Detectors & Mechanical Systems

w.j. llope

DOE Review of ☆TOF

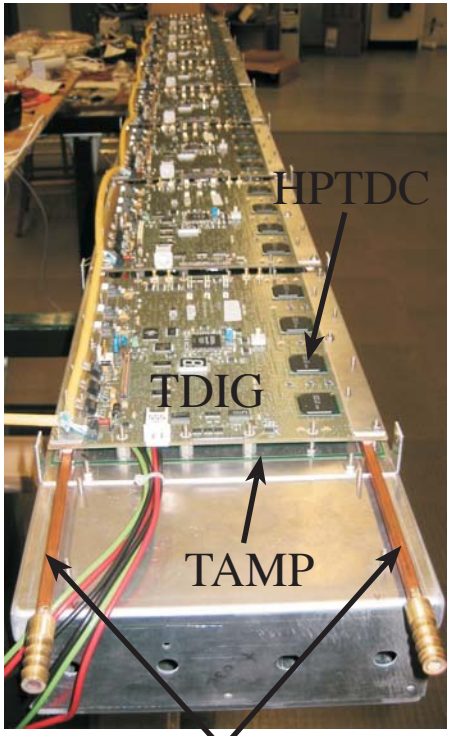
BNL, Sept. 25-26, 2006

Outline:

- TOFr5 & Final Tray mechanical design
- Acceptance simulations
- Tray Final Assembly and Installation
- Start Detector
- Gas System
- Databases
- Review Action items
- Plans

TOFr5 (Runs 5 & 6)

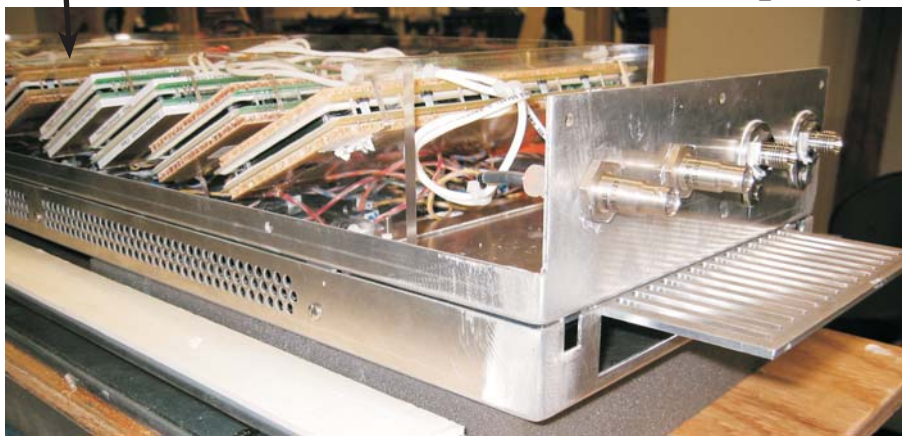
First attempt at on-board digitization
Back to two layers of on-board electronics
Integrated cooling loop
new batches of MRPCs (USTC & Tsinghua)

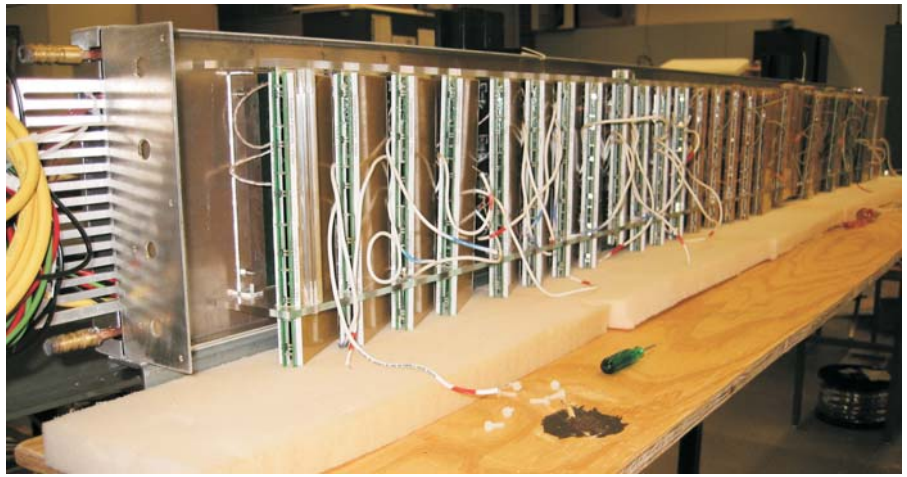


perf. cover assy

cooling loop

"Inner Sides" instead of sawtooths...
lexan machined on hurco machine to few mils
MRPCs held in reveals cut into the inner sides
Inner sides bolt to underside of top assy





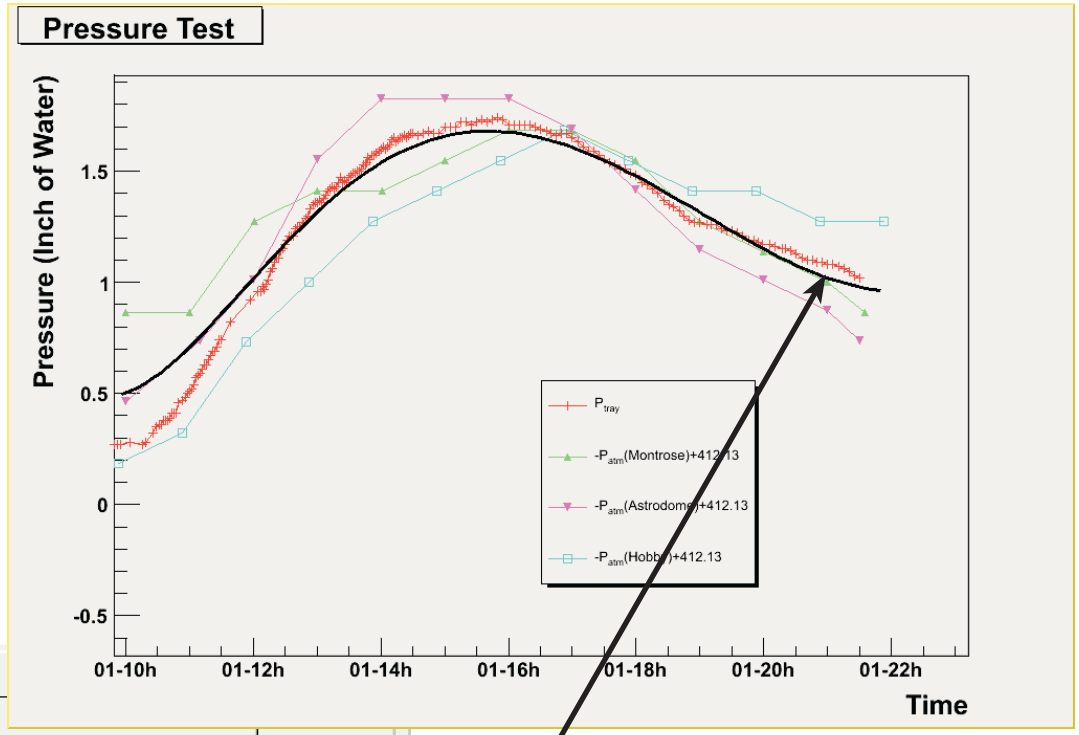
- ~~fabrication extremely labor intensive~~...
  ~~sawtooths, rail assy~~
- ~~complicated gas sealing~~...
  ~~gaskets~~, *less* sealant
- ~~MRPC placement w/in box too imprecise~~...
  ~~each sawtooth placed individually~~
- ~~overall, too tall~~

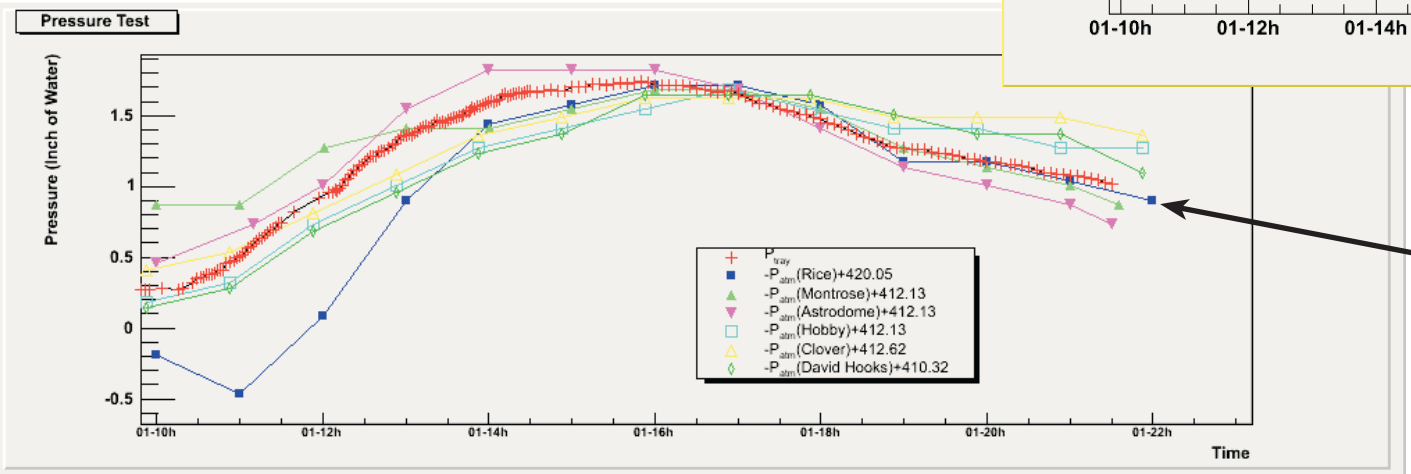
small tweaks to box & inner sides design
integration of TINO, TDIG version 2, & cooling

TOFr5 cooling loop tests & efficiency/power estimates:
http://wjllope.rice.edu/~TOF/TOFr5/Ttests/TOFr5_T_tests.htm

