FDIRC prototype status

J. Va' vra

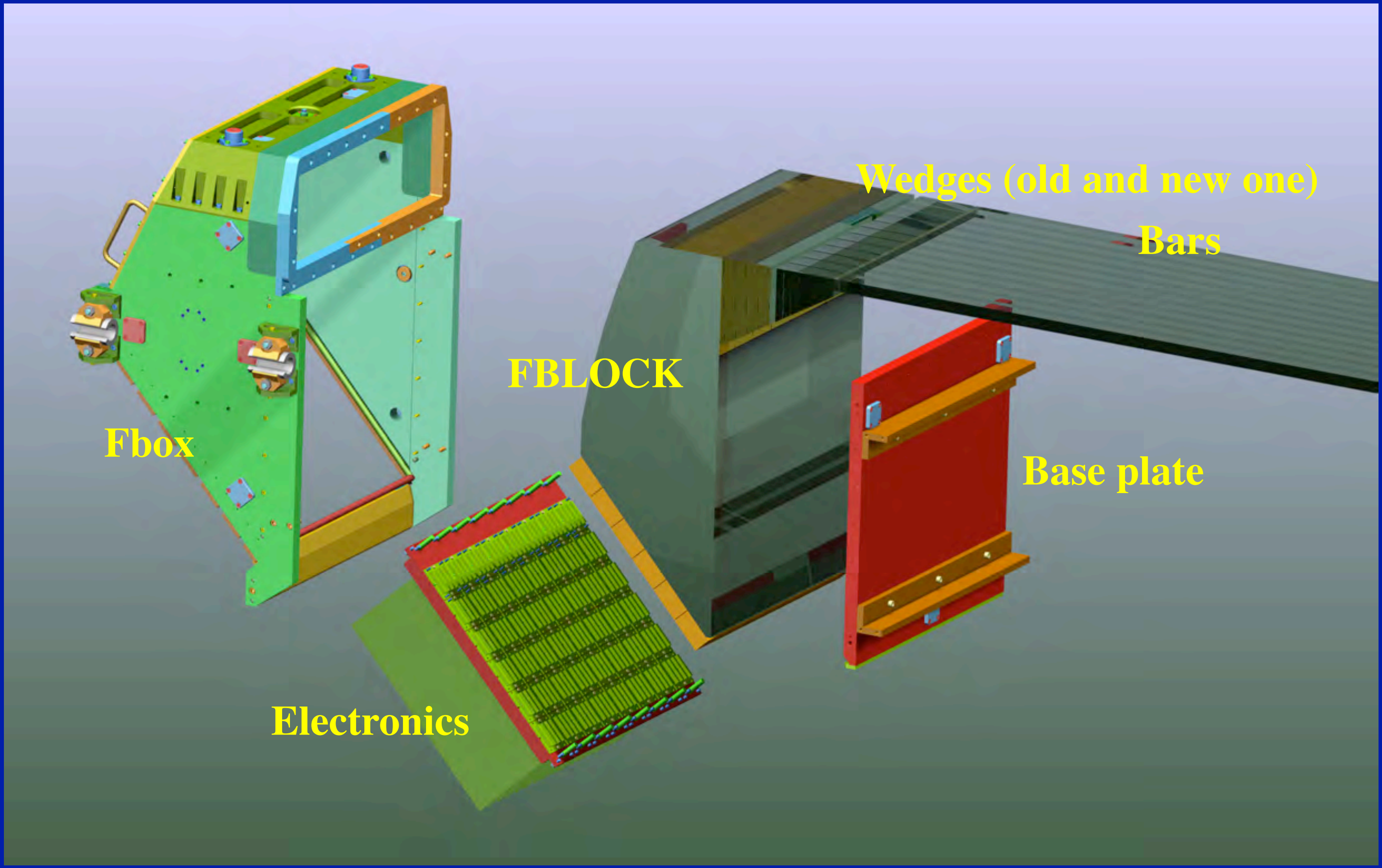
SuperB collaboration meeting in Elba, May 2012

Content

- FDIRC prototype completion.
- Plan for the next month.
- Plan for the next 6-12 months.
- What next ?

How it goes together ?

