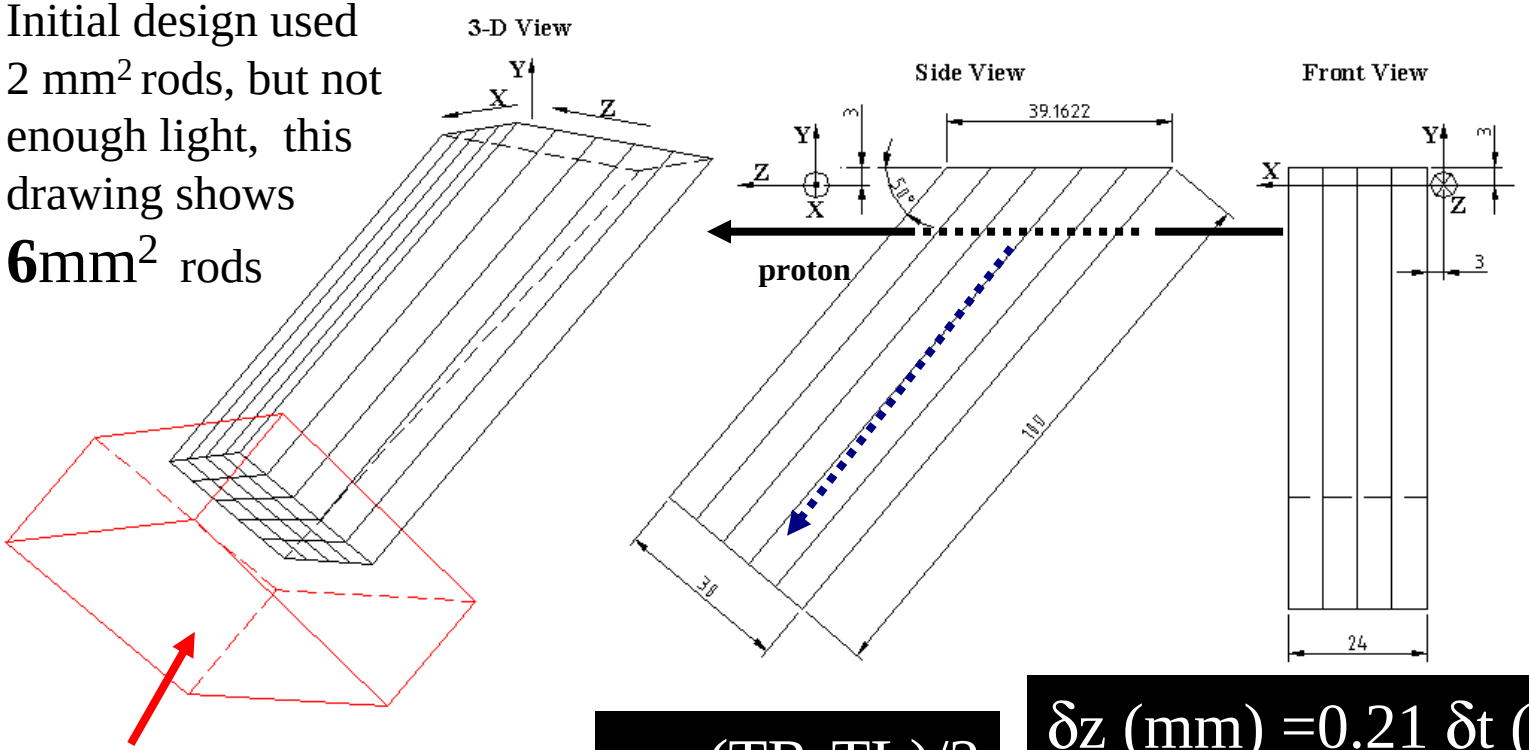
QUARTIC: UTA Update

Andrew Brandt , Chance Harenza, Joaquin Noyola, **Pedro Duarte**

Preliminary UTA drawing of Mike Albrow's concept for a fast time resolution Cerenkov counter:

Initial design used 2 mm^2 rods, but not enough light, this drawing shows **6**mm^2 rods



Microchannel plate PMT

$z=c(TR-TL)/2$

δz (mm) $=0.21\ \delta t$ (psec)
(2.1 mm for $\delta t=10$ psec)

