TOFp Status

W.J. Llope, N. Adams, P. Sappenfield, E. Rareshide, S. Becker, G. Eppley, G. Mutchler, and E. Platner
for the STAR-TOFp group

11/18/98 TOFp Proposal released
12/01/98 Review committee formed and charged
12/15/98 VideoCon Review...
01/06/99 ...more discussions with review committee

04/13/99 Committee report released and
SysTest-I Proposal requested
04/22/99 SysTest-I Proposal released
05/21/99 SysTest-I approved by spokesman

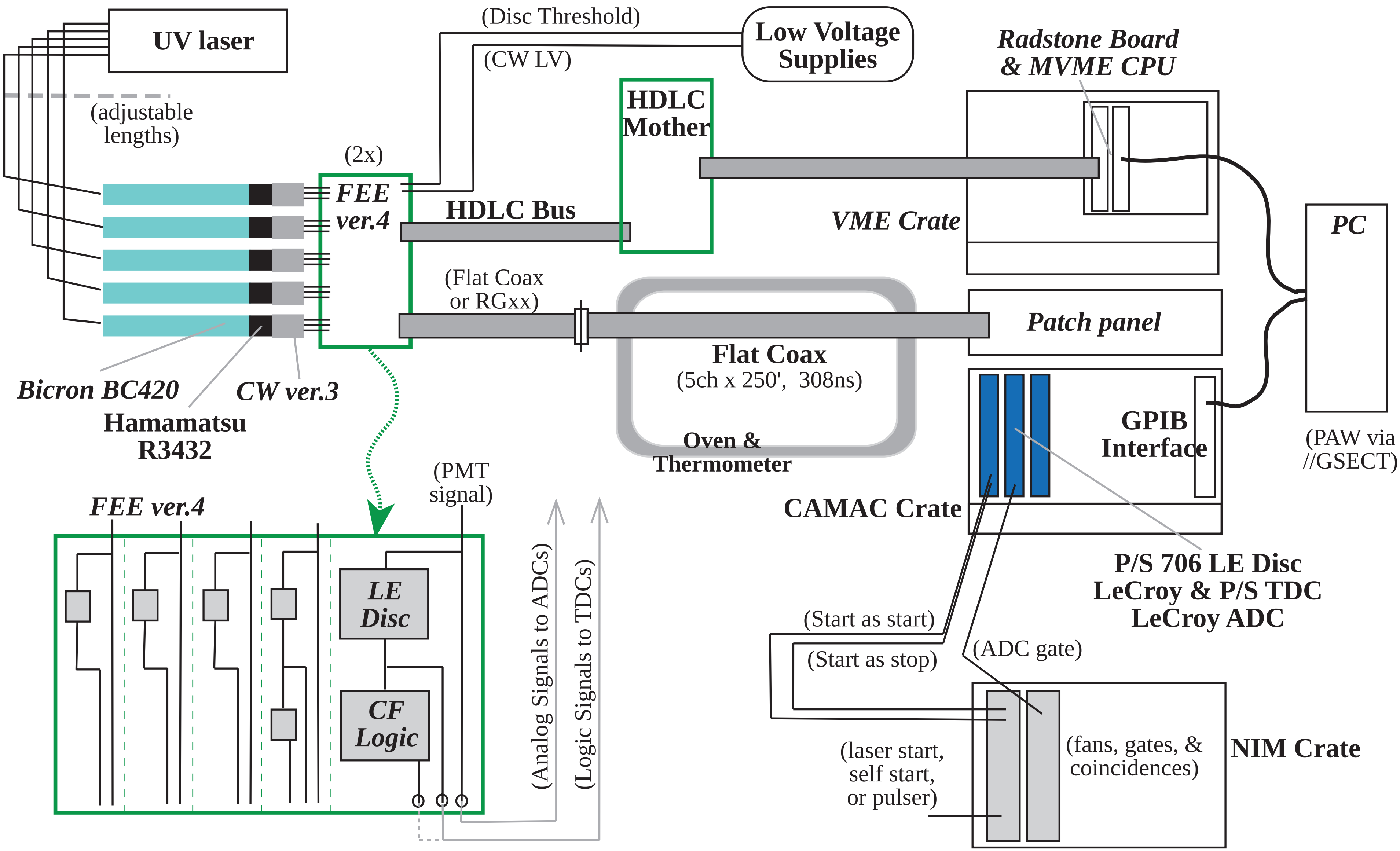
06/08/99 20 k$ located to begin SysTest-I
(special thanks to Tim Hallman)

→ roughly five month pause....
but now very much underway on Systest-I...
Appropriateness of **Flat-Coax cable**
Performance of **CW bases**
Performance of **custom FEE**
Performance overall inc. **CAMAC readout**
Manpower?
The Start Detector we need...