M. Benettoni

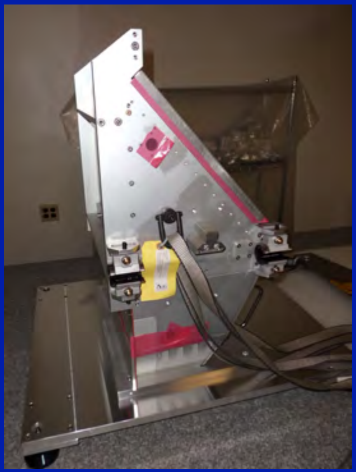
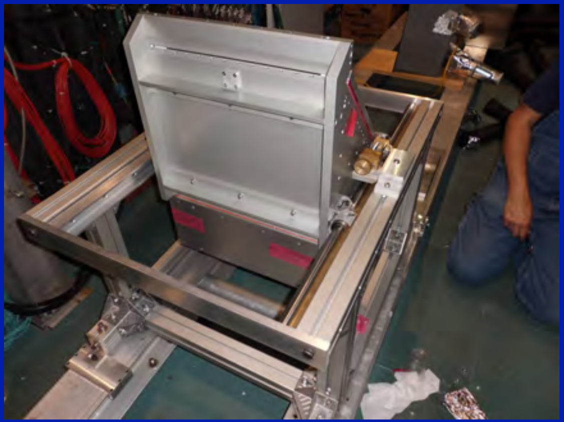


Photon camera assembly and move to CRT

M. McCulloch and J. Va'vra





- **Had to learn how to handle a heavy and fragille FBLOCK.**
- **But generally smooth operation.**

Bar box move to CRT

Help of riggers

- **Generally a smooth operation.**

Alignment of FBLOCK before gluing

M. McCulloch and J. Va'vra

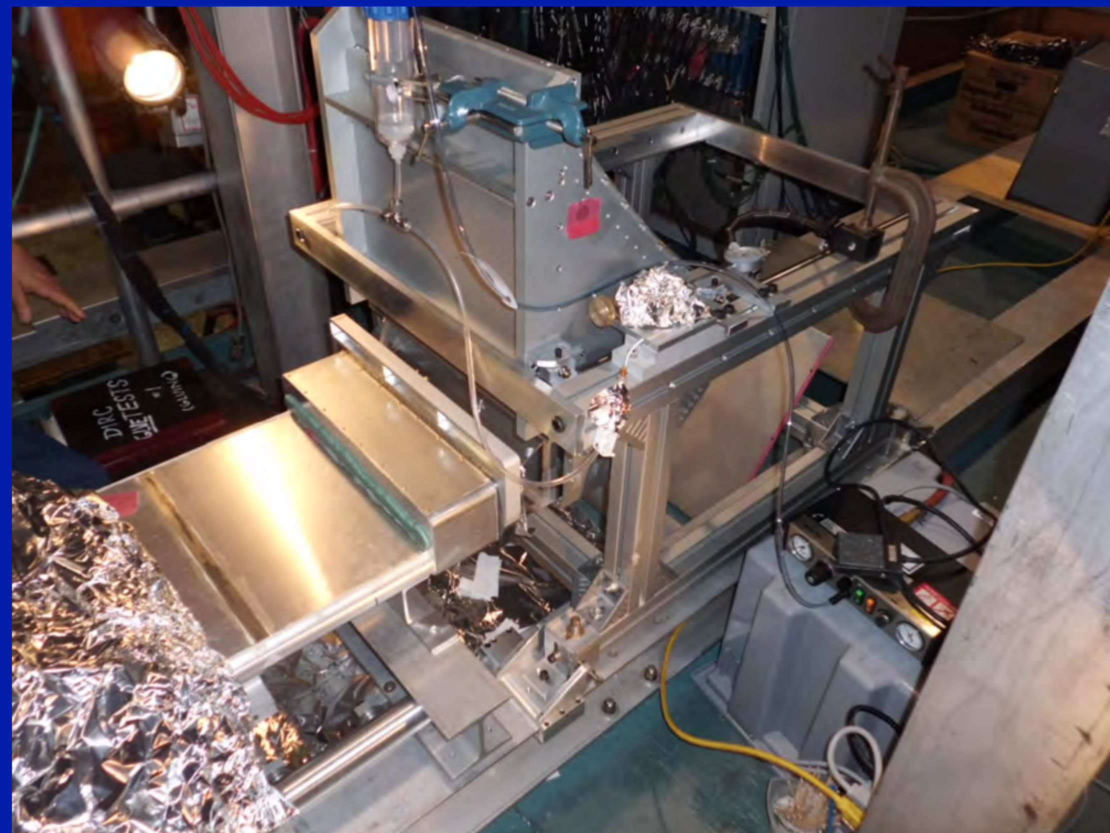
RTV gap.