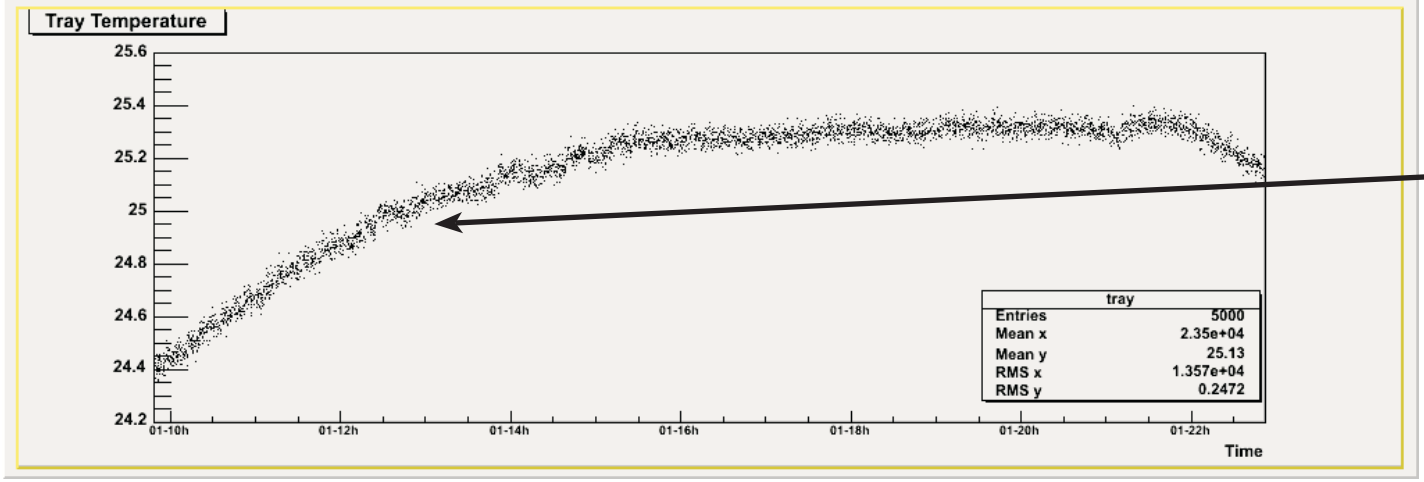
Repeated TOFr5 leak-test @ Rice.....

tray was as removed from STAR after Run-5
leak-testing done over longer period
more complete tabulation of atmospheric pressure



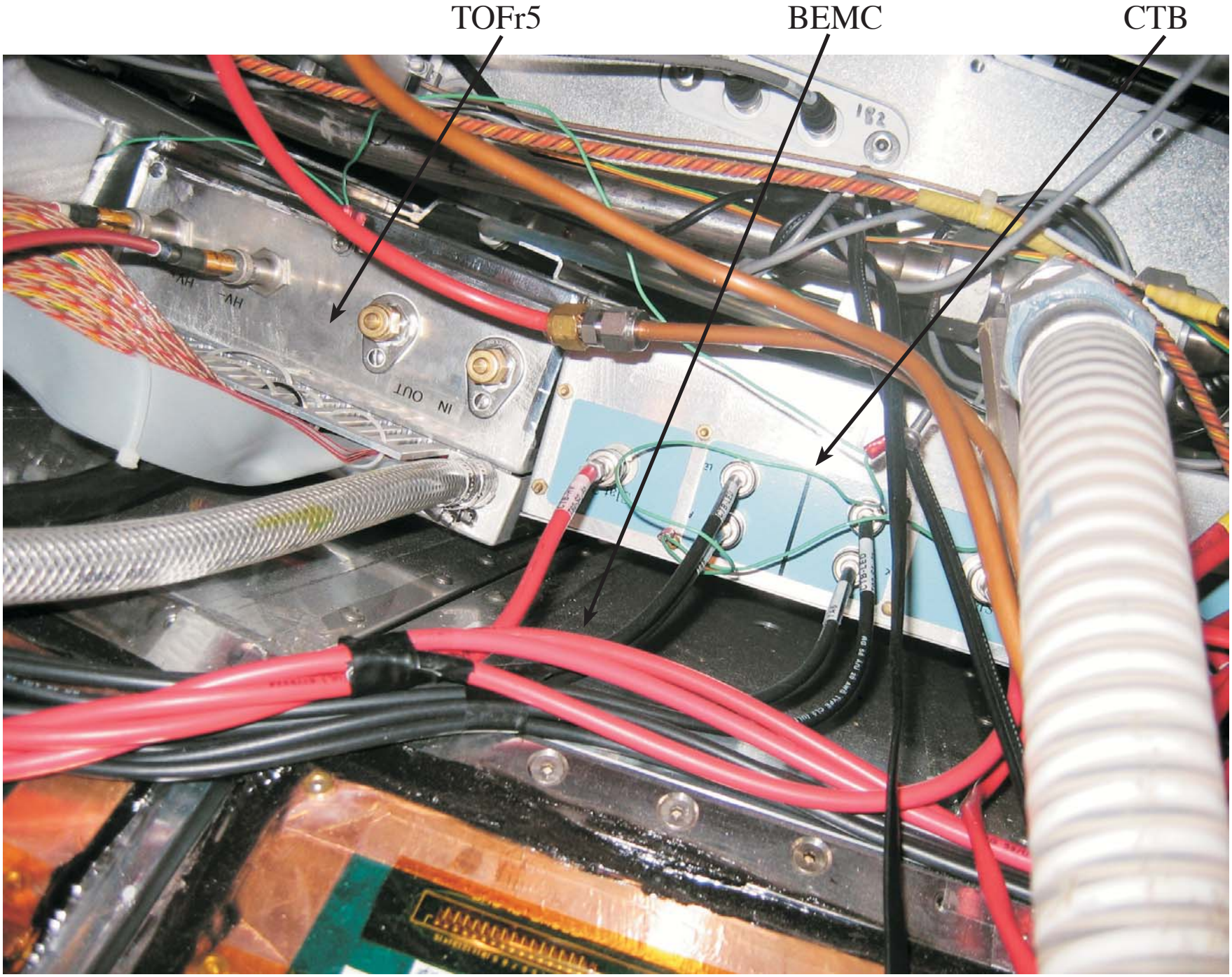


tray appears leak-less here.



this temperature variation
during the test is a
~0.1% effect...

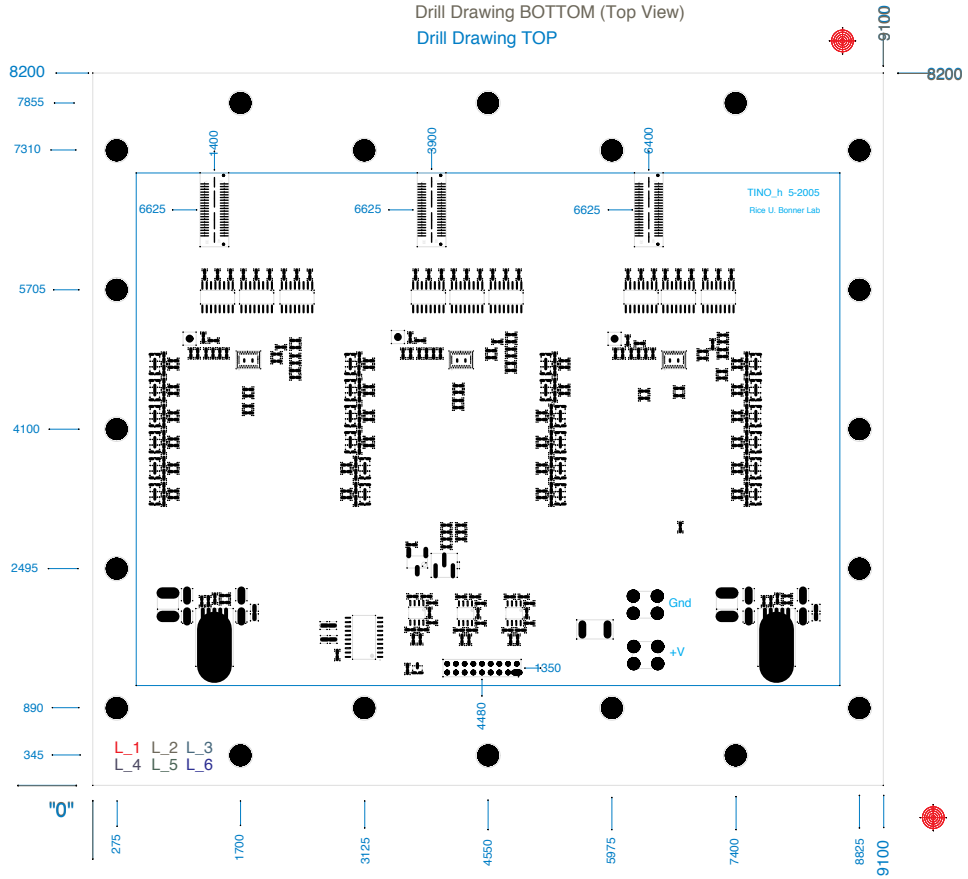
TOFr5 “height” as installed (for Run-6).



Mechanical Design Summary

3 generations of TOFr trays
(all rebuilt from the ground up)
all met the physics goals

- simple, quick, & repeatable to assemble
- gas-tight (by simplified design)
- very precise detector positioning
- open-box MRPC→FEE testing
  - air-core transformer tests
  - time-domain reflectometry tests



Final Tray: "TOF"....

simpler cooling loop design
  1/4" square → 1/4"x3/8" rectangular
  2 shims/TDIG disappear...
solid cover
  better control of radiated heat?

numerous small tweaks to mech. design

TINO
  lower power
  no ringing?
  fully differential
  multiplicity outputs on-chip
  now only need positive LV
6-pairs of signal pigtail → 1 ribbon cable

next TDIG
  accepts signals from TINO
  try to address timing cross-talk
  multiplicity to STAR Trigger System
  stretching for start-side ToT

TCPU now on-board too (the 17^{th} board)

