



## Detectors & Mechanical

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US DOE review of STAR TOF  
BNL, August 11-12, 2008

### Outline:

- First delivery & WAH test stand
- Gas system
- Water system
- Installation - procedure & fixture
- Start detector

# WAH Testing

Flow Freon, raise HV

show HV stability and “low currents”

Apply LV one tray at a time

show “low noise rates” and search for any dead channels

Repeat tests later (improved gas quality)

Before Run-8

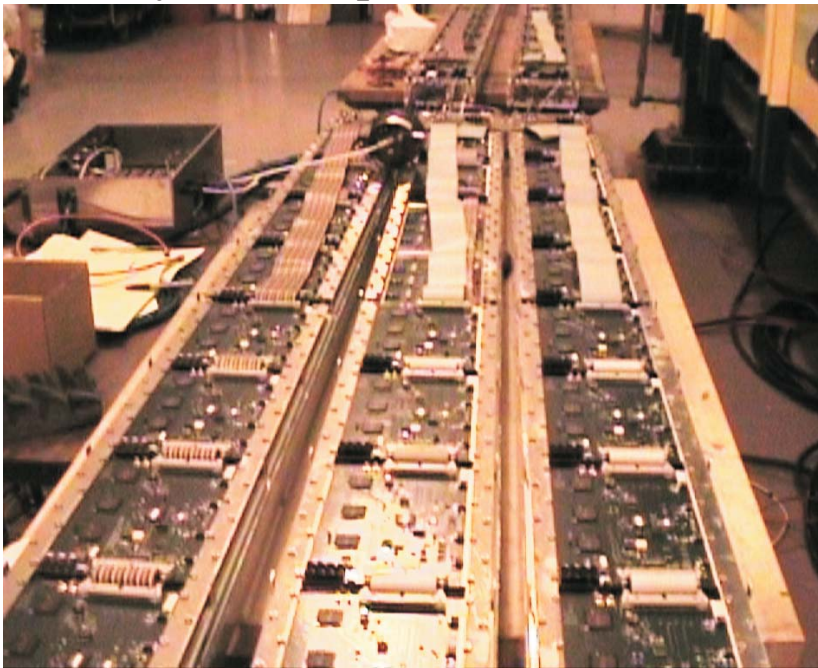
5 trays

3 large tables

all facilities from platform

temporary gas runs from NE corner

trays tested open



wrong model for testing 25-30 trays at a time  
...new test stand constructed at UT



First delivery of final trays to WAH on Monday June 30, 2008



Test Stand Reassembled  
trays unpacked & installed  
connected to gas system  
and HV system  
by Thursday July 3, 2008

