

MTD Mechanics

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MTD Review
BNL, Sept. 17, 2010

Outline:

- MTD7 & MTD9 Prototypes
- MTD11 Project
 - New MRPC design
 - First Bench/Cosmics Results
- Full System
 - Tray Design
 - Tray Mounting
 - Mechanical Integration
 - Gas & HV systems
 - Assembly Team & Space
- Conclusions

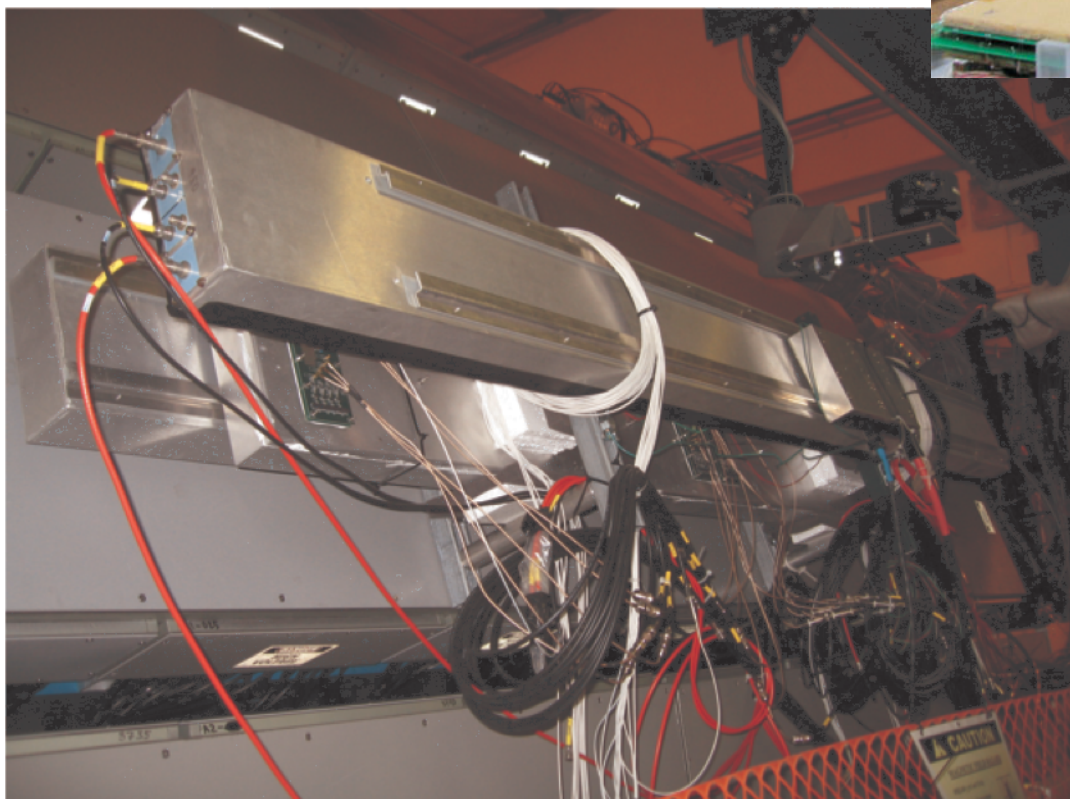
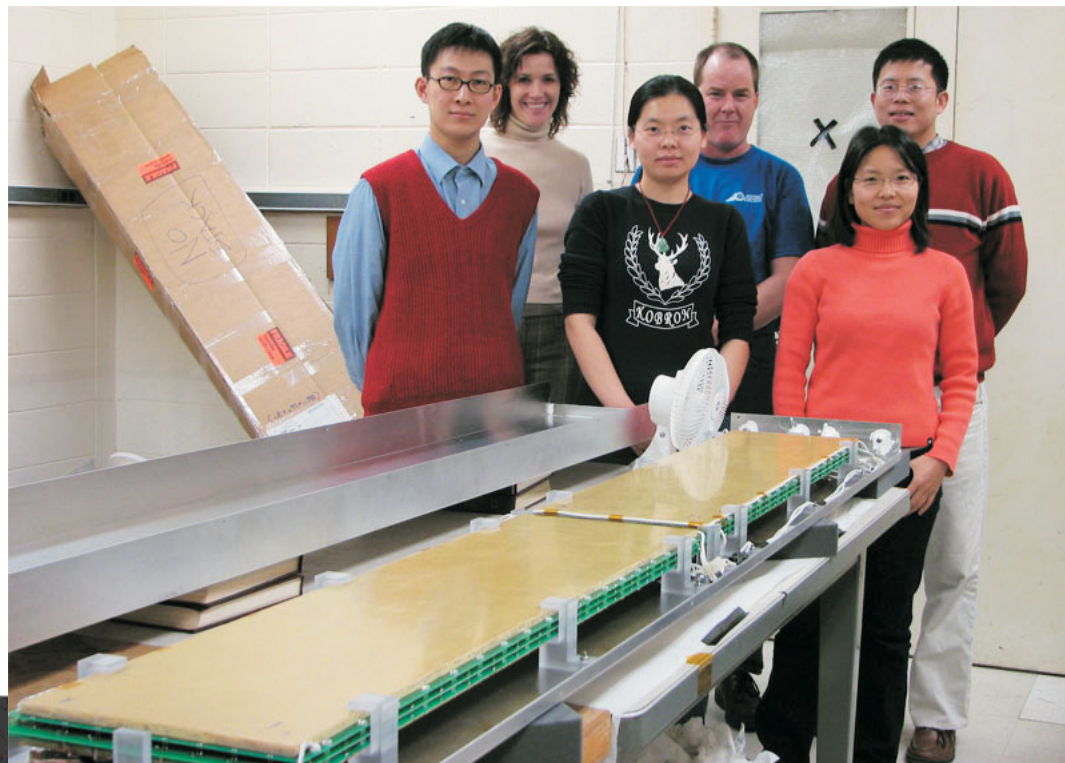
MTD7

