Status of FDIRC prototype in CRT test at SLAC

(running now with a new BLAB2 chip)

J. Va'vra, SLAC

Brief and very preliminary !!

FDIRC tests in CRT

- People involved at present:

  - Gary Varner, Larry Ruckman, Kurtis Nishimura from Hawaii University
  - Jerry Va'vra and David Aston from SLAC

- Aim:

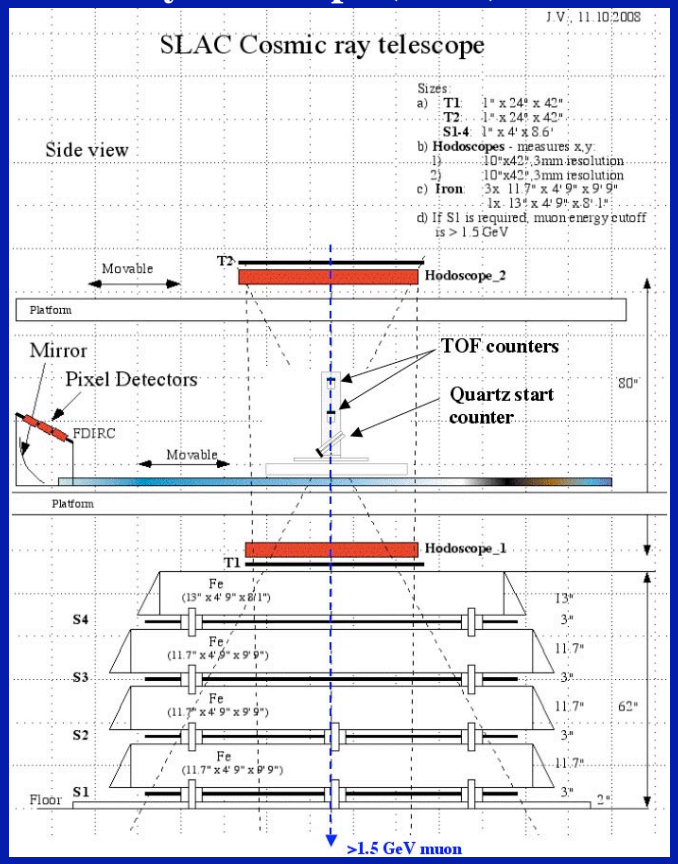
  - **Verify that the new ASIC-based BLAB2 waveform digitizing electronics can deliver a similar performance as the old SLAC CFD/TDC- based electronics, which was successfully tested in the ESA beam test.**
  - **Prepare CRT for tests with a final FDIRC SOB made of a solid fused silica.**

- Status:

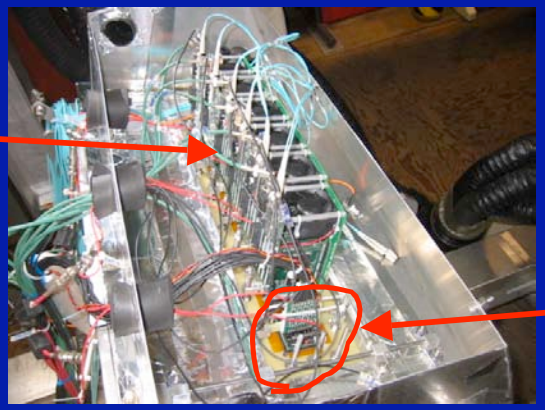
  - Some things seem to work well: DAQ, CRT tracking, trigger, start counter resolution.
  - We are working on (a) understanding of the timing resolution with the BALB2 chip, and (b) understanding of the CRT software to fully reconstruct Cherenkov images in 3D
  - I am presenting some plots from my data analysis program from a point of view of a user of the chip, not a designer of it. Still very preliminary !! Presenting the progress report only.