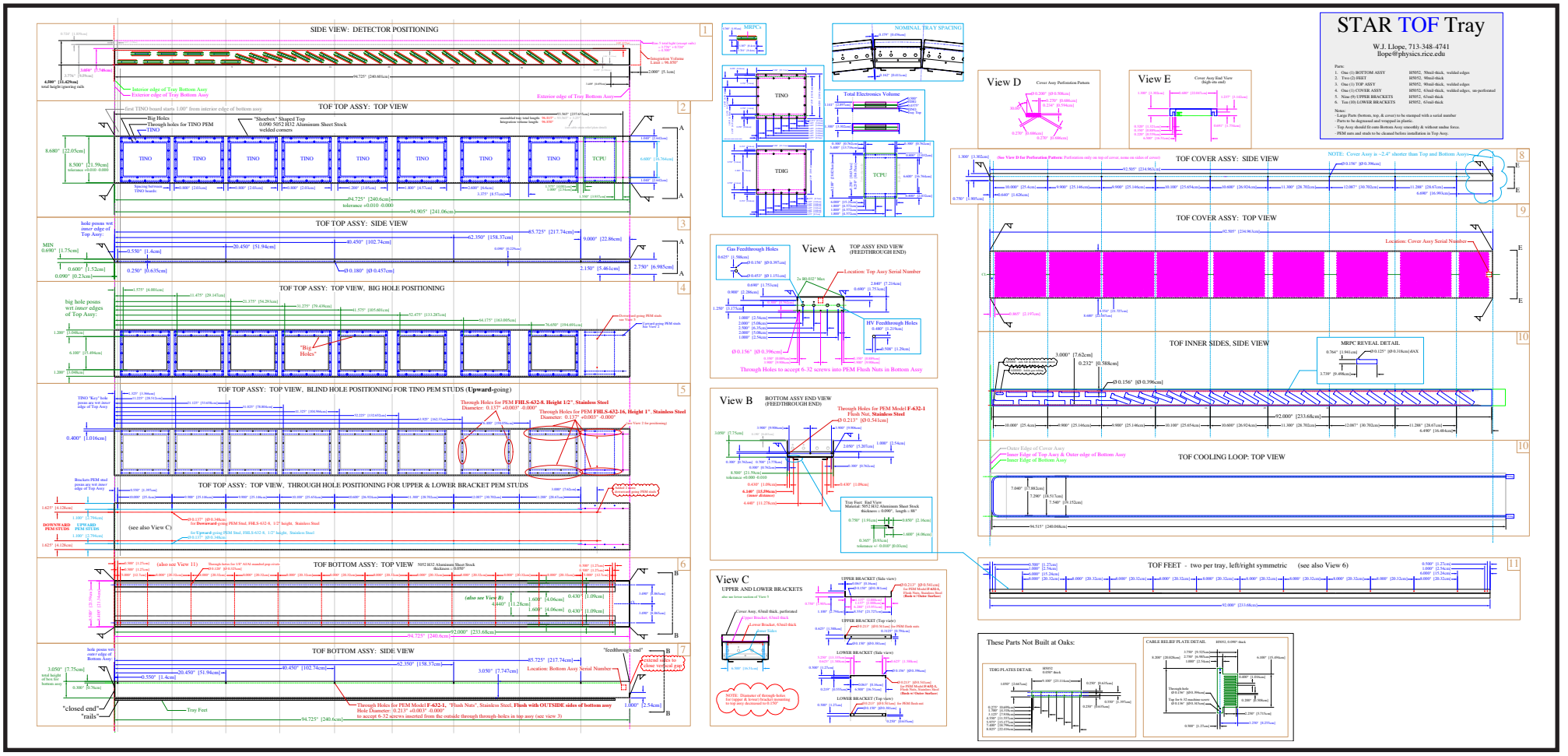
Modifications TOFr5 → TOF

- new MRPC positioning - better acceptance over a wider η-range!
- welded feet replaced by riveted feet
- rectangular Cu cooling loop (improves thermal path, no need for Al shim pieces)
- change Inner Sides from Acrylic to Lexan (bulk material in-hand)
- gas tube slot in Inner Sides
- reflect mount holes in Inner Sides (helpful for fabrication)
- TINO hole footprint and hole pattern, simplify Big Holes
- PEM stud lengths to match TDIG hole pattern
- extend length of Bottom, Top, & Cover to provide TCPU mount
- new PEM studs for TCPU mount and cable pigtail strain relief
- align Top to Bottom side screws with Upper & Lower Brackets (eases Inner Sides install)
- notches in Inner Sides Reveals (eases MRPC removal)
- ~~counter-sink side screws for Top to Bottom fastening~~
- ~~shorten PEM studs for lower brackets~~
- decrease bracket through-hole diameter
- ~~move Inner Sides outwards ~1/4”~~

Unchanged

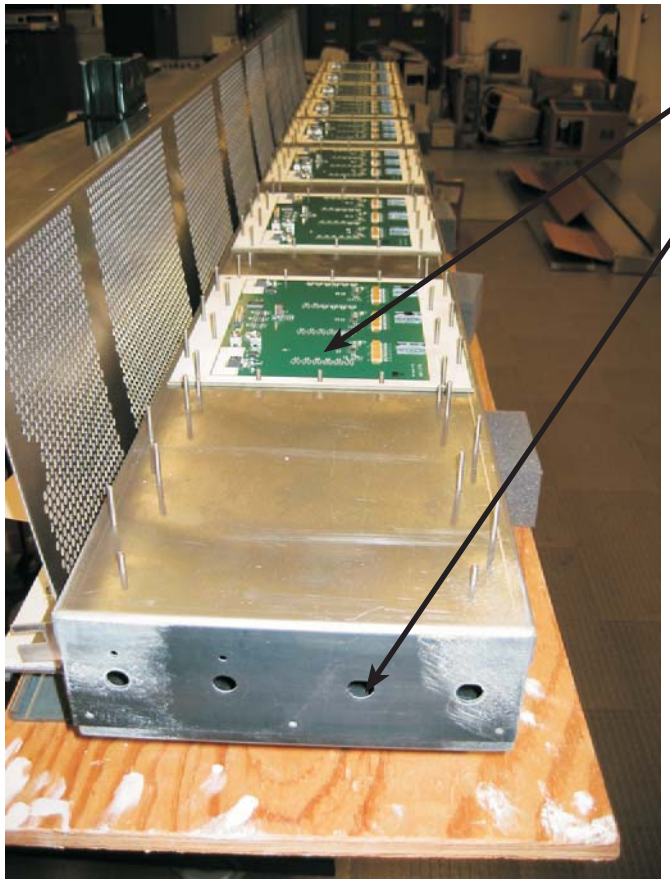
- all heights
- rail dimensions and positioning
- gas sealing technique (shoe-box top & DC730)
- all fabrication and testing procedures

TOF Design (72”x36” PDF)



First batch of “final” trays
delivered 9/21/2006

shoebox top assy



Final TINO boards

for gas & HV connectors

(solid) cover assy

bottom assy
(feet not attached)

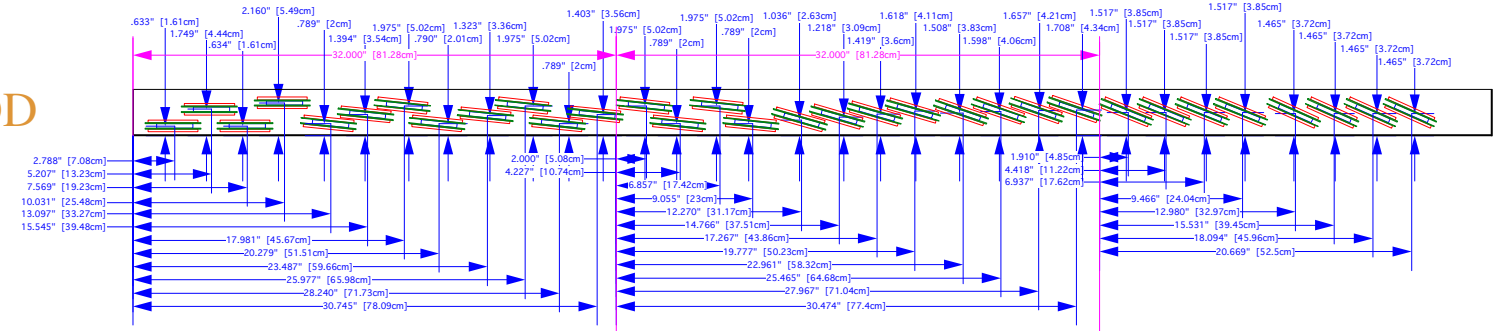
cover is shorter than top...

Initial order qty = 7
one for feet strength test
one for new power/heat/T test
the rest go to UT next week

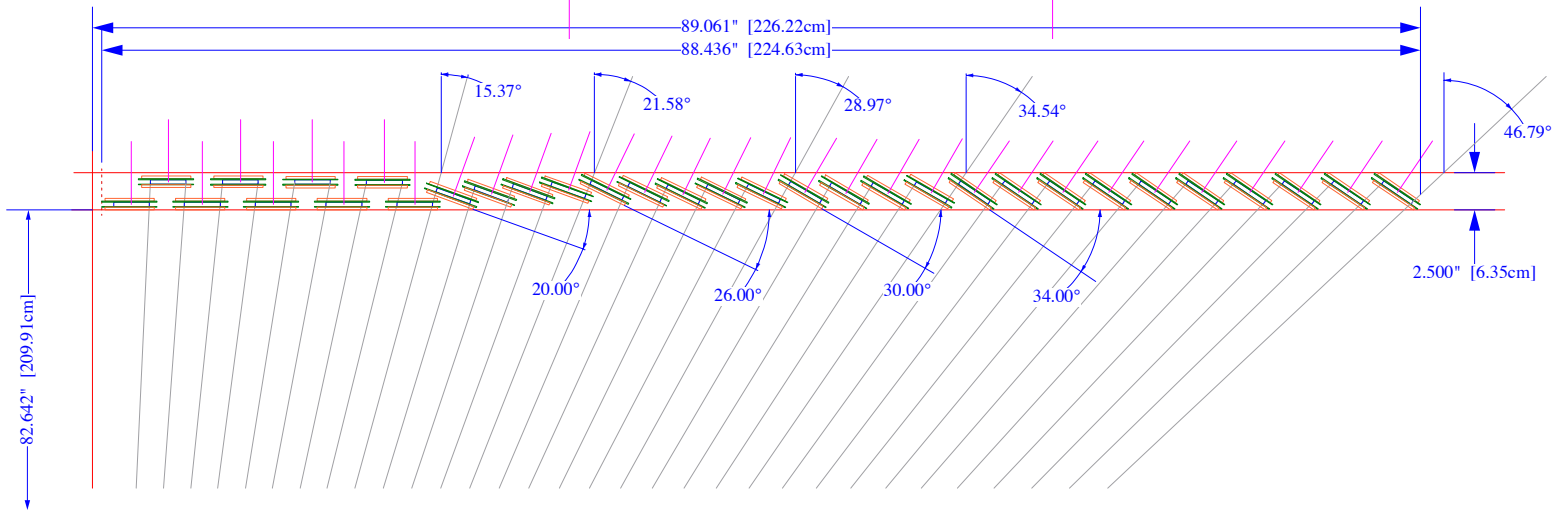
MRPC Acceptance Simulation

- MRPCs positioned w.r.t. Z=0 in the very small space available
- when Z_{vtx} != 0 → gaps (overlaps) in the MRPC acceptance on the same(opposite) side of STAR
- new **GEANT** simulation to quantify these effects...