Two “LMRPCs” end-to-end
2x6 strips

TOF-style “shoebox” enclosure
Built in Houston
Assembly at BNL

Simple FEE & long cables
Digitization on platform
in old TRG electronics (CDB boards)

Operated throughout Runs 7 and 8...



Showed “matching enhancement”
from muons

Smooth operation, no major problems...

Time resolution was poor ($\sim 300\text{ps}$)
due to long cables and digitizers used.

MTD9

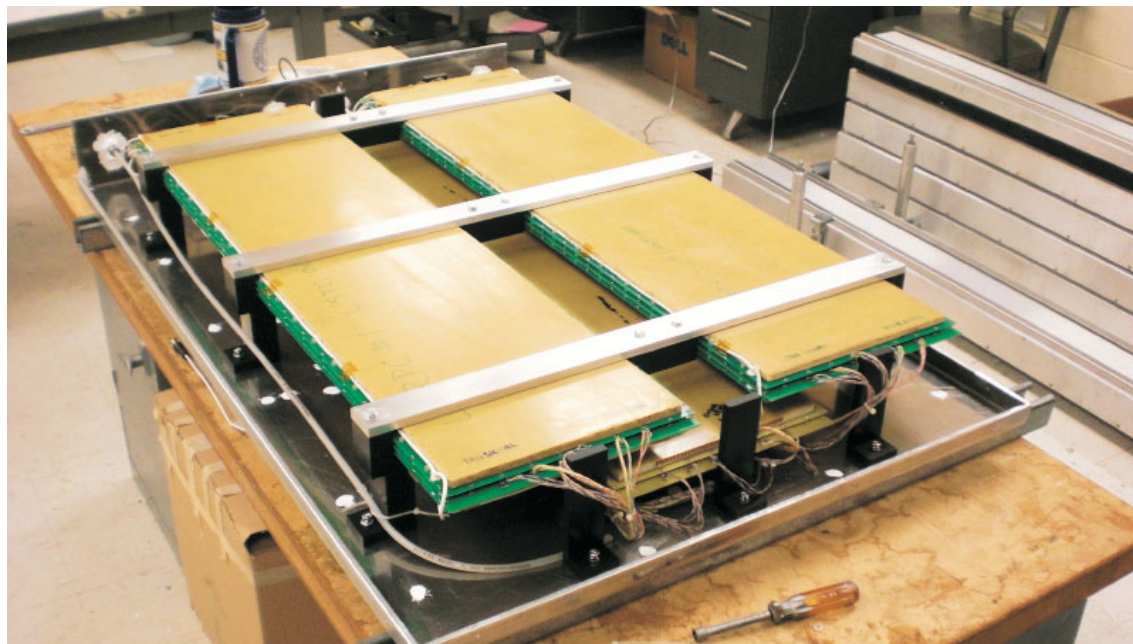
Three “LMRPCs” side-by-side
3x6 double-ended strips

Very heavy “Shoebbox” enclosure

TOF TINO FEE

TDIG on-board digitization

Operated throughout Runs 9 and 10...



wide unistrut frame w/out detector....



frame with MTD9 installed....