Successful BNL Safety Review of teststand area  
Tuesday July 1, 2008

- no loading trays above shoulder height w/out manlifts
- no unattended voltage

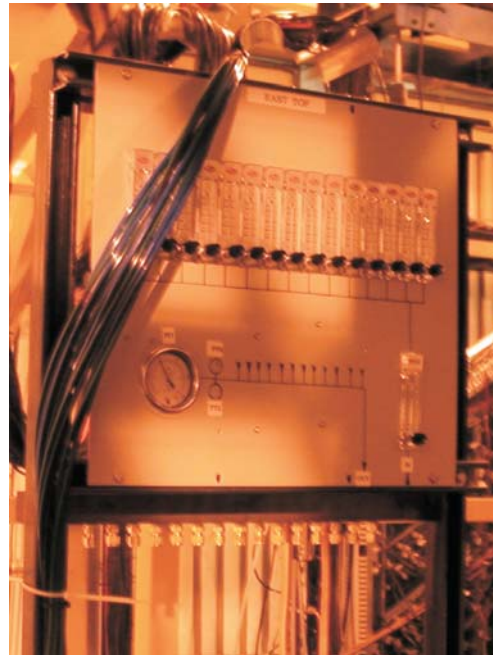


# Gas System

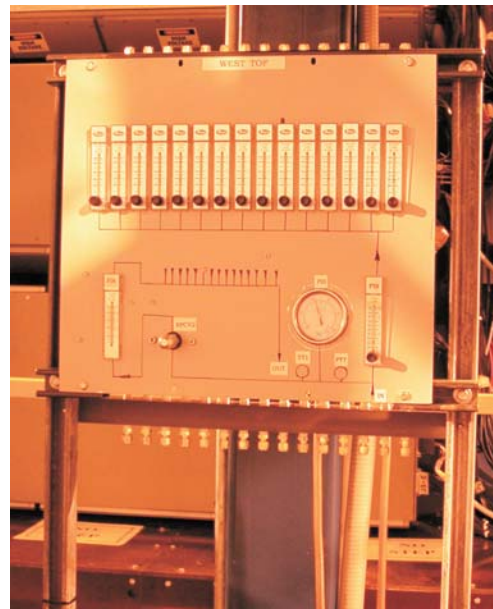
main control panel



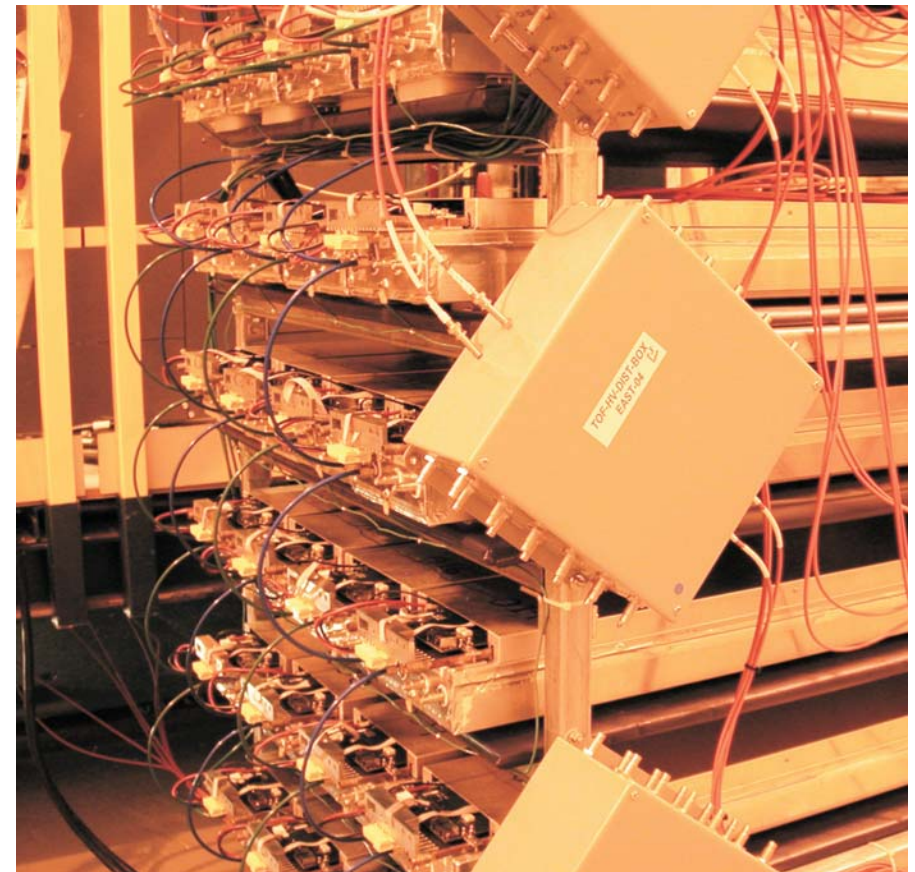
east distribution



west distribution



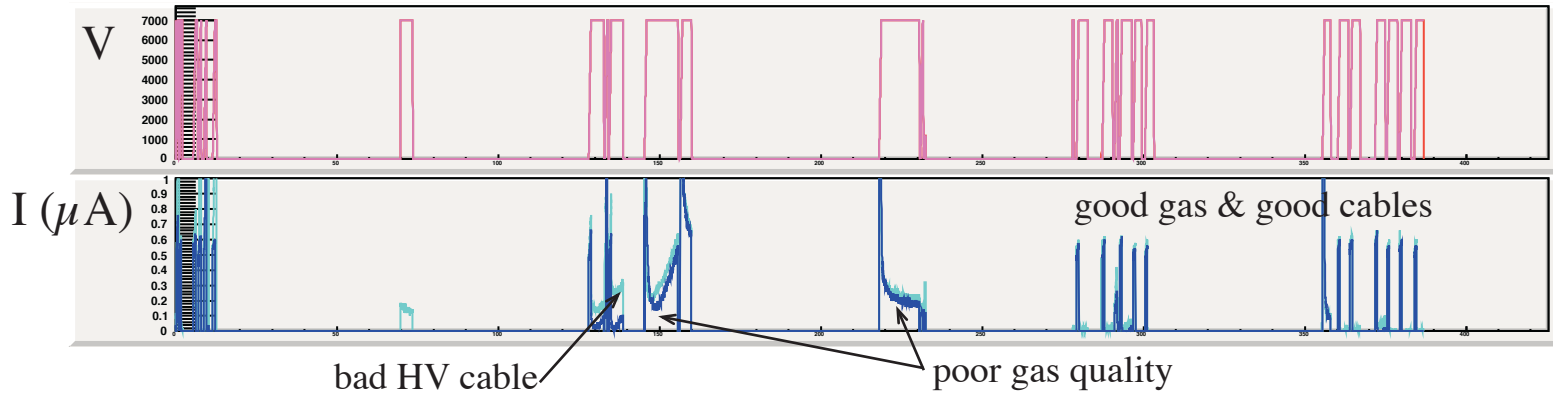
six supply-return loops to teststand  
5 trays per loop



Quite some growing pains getting used  
to full gas system & dist. panels

Not yet recirculating gas  
a return line needs to be cleaned  
planned October 2008

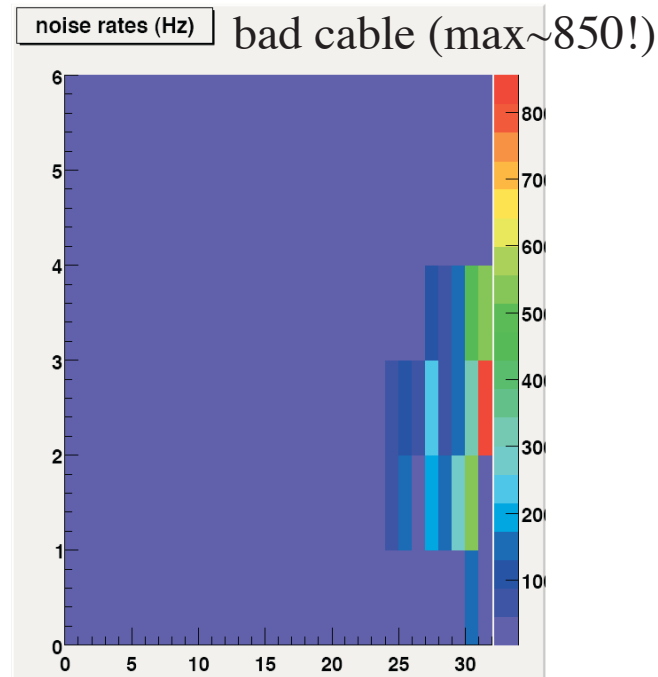
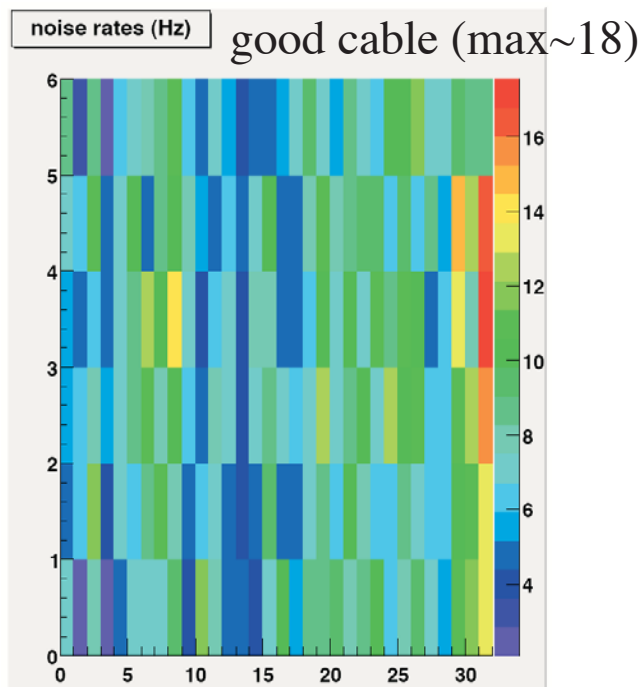
# Test Stand Results (HV Stability, HV current draw, noise rates)