On track for re-review in Sept 1999

Install during March 2000 Shutdown

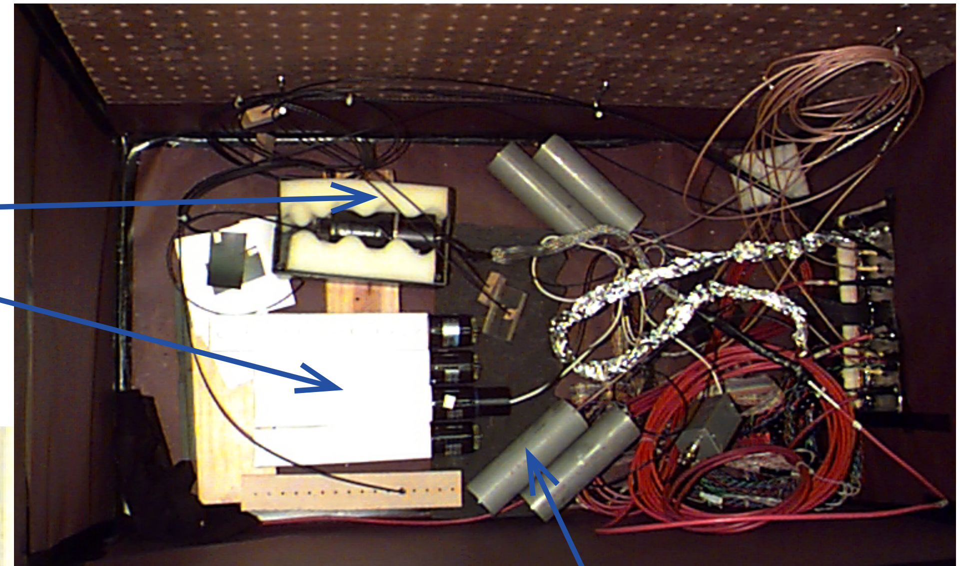
SysTest-I Schematic



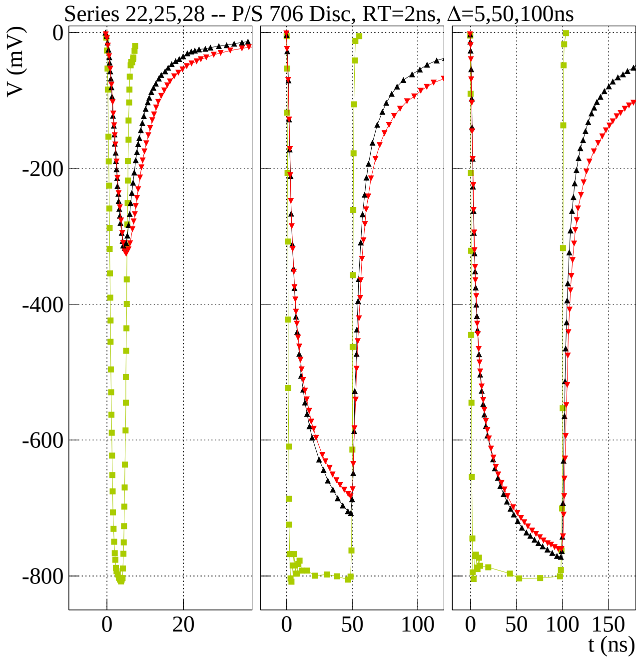
Also on hand:		
	Discriminators	P/S 704 (4), 715 ... LRS 621BL and 623B ... Ortec 934cfd ... P/S 706 (∞)
	ADC/TDC	LRS 2249A (4), 2228A (2), 2228 (3) ... P/S 7186 (2), **P/S 7186H (3)**
	Scopes	**HP Infinium (1.5 GHz, 8 GS/s)** & Tektronix TDS640A (500 MHz, 2 GS/s)

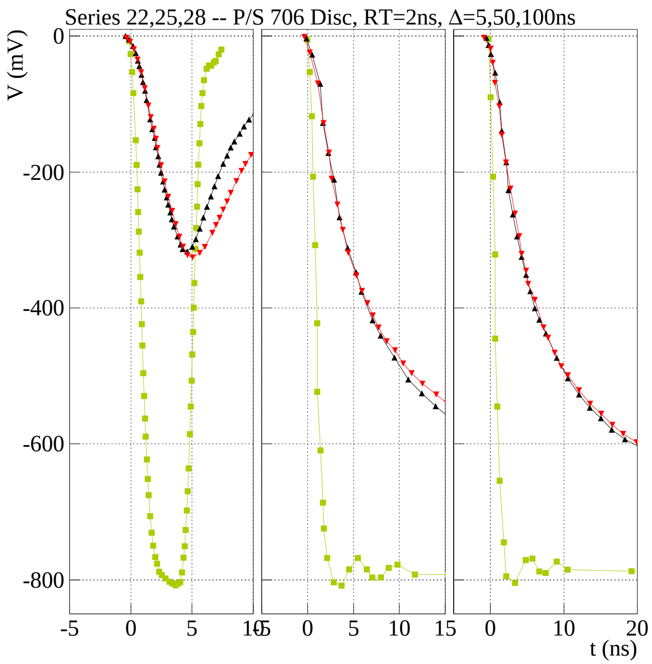
The Present Set-up...