- **All done with precision block, shims, calipers and levels.**
- **Tricky at times.**
- **See alignment results of this step in:**

http://www.slac.stanford.edu/~jjv/activity/fdirc/Critical_dimensions_v7.pdf

Gluing of FBLOCK and bar box

M. McCulloch, J. Va'vra and M. Benettoni



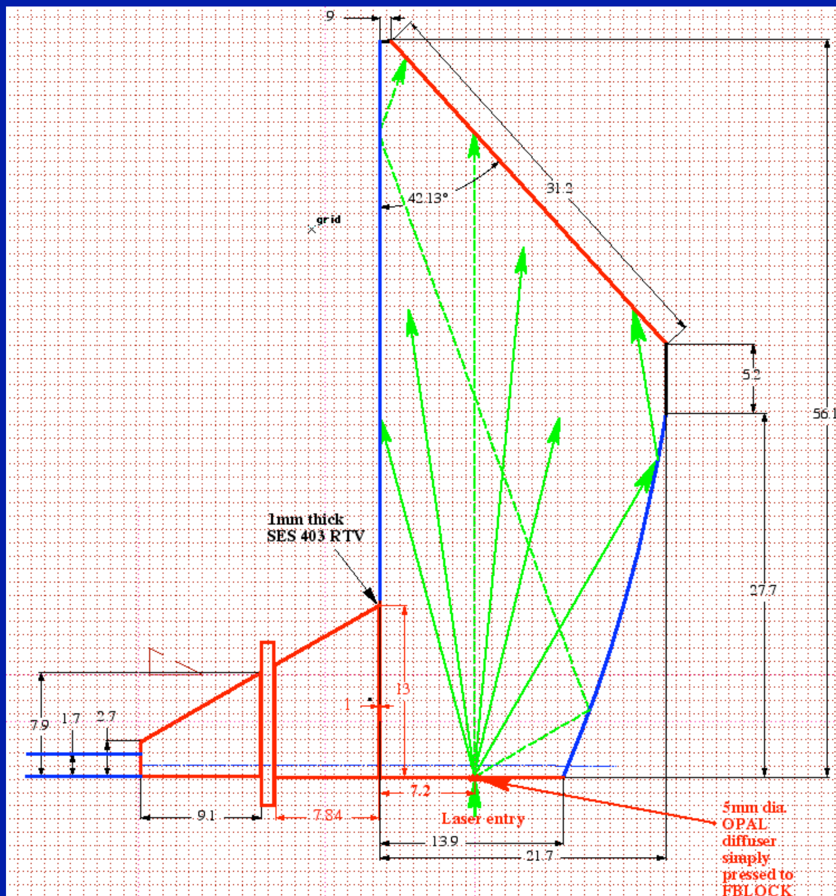
- **Set up a gap between FBLOCK and wedge to be 1mm.**
- **The setup has to be stable (1 mil change in gap => 2-3 mm change in glue height !!!**

A final alignment measurement after gluing

- **The alignment check was done with the FERO digital arm.**
- **Examples:**
  - Angle between the front FBLOCK surface and the New Wedge bottom surface: **90.081°**
  - Angle between the FBLOCK bottom surfacce and the New Wedge bottom surface: **180.054°**
  - Gap between FBLOCK and the New Wedge: **1.17 mm**
- **See details in:**

http://www.slac.stanford.edu/~jjv/activity/fdirc/Critical_dimensions_v7.pdf

Laser entry



- One can see OPAL diffuser pressing on FBLOCK from its bottom surface.
- See details in:

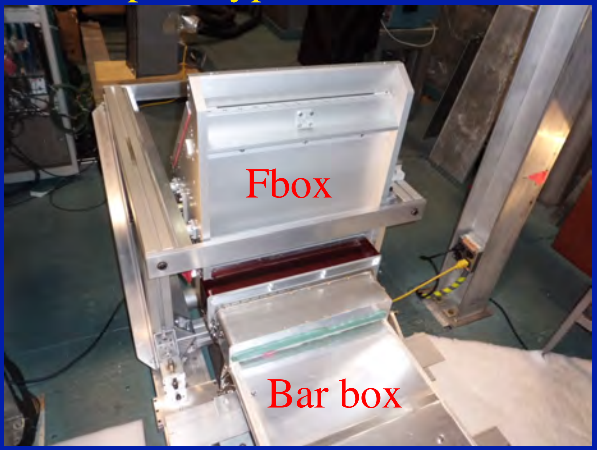
  http://www.slac.stanford.edu/~jjv/activity/fdirc/Critical_dimensions_v7.pdf

FDIRC test in CRT

SLAC Cosmic Ray Telescope (CRT):

- ~1.5 mrads track resolution
- > 1.6 GeV muon energy
- 3D tracking
- 46" thick iron absorber, ~ 55" x 90" size

FDIRC prototype located in CRT:



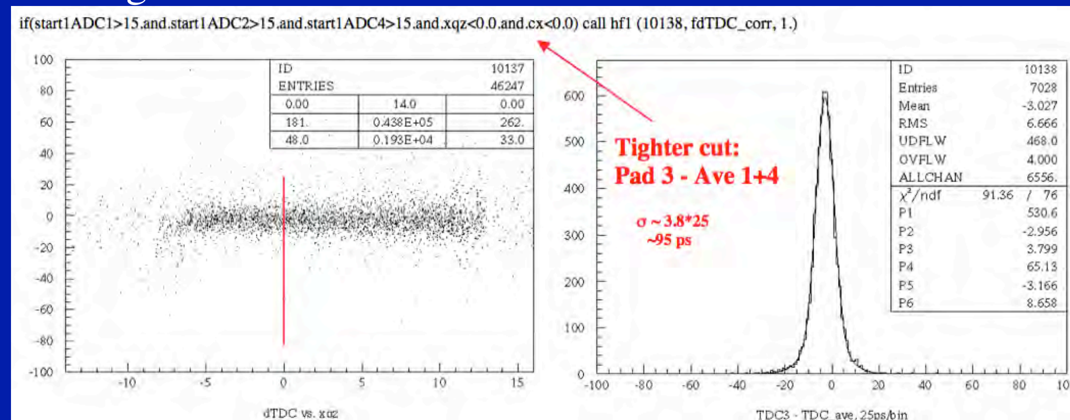
Detector plane

- **Fabrication of the FDIRC prototype optics and mechanics successfully finished !!!**

Start counter and precise position definition

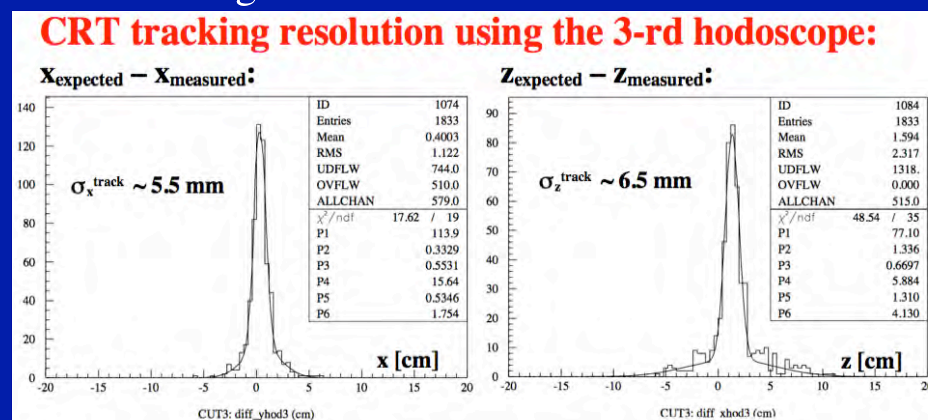
Start counter:

Timing resolution:



2mm fibers in x & y:

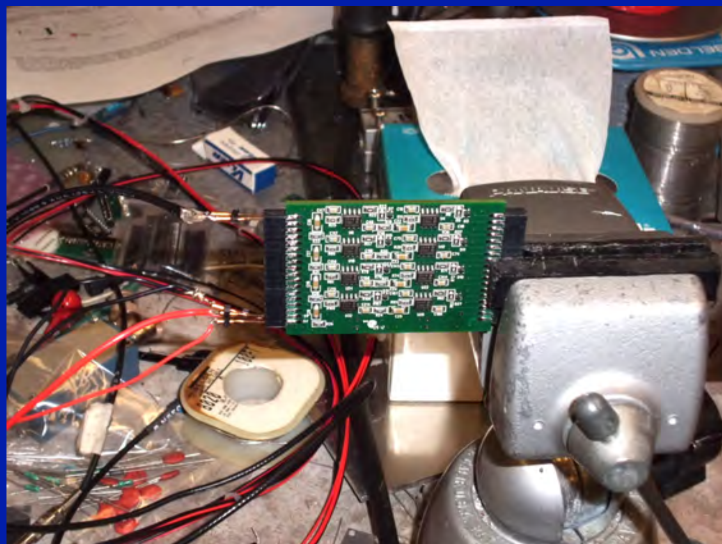
CRT tracking resolution:



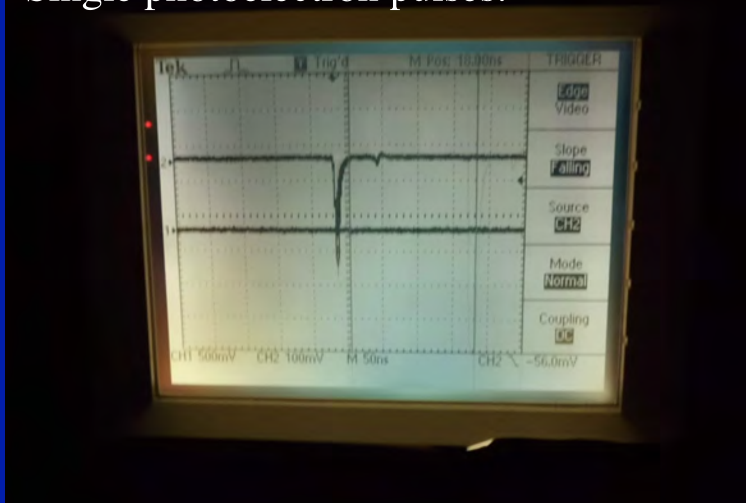
- **Start: MCP-PMT with 4 pads coupled to 2 quartz bars. Pad #3 is the time reference of the CRT system.**
- **The 3-rd hodoscope provides a precise definition of a track.**

SLAC amplifier – the 4-th version

J. Va'vra (tests)



Single photoelectron pulses:

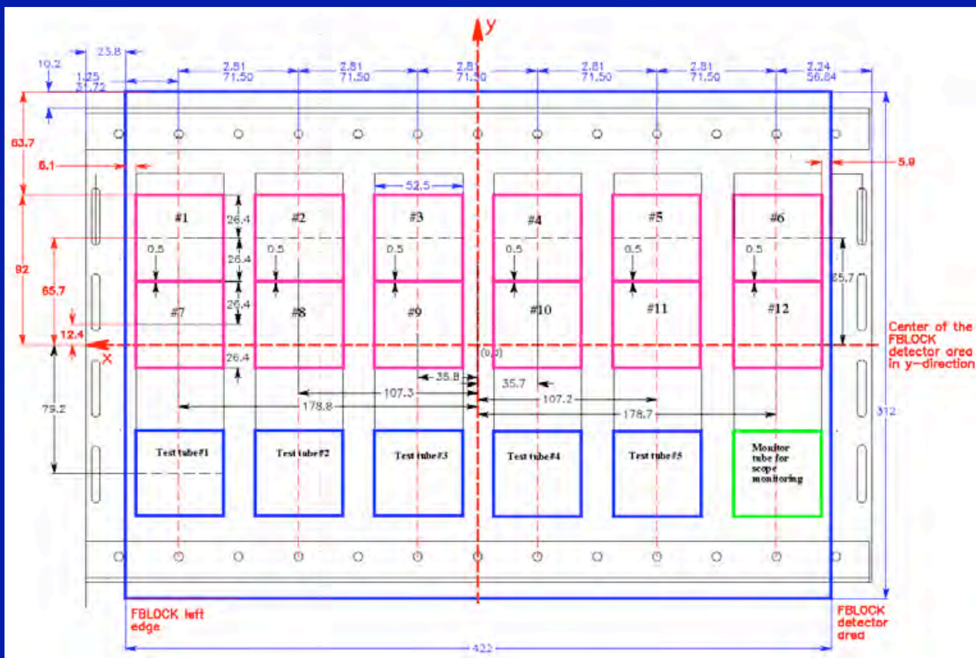


- **Modify the existing PC board design with a SLAC designer to be compatible with the IRS2 waveform digitizing electronics.**
- **Order 64 boards and arrange for loading.**
- **Test it in the scanning setup with single photoelectrons.**
- **Ship one board to Hawaii for tests with the IRS2 electronics.**