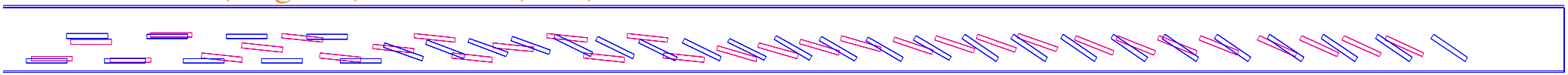
TOFr5 in CADD



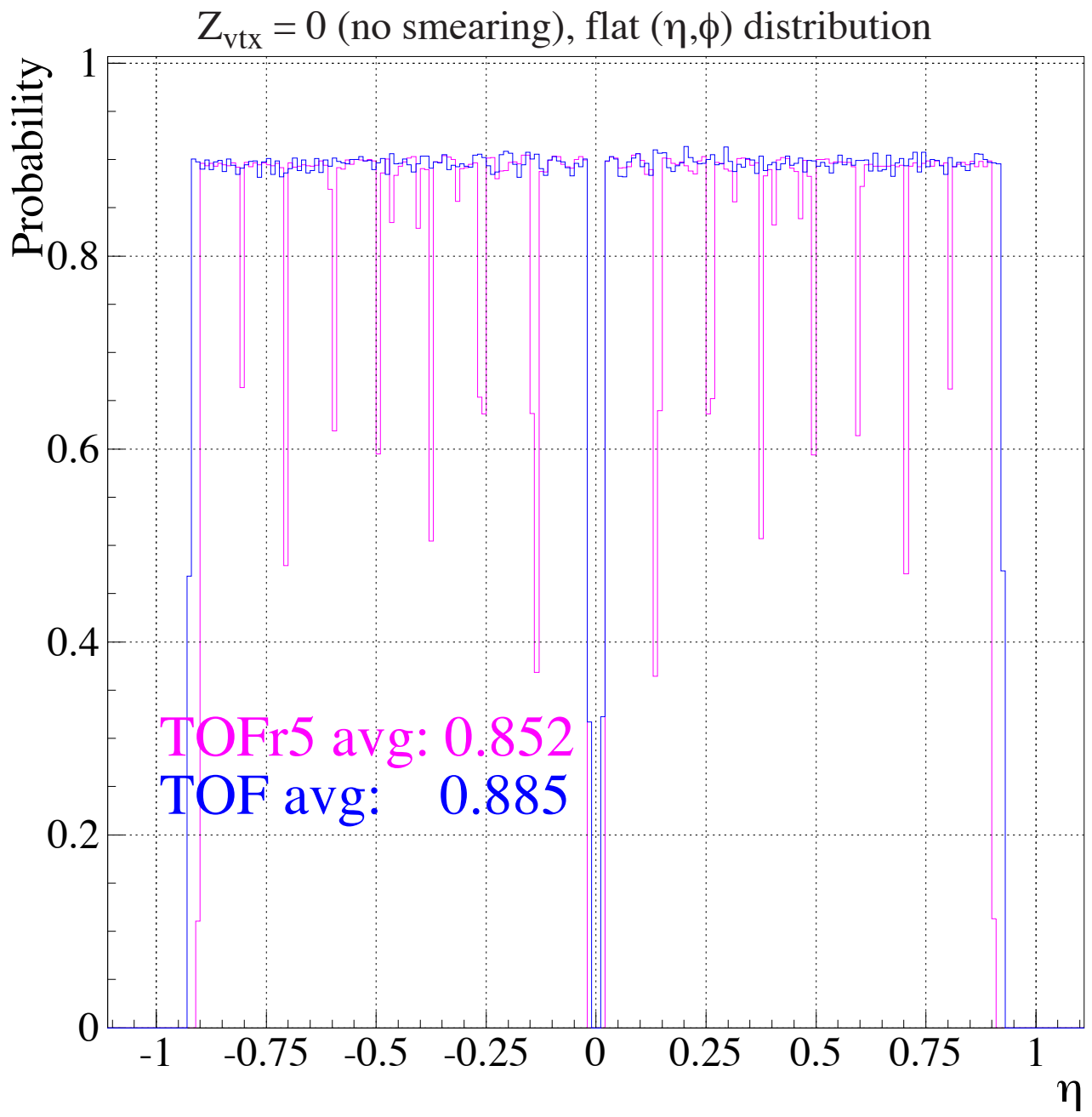
TOF in CADD



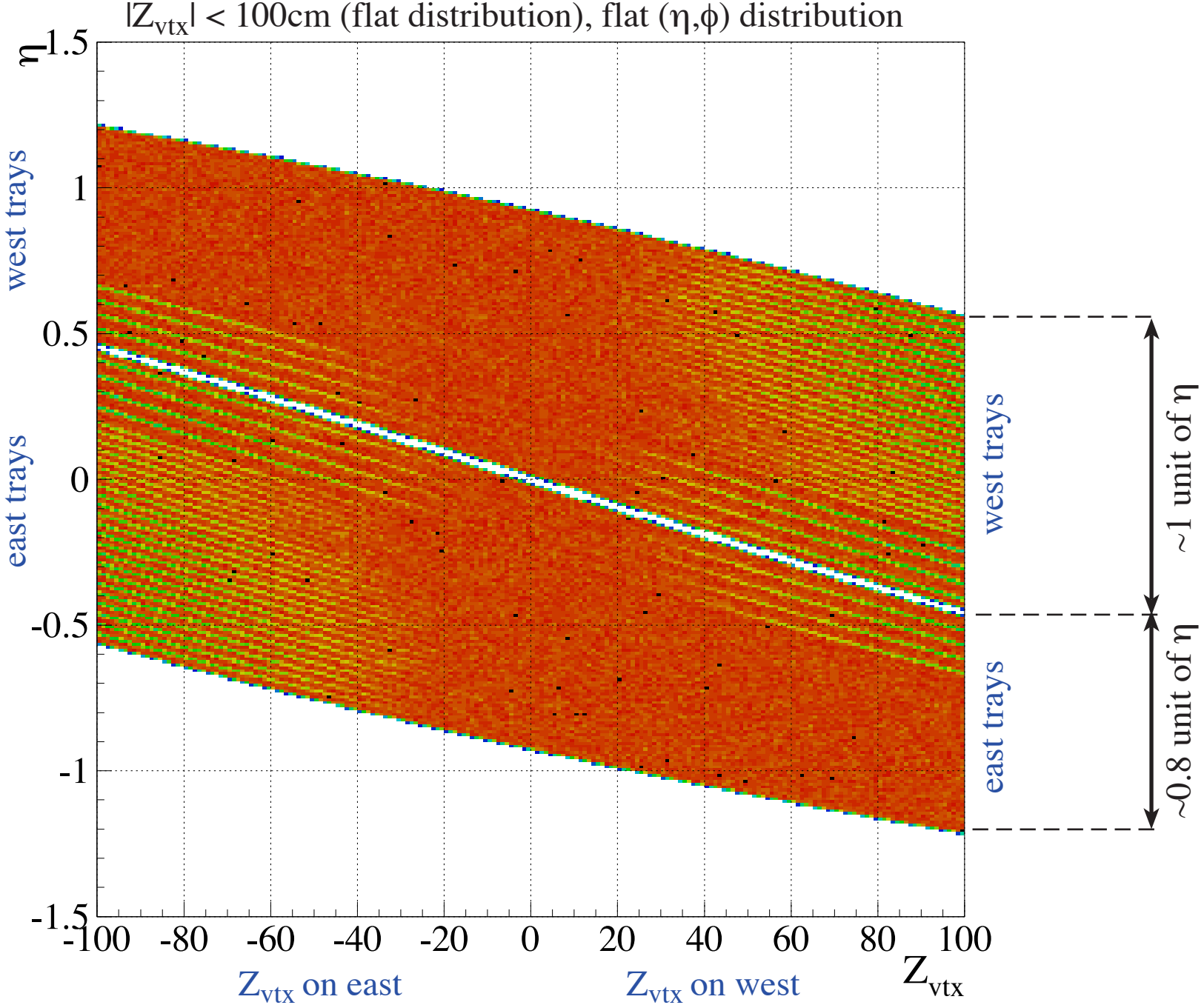
TOFr5 (magenta) and TOF (blue) in **GEANT**



throw 10 GeV/c muons at the detectors through vacuum, with controlled Z_{vtx} smearing
then count 0, 1, & 2 hit events as a function of (Z_{vtx}, η, ϕ)...

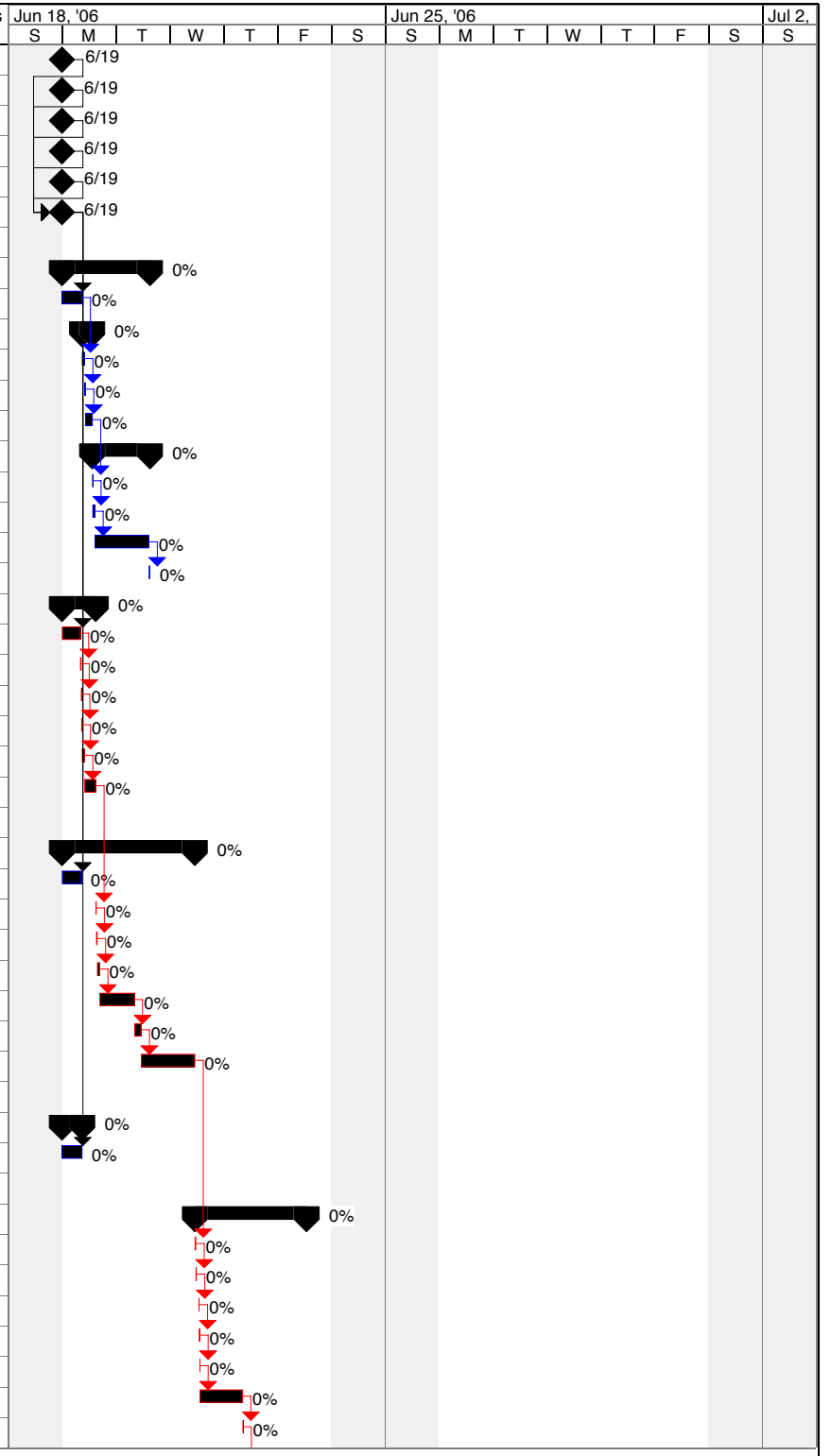


Compared to TOFr5, TOF has a better acceptance over a wider η-range!

