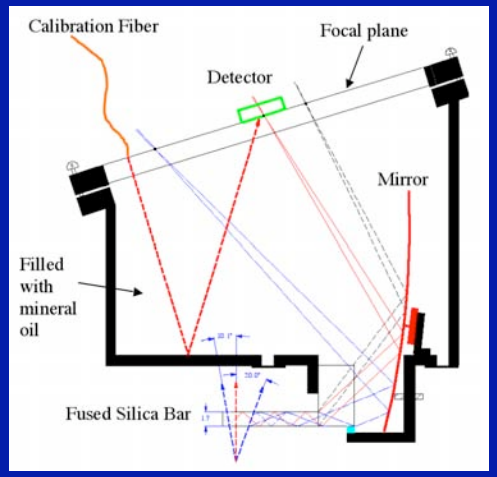
2-nd: Done in situ

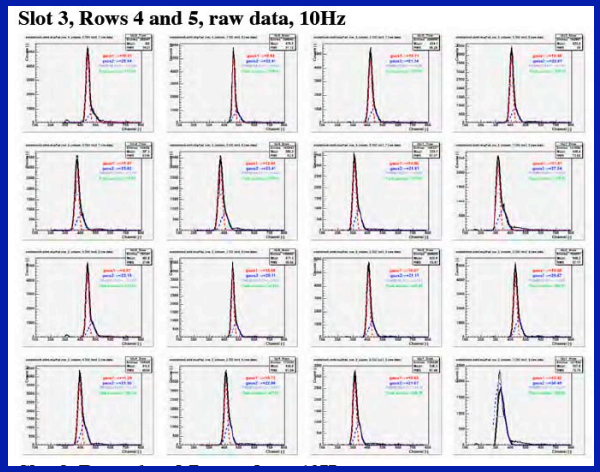
1-st: Done in the clean room

- **These are large area glue joints. We have never done such a large area, so we need to do tests. However, we can get to it after D&D has finished.**
- **Plan to use Shin-Etsu RTV 403. Did tests with it. It is radiation hard, and has good transparency. The glue was ordered.**

Laser calibration in the FDIRC prototype

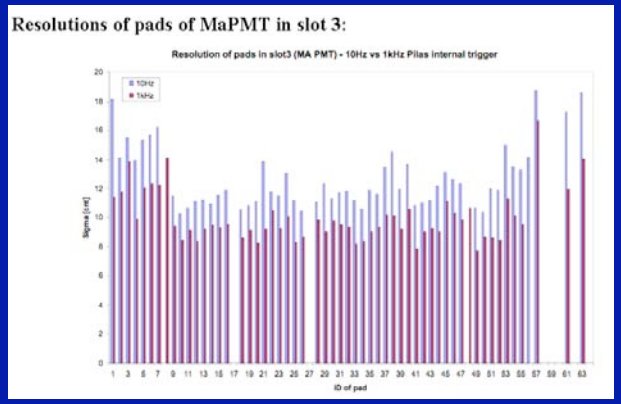
Pencil-like laser beam hits etched Al surface:

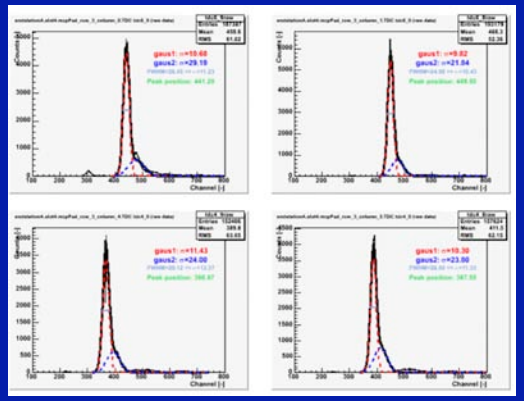




H-8500 time distributions are very clean

H-8500 resolution typically σ_1 ~200-250ps:





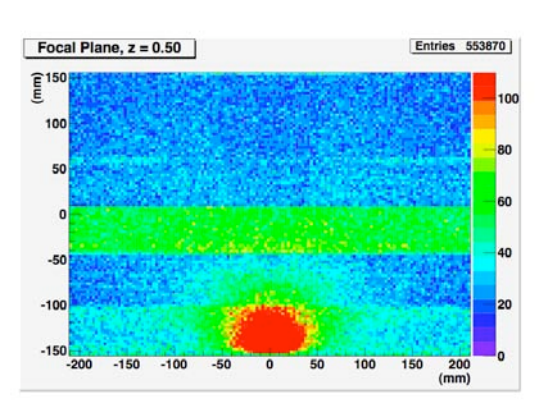
H-8500 timing resolution double-Gaussian fit details

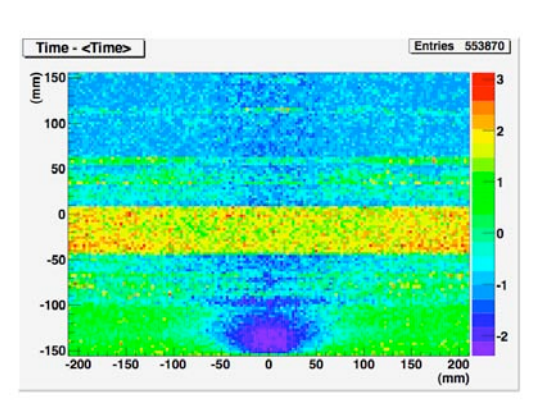
- **The resolution was used only as a check of performance. We used the mean values to determine the cable offsets (had 16ns long LEMO cables between the amplifier & CFD).**
- **The final FDIRC will not have such cable offsets.**

Simulation of the laser calibration in FDIRC

D. Roberts MC simulation

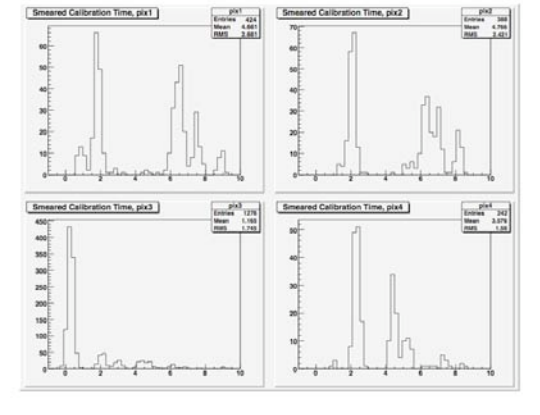
Distribution of hits in the focal plane:





Distribution of Time - <Time>

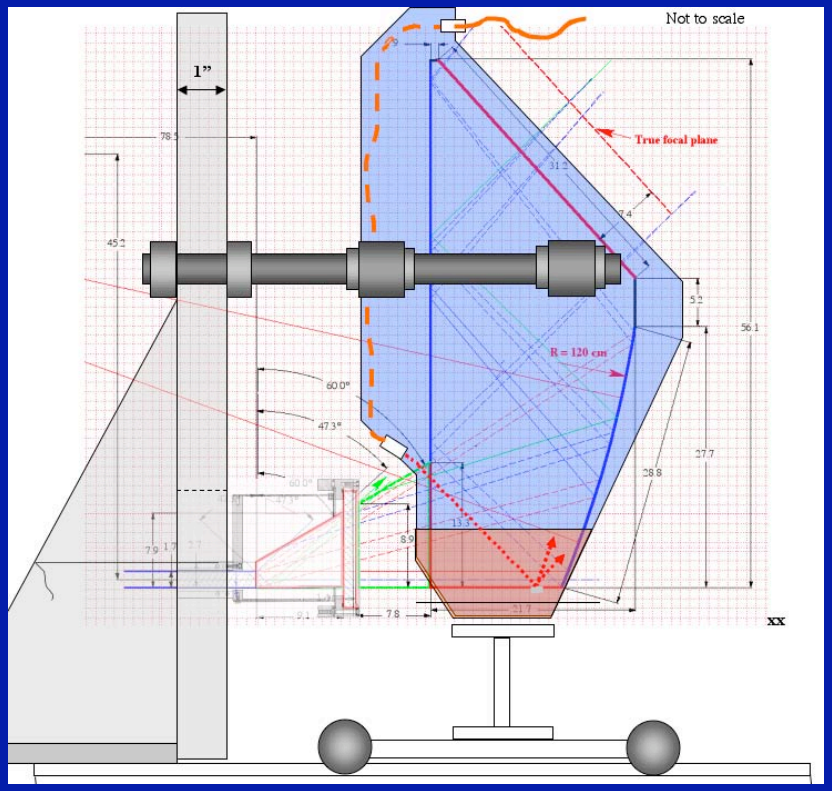
Timing distributions:



- **The timing distributions are a bit more complicated than in the FDIRC prototype, because of side reflections.**

Possible implementation of the laser calibration in FDIRC in CRT

J. Va'vra



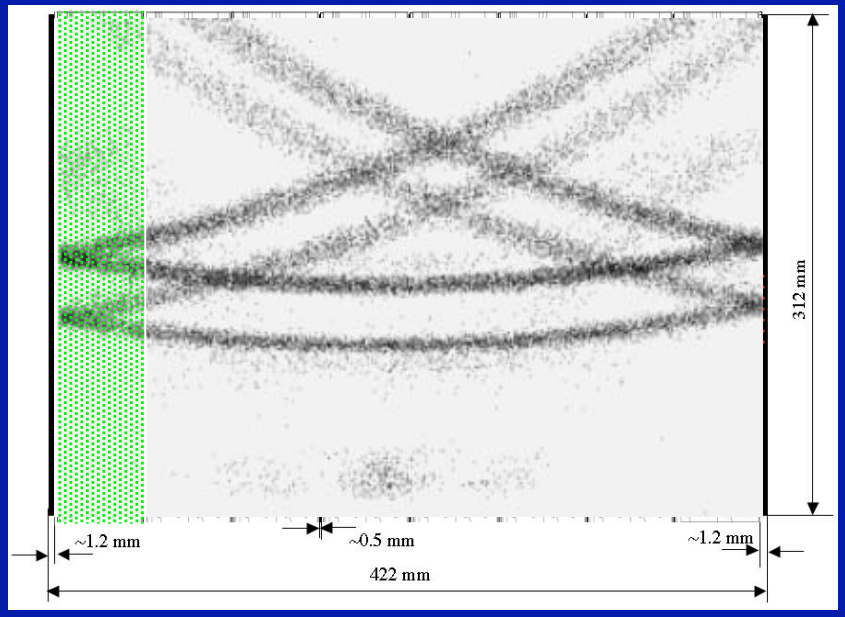
- **Fiber comes to a bulkhead fiber connector in easily accessible spot, and the continues as another segment ending in the lens, producing parallel pencil-like beam. The beam is reflected from a small piece of etched aluminum glued to the bottom of FBLOCK.**

Electronics coupling to FBLOCK in CRT

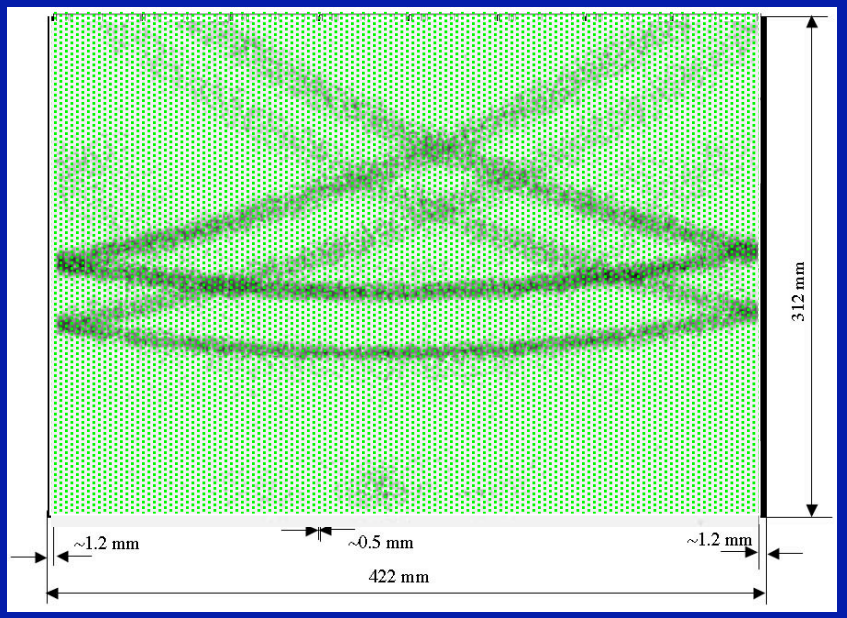
Christopher Beigdeger, Massimo Benetonni and J. Va'vra