FDIRC tests in CRT

Cosmic Ray Telescope (CRT):

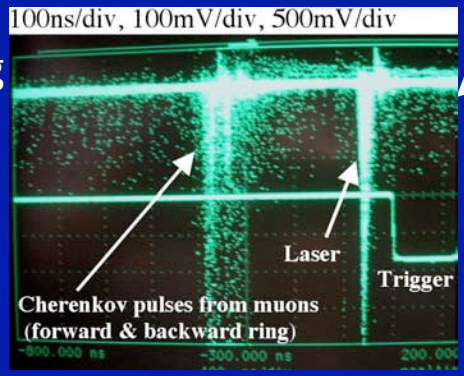


BLAB2 electronics



Old SLAC amplifier for monitoring purposes

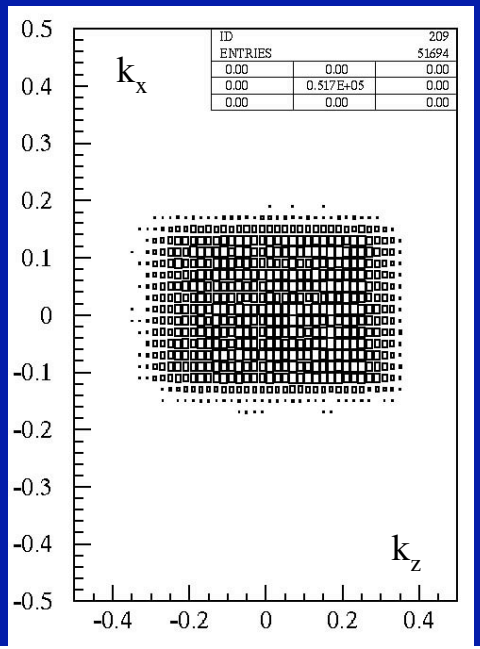
Analog Monitoring



- **T1*T2*Qtz_counter rate ~ 12k/24 hours, T1*T2*S1*Qtz_counter rate ~ 6k/24 hours**
- **Slot 1 has an old SLAC amplifier; slots 2-7 have new BLAB2 chip electronics.**