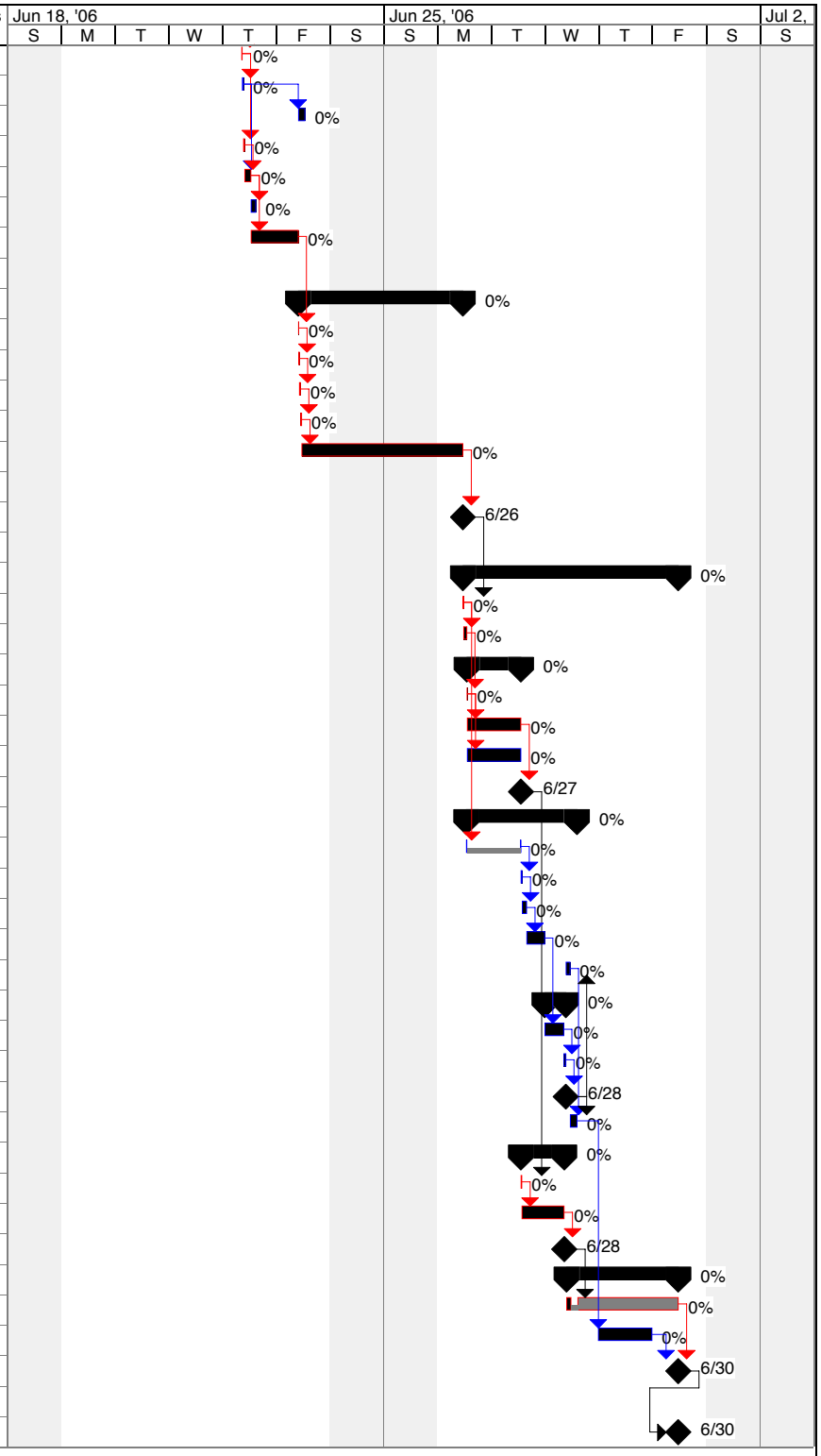


gaps and overlaps become significant for $|Z_{vtx}| > \sim 30$cm

ID	Task Name	Duration	Start	Finish	Predecess
1	Inner Sides available	0 days	Mon 6/19/06	Mon 6/19/06	
2	Cooling Loop available	0 days	Mon 6/19/06	Mon 6/19/06	
3	Tray Structures and Hardware available	0 days	Mon 6/19/06	Mon 6/19/06	
4	TINO & TDIG in Hand	0 days	Mon 6/19/06	Mon 6/19/06	
5	Wire and Cabling available	0 days	Mon 6/19/06	Mon 6/19/06	
6	All Parts in Hand	0 hrs	Mon 6/19/06	Mon 6/19/06	1,2,3,4,5
7					
8	Tray Structure Prep	14.25 hrs	Mon 6/19/06	Tue 6/20/06	
9	inspection & documentation	1 hr	Mon 6/19/06	Mon 6/19/06	6
10	clean bottom, top, cover & brackets	3.5 hrs	Mon 6/19/06	Mon 6/19/06	
11	dip	1 hr	Mon 6/19/06	Mon 6/19/06	9
12	dry	0.5 hrs	Mon 6/19/06	Mon 6/19/06	11
13	isopropyl scrub	2 hrs	Mon 6/19/06	Mon 6/19/06	12
14	bottom assy prep	9.75 hrs	Mon 6/19/06	Tue 6/20/06	
15	move bottom assy to bottom prep area	0.25 hrs	Mon 6/19/06	Mon 6/19/06	13
16	seal inner corners and welds	1 hr	Mon 6/19/06	Mon 6/19/06	15
17	curing (bottom assy inner)	1 day	Mon 6/19/06	Tue 6/20/06	16
18	add kapton layer	0.5 hrs	Tue 6/20/06	Tue 6/20/06	17
19	top assy prep	6 hrs	Mon 6/19/06	Mon 6/19/06	
20	move top assy to fixture (top topside up)	0.25 hrs	Mon 6/19/06	Mon 6/19/06	6
21	install upper brackets	0.25 hrs	Mon 6/19/06	Mon 6/19/06	20
22	install cover assy	0.25 hrs	Mon 6/19/06	Mon 6/19/06	21
23	invert top+cover assy (top topside down)	0.25 hrs	Mon 6/19/06	Mon 6/19/06	22
24	seal PEM studs on underside of top assy	1 hr	Mon 6/19/06	Mon 6/19/06	23
25	curing (top assy inner)	4 hrs	Mon 6/19/06	Mon 6/19/06	24
26					
27	TAMP to top assy	19.25 hrs	Mon 6/19/06	Wed 6/21/06	
28	TAMP inspection & documentation	0.5 hrs	Mon 6/19/06	Mon 6/19/06	6
29	invert top+cover assy (top topside up)	0.25 hrs	Mon 6/19/06	Mon 6/19/06	25
30	remove cover assy and upper brackets	0.5 hrs	Mon 6/19/06	Mon 6/19/06	29
31	reclean near big holes	1 hr	Mon 6/19/06	Mon 6/19/06	30
32	install ground washers	0.5 hrs	Mon 6/19/06	Tue 6/20/06	31
33	seal and bolt down TAMPs to top assy	3 hrs	Tue 6/20/06	Tue 6/20/06	32
34	curing (TAMP to top assy)	1 day	Tue 6/20/06	Wed 6/21/06	33
35					
36	MRPCs	1 hr	Mon 6/19/06	Mon 6/19/06	
37	inspection & documentation	1 hr	Mon 6/19/06	Mon 6/19/06	6
38					
39	Loading the Inverted Top Assy	16.77 hrs	Wed 6/21/06	Fri 6/23/06	
40	install upper brackets and cover assy	0.5 hrs	Wed 6/21/06	Wed 6/21/06	34
41	invert top+cover assy (top topside down)	0.25 hrs	Wed 6/21/06	Wed 6/21/06	40
42	install lower brackets	0.25 hrs	Wed 6/21/06	Wed 6/21/06	41
43	install "closer" inner side	0.25 hrs	Wed 6/21/06	Wed 6/21/06	42
44	rotate fuxture (top on side, closer inner side horizontal)	0.02 hrs	Wed 6/21/06	Wed 6/21/06	43
45	install MRPCs inc connections to TAMP	4 hrs	Wed 6/21/06	Thu 6/22/06	44
46	install cross-pieces and "other" inner side	0.25 hrs	Thu 6/22/06	Thu 6/22/06	45