MTD11 Patch

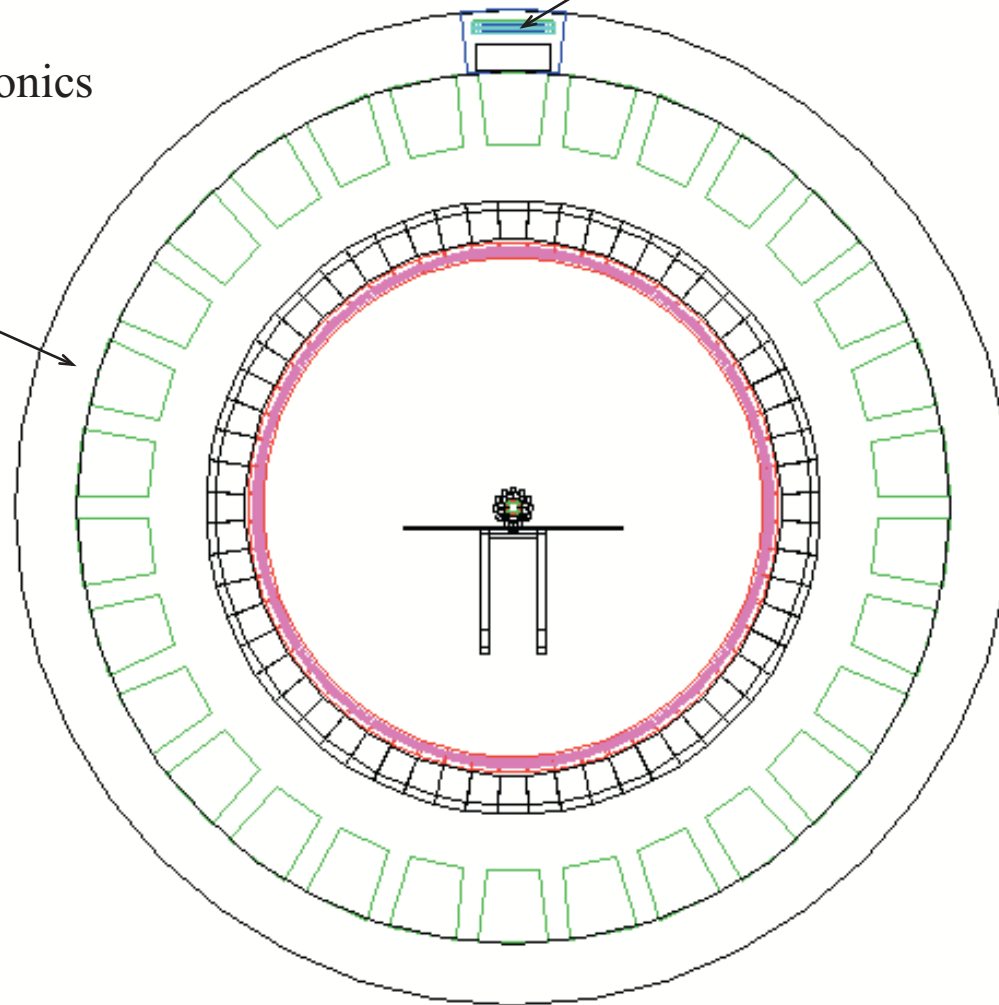
Three “WMRPCs” on one backleg
12 double-ended strips in each box
Plus MTD9 tray

All with MFTB/MINO/MTRG electronics

Three “MTD11” trays
on one backleg @ 12 o'clock

Existing MTD9 tray
East, ~10 o'clock

MTD11 MRPCs (3 needed) from:
USTC (2 MRPCs)
Tsinghua (1 MRPC)



Main Goals of this effort are:

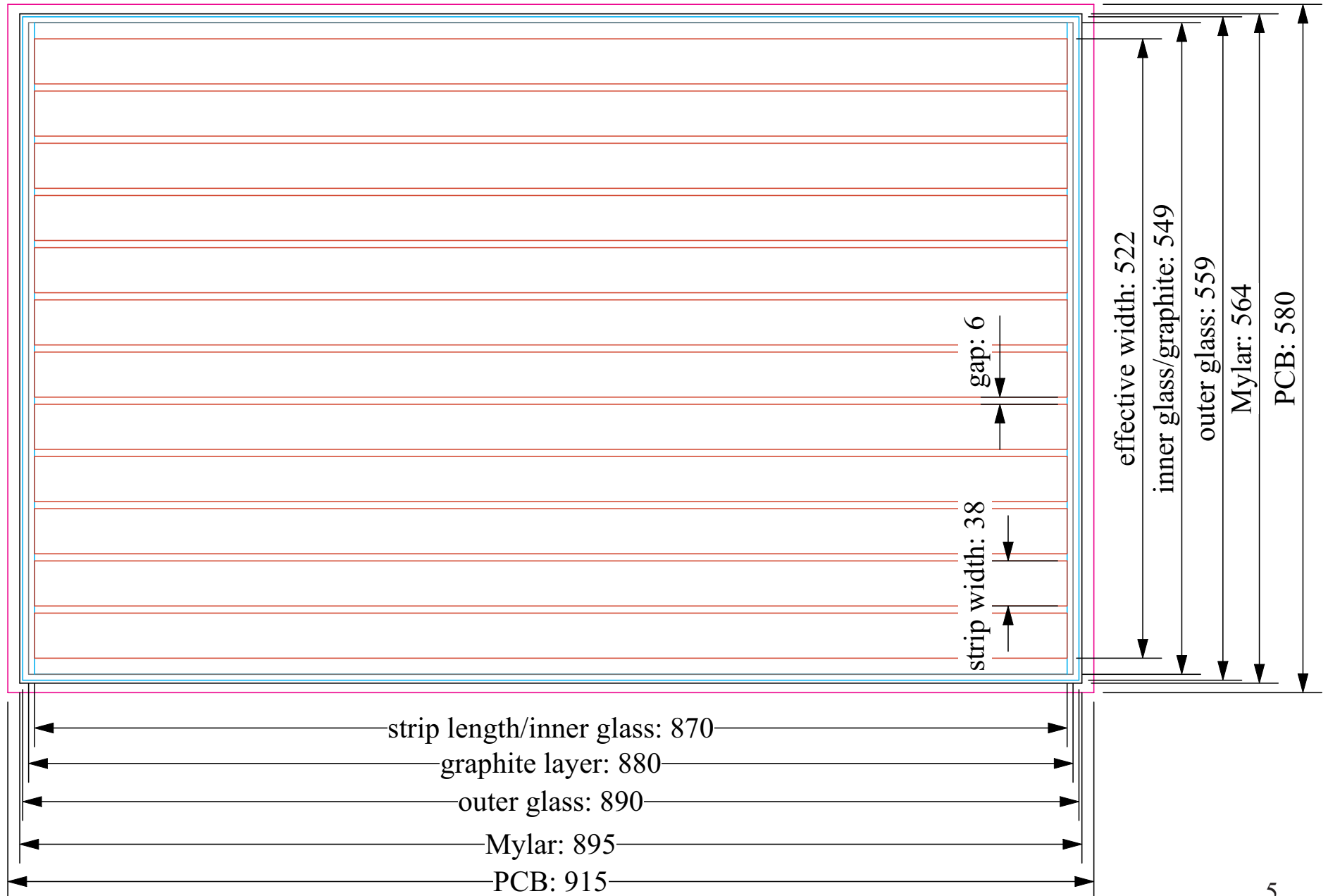
- design & implement new tray structure for WMRPCs, & tray mounting scheme
- develop installation and maintenance procedures (including BEMC!), gain operations experience
- show successful operation of WMRPCs in STAR in Run-11

USTC Prototype

Outer (PCB) 58.0cm x 91.5cm
Active (Pads) 52.2cm x 87.0cm

Height = 3cm

Weight = 13kg (29lbs)