not shown:
Oven, HVSys cells

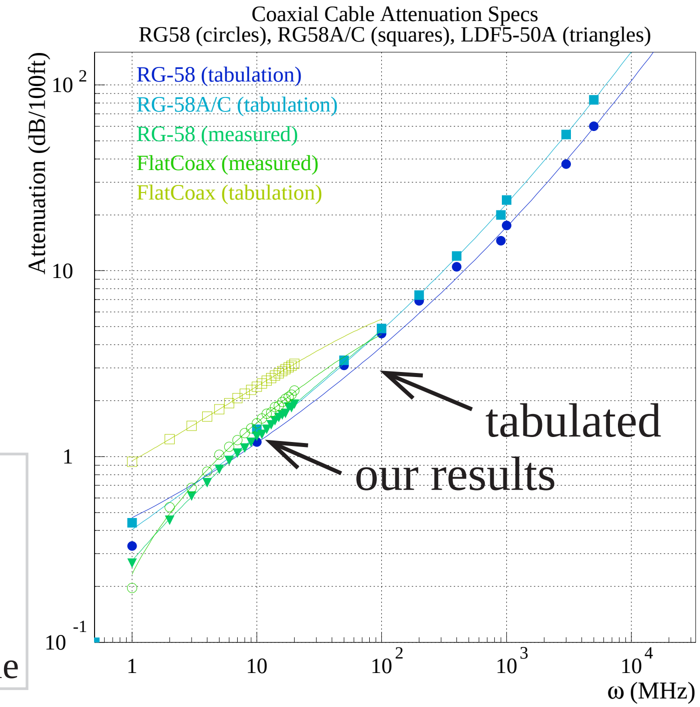


Comparison of Flat-Coax and RG58

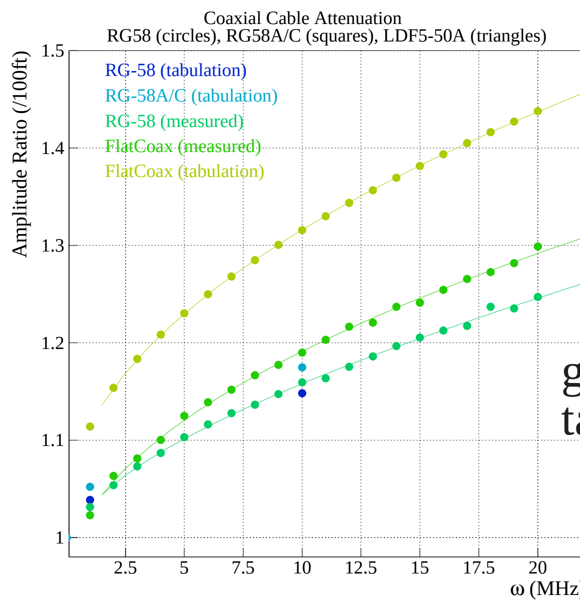




no discernable difference in cable rise times...
both have τ~5ns per 250’



Sine wave attenuation
Range 0.1 - 20 MHz
Measured
250ft RG58-AU
250ft Flat Coax
Plot equiv. 100ft of cable



good agreement with
tabulations...

Signal propagation simulations...

$$\alpha^*(f,Z) = [c_0 + c_1\sqrt{2if} + c_2 f]_Z \qquad (1)$$

$$\mathcal{R}(\alpha^*) = \frac{\mathrm{LOG}(10)}{20}\,\lambda(dB) \qquad (2)$$

where $c_0 = R_{dc}/2Z$ and c_1 and c_2 are fit parameters for a given cable type, (*e.g.* RG-58, Flat coax) and length, Z.

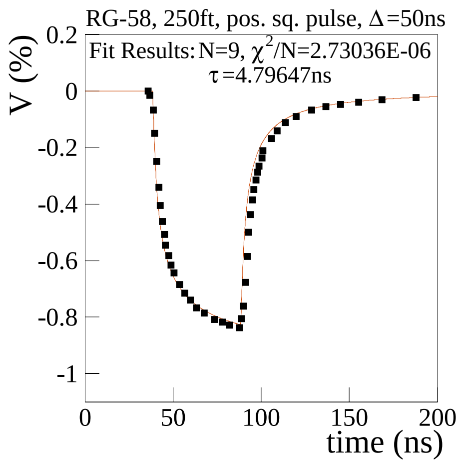
$V_{input}(0,t)$ is an arbitrary voltage waveform

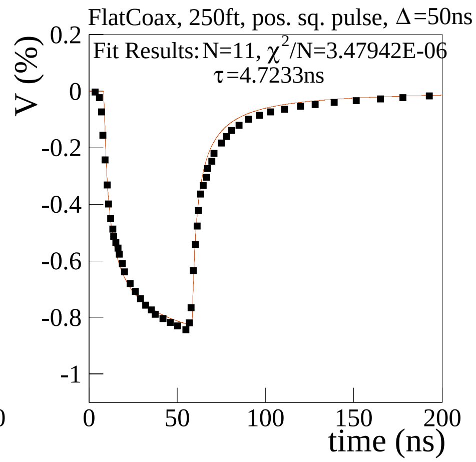
$$F^*_{input}(\omega) = \int_{-\infty}^{\infty} V_{input}(0,t)\; e^{-i\omega t}\; dt \qquad (3)$$

$$F^*_{output}(Z,\omega) = F^*_{input}(\omega)\; e^{-\alpha^* Z} \qquad (4)$$

$$(\omega = 2\pi f)$$

$$V_{output}(Z,t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} F^*_{input}(\omega)\; e^{i\omega t}\; e^{-\alpha^* Z}\; d\omega \qquad (5)$$

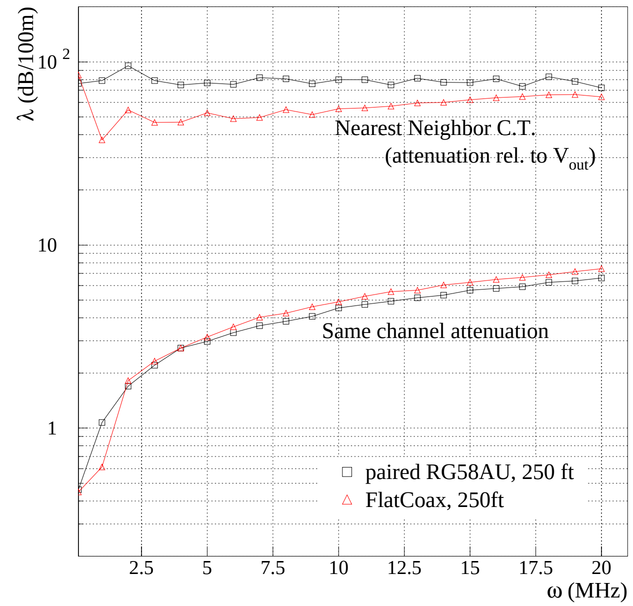




Cross Talk...

250ft long "pair" of RG58...
250ft long flat coax, 4 wide...