Detector plane:

(a)



(b)



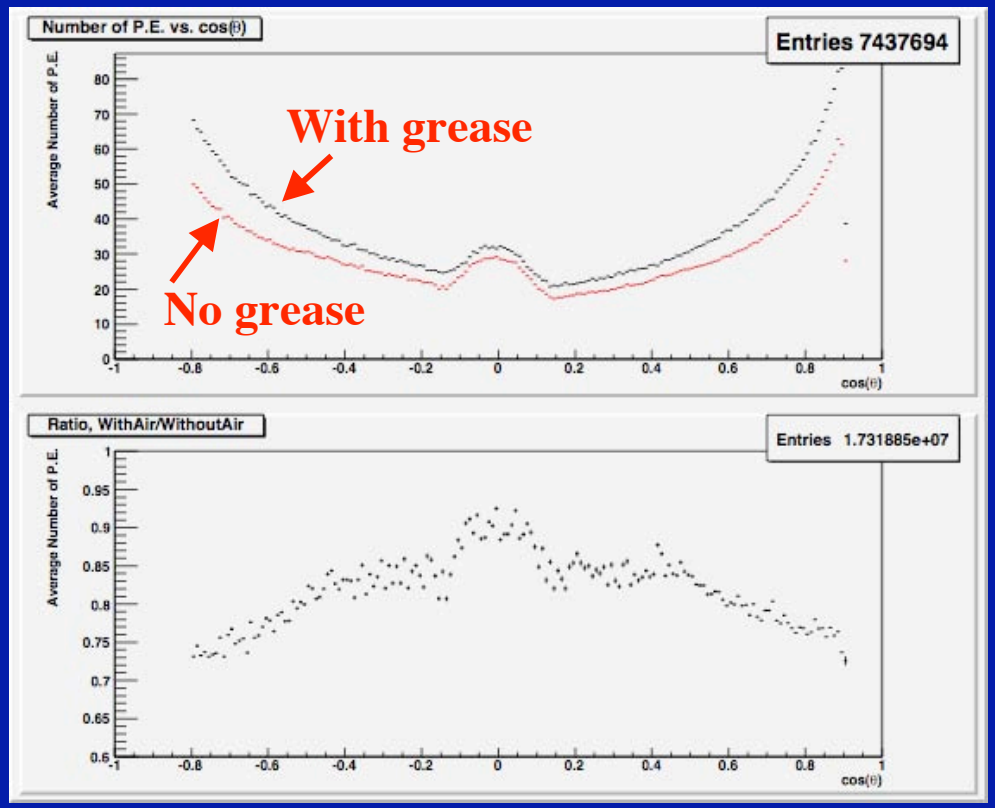
- **Two motherboard options were discussed:**
  - (a) Small one for 6 detectors, or (b) Large one for 48 detectors.
- **We will have both LAL TDC/ADC and Hawaii BLAB3 electronics.**
  - Gary has agreed to be compatible with this motherboard, i.e., to have male pins on his PC boards to plug into our board.
- **Detectors are plugged into the motherboard first. The board provides the alignment.**
- **From a maintenance point of view, it seems to me, that it is difficult to apply the grease or RTV optical coupling between the detectors and FBLOCK. Need testing.**

Ring: $\theta_{dip}=88^o$, $\phi=90^o$
(Doug Roberts)