USTC Prototype Dimensions

note these are single-stack MRPCs, unlike the “LMRPCs” used in MTD7 and MTD9

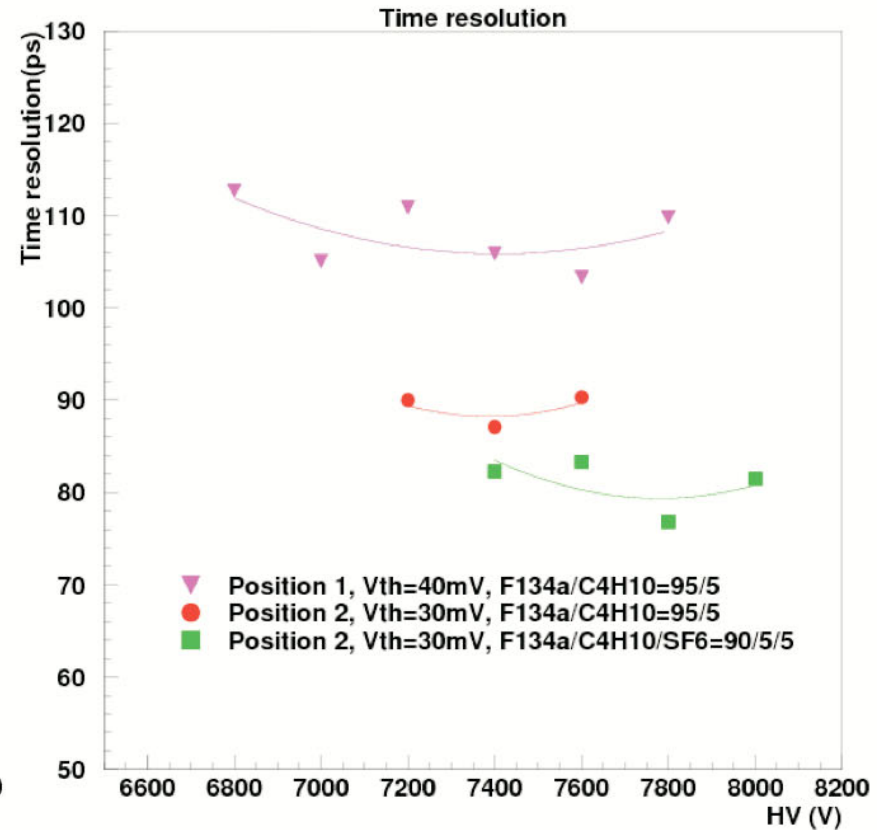
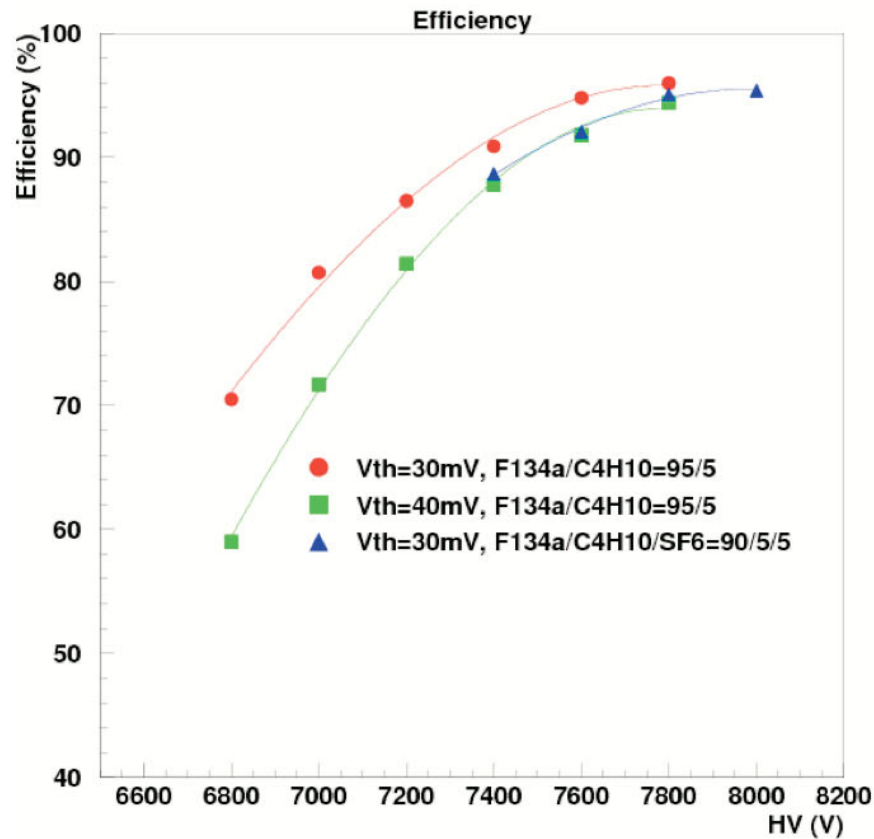
Unit: mm

Material	length	width	thickness	Notes
Strips	870	38	0.035	12 strips with 6mm gaps in between
Inner glass	870	549	0.7	5 pieces
Outer glass	890	559	1.1	2 pieces
Licron electrode	880	549		
Mylar	895	564	0.15	2 pieces
PCB	915	580	0.9	2 pieces
honeycomb	890	559	10	2 pieces
Double-side tape	890	559	0.13	2 pieces, for the honeycomb
Gas gaps			0.25	6 gaps