Cable #	I+	I-
26	0	0
27	0	0.02
28	0.02	0
29	0.02	0.02
30	0.04	0.04
31	0.04	0.04
32	0	0
33		
34	0.4	0
35	0	1.5
36	0	0.2
37	0	0.34
38	0.08	0
39	0	0
40	0.14	3.08
41	0	0.02
42	0	0.4
43	4	0.1
44	0.04	0
45	0	0.04
46	0	0.02
47	0.04	0
48	0.56	0
49	4.6	0
50	0.06	0.46
51	0.02	0.04
52	0.1	0
53	0.56	0.02
54	0.2	0.06
55	0	0.02

Significant leakage current from some HV cables!

Also increases “noise rates” for MRPCs close to HV feed-throughs!



All trays ramped with good cables.

All noise rates < 50Hz once gas quality improved

One new dead channel

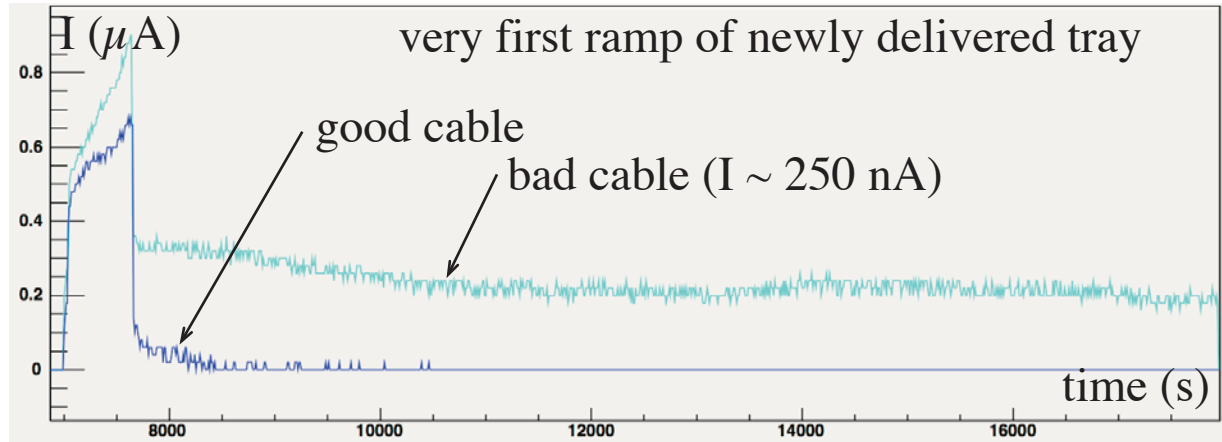
# HV Cable Leakage Current (cont.)

Three separate fabrication batches at KC Electronics

- Batch 1: 30 @ 20'
- Batch 2: 80 @ 25'
- Batch 3: 150 @ 30'

-----  
260 total

10 @ 20' used in Run-8...



Leakage current test results in the last few days:

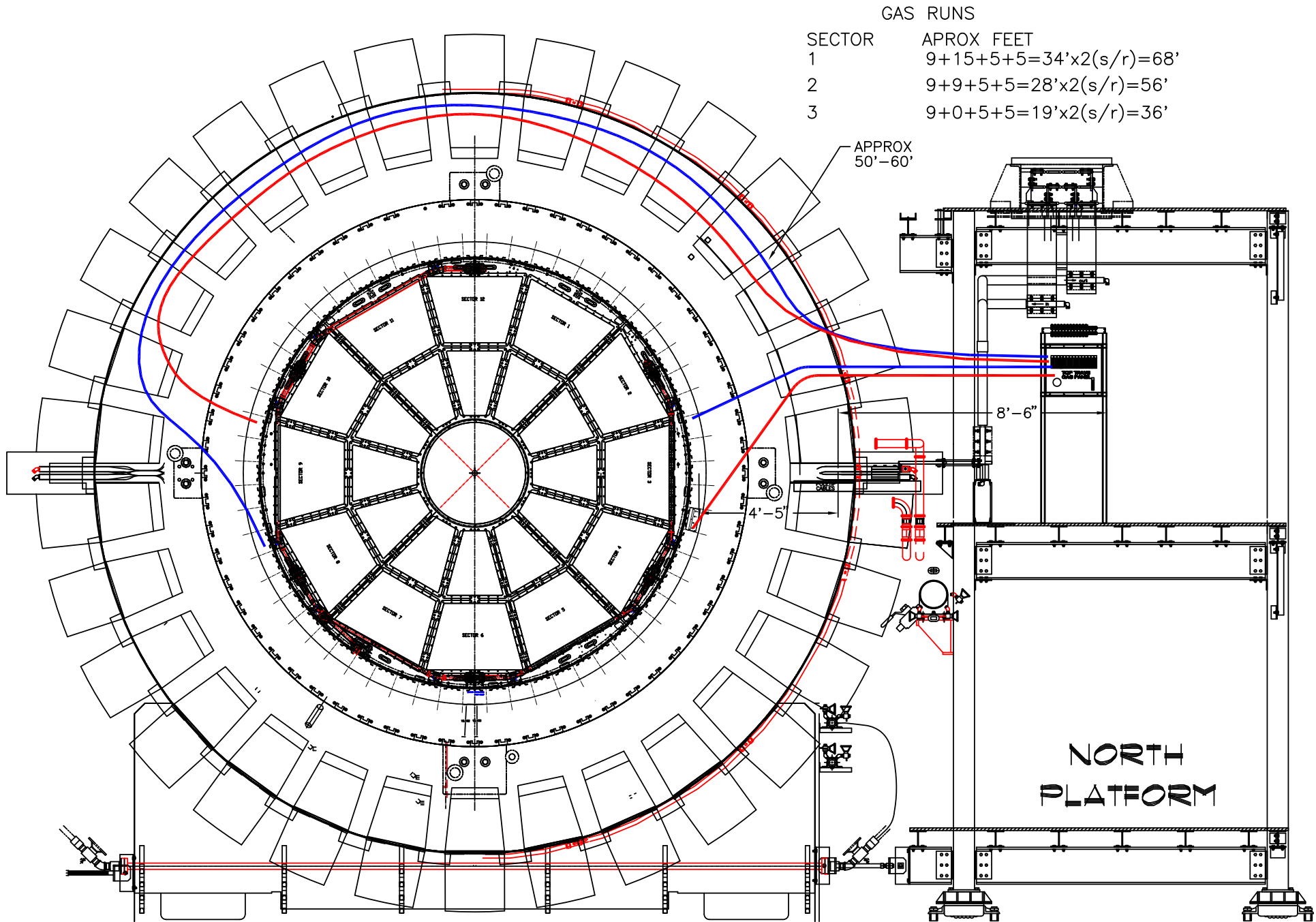
- 110 of the 30'
- 20 of the 20'
- 9 hour test of some of the “worst” 30' cables