Preliminary



• at 20 MHz, FlatCoax cable amplitude cross talk for sine wave input is about 1%

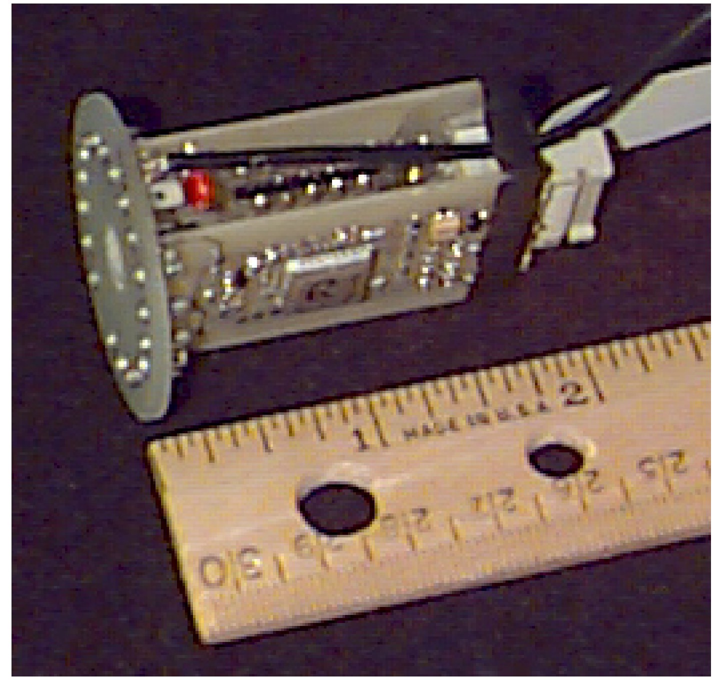
• at same frequency, "RG58 pair" amplitude cross talk a factor of 5-10 less.

but 1 to 20 MHz is only a fraction of the relevant frequencies..

In progress: amplitude C.T. for actual signals...
L-L, L-A, A-L, A-A
timing C.T. using the Infinium...

Voltage

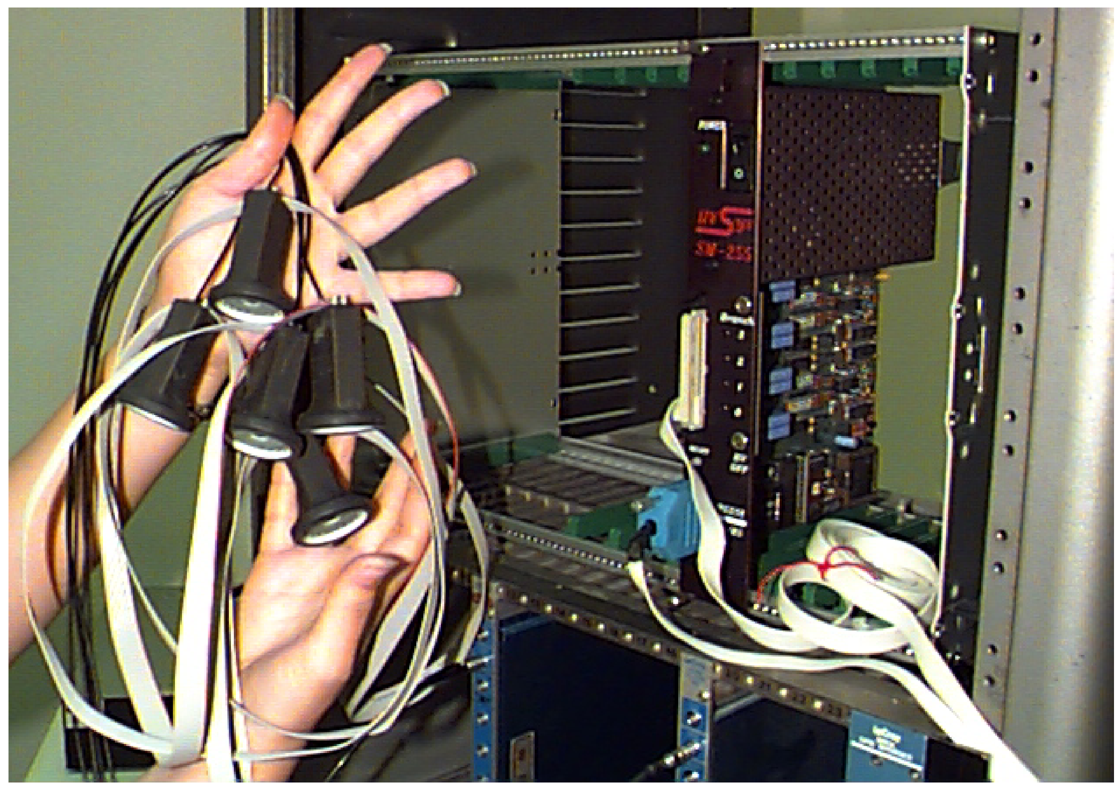
TOFp proposal suggests Nick Adams' (Rice) version III CW bases
simpler than previous versions, and stable
on original schedule, would have been best approach
the present schedule cannot afford this any more...



EMCO (declined to quote for our specs)
Hamamatsu (don't work in magnetic fields)
HVSys Valery Astakhov *et al.*
http://www.tsl.uu.se/~sukhanov/HVSys/Astakhov/welcome.htm

- simple control via System Module — 6U VME, connects only to PC & AC power
- single bus for all cells in a tray — only feedthrough is single 10 ch. ribbon
- cells are small — diameter 1.5", length ~ 2"
- power <0.5 W/cell, or <25 W/tray — practical upper limit is 50 cells/tray
- cost/cell ~80$, and can be produced quickly
- System Module (2 k$) already in hand
- for testing, simple DOS GUI to control cells