Total thickness: 29.63mm

USTC also intends to build a 220 μ m version

USTC Prototype -- First Bench Test Results



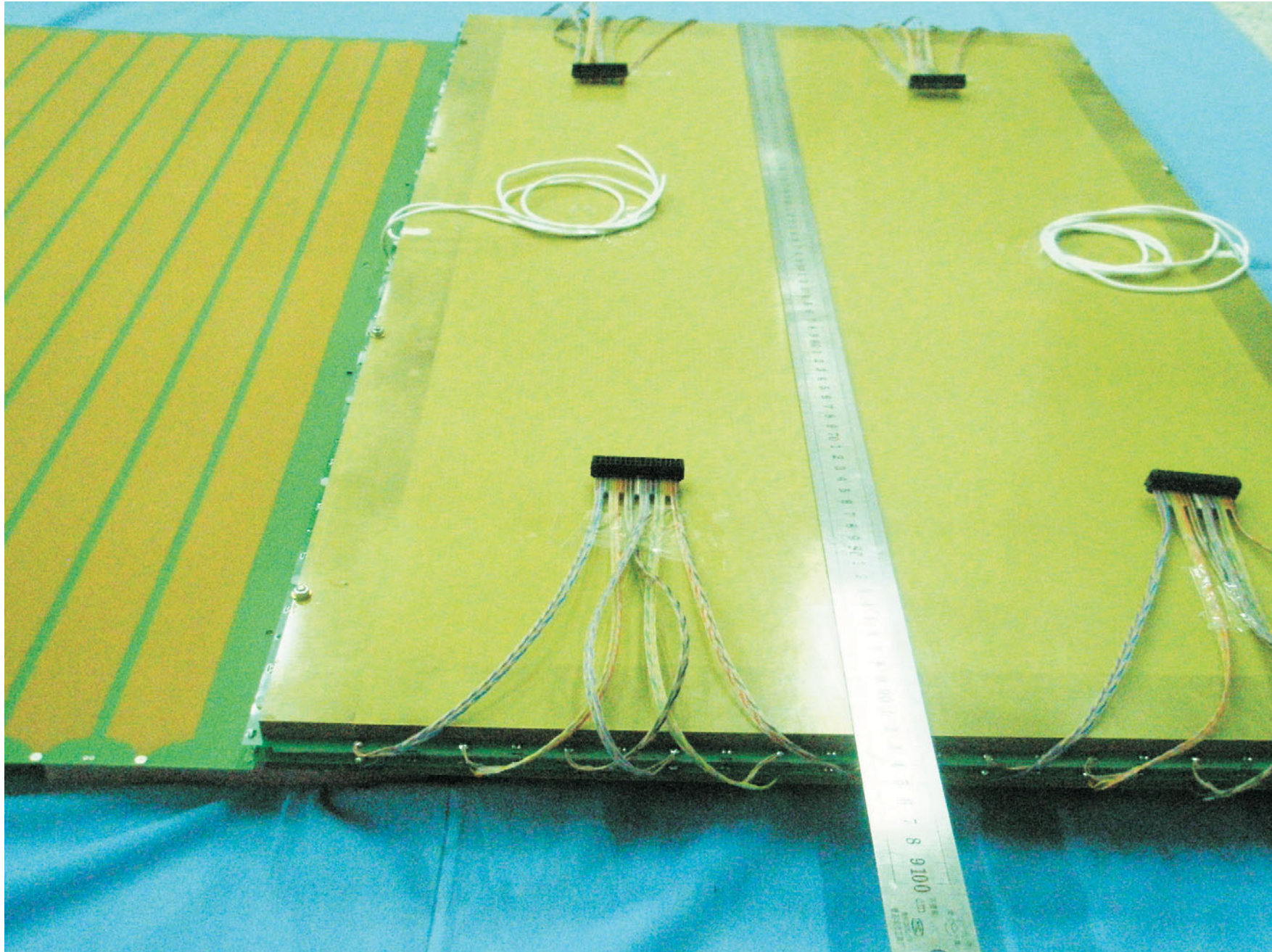
Position 1 straddles two strips, Position 2 is centered on a single strip

Noise Rates: (note 330 Hz = 1 Hz/cm²)

- **With HV filter:**
- **HV=8000V, Vth=30mV (R134a:C4H10:SF6=93:5:2)**

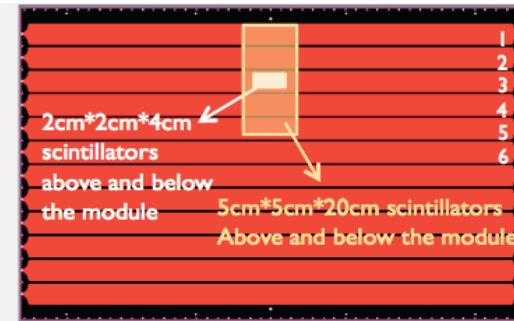
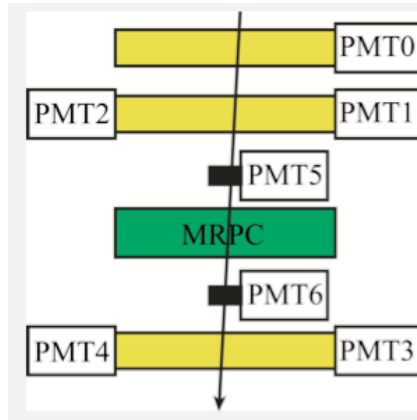
Strip No.	1	2	3	4	5	6	7	8	9	10	11	12
Left	479	253	407	359	310	274	255	252	321	390	259	346
Right	526	280	326	303	163	235	320	266	377	400	280	313