Optical coupling: grease vs. air

D. Roberts

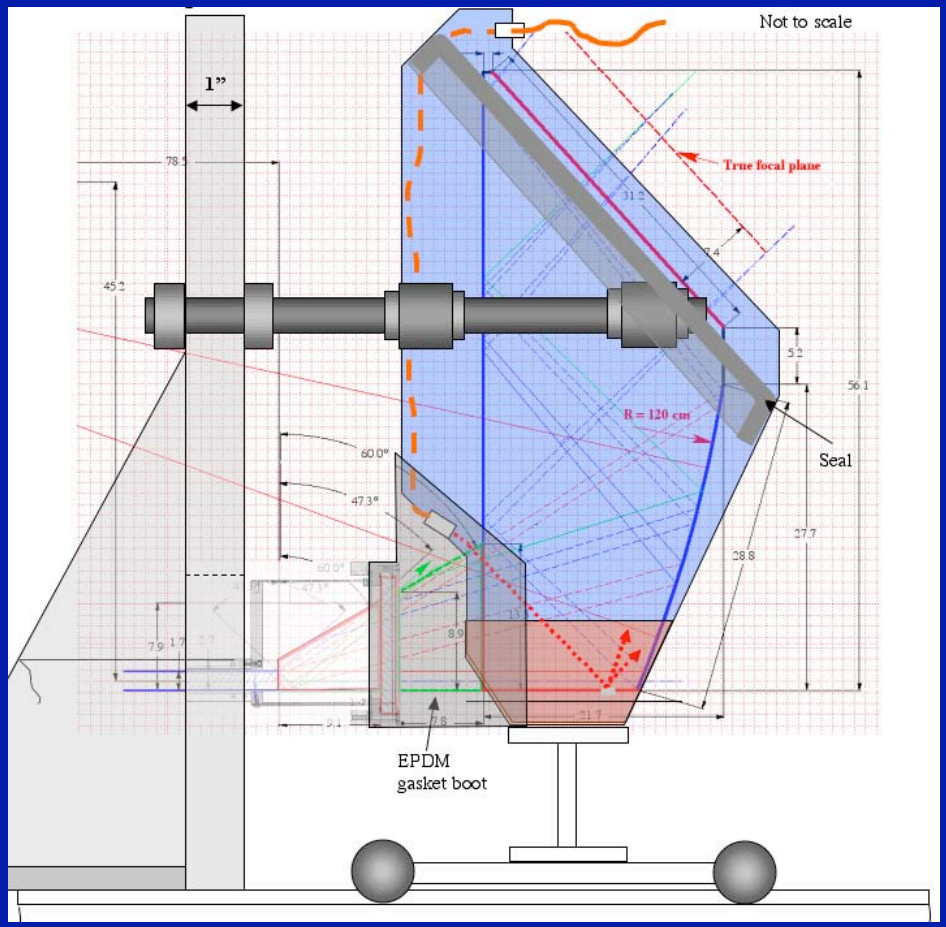
MC simulation:



- **Loss of photoelectrons: 8-25% as one goes from the center to the wing.**
- **On the other hand, photons near the Cherenkov wing have worse angular resolution. Should really compare θ_c resolutions for 2 cases.**

Gas seal

Need to develop gaskets, similar to the EPDM gasket on the bar box:



- **Need to flow N_2 gas around the FBLOCK's surfaces to prevent the a moisture condensation and the pollution accumulation on the surfaces.**

Schedule

- **Raw quartz finished:** **Nov. 17, 2010**
- **FBLOCK optics finished:** **Feb. 15, 2011**
- **Mechanical & optical tests with FBLOCK:** **Feb.-March 2011**
- **Glue tests:** **Jan.-Feb., 2011**
- **Mechanical support:** **Feb.-March, 2011**
- **Decision on the detector coupling to quartz:** **March 2011**
- **Detectors installation:** **May, 2011**
- **Final detector motherboard:** **March 2011**
- **Electronics installation:** **May-June, 2011**
- **Laser calibration:** **May 2011**
- **Common DAQ system:** **March-May, 2011**
- **Start running in CRT:** **Summer 2011**