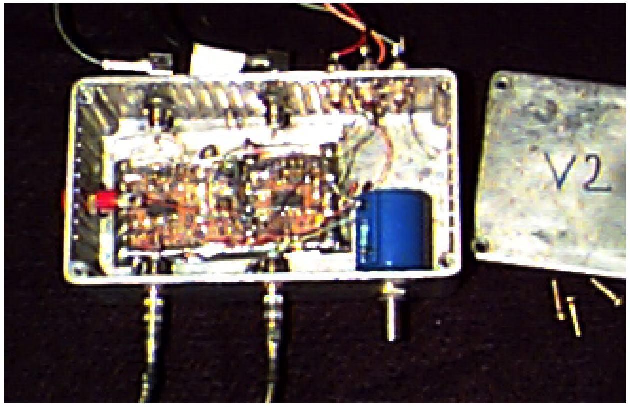
06/04/99: began discussions with Valery...
06/09/99: agrees to make 6 cells on spec...
06/19/99: design specs for TOFp finalized...
07/04/99: TOFp cells complete...
07/05/99: cells carried to Dallas by a friend...
07/08/99: cells arrive at Rice...

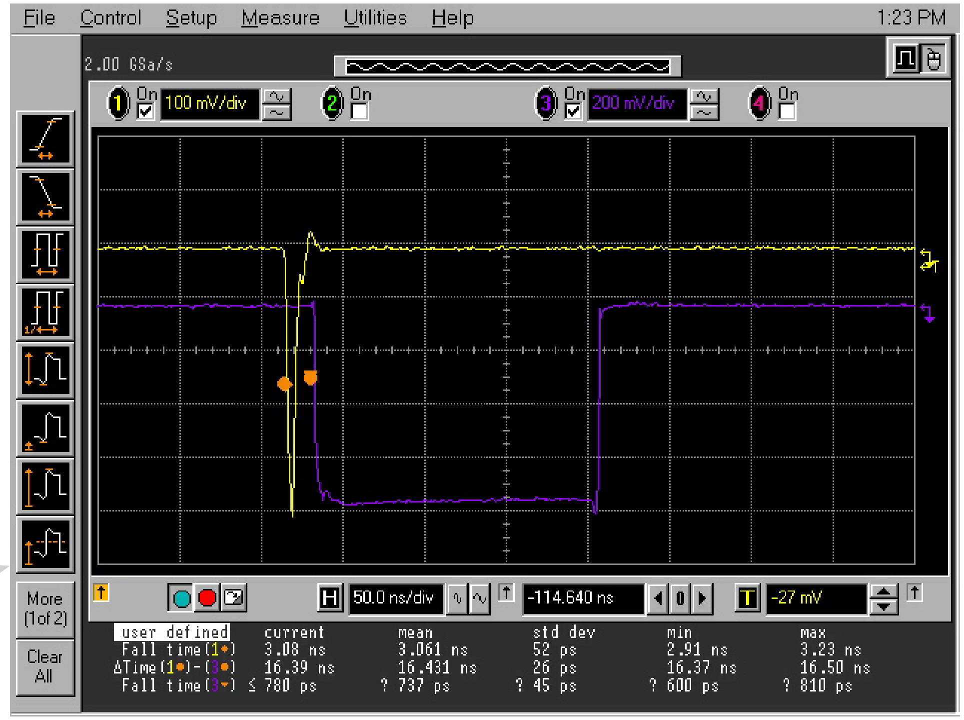


presently testing:
stability...
confirm power draw...
linearity/gain curves from diff. systems...
performance magnetic field on vs. off...

FEE version II

LE, 2ch, RT~750ps (commercially, RT~2.5 ns)