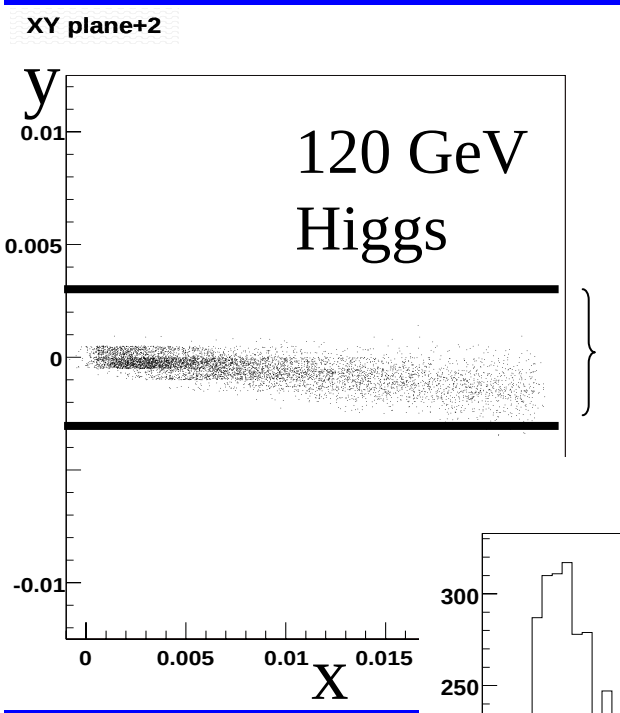
UTA News

- Formed group with 2 undergrads and grad student
- Contacted vendors
- Calculated background rejection as f(resolution)
- Calculated light output
- Calculated time distribution
- Poster session at UTA leads to EE contacts
- Pico-sec workshop (short but valuable)

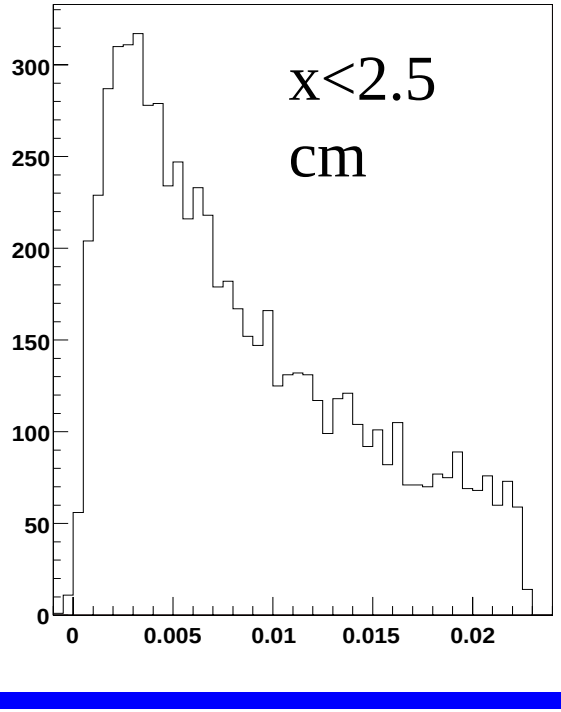
- Submitted internal preproposal for Texas ARP;
  11/30/05 approved for ARP submission (12/79!)
  2/14/05 deadline; 4/20/05 decision; 5/15/05 funds
  $100k/2 years
  mechanics+students?