Leakage Current	Total	Box1	Box2	Box3
$I \leq 0.02 \text{ uA}$	= 28	4	16	8
$0.02 < I \leq 1.00 \text{ uA}$	= 52	25	3	24
$1.00 < I$	= 30	21	1	8
$I \leq 0.02 \text{ uA}$	= 0.25	0.04	0.15	0.07
$0.02 < I \leq 1.00 \text{ uA}$	= 0.47	0.23	0.03	0.22
$1.00 < I$	= 0.27	0.19	0.01	0.07

- Different success rates for 30' cables by “box” suggested chronological correlation at KC
- All of the tested 20' cables have  $I < 0.02 \text{ uA}$  (...O.K...)
- Longer term test shows that 30' cables with  $I < 1 \text{ uA}$  will “burn in” over 4-6 hrs to  $I < 0.02 \text{ uA}$ .
- Representative from KC electronics to visit the site on Wednesday this week.

# Gas distribution runs defined (J. Scheblein STSG), total tubing = 3000 feet.

Z:\Dwgs\TOF\TOF-TRAY-GAS-RUN-Llope.dwg, 8/5/2008 4:08:49 PM



## GAS RUNS

SECTOR	APROX FEET
1	$9+15+5+5=34' \times 2(s/r)=68'$
2	$9+9+5+5=28' \times 2(s/r)=56'$
3	$9+0+5+5=19' \times 2(s/r)=36'$

APPROX  
50'-60'

8'-6"

4'-5"

NORTH  
PLATFORM

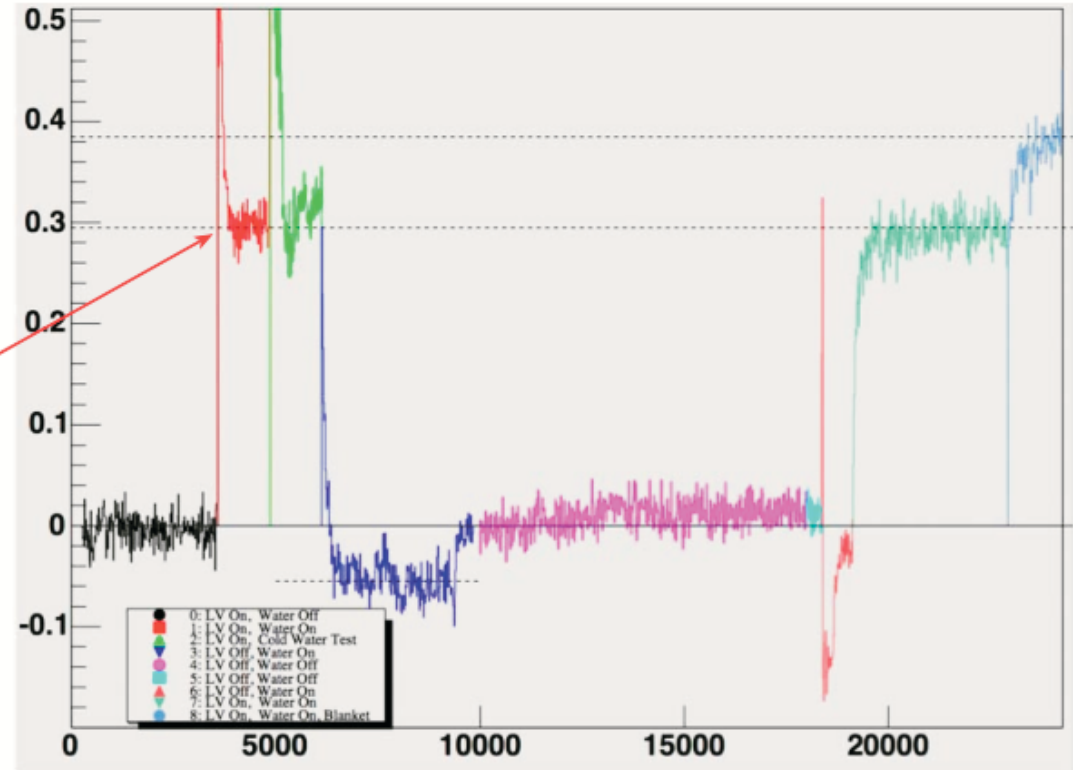
# Water System -- copper water loop running between TINO & TDIG

## Power tests of TOFr5

140W total  
square loop + shims  
perforated tray cover

water  $T_{input} \sim 31$  deg C  
flow rate  $\sim 1.36$  Gpm  
water  $\Delta T \sim 0.295$  deg C

$P(\text{water}) \sim 105$  W  
 $P(\text{radiative}) \sim 35$  W  
 $P(\text{convective}) < 1$  W