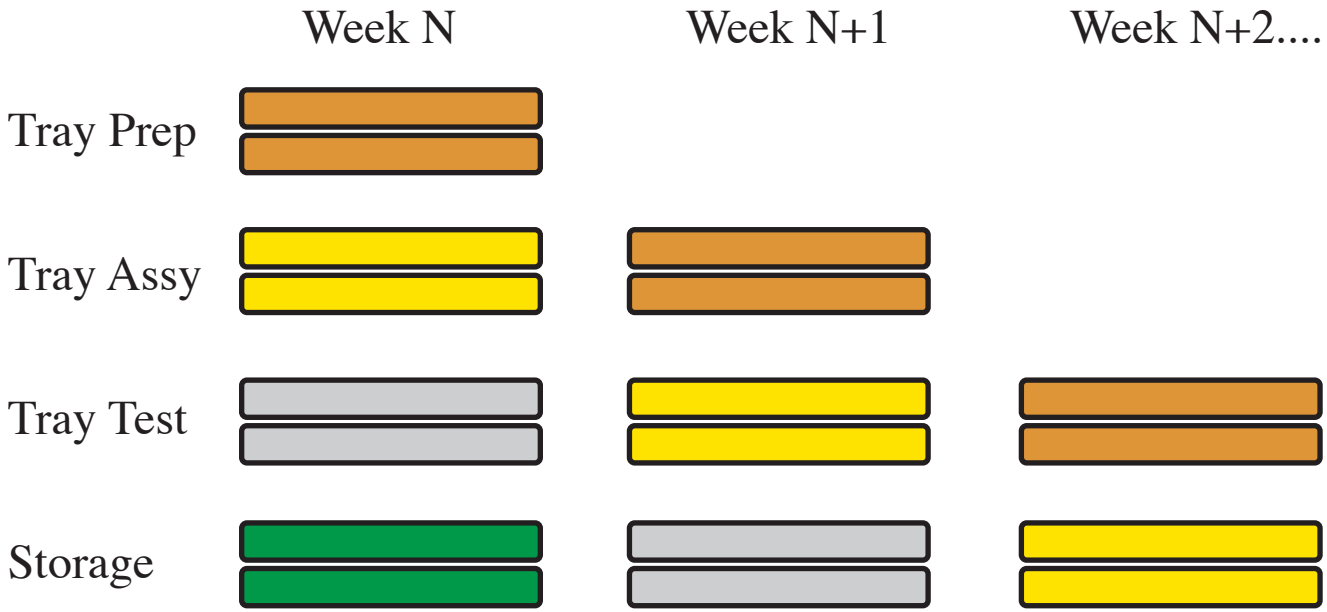


ID	Task Name	Duration	Start	Finish	Predecess
47	rotate fixture (top topside down)	0.25 hrs	Thu 6/22/06	Thu 6/22/06	46
48	install reynolds connectors with sealant	0.5 hrs	Thu 6/22/06	Thu 6/22/06	47
49	install HV bus wiring to each MRPC	2 hrs	Fri 6/23/06	Fri 6/23/06	48
50	install gas feedthroughs & interior tubing	0.5 hrs	Thu 6/22/06	Thu 6/22/06	47
51	curing (F/T connectors on top assy)	2 hrs	Thu 6/22/06	Thu 6/22/06	48,50
52	HV tests	2 hrs	Thu 6/22/06	Thu 6/22/06	51
53	MRPC connectivity tests	6 hrs	Thu 6/22/06	Fri 6/23/06	51
54					
55	Tray Closing	9.5 hrs	Fri 6/23/06	Mon 6/26/06	
56	test fit bottom assy onto top assy	0.25 hrs	Fri 6/23/06	Fri 6/23/06	53
57	scribe	0.25 hrs	Fri 6/23/06	Fri 6/23/06	56
58	remove bottom assy and apply sealant	0.5 hrs	Fri 6/23/06	Fri 6/23/06	57
59	install bottom assy, install machine screws	0.5 hrs	Fri 6/23/06	Fri 6/23/06	58
60	curing (bottom assy onto top assy)	1 day	Fri 6/23/06	Mon 6/26/06	59
61					
62	Tray Closed	0 hrs	Mon 6/26/06	Mon 6/26/06	60
63					
64	Electronics installation and Testing	32.25 hrs	Mon 6/26/06	Fri 6/30/06	
65	rotate tray (top topside up)	0.25 hrs	Mon 6/26/06	Mon 6/26/06	62
66	move completed tray to tray test area	0.5 hrs	Mon 6/26/06	Mon 6/26/06	65
67	Gas flow for testing	8.25 hrs	Mon 6/26/06	Tue 6/27/06	
68	connect tray to gas system	0.25 hrs	Mon 6/26/06	Mon 6/26/06	66
69	gas flow started	1 day	Mon 6/26/06	Tue 6/27/06	68
70	Gas Leak testing wtih sniffer	1 day	Mon 6/26/06	Tue 6/27/06	68
71	Gas Quality Acceptable for HV tests	0 hrs	Tue 6/27/06	Tue 6/27/06	69
72	TDIG Installation	17.5 hrs	Mon 6/26/06	Wed 6/28/06	
73	remove cover assy and upper brackets	0.5 hrs	Mon 6/26/06	Tue 6/27/06	65
74	install cooling loop	0.5 hrs	Tue 6/27/06	Tue 6/27/06	73
75	install TDIG boards	2 hrs	Tue 6/27/06	Tue 6/27/06	74
76	install LV bus (lugs on-tray to boards)	1 hr	Tue 6/27/06	Tue 6/27/06	75
77	Install TDIG cabling (canbus etc)	2 hrs	Wed 6/28/06	Wed 6/28/06	81
78	LV power test	1.5 hrs	Wed 6/28/06	Wed 6/28/06	
79	install LV test cables (supply to lugs on-tray)	0.5 hrs	Wed 6/28/06	Wed 6/28/06	76
80	LV power-up and documentation	1 hr	Wed 6/28/06	Wed 6/28/06	79
81	LV test passed	0 hrs	Wed 6/28/06	Wed 6/28/06	80
82	Firmware and other electronics setup	2 hrs	Wed 6/28/06	Wed 6/28/06	77,81
83	HV Performance	4.25 hrs	Tue 6/27/06	Wed 6/28/06	
84	connect HV cables	0.25 hrs	Tue 6/27/06	Tue 6/27/06	71
85	ramp HV and collect V/I data	4 hrs	Tue 6/27/06	Wed 6/28/06	84
86	Tray Stable at Full Voltage	0 days	Wed 6/28/06	Wed 6/28/06	85
87	DAQ Performance	18 hrs	Wed 6/28/06	Fri 6/30/06	
88	Noise rate tests, dead channel identification	2 days	Wed 6/28/06	Fri 6/30/06	86
89	INL Calibration	1 day	Thu 6/29/06	Thu 6/29/06	82
90	Final test documentation	0 hrs	Fri 6/30/06	Fri 6/30/06	88,89
91					
92	Tray complete & Ready for Cosmics Testing	0 hrs	Fri 6/30/06	Fri 6/30/06	90



The procedure is generally
a series of several “few minute” operations per tray
punctuated by several ~24 hrs periods of waiting per tray (sealant curing, gas flow, etc...)

Fabrication model: at the end of each week
two trays emerge from the tray prep area
next week these will be in the tray assembly area
& two trays emerge from the tray assembly area
next week these will be in the tray testing area (gas flow, INL, noise rates, HV draw, etc)



manpower assumed is 2.5yr Mechanical Technician and 2 FTE undergraduates for 2yrs at UT
assumes also UT Postdoc (0.5 FTE) for Fabricated Tray testing
Rice Postdoc (0.5 FTE) for Electronics testing

UT machine shop fabricates inner sides and cooling loops

tray fabrication workflow and fabbed tray documentation system is under development.

Tray Fabrication Milestones

(Previous Project Plan):

Date	No. Trays	No./week
10/06	4 trays	0.5 trays/week
01/07	10	0.8
04/07	10	0.8
07/07	14	1.1
10/07	14	1.1
01/08	16	1.3
04/08	18	1.5
07/08	20	1.7
09/08	20	1.7
	---	
	126 trays	

(Present Project Plan):

Date	No. Trays	No./week
1/23/07	4 trays	0.5 trays/week
4/27/07	10	0.8
7/12/07	10	1.0
9/24/07	14	1.4
12/6/07	14	1.4
2/15/08	16	1.6
4/30/08	18	1.8
7/30/08	20	1.7
10/29/08	14	1.2
	---	
	120 trays	

installation plan:

"Skill-of-the-Craft"
can install either in AB or WAH
Both US & Chinese institutions participate in installation and commissioning

installation requires several fixtures (TPC support fixture and Tray installation fixture)

Installation

same basic idea as CTB, but TOF trays are too heavy for two people
need a rail holder on spreader bar, hanging from hook: “Tray installation fixture”

slide-in both trays at specific phi-position from East side

only pigtail cabling coming off of the tray is for LV, all other connections made after insertion

need special fixture to support TPC for trays behind support arms for 3 and 9 o’clock trays

Installation Manpower

Tray pre-install testing: Collaboration

Tray mechanical installation: TOF Group & STSG Techs

Tray post-install work:

water system:	STSG Techs
data cables:	TOF Group
LV cables:	TOF Group & STSG
HV cables:	TOF Group & STSG

space at BNL for tray testing and storage during runs now identified (East end of ☆AB)

Installation Schedule

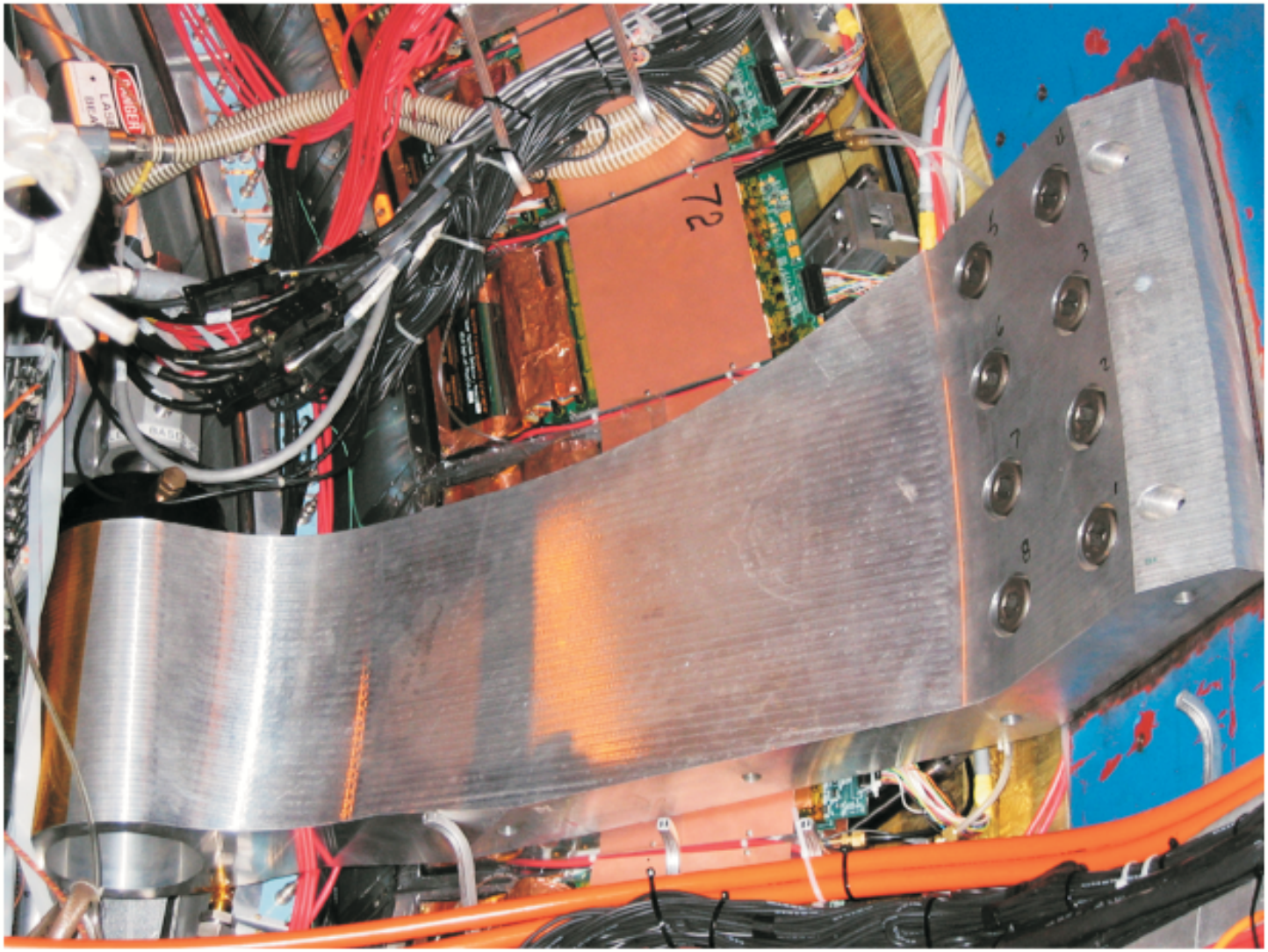
we install however many trays we have available in each long shutdown

tray arrival at BNL and successful pre-installation testing meets deliverable requirement