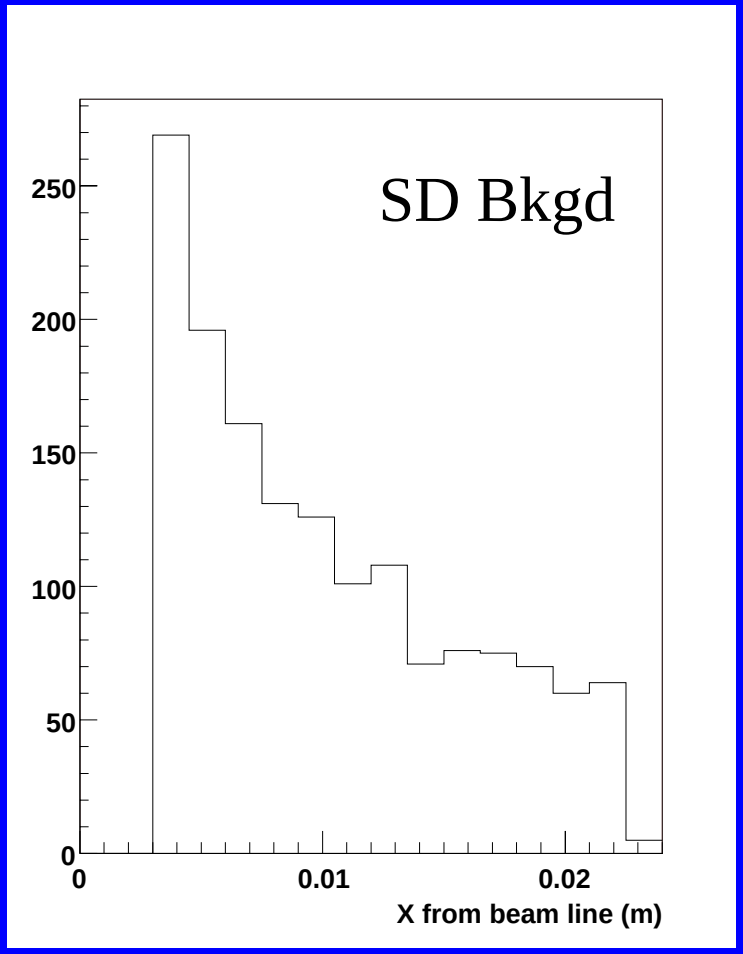
- Plan to submit DOE ADR 12/15/05 need help!
  $100k/1 year possible 5/16? funded

Where do Protons go at 420m



±3mm

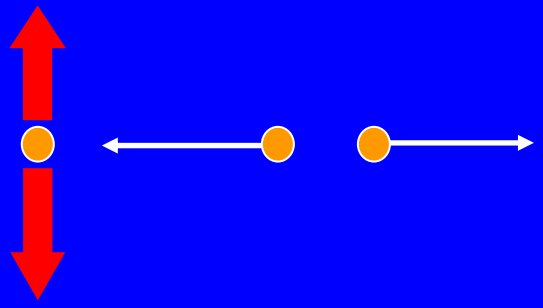




Implies x-segmentation useful for multiple p's in a detector

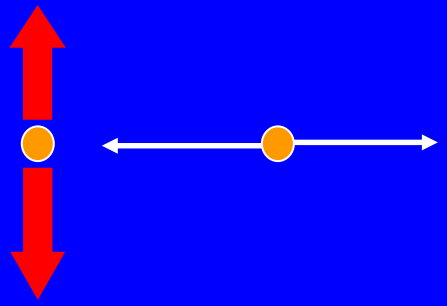
QUARTIC Background Rejection (UTA)

1) 2 single diffractive protons overlayed with a hard scatter (1% of interactions have a proton at 420m)



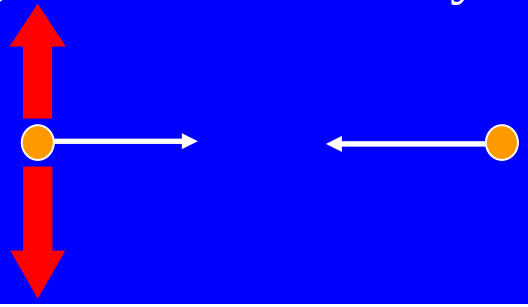
97.4% of events primary vertex and fake vertex from combining proton times more than 2.1mm (1σ) apart ; 94.8% if 20 psec

2) double pomeron overlayed with a hard scatter



97.8% of time vertices more than 2.1mm apart; 95.6% if 20 psec

3) hard SD overlayed with a soft SD



95.5% of time primary vertex and fake vertex more than 2.1mm apart; 91.0% if 20 psec

Cerenkov Light in Fused Silica (UTA):