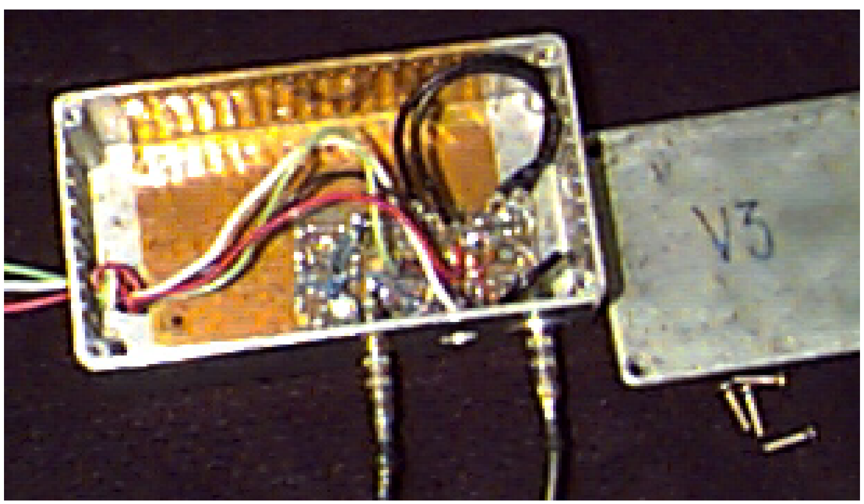


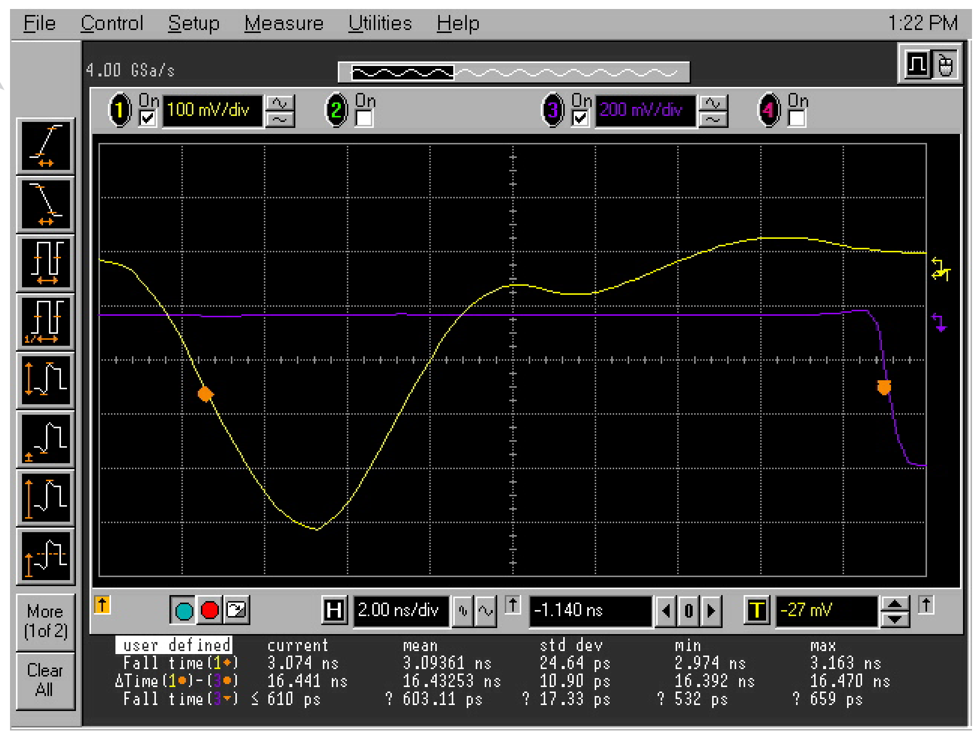
FEE version III (completed 7/22/99)

CFD, 1ch

→ RT ~ 610ps

→ resolution ~11ps

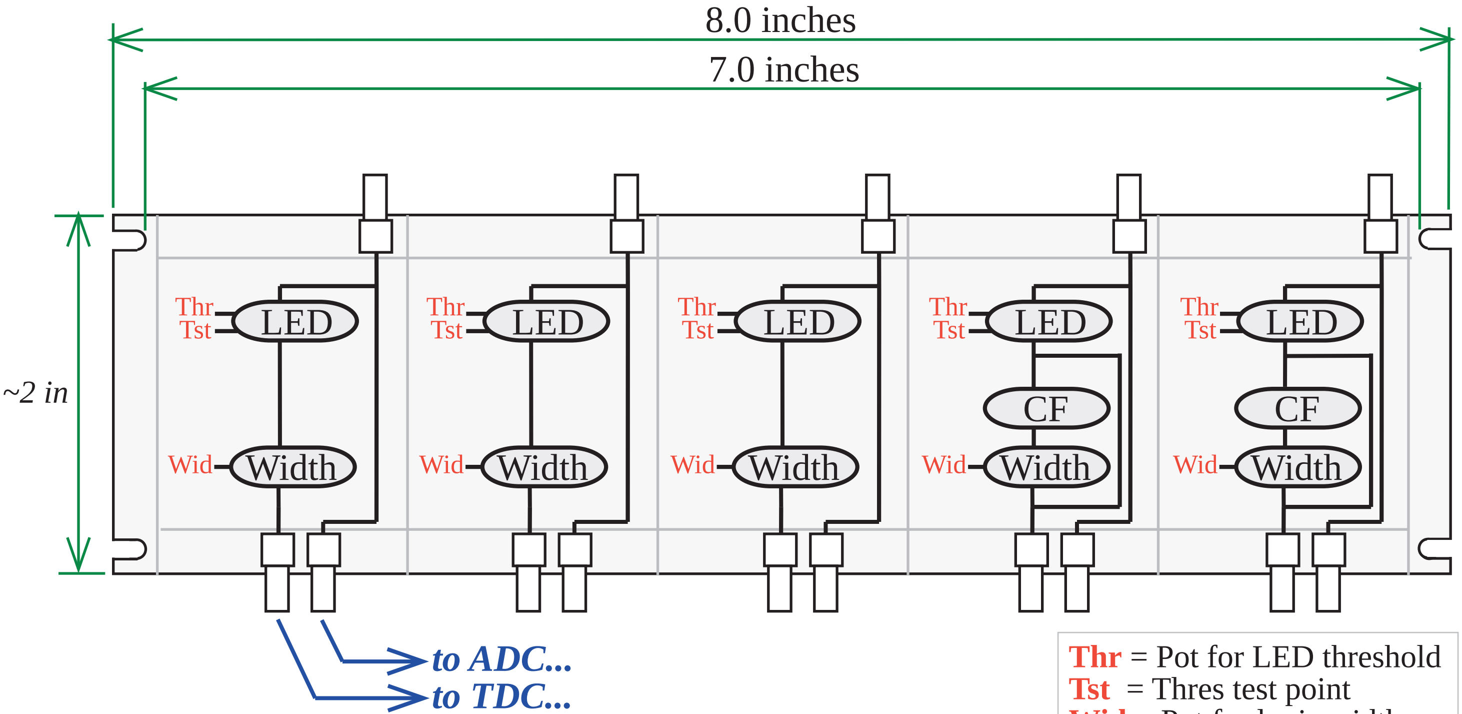




Functional Description of TOFp FEE version IV

WJL, 7/6/99 (revised 7/23/99)

History:
v. I - 1ch, first breadboard
v. II - 2ch LE, RT~0.75ns
v. III - 1ch. first version of LE+CF
v. IV - 5ch LE w/ 2ch CFD



Thr = Pot for LED threshold
Tst = Thres test point
Wid = Pot for logic width

→ 2 boards, each 5 channels (3 ch LE+width, 2 ch LE+CF+width).

Dimensions:
Board width to bolt onto TOFp cooling rails. Minimize length.

I/O specs:
LE thresholds individually adjustable from *50 mV to 1V*
output rise time < 1ns, and minimized. (v.III has RT~0.6 ns)
output fixed flat-top voltage, NIM standard -800 mV
output widths individually adjustable in range *20ns to 100ns*
dead time = 100ns (=widest adjustable gate, dec. in ver.V)
provide board space and connections for input protection.