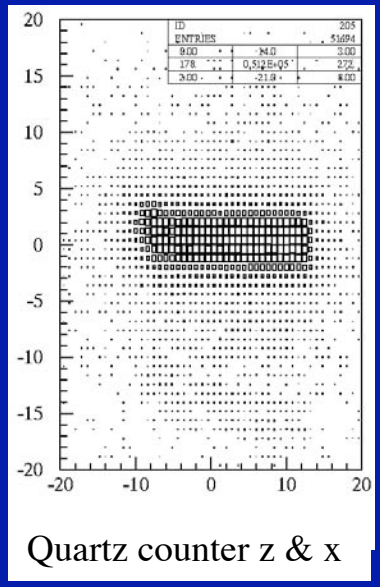
CRT tracking

Angular range

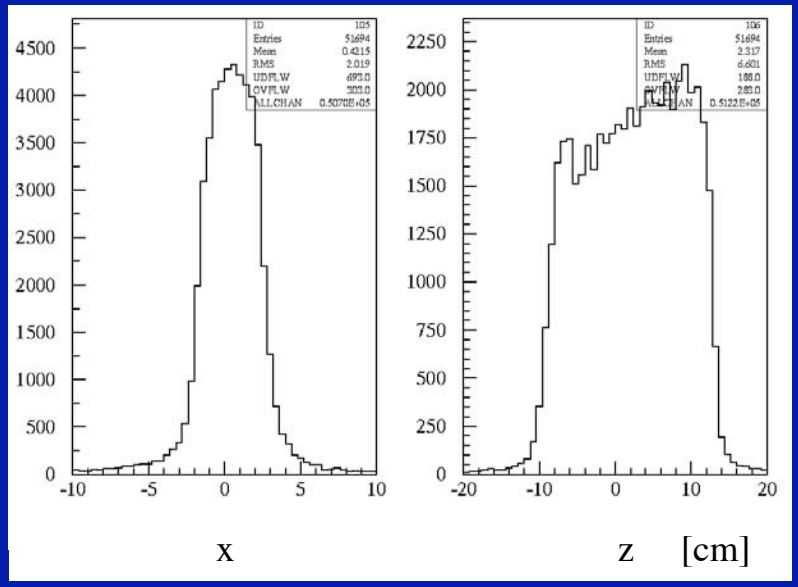


Track direction cosines

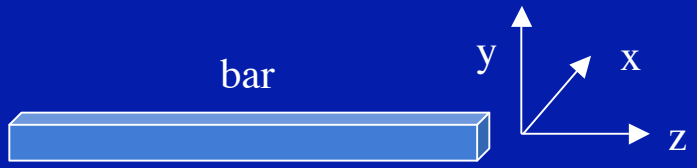
Tracking resolution



Quartz counter z & x



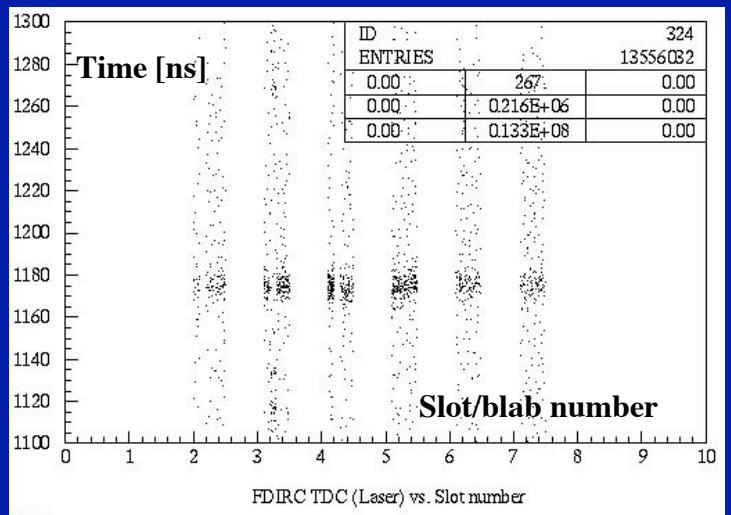
x z [cm]



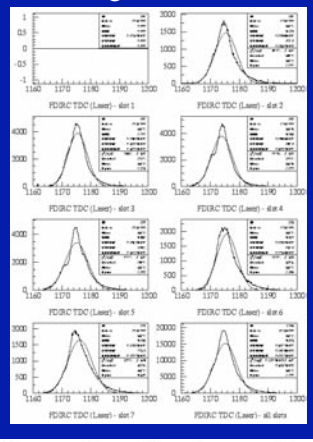
- **Minimum energy cutoff < 1.5 GeV**
- **Angular resolution ~ 1.5 mrads**
- **Positional resolution < 1 cm**
- **It seems to work, but a final test will be to get a good Cherenkov angle resolution track directions. It will require some work to make out of it a trully scientific instrument.**

Laser & Cherenkov ring in time domain

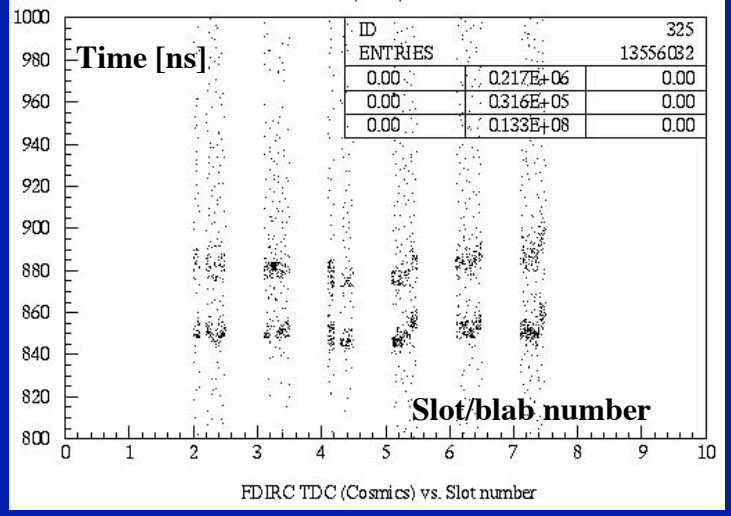
Laser:

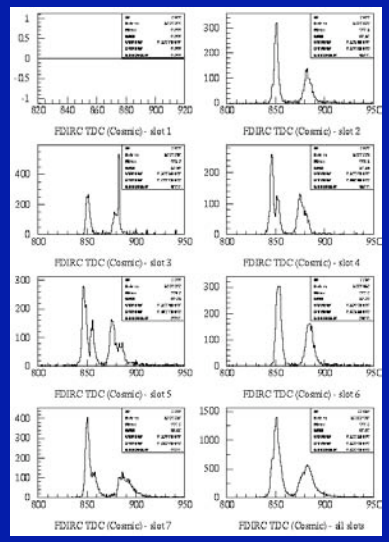


Projections:



Cosmics:



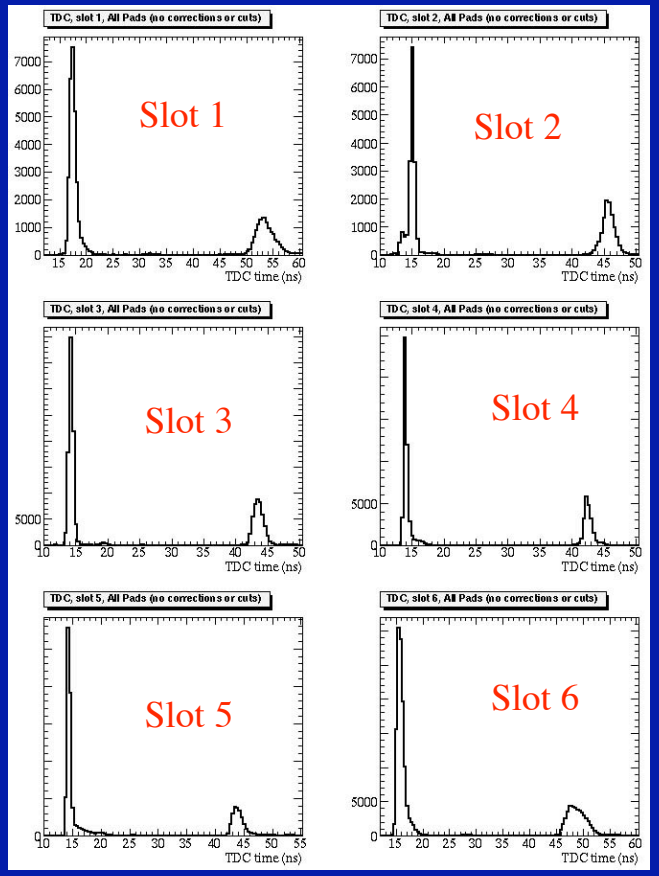


Time [ns]

- **The electronics is clearly working. However, we still have a lot of puzzles.**

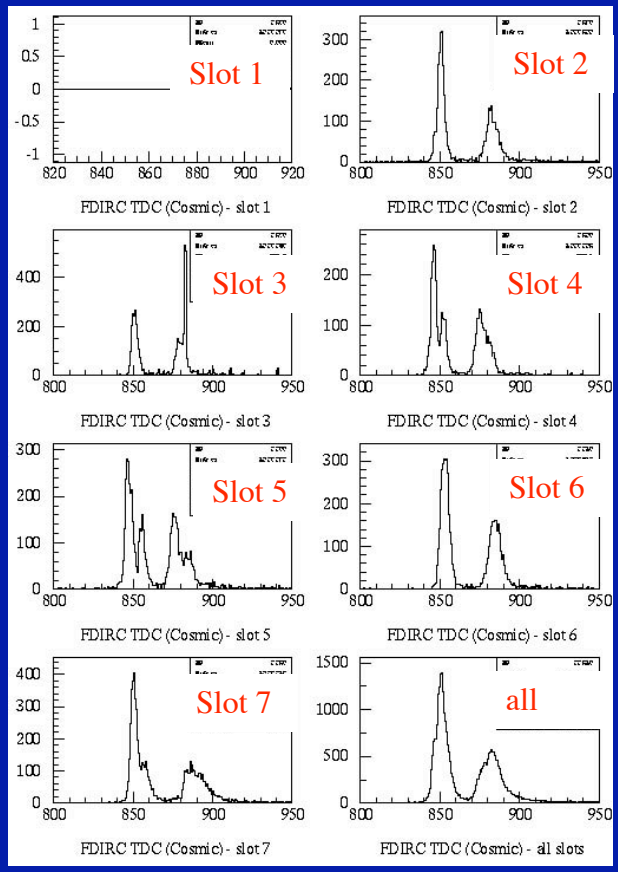
Cherenkov ring: beam test vs. cosmics

Beam test (SLAC amp. & CFD & TDC):