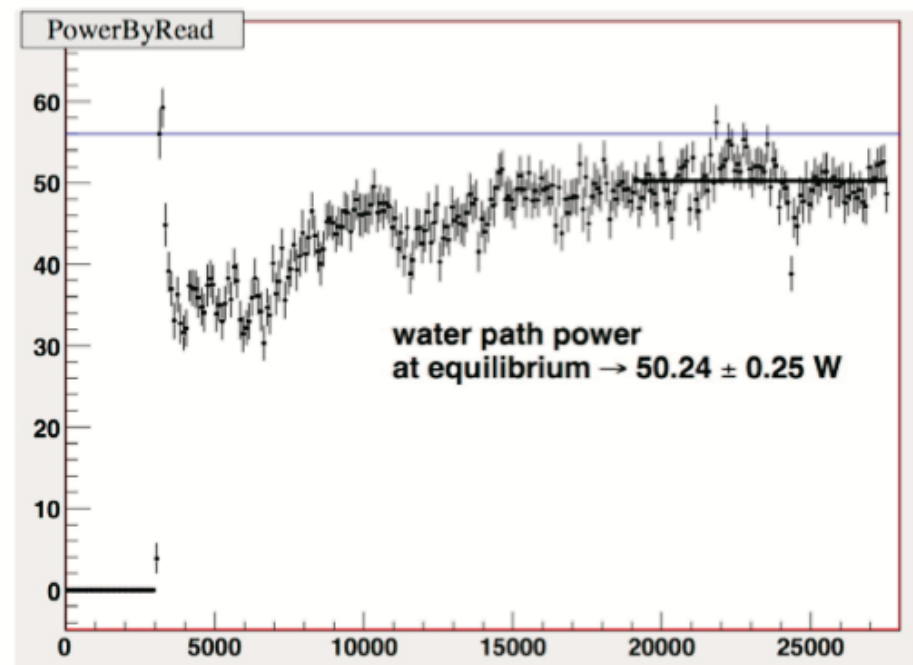
## Power tests w/ early TDIG-Ds

55W total  
rectangular loop + thinner shims  
solid tray cover

water  $T_{input} \sim 31$  deg C

$\Delta T \sim 0.07$  deg C

$P(\text{water}) \sim 50$  W





## Water System (cont.)

### Requirements:

- leakless
- Temperature ~25 deg C
- Pressure ~50 psi
- Flow rate ~1-2 Gpm

No leaks in for single trays in Runs 4-6  
(no water for Run-3 tray)

5 trays in Run-8

two leaks during and afterwards

1 during run req. pole-tip removal

1 on July 3, 2008

leaks occurred at connection of  
vinyl braided hose to Tray Cu loop barbs

Will use more expensive high-performance  
clamps from now on.

re-torque after 2 weeks

Additional TOF cooling loop delivered  
to BNL with first batch of 30 trays to  
long-term-test leaklessness....

### Distribution system design (from STSG)

- source is MCW not TPC water  
T ~ 16 deg C
- 2 manifolds on each side of STAR
- 3/4" hose from manifolds to new fan-outs
- 6 ports on each fan-out  
→ 24 ports total

5 trays on each water loop, same as the  
5 trays on each gas loop, same as  
1 TPC sector

(open question) is water too cold?

heating required to control condensation?

to be discussed during an TOF+STSG

“infrastructure” discussion tomorrow morning.

MCW system shared with other subsystems



Bridge Opening T-Bolt  
Hose Clamps

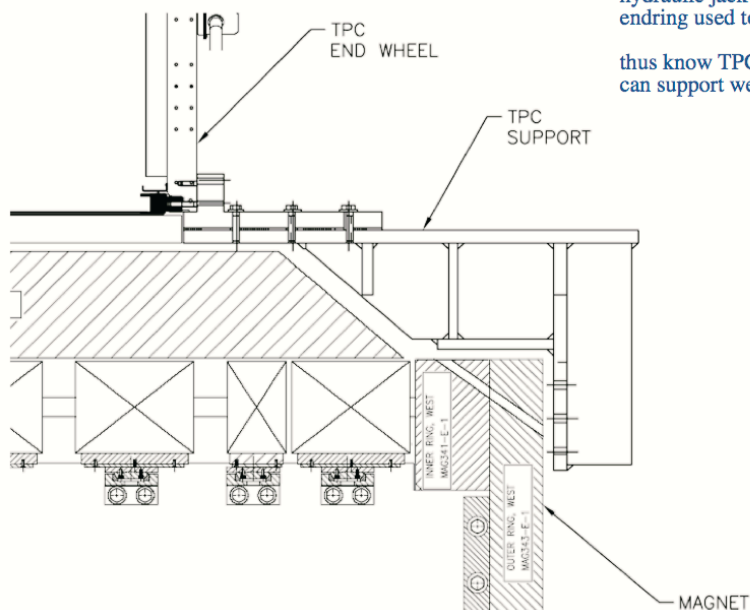
# Tray Installation

large TPC support arms at 3 and 9 o'clock



requires special fixture to support TPC while inserting trays at these locations

TPC 6 o'clock Support Concept



During BEMC installation, hydraulic jack on TPC support ending used to support TPC.

thus know TPC support endings can support weight of TPC.

fixture is designed, and will be available during run-10 shurdown

First 30 trays to go on West 2 - 8 o'clock installed from the east

Next 30 trays complete the West ring

Next 30 trays to go on East 2 - 8 o'clock

Final 30 trays behind support arms and complete the East ring

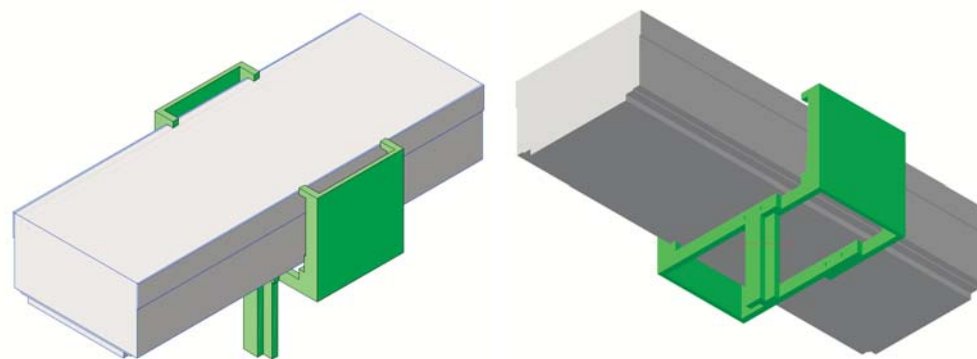
Lots of discussion about an insertion fixture

- “squeezing” trays might stress MRPCs
- need to limit stress on tray feet

~~TPC Rail on spreader arm hung from crane~~

~~Rail bolted to magnet end-rings~~

Special tray clamps to protect tray skin



Choreography of insertion procedure, touch-points, etc, part of TOF+STSG discussion tomorrow morning

# Start Detector Status

## Cosmic tests before Run-6

single detector  $\sigma \sim 125$  ps

## Run-6:

only 2 weeks of data

MOSFET-base failures at  $\sim$ one/day.