Connections:
5 lemo female take 5 PMT signals
10 lemo female give 5 logic & 5 PMT signals

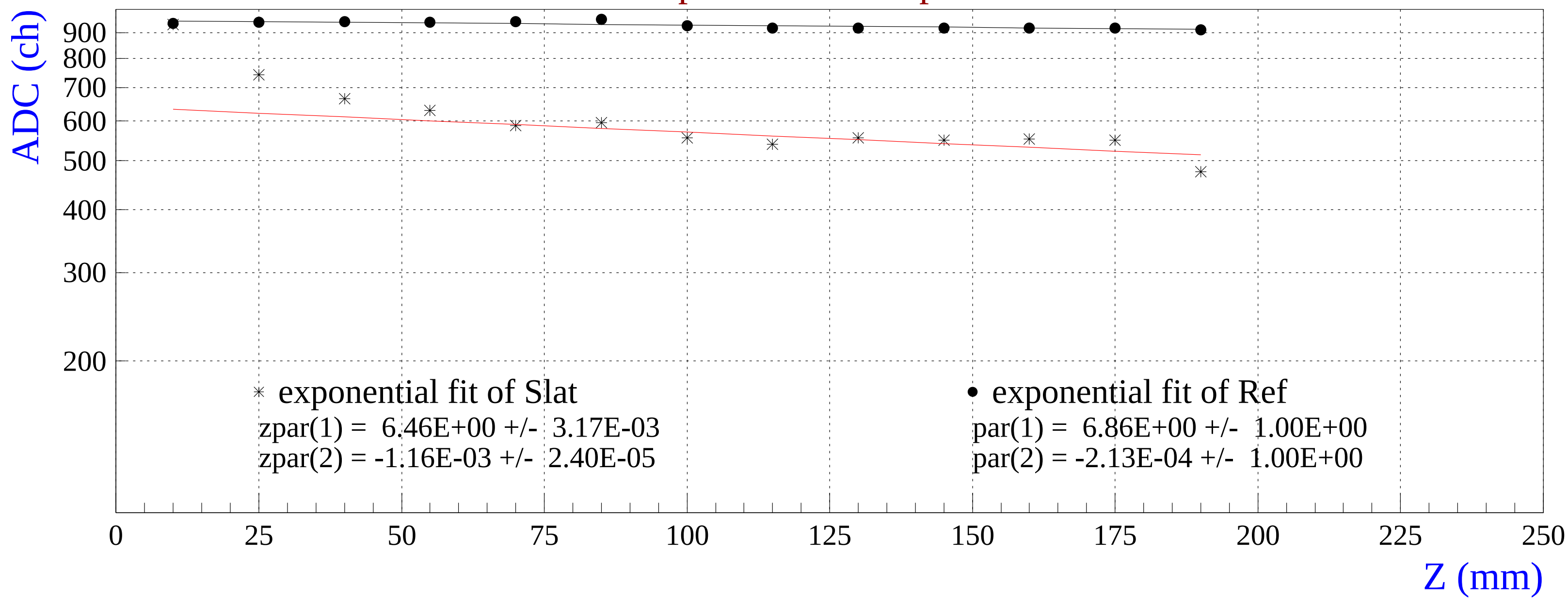
Present Schedule:
1 week - design/construct/test v.III (complete 7/22/99)
1 week - artwork for version IV
2 days - PCB fab (shopped)
1 week - stuff/test

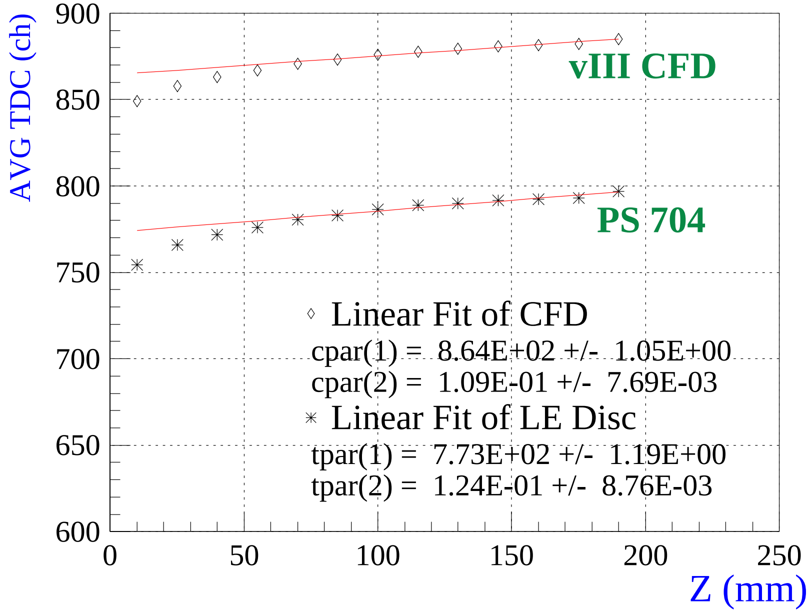
→ ***Completion of two (2) Version IV boards expected Aug 7, 1999***.