Time [ns]

Cosmics - accept all tracks (BLAB2 chip):



Time [ns]

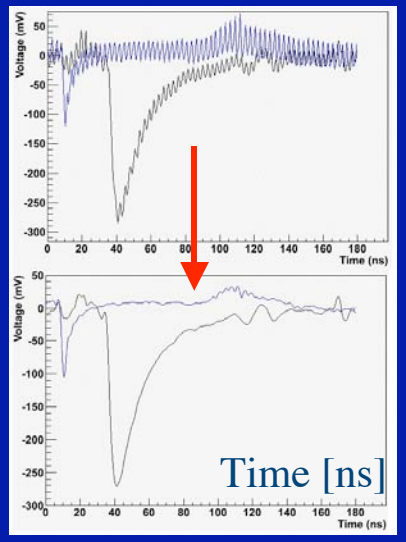
Conditions:

- track hits a bar
- track reaches bottom stack
- accepts all kz, kx
- ave. dip angle = 90°

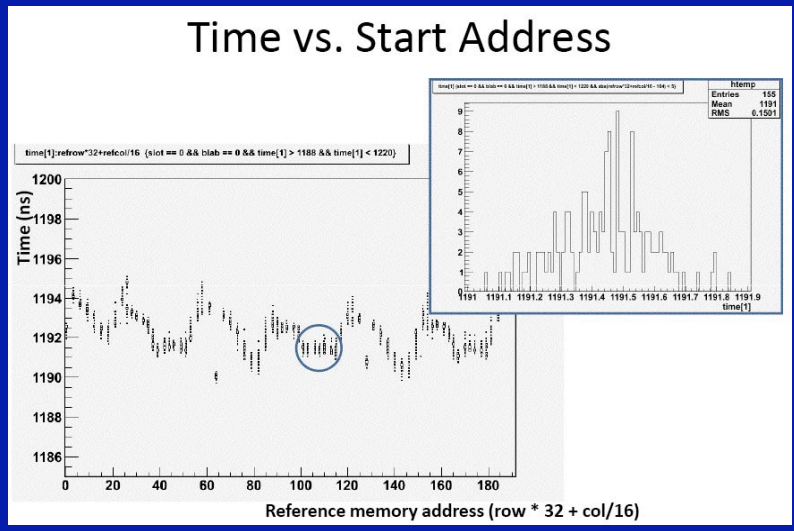
- **The timing distributions are broader than in the beam test due to: (a) tracking (no corrections yet for k_x & k_z), plus (b) we still have some BLAB chip puzzles.**

Some BLAB2 puzzles

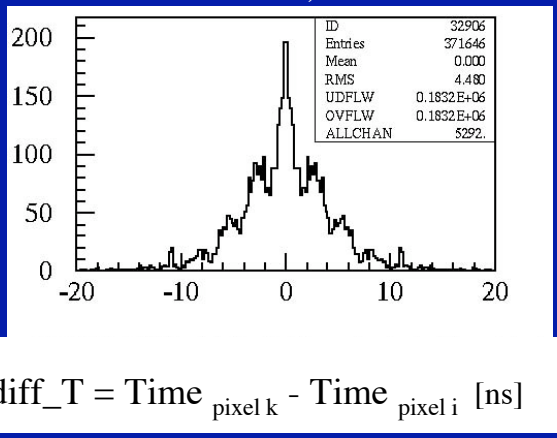
300 MHz oscillation is taken out by a digital filter



The other slower oscillation is not yet understood. There seems to be change of the amplifier gain as a function of clock and repeats every 512 columns, and it depends on even & odd grouping. We hope to correct it as well.