TOF participates in annual Shutdown Planning exercise
we quote # trays to be installed
estimates of time and manpower required

Installing TOF Trays behind TPC Support Arms

Requires support of TPC at 6 o'clock
Removal of TPC east support arms



Pre-installation Testing

done onsite after trays shipped to BNL

requires

- Freon-only gas system
- HV
- spare TCPU and one LV supply
- laptop with pcan dongle
- simple water flow system would be very helpful
- ~100 sq.ft. of floor space somewhere close to WAH

Test Suite:

- HV stability
  - must hold +/-7125 V for >24 hours
- HV currents
  - must be <40 nA/side after HV on for 24 hours
- LV currents
  - must be to final specification w/in ~0.5A
- R/O
  - all 8 TDIG boards must respond to pcanloop/pc commands over actual data path cabling
- Noise rates
  - must be <40 Hz in all channels
- Dead channels
  - must be <6/tray
- Leak Test
  - must hold initial pressure for 6 hours

Post-installation Testing

done after trays are on rails and fully cabled up.

requires

- actual gas system (freon-only)
- HV via CAENs
- TCPU connection to THUB
- STAR water system

Test Suite:

- HV stability
  - must still hold +/-7125 V for >24 hours
- HV currents
  - must still be <40 nA/side after HV on for 24 hours
- LV currents
  - must still be to final specification w/in ~0.5A
- R/O
  - all 8 TDIG boards must respond to pcanloop/pc commands over actual data path cabling
- Noise rates
  - must still be <40 Hz in all channels
- Dead channels
  - must still be <6/tray

Start-Side Status and Plans

pVPD detectors work well but...
an increased coverage/higher channel count within the similar integration volume is needed

Basic idea

pVPD 2” linear PMTs + significant shielding → 1.5” mesh PMTs + no shielding...

increase number of detector channels on each side from 3 to 19...

same Z-location as pVPD (Runs-2 to -5) but smaller radial extent...
total weight is 2/3 of that of the pVPD

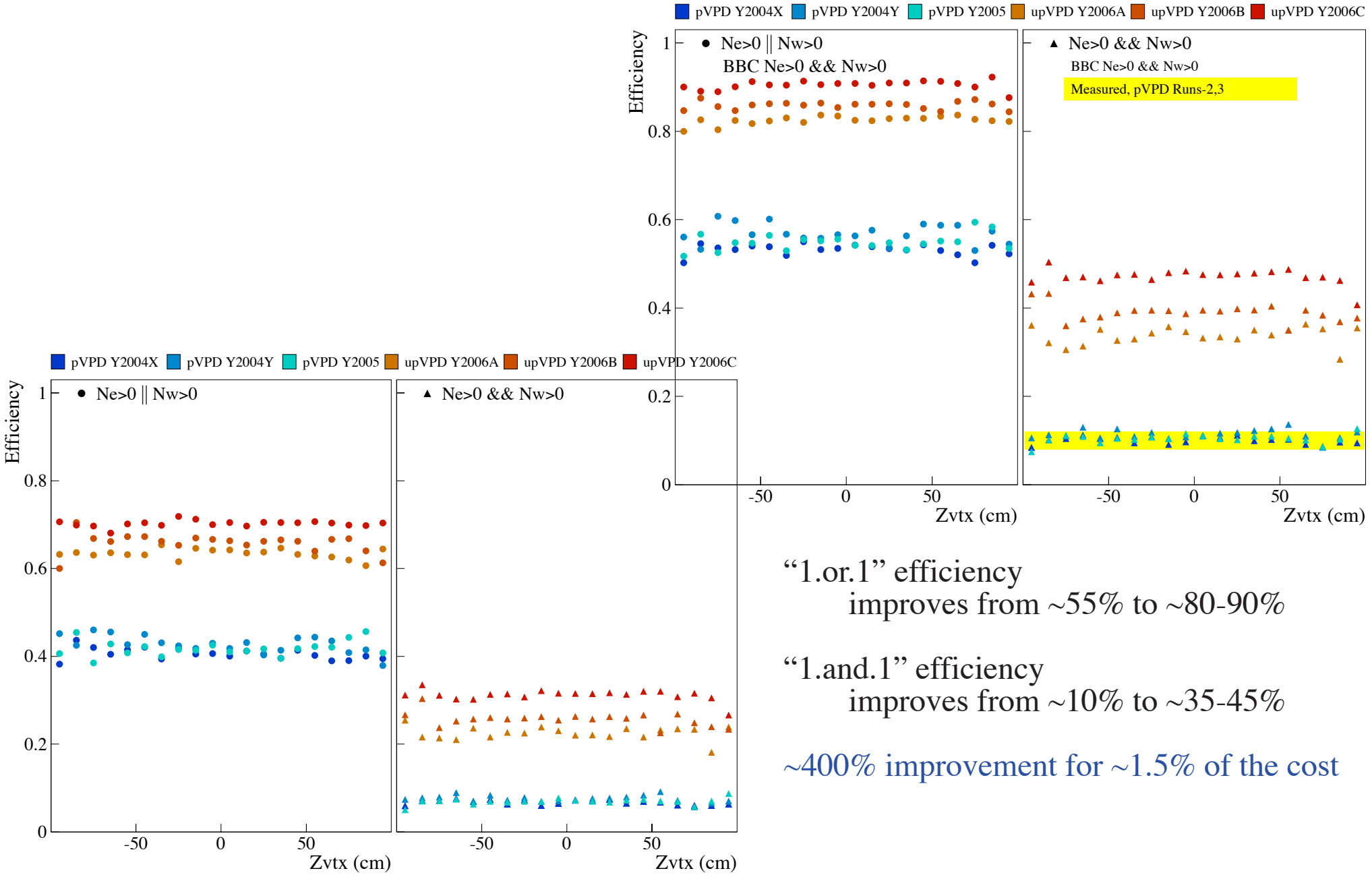
Electronics: TPMD + TDIG(new) + TCPU + THUB

HV from BBC’s LeCroy 1440 supply, cabled & ready now.

PMTs for prototype detector will be R5946 PMTs from decommissioned TOFp
already separated from the TOFp slats, and gain & dark current tested.
Pb converter + Scint

Simulations of the Upgraded pVPD (Performance)

- concentrate on minimum bias p+p collisions (pythia, MSEL=2)
- study efficiency by which detector can produce start times for the different detector geometries



"1.or.1" efficiency
improves from ~55% to ~80-90%

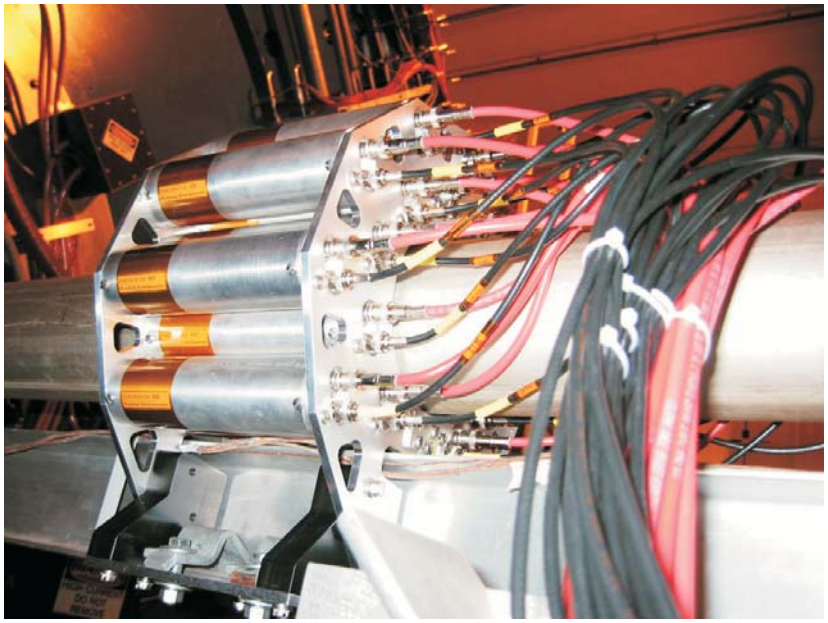
"1.and.1" efficiency
improves from ~10% to ~35-45%

~400% improvement for ~1.5% of the cost

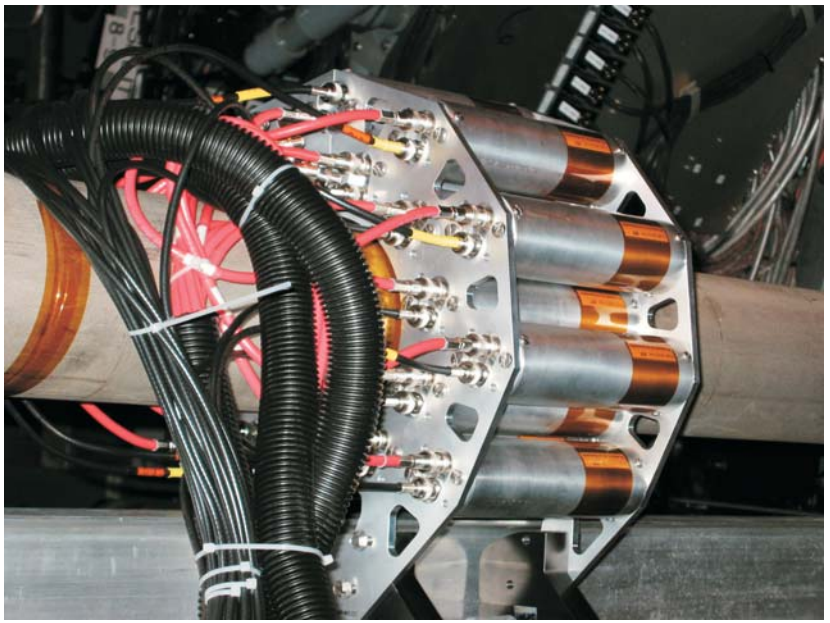
upVPD is now constructed!

PMTs from TOFp
Mechanical structure machined at UT-Austin
linear high-rate bases from UCLA

East



West



Gas System Status

- Design review held at BNL in April 2006 (B. Stringfellow, H. Wieman, R. Brown, L. Kotchenda, & G. Eppley)
- Updated cost profile (still fits in budget)
- Replacing present gas control computer this run, new one will be used in final gas system

The system:

- regulates the flow rate
  with provisions to recognize and compensate for rapid atmospheric pressure changes
- monitors the gas mixture's temperature, flammability, Oxygen-content, and humidity
  drying and purification of a fraction of the mixture is possible when needed
- includes a control and DAQ computer system that with EPICS logs system parameters
  and provides a means of remote control
- is nominally a closed circuit system,
  but small amounts of fresh mixture are added & the same amount of existing mixture is vented.
  this "small amount" adjustable in range: 100 - 550 ccm
  factor ~2 to ~9 larger than present vent rate (63ccm & one tray in an open system)
  system can be run "open" for purging.