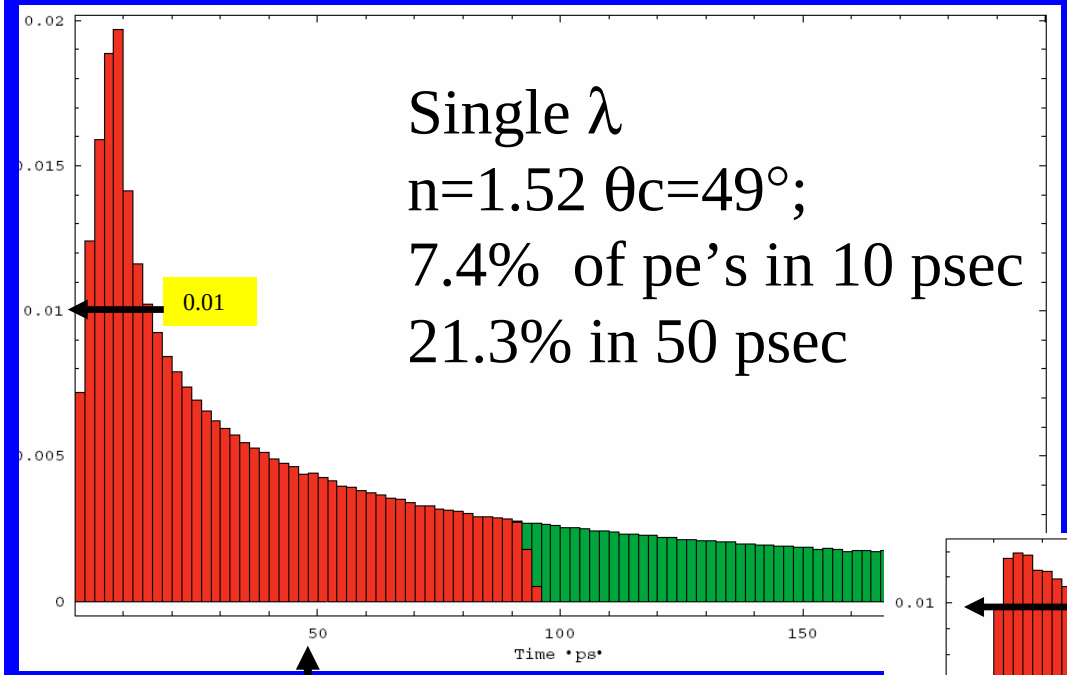
$$\#\,pe = 2\pi\alpha L \sin(\theta c)^2 \int_{\lambda 1}^{\lambda 2} 1/\lambda^2 d\lambda$$

λ	#PE	QE	#p*Q E	Θc	n
180-250	1652.6	15.70%	259.5	49.6	1.544
250-350	1148.7	18.00%	206.8	47.8	1.490
350-450	624.7	19.90%	124.3	47.2	1.471
450-550	394.3	11%	43.4	46.9	1.464
550-650	271.1	1.50%	4.1	46.7	1.458
total			638.0		

UV is important!
640-650 total pe's :
130 pe/6mm rod

#P ave	θc ave	L	Q E ave	#P.ave*QE	ave
4161.6	48.8	3.99cm	15.57%	648.0	

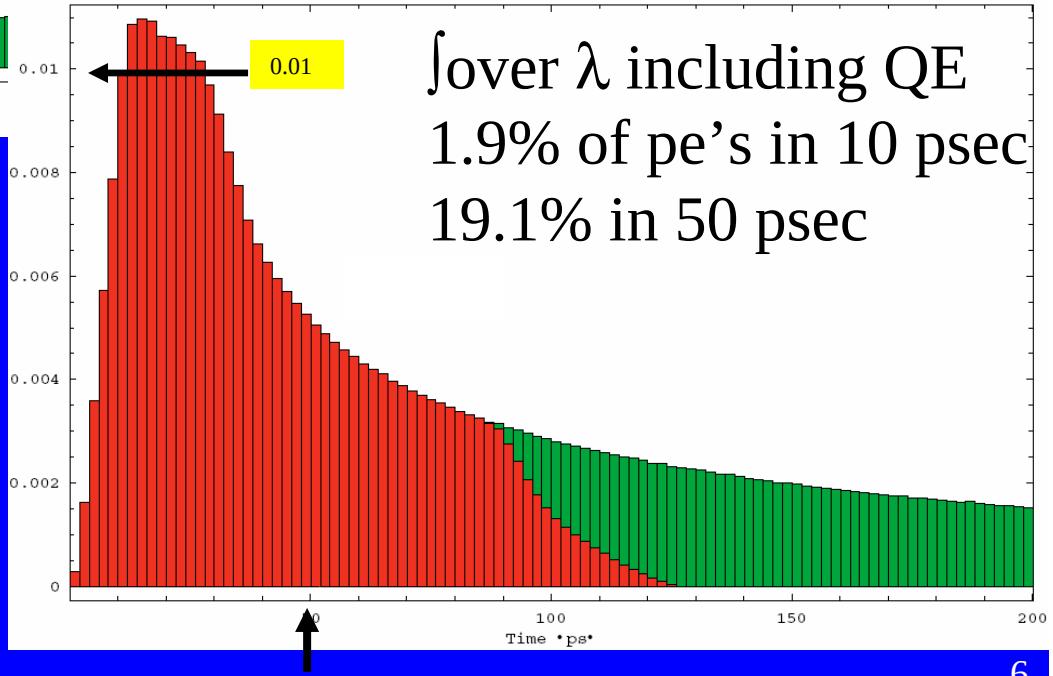
Preliminary Time Distributions (UTA):