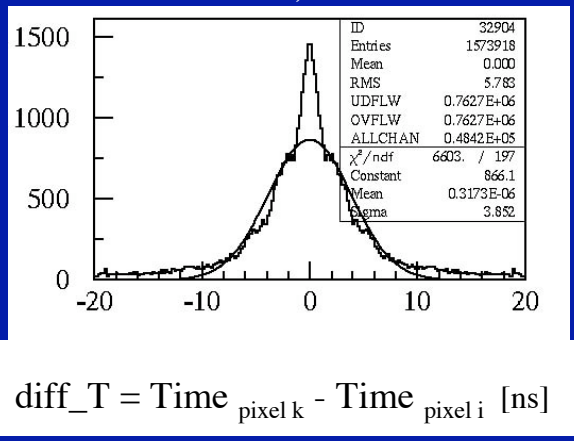


Cosmics: slot 4, BLAB 1



diff_T = Time $_{\text{pixel k}}$ - Time $_{\text{pixel i}}$ [ns]

Laser: slot 4, BLAB 1

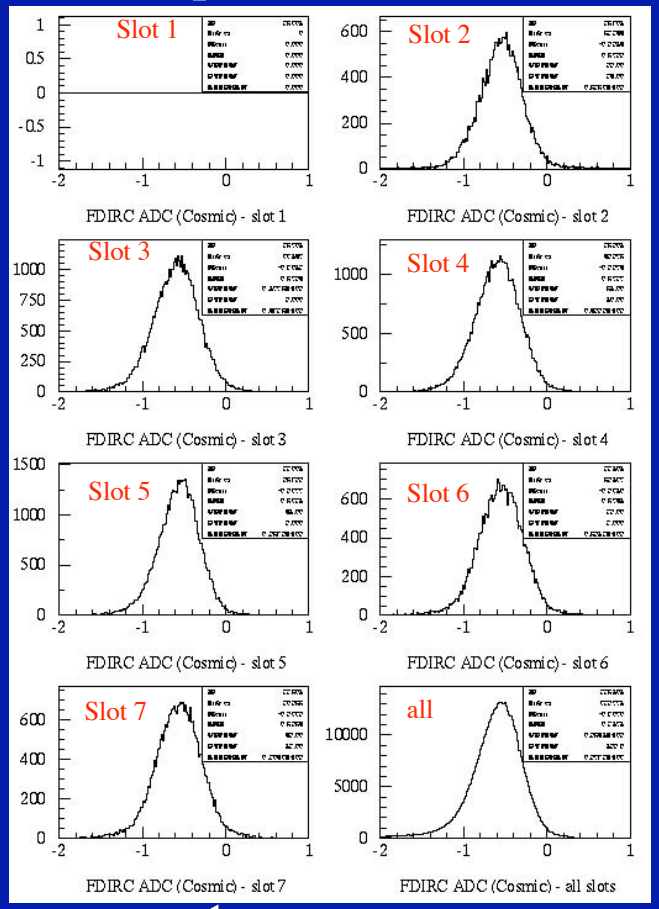


diff_T = Time $_{\text{pixel k}}$ - Time $_{\text{pixel i}}$ [ns]

σ_{laser} ~ 2-3 ns

BLAB2 chip measures also pulse heights

Cosmics - accept all tracks (BLAB2 chip):



- **This is an advantage as one can interpolate between pads..**
- **Perhaps the amplifier is saturating a bit. Will be fixed in BLAB3.**

A crucial point is to get the MC program going again

- **History of people involved in this effort:**
  - J. Va'vra created design using a manual ray tracing, and gave it to Ivan Bedajanek.
  - **Ivan Bedajanek - created the MC program and verified that the above design was OK.**
  - Joe Schwiening - added a few things to it after Ivan left.
  - Alexei Botov - made it compatible with a latest version of GEANT 4
  - Dave Aston will work on it, and will also take care of the continuity in future
  - **Larry Ruckman, a student from Hawaii University, just determined the pixel-based constants using Ivan's method. This includes:**
    a) New detector plane geometry, new detector sizes, new pixel sizes, new QE, etc.
    b) New pixel assignments of k_x, k_y, k_z, top for $\Theta_{dip} = 90^o$ and for average λ.

- **Immediate plans for the pixel-based analysis:**
  - Correct these MC constants, developed for $\Theta_{dip} = 90^o$, for any dip angle in CRT using tracking-based constants of k_x, k_y and k_z.

In parallel

a) Continute to work on the BLAB2 chip timing resolution issues. Want to check if we can correct some of the effects.

b) Right now, I am looking at a comparison of the BLAB2 chip electronics with our old SLAC Amp/CFD/TDC analog electronics for a similar running conditions.

c) Determine what has to be redesign for the BLAB3 chip.