First Tsinghua Prototype
slightly longer (93cm instead of 91.5cm)

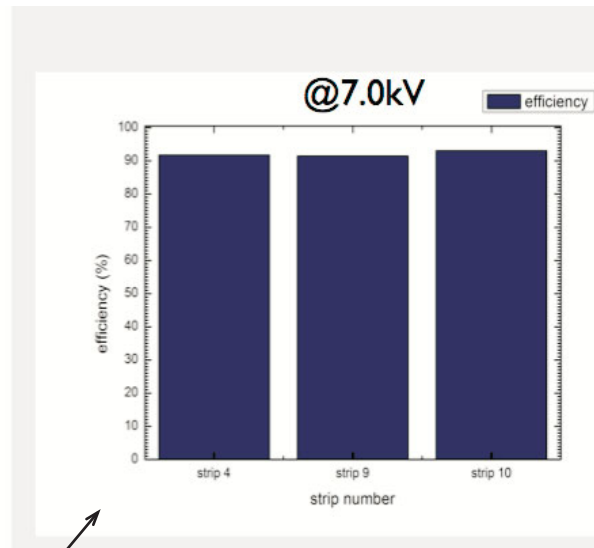
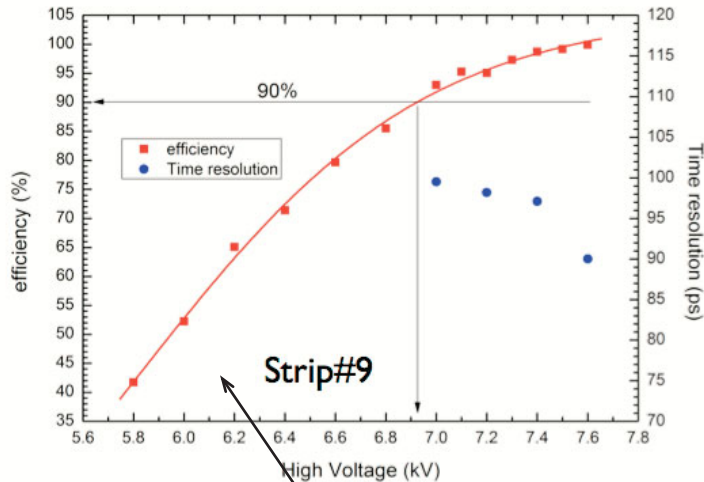


Using 95% Freon + 5% isobutane

Statistics limited still, will continue to test 2-3 more weeks



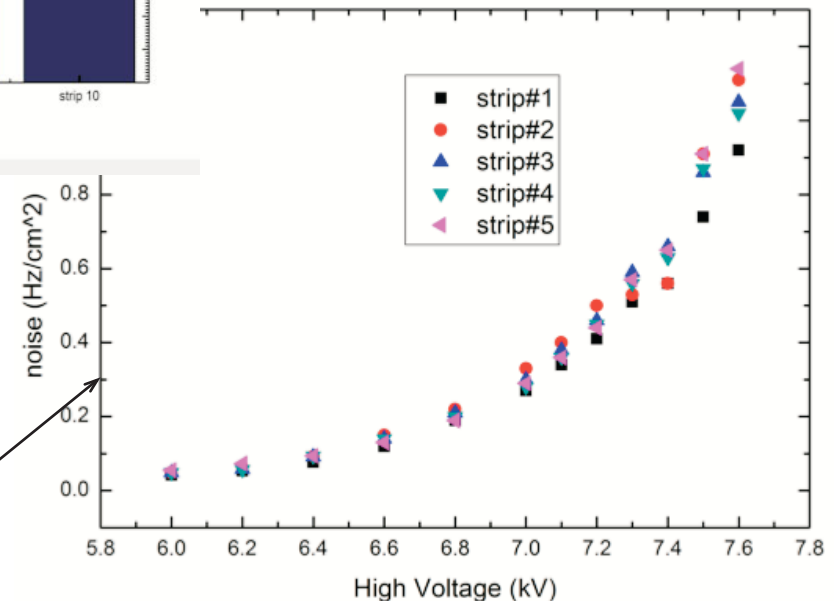
$$\text{Efficiency} = \frac{\text{Count that PMT1-6 \& MRPC have signal}}{\text{Count that PMT1-6 have signal}}$$