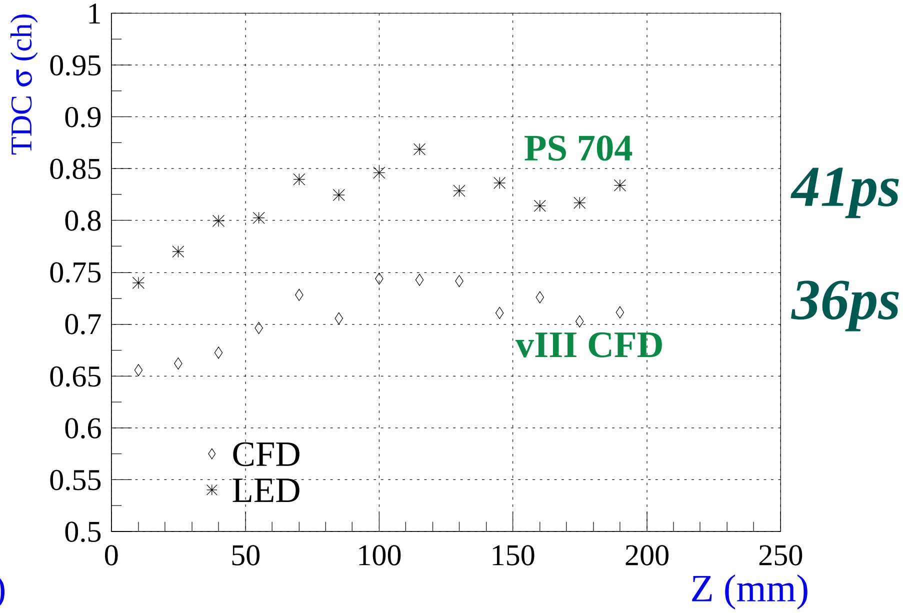
• single discrimination to LRS TDC
• short cables

Preliminary

Position Test and Comparison of TOFp FEE V4 and P/S 704



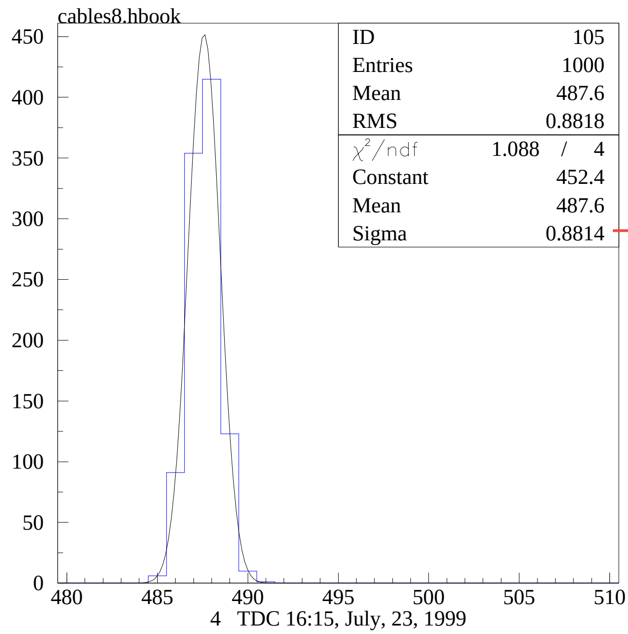




Preliminary!

Results from the big full system

- large laser pulses...
- BC420 20x4x2cm + Epotek 301 + R5946 + 2:1:...:1 CW base
- First discrimination is Rice V.III
- 250 feet cable between 1st and 2nd discrimination
- Second discrimination is P/S 704
- CAMAC digitization to LRS 2228A TDC (50ps/ch)
- GPIB readout to PC and HBOOK/PAW



~45 ps

~36 ps w/ short cables

sqrt(45**2-36**2) ~ 20 ps contribution
from 250ft cables on both start and stop,
→ ~14 ps contribution from a 250ft cable...

important coming tests:

- Better control of Edep by Laser! (via filters)
- Fake slewing...
- FEE version IV + P/S 704
- FEE version IV + P/S 7106
- P/S 7186H TDC ...
- Temperature dependence of timing...

Conclusions on the SysTest so far:

- we still like sept. 99 for the next review...

Central China Normal University
Wuhan, China

Discussions began a few months ago amongst:
Liu, Lianshou (Director, IOPP/CCNU),
T. Hallman (BNL),
myself and B. Bonner (Rice), and
X.N. Wang (LBNL)...

possible major contributions to TOFp & TOF by IOPP group...

- Applying for CNNSF funding
  possible ~late 2000?

- Pursuing University funds for immediate use...
  "Expert" mtg, discussed and approved
  Approved by CCNU President, ~7/25/99

The political arrangements are being discussed...
The plan being discussed involves:
- Support ~5 visitors to Rice & BNL...
- Deliver ~25 R5946 PMTs...
- Deliver DAQ/TRG interface...

Declan Keane reaffirms interest in significant KSU participation
Rice (~6), LBNL (~2), CMU (~1), MIT (~1) still active...

Time of Flight means starts *and* stops... time resolution is the quadrature sum of the two...

circa TOFp proposal, our understanding was the VPD would not exist in Year 1.
- we simulated TOFp-based corrections to ZDC (~250ps)
  - → ~50ps resn. under favorable conditions, 91% efficient
  - this correction only works in highest mult collisions...
  - in peripheral Au+Au, Si+Si, p+p, → ~200ps starts?

a simple <= ~16ch pVPD would solve the problem rather effectively
most of the detector/electronics can be borrowed → conventional and very cheap

Recent interest/actual work towards a VPD or pVPD...

Bellwied/Pandey *et al.*	Bench tests of resolution of prop. electronics
Kaplan/Russ *et al.*	New simulations
John Mitchell	Possible interest in significant participation...
Crawford *et al* and TOFp...	

*What TOFp needs from a pVPD is **not** the full functionality of the well-known VPD.*

TOFp wants $N_{ch} >> 2$, up to N_{ch}~16 (N_{ch}/2 elements per side)
TOFp only wants N_{ch} analog signals with pVPD PMTs → TOFp ADCs...
N_{ch} logic signals from disc *close by* → TOFp TDCs...
CTB or equiv pretrigger as for RICH...
...then logic local to TOFp forms TOFp master starts