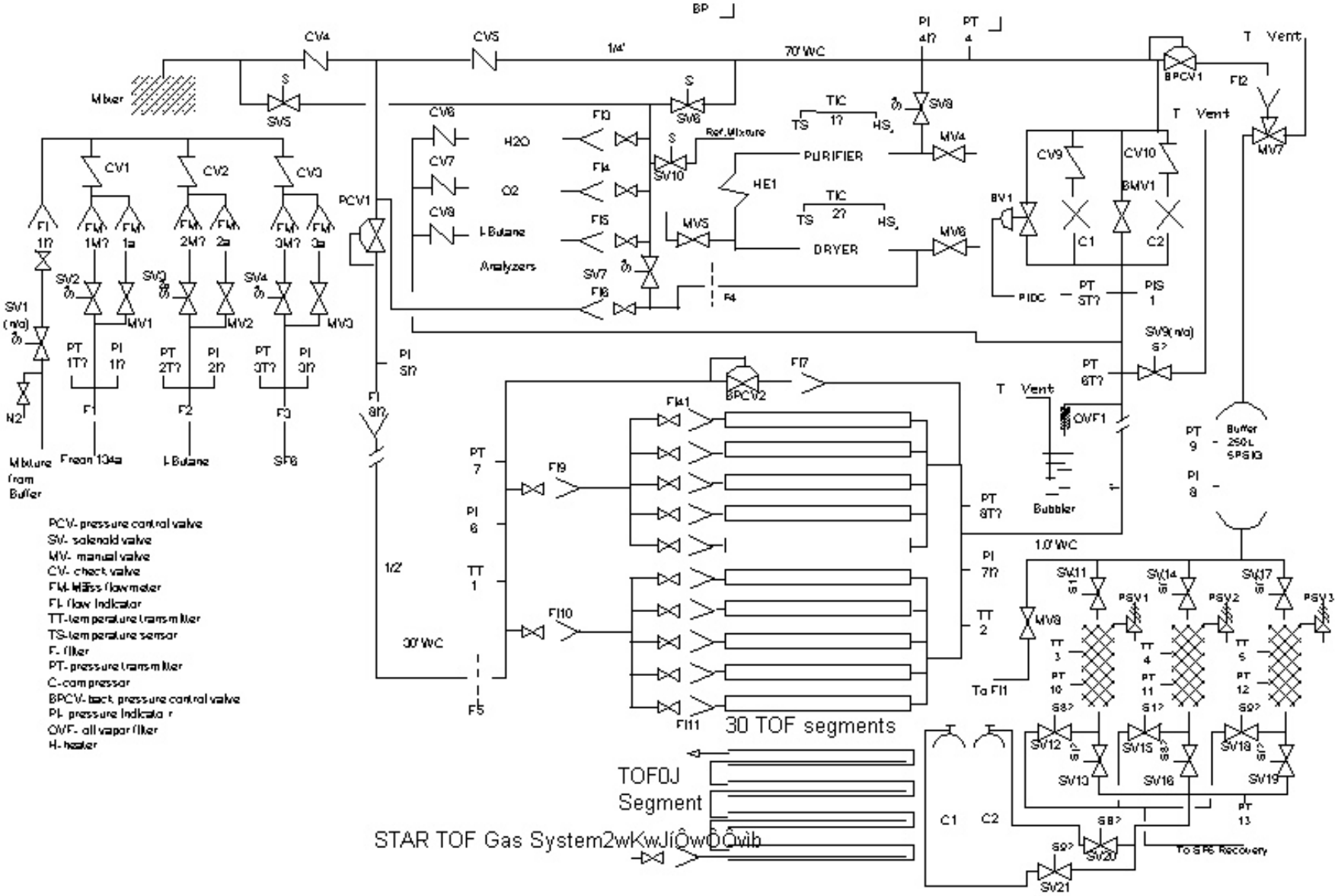
Leonid proposes three versions of the gas system.

1. recirculation with a small amount of mixture vented to the atmosphere. In the case of barometric pressure increasing(tornado) the TOF pure R-134a will be added to compensate TOF pressure drop. It means the mixture content will be changed inside TOF.

2. recirculation with a small amount of mixture vented through 250 liter buffer. In this case the buffer mixture will be used to compensate for the TOF pressure drop during tornado.

3.recirculation with a small amount of mixture vented to the recovery system. A new Freon Recovery system will permit one to recycle Freon R-134a. You can save money up to $10000 per run.

My opinion. I prefer version 3.
PHENIX will use the same mixture(134a+5%SF6+5%iButane) for their TOF and other new detector.



design allows for 3 components
Leonid favors including a Freon-Recycling system jointly supported by us & PHENIX
schematic above shows a recirculating system
system that vents through a 250 liter buffer has also been designed.

Database Status

RICE

Return to DB Login Page

Database Login

Both of these areas are password protected. The experts login is only for users priviledged to insert, delete, and alter data. General STAR users are allowed to view all data but cannot modify them.

Login to the TOF Database as an expert user

Login to the TOF Database as a general STAR user

UT@Austin Database

Chinese MRPC Database

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RICE

Return to DB Login Page

Database Index

The following DATABASEs are available now.

Goto TRAY Database	**Search for TRAY#:**	Add new TRAY
Goto MRPC Database	**Search for MRPC#:**	Add new MRPC
Goto TINO Database	**Search for TINO#:**	Add new TINO
Goto TDIG Database	**Search for TDIG#:**	Add new TDIG
Goto TCPU Database	**Search for TCPU#:**	Add new TCPU

Advanced Query

TOF Digital Journal

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RICE

Return to DB Home

TOF DATABASE expert User

Search for:

TRAY#:

Add A Tray

TRAY Database

MRPC Database

TINO Database

TDIG Database

TCPU Database

Advanced Query

TOF Digital Journal

Tray Status Summary Table(TOTAL 39)

	Tray #	Arrive@Rice	Arrive@UT	Arrive@BNL	Current Location	Status	Positon in TOF	Details
1	1	2006-09-19	2006-09-20	2006-09-20	unknown	Unknown	east1	Details
2	2	2006-09-20	2006-09-20	2006-09-20	Unknown	Unknown	east1	Details
3	3	2006-09-20	2006-09-20	2006-09-20	Unknown	Unknown	east1	Details
4	4	2006-09-20	2006-09-20	2006-09-20	unknown	Unknown	east1	Details
5	5	2006-09-20	2006-09-20	2006-09-20	unknown	Unknown	east1	Details
6	6	2006-09-20	2006-09-20	2006-09-20	Unknown	Unknown	east1	Details
7	7	2006-09-20	2006-09-20	2006-09-20	unknown	Unknown	east1	Details
8	8	2006-09-20	2006-09-20	2006-09-20	unknown	Unknown	east1	Details
9	9	2006-09-20	2006-09-20	2006-09-20	Unknown	Unknown	east1	Details
10	10	2006-09-20	2006-09-20	2006-09-20	Unknown	Unknown	east1	Details
11	11	2006-09-20	2006-09-20	2006-09-20	Unknown	Unknown	east1	Details
12	12	2006-09-20	2006-09-20	2006-09-20	Unknown	Unknown	east1	Details
13	13	2006-09-20	2006-09-20	2006				
14	14	2006-09-20	2006-09-20	2006				
15	15	2006-09-20	2006-09-20	2006				
16	16	2006-09-20	2006-09-20	2006				
17	19	2006-09-20	2006-09-20	2006				
18	20	2006-09-20	2006-09-20	2006				
19	21	2006-09-20	2006-09-20	2006				
20	22	2006-09-20	2006-09-20	2006				

Forw

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RICE

Return to DB Home

Tray# 1

Search Tray#:

Add A New Tray

Edit this Tray

TRAY Database

MRPC Database

TINO Database

TDIG Database

TCPU Database

Tray# 1 information

				Tray #	1				
Tray TOP#	1	Tray Bottom#	1	Tray Cover#	1	Received by	Jing	Current Location	unknown
Arrive@Rice	2006-09-19	Ship to UT	2006-09-20	Arrive@UT	2006-09-20	Ship to BNL	2006-09-20	Arrive@BNL	2006-09-20
Length	234	Width	56	Height	66	Position in TOF	east1	Status	Unknown
				TCPU	TCPU0001				
TINO:	1 - 8:								
TDIG:	1 - 8:								
MRPC:	1 - 8:								
MRPC:	9 - 16:								
MRPC:	17 - 24:								
MRPC:	25 - 32:								
Comments									

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“Mechanical” Action Items from STAR Review, January 26-27, 2006

mechanical specifications agreement between the U.S. and Chinese collaborators dealing with the individual MRPC modules.

actual average weight, and some measure for the expected distribution of the weights (e.g. rms), of the final TOF trays is not known.

the Finite Element Array (FEA) analysis indicates that the weight of the TOF array will not distort the vessel to a degree that causes concern, the committee felt that this calculation should be empirically checked if practicable.

not clear ... whether the distortion of the STAR magnetic field due to the material in the TOF trays had been studied

not clear whether the difference in radiation length between the existing CTB trays and the TOF trays had been documented and circulated

staging and testing the TOF trays at BNL requires an area to be identified. The necessary area (e.g. how many m2 and any constraints on shape of area) should be specified, and then identified and allocated

mechanical structure designed and built to store the trays during this testing/stageing process.

what will be done with the CTB trays as they are removed

some problems encountered in the past in sliding prototype TOF trays onto the rails on the TPC gas vessel. The cause of this past problem had been diagnosed by the TOF group (detached and crumpled Teflon tape).

a few electronics boxes (e.g. HV distribution and THUB boxes) which had not yet reached final design, and which had to be located and mounted somewhere on the STAR magnet. The locating of these boxes, and schemes for mounting them, should be determined and documented

Near Term Focus

- first batch of "final trays" just fabricated, delivered to Rice on Sept 21, 2006
  fit and finish checks, dimensions & tolerances check
- build single tray without electronics or MRPCs to check everything fits together correctly
  including cooling loop and inner sides
- single-rail load test
- upon the availability of the (completely new) electronics:
  build a new full sealed tray w/ MRPCs and electronics
  try get this done early enough to get some data in Run-7
- repeat temperature, heat and power flow tests with new tray and electronics
  ~100W vs 140W, more efficient cooling loop, solid cover
- finalize tray mechanical and assembled tray database (see next page for present status)

Slightly Longer Term

- final production of 120 trays
- design and fabricate tray installation fixture and TPC support structure
- ramp up UT assembly line