Single λ
n=1.52 θc=49°;
7.4% of pe's in 10 psec
21.3% in 50 psec

50 psec

red = totally internally reflected light
green = extra light if aluminized

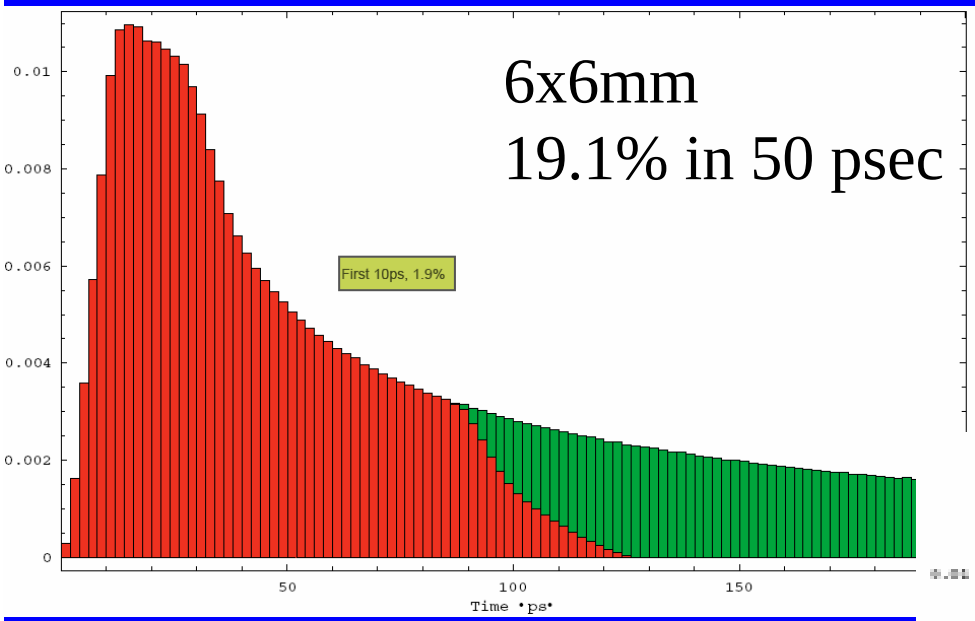


∫over λ including QE
1.9% of pe's in 10 psec
19.1% in 50 psec

Joaquin's program

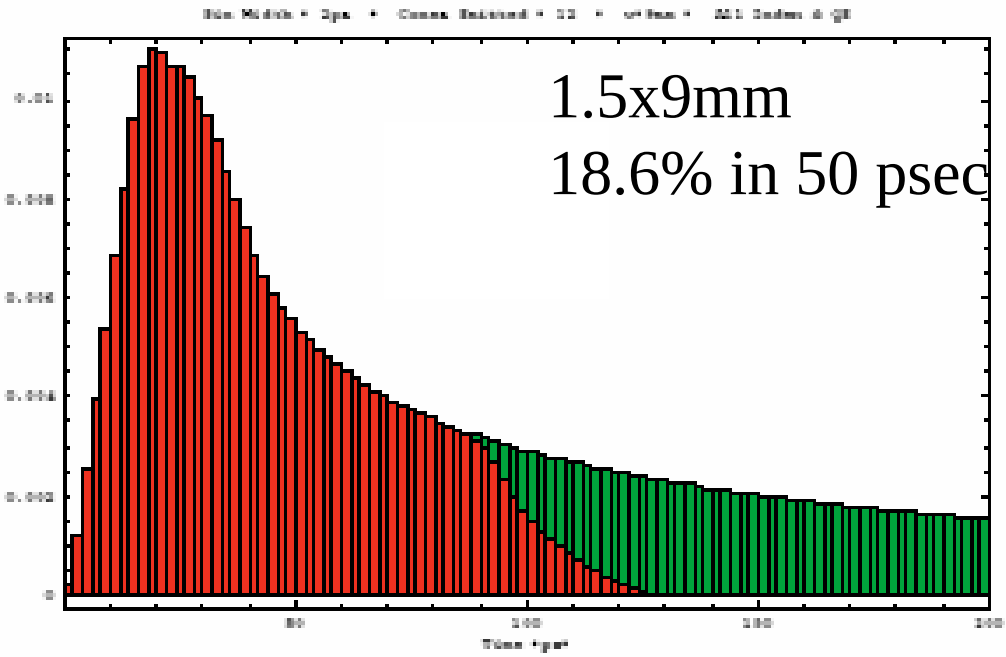
50 psec

Preliminary Time Distributions (UTA):