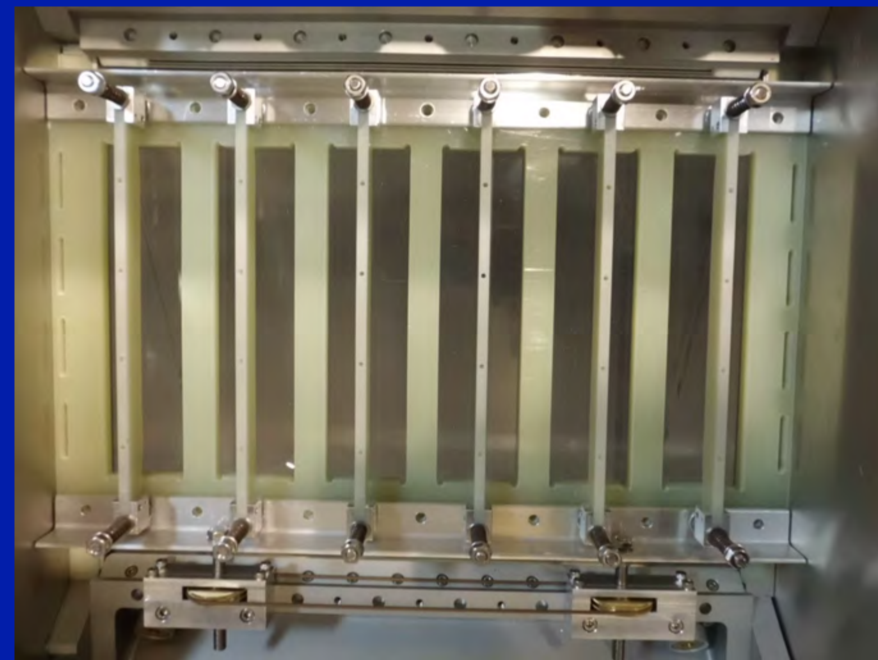
G-10 Detector holder for the CRT test

J. Va'vra and M. McCulloch

Detector positions defined:



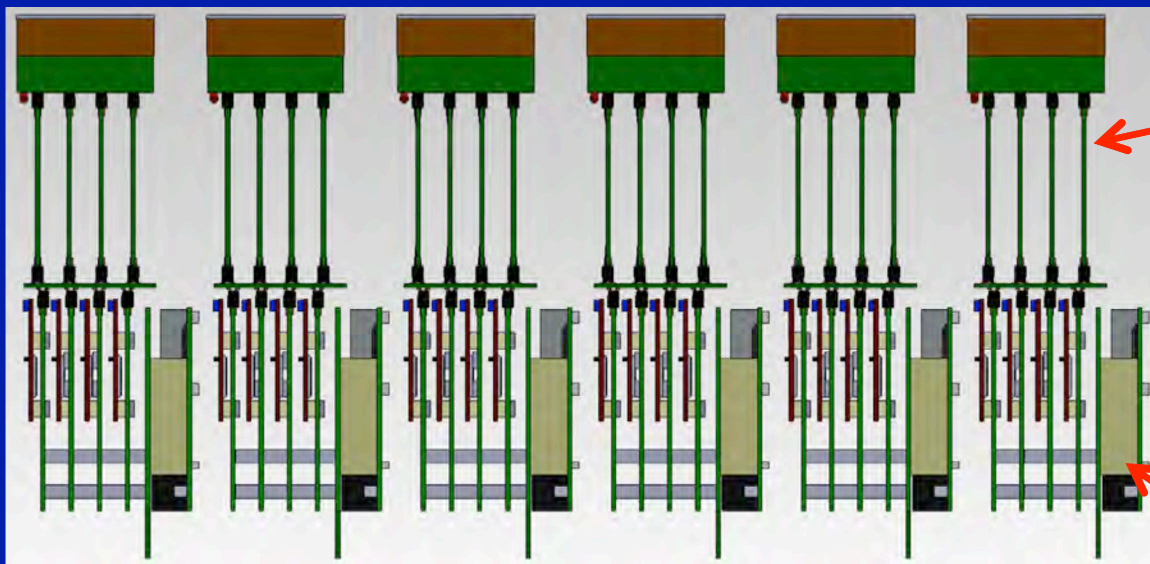
G-10 holder to keep detectors & electronics in place:



- **The G-10 holder will accommodate 12 detectors with IRS2 electronics.**
- **Tubes placed in a region with most hits (according to Dough's MC simulation).**
- **One detector for analog monitoring (to setup relative timing for laser & CRT events).**
- **5 spare detector setups for future LAL electronics or other detector schemes. One example is four R11256 detectors, which would replace one H-8500 tube.**

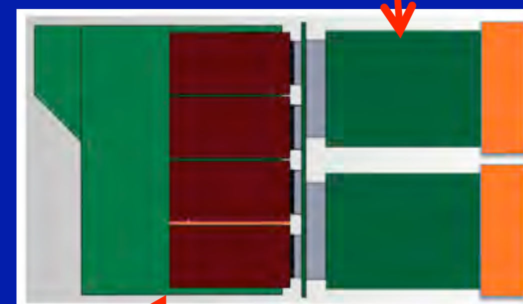
SLAC amplifier + Hawaii IRS2 digitizer

Top view:



SLAC amplifier

Side view:



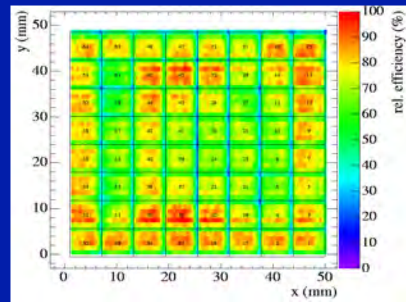
H-8500

IRS2 electronics

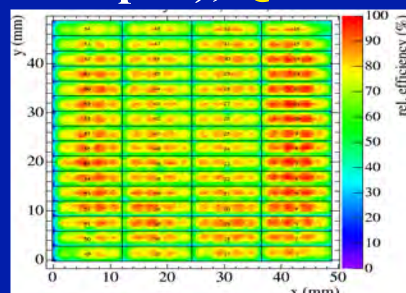
- **Each IRS2 package handles 2 SLAC amplifiers & 2 H-8500 tubes.**
- **Benefit of this electronics: will have time & pulse height on every pixel.**
- **It is crucial to have timing work to a level of ~200 ps, otherwise it is wasted effort.**

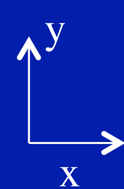
FDIRC photon detectors

1) **H-8500** (arrange to 6 x 12mm pad), **QE ~ 24%** (selected) – **nominal design in TDR**



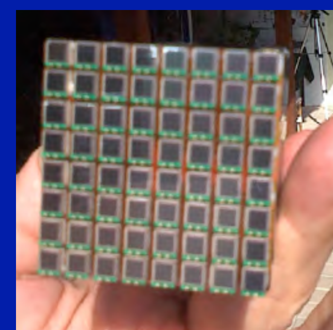
2) **H-9500** (arrange to 3 x 12 mm pad), **QE ~20-24%**.





3) **R11256-00-M64** (arrange to 3 x 24mm pad), **Super Bialkali QE ~ 36%.**

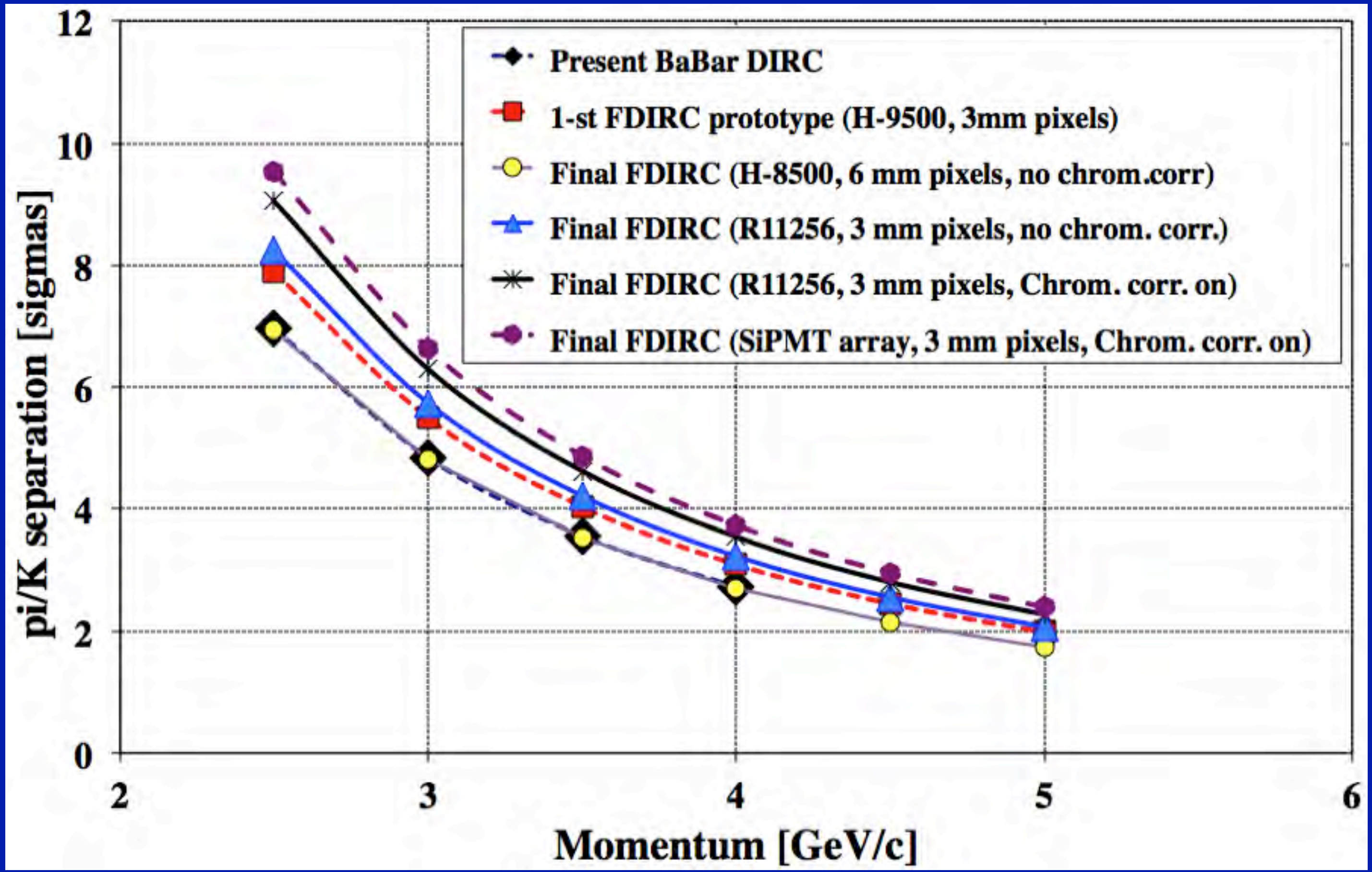
4) **Hamamatsu SiPMT array C11206-0808FA** (arrange to 3 x 12 mm pads), **PDE ~ 52%.** This option is not considered because of a large noise at room temperature, which could get worse with a large neutron dose.