## Run-7 (Au+Au)

new linear bases

primary input to STAR min.bias trigger

trigger Zvtx resn  $\sim 5$  cm

only TOF-digitized data from last 2 days

canbus data (no event structure)

un-triggered events

west side only

single detector  $\sigma \sim 170$  ps

recognized some ringing before Run-8

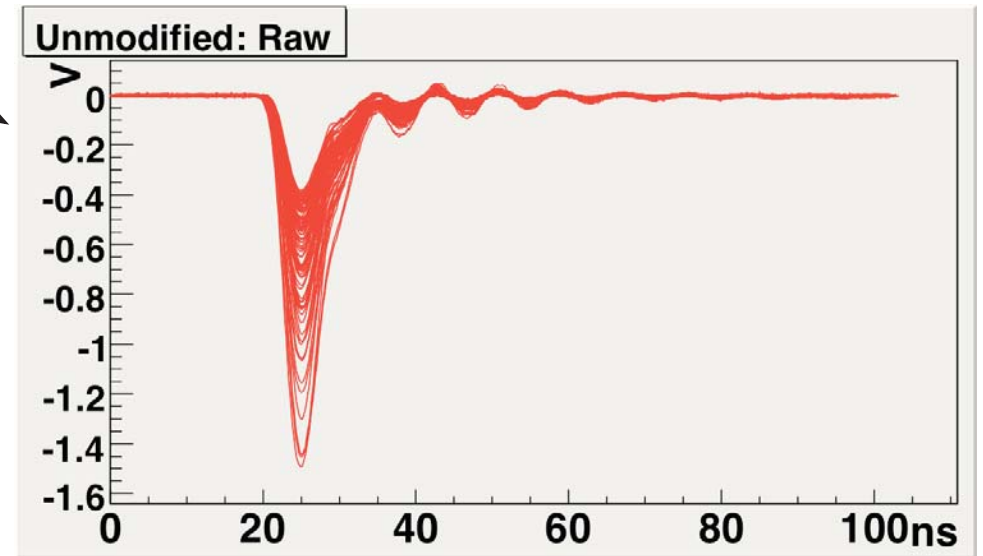
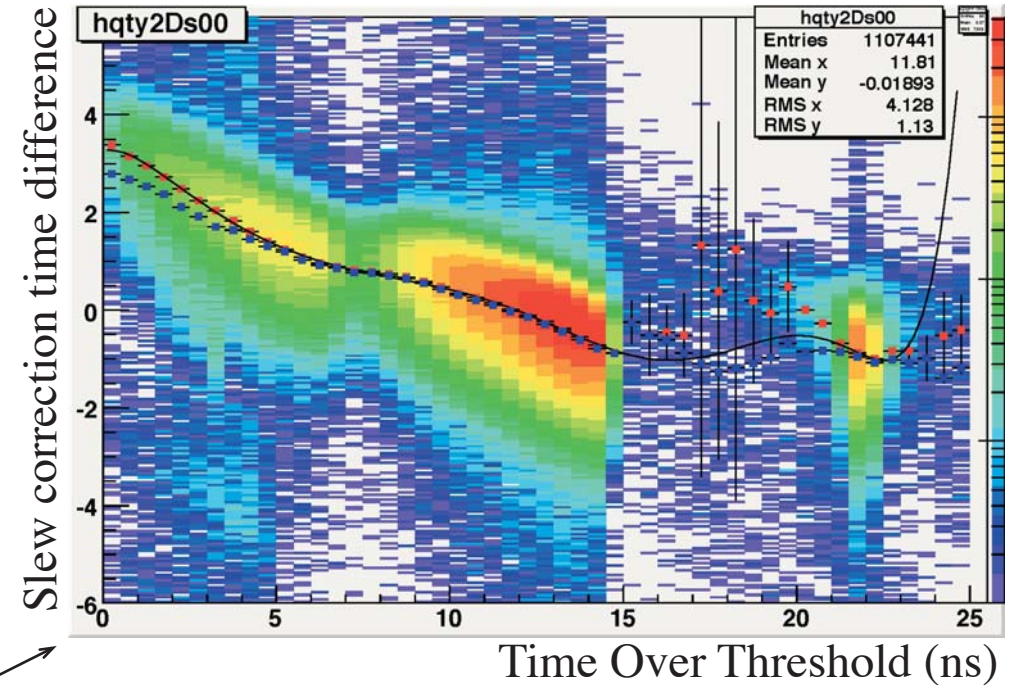
additional 12ns & 24ns cable sections used  
to avoid HPTDC cross-talk

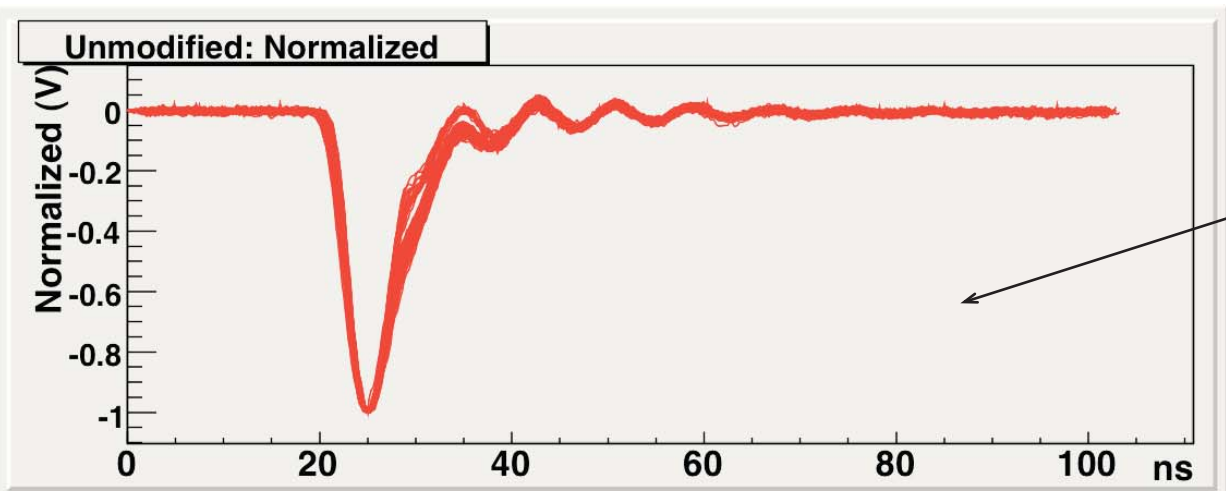
## Run-8 (d+Au, p+p, & 9 GeV Au+Au)