6x6mm
19.1% in 50 psec

Mike says:
"what about 1.5x9mm?"



TOF Notes

- **Preliminary design studies are promising**
- **Burle 85021 600 has 1.5 mm pixels could give very useful x-segmentation for measuring multiple protons in same detector**
- **Funding!**

DOE ADR

I) Intro on TOF counters
previous limitations
components of time resolution
detector, readout device, TDC
10 psec study (cerenkov+MCP in beam w/scope)
Burle advantage, price, area, pixels—if improve time resolution viable for many physics applications

Budget?

II) Physics motivation
a) Particle ID
b) Vertex measurement
c) Cosmic Ray
d) other

III) Plan of work
Test 2 detectors with 3 types of pmt's in test beam (Quartic+Gastof)
Simulation? (mention sim work already done at uta+alberta, what about pmt sim?)
Measure w/scope, electronics in phase II?

Burle Collaboration

BURLE INDUSTRIES, INC. | 1000 New Holland Ave. | Lancaster, Pennsylvania 17601-5688 | U.S.A. | Telephone (717) 295-6000

BURLE

1 December 2005

Dr. Andrew Brandt
Associate Professor of Physics
University of Texas, Arlington
PO Box 19059
Arlington, TX 76019

Dear Dr. Brandt,

As you know, BURLE INDUSTRIES, INC. is a leading manufacturer of photomultiplier tubes for the medical, biomedical and research communities. As an advanced device company we recognize the necessity to maintain a strong effort in the development of new technology. We recently developed a unique 50mm square MCP-PMT with excellent timing performance known as the PLANACON. In addition, these devices utilize construction technique that allows flexible configuration of the anode readout pattern and are insensitive to magnetic fields. All of these features make the PLANACON ideally suited to your Ultra-fast TOF detector.

As part of your proposed Advanced Detector Research Program, BURLE agrees to fabricate a series of prototype test devices based on our 50mm PLANACON. Our current technology utilizes a 25 micron pore MCP for electron multiplication and a standard flat faceplate. To further characterize and improve the timing properties of these devices we will provide you with the following: 2 PLANACONs having 25 micron pore MCPs and a standard faceplate, 2 PLANACONs having 10 micron pore MCPs and a standard faceplate, and 2 PLANACONs having 10 micron pore MCPs and a stepped faceplate which reduces the photocathode-to-MCP gap. This will allow you to characterize the effect of MCP pore size and cathode-to-MCP gap on the timing performance of the PLANACON. Further, we will try to equip at least one of these devices with MCPs having increased current capacity.

I would like to wish you success on your U.S. Department of Energy Advanced Detector Research Program (DE-FG01-05ER05-27) proposal "Development of an Ultra-fast Time of Flight Counter." BURLE is excited about partnering with you to realize this important advance in Time of Flight instrumentation.

Sincerely,

Paul L. Hink, Ph.D.
VP & General Manager, Photomultiplier Tubes

To further characterize and improve the timing properties of these devices we will provide you with the following: 2 PLANACONs having 25 micron pore MCPs and a standard faceplate, 2 PLANACONs having 10 micron pore MCPs and a standard faceplate, and 2 PLANACONs having 10 micron pore MCPs and a stepped faceplate which reduces the photocathode-to-MCP gap. This will allow you to characterize the effect of MCP pore size and cathode-to-MCP gap on the timing performance of the PLANACON. Further, we will try to equip at least one of these devices with MCPs having increased current capacity.

Budget

Pedro summer $10k
Travel $fewk
Engineer 3 mo's $25k
Equipment?
+?

Help!

Mrenna physics
CDF TOF physics
Swordy Cos ray physics
Burle on MCP's
Jim on electronics
Mike on test beam? other?
K on Gastoff
Yuji Enari?

see Credo (simulation) and Tang (electronics) talk