FDIRC detector choice and PID performance

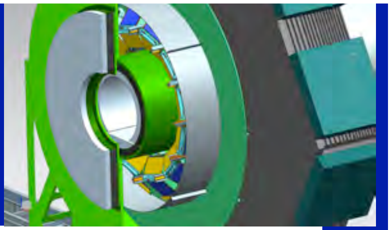
J. Va'vra

FDIRC π/K PID performance:



- A choice of R11256 with a super-bialkali QE ~ 36% and 3mm pixel size in the y-direction would lead to a significant improvement.
- SiPMT-array solution would be even better, but one has to worry about the noise.

FDIRC Expected rates



J. Va'vra (based on simulation results of Alejandro Perez)

1) Contribution from active volume (with & without shielding):

	Lumi	H-8500 MaPMT rate	One single Double-pixel rate	Total dose (after 50 ab^{-1}) (~ 10 years)	Expected anode current at a gain of ~2×10^6	Maximum allowed current for 10 years of operation
without	10^{36}	~ 3.84 MHz	~ 120 kHz	~ 1.3 $C/cm^2/50\ ab^{-1}$	~ 1.2 µA /PMT	~ 10 µA /PMT
with	10^{36}	~ 1.5 MHz	~ 50 kHz	~ 0.5 $C/cm^2/50\ ab^{-1}$	~ 0.5 µA /PMT	~ 10 µA /PMT

2) Contribution from FDIRC photon camera (with & without shielding):

	Lumi	H-8500 MaPMT rate	One single Double-pixel rate	Total dose (after 50 ab^{-1}) (~ 10 years)	Expected anode current at a gain of ~2×10^6	Maximum allowed current for 10 years of operation
without	10^{36}	~ 17.6 MHz	~ 550 kHz	~ 5.9 $C/cm^2/50\ ab^{-1}$	~ 5.6 µA /PMT	~ 10 µA /PMT
with	10^{36}	~ 1.92 kHz	~ 60 kHz	~ 0.6 $C/cm^2/50\ ab^{-1}$	~ 0.6 µA /PMT	~ 10 µA /PMT

- A safety factor of less than ~2 only !!!! => need to shield photon camera:
- New shielding: 10 cm Polyethylene + 10 cm lead + 2 x 2.5 cm steel + thicker tungsten.
- With the shielding we have a safety factor of ~10x, without less than a factor of 2x !!!

Goals of the study

- **Topic:**
- Study bars #6 and #1 in position #3 initially.
- Verify that the new FDIRC optics works by measuring the Cherenkov angle resolution and its tail, comparing it with the 1-st FDIRC prototype results.
- Study an effect of ambiguities on the Cherenkov angle tails.
- Study the chromatic error correction by timing using 3D tracks.
- Study of several new detector options.
- Study effect of background rates on FDIRC Cherenkov angle resolution and its tails by adding a random light noise while taking normal CRT data.

Summary and plans

- **FDIRC prototype is in CRT and ready for the electronics.**
- **Time schedule:**
  - Detector placement, HV connections: June 7-10, 2012.
  - Monitor tube setup with a laser: June 10-15, 2012.
  - Hawaii electronics: June 20-22, 2012.
  - Initial tests of DAQ and data format: June 25-30, 2012.
  - The first dst file for software development: July 15-30, 2012.
  - The 1st run on bar #6: August – Sept., 2012.
  - The 2nd run on bar #1: Sept. – October, 2012.
  - The 3rd run on bar #12: October – Nov., 2012.
  - The 4th run on bar #6 (add assynchronours bckg.): Nov. – Feb., 2012.
  - French electronics: March 2013 ?