again, an input to STAR trigger

single detector  $\sigma \sim 130$ -140 ps

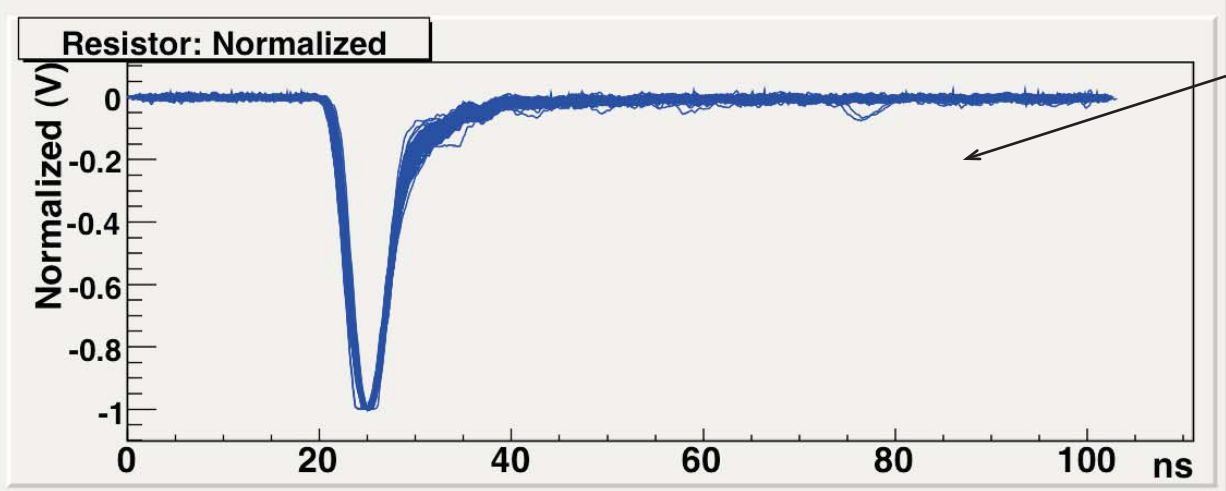
in both p+p and d+Au





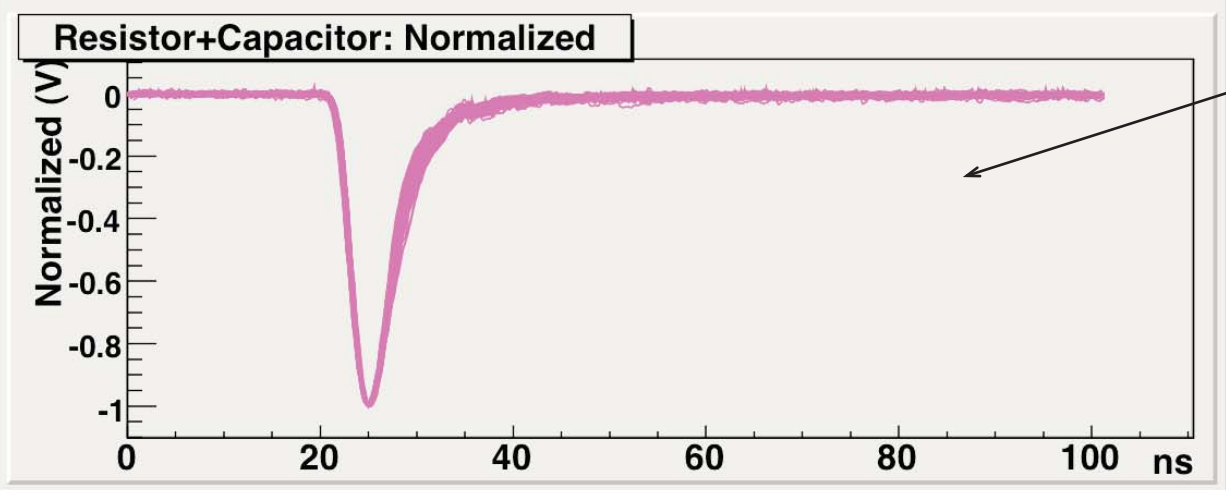
Normalized to 1V pulse height

un-modified



resistor modification

all bases now have this modification



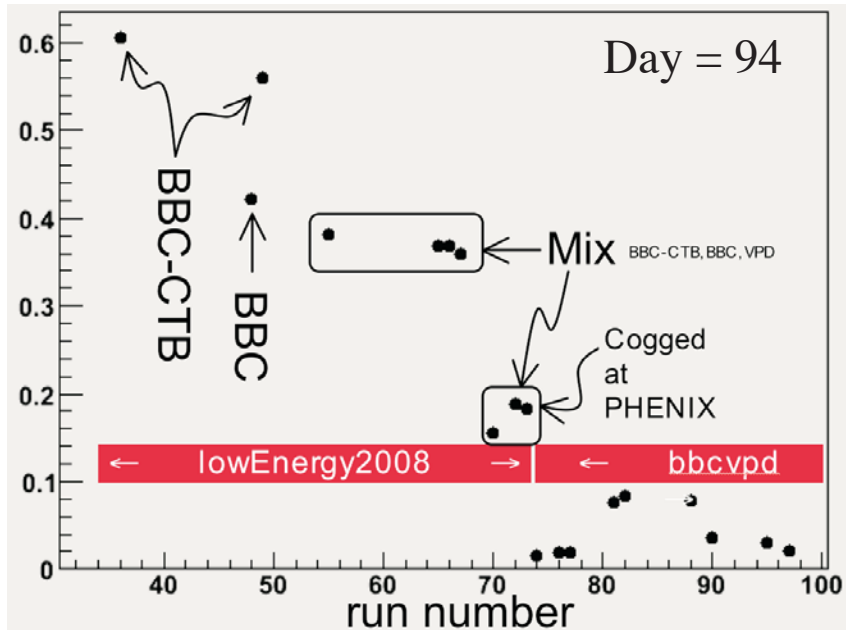
resistor + capacitor modification

additional small improvement  
but more difficult to solder

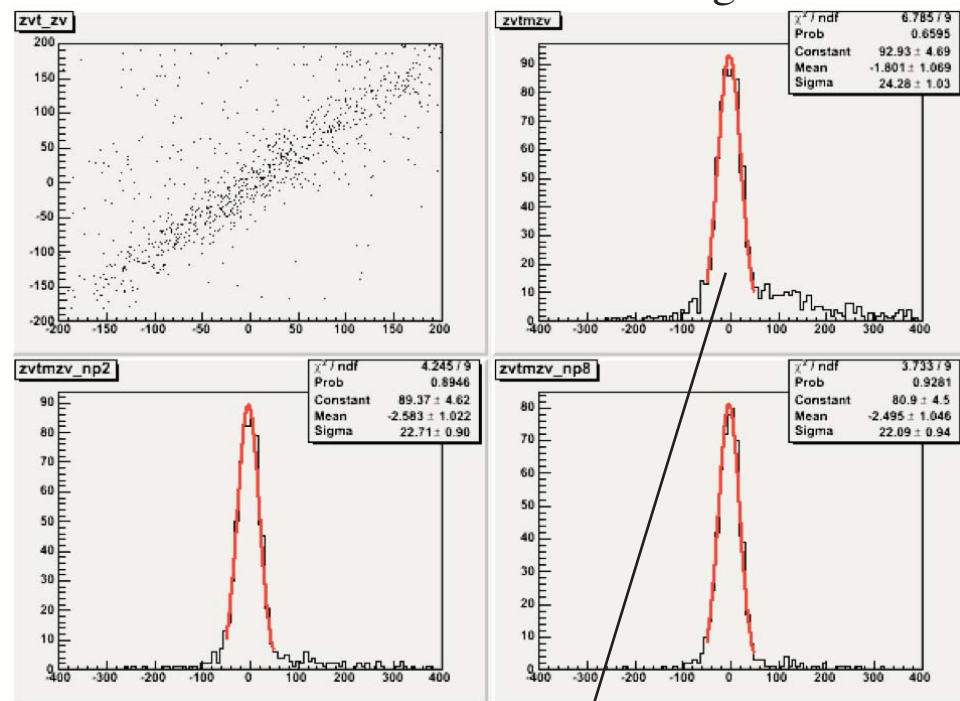
will be done too

# Start Detector in Low Energy Run-8 (9 GeV)

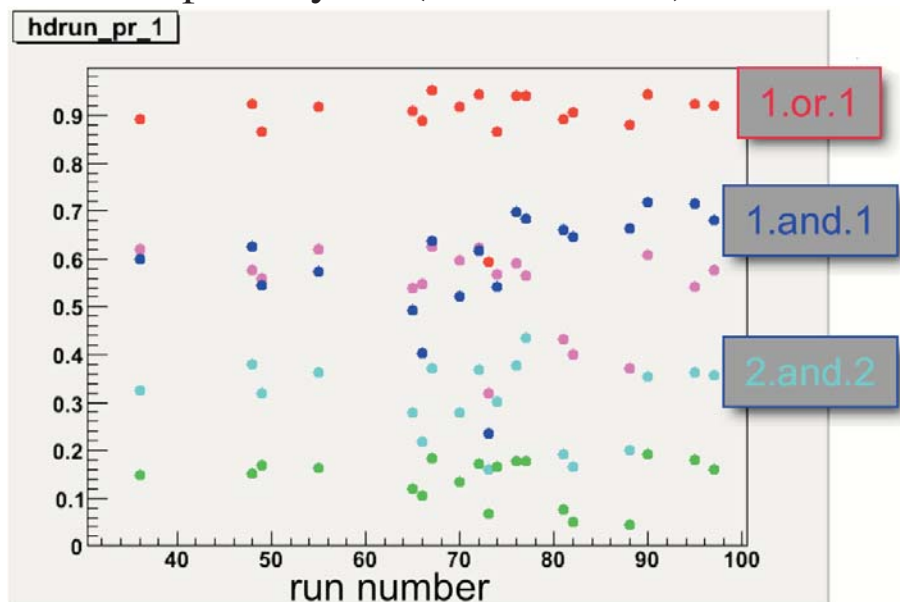
some ☆ problems triggering on actual collisions



Zvtx from upVPD timing vs Zvtx from tracking...



nprimary>0 (or nvertex>0)



Zvtx resn ~ 22-24 cm

no upVPD slewing correction  
earliest hits on east and west

→ single det  $\sigma \sim 1$  ns (as expected!)

upVPD coincidence efficiency ~ 60% !!!

## Summary

- test stand now “permanent” part of south section of WAH & BNL Safety Committee-approved facilities needed for testing (HV, LV, and gas) use the full-system interfaces, which tests these too. available for all subsequent tray shipments.
- first delivery of 30 trays was “successful”
  - all trays pass on-site test suite, one new dead channel
  - now total of 3 dead channels in 35 delivered trays ( $3/6720 = 0.04\%$ )
  - only issue is measurable leakage current in some of the short HV cables ( $\sim 1\text{-}2\text{ M}\Omega$ )
- gas system nearly complete, not yet commissioned
  - some growing pains in the last few weeks....
  - some pipes need to be cleaned, etc, but the full system is now coming “on-shell”
  - not recirculating gas yet
- water and gas distribution networks now designed by STSG, parts ordering now underway
  - water - major improvement to the clamp connection to each tray
  - gas - gas runs defined, parts ordered, installation beginning mid-August.
- tray insertion fixturing involving specific mechanical devices does not seem practical...
  - present approach is instead a rigorous definition of the choreography and touch points.
- important meeting between STSG and TOF tomorrow morning to work through these & other issues
- TPC support structure designed. to be made available in the next shutdown.
- Start detector is (somewhat surprisingly) highly-efficient ( $\sim 60\%$ ) during the 9 GeV test run in Run-8
  - Start Detector base “ringing” now reduced via electronic modifications