Efficiency >90% at 6.9 kV
Time Resn <75ps

good uniformity

noise rates at 7 kV are ~0.3 Hz/cm²



MTD11 and Full System “Tray” Basic Idea

Minimize box w.r.t. WMRPC (minimize gas volume, weight, footprint)

Welded architectural aluminum channel + bottom plate (UT-Austin)

Precision 90mil top plate w/ PEM studs (Oaks, Houston)

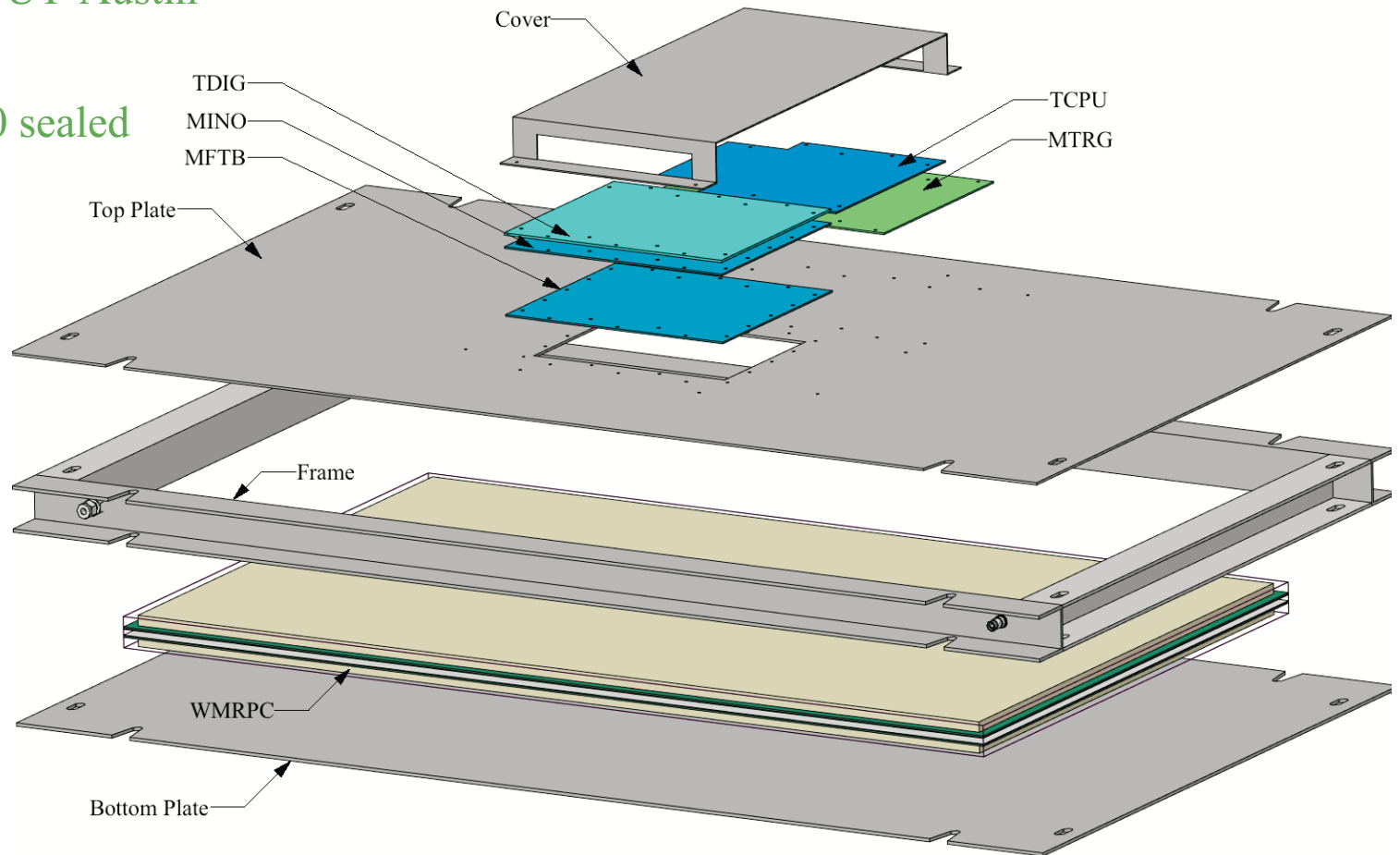
Tray Assembly & Test at UT-Austin

Top welded to sides

Bottom bolted & DC730 sealed

All trays have
3-layer stack of
MFTB
MINO
TDIG

1 TCPU & 1 MTRG
per backleg,
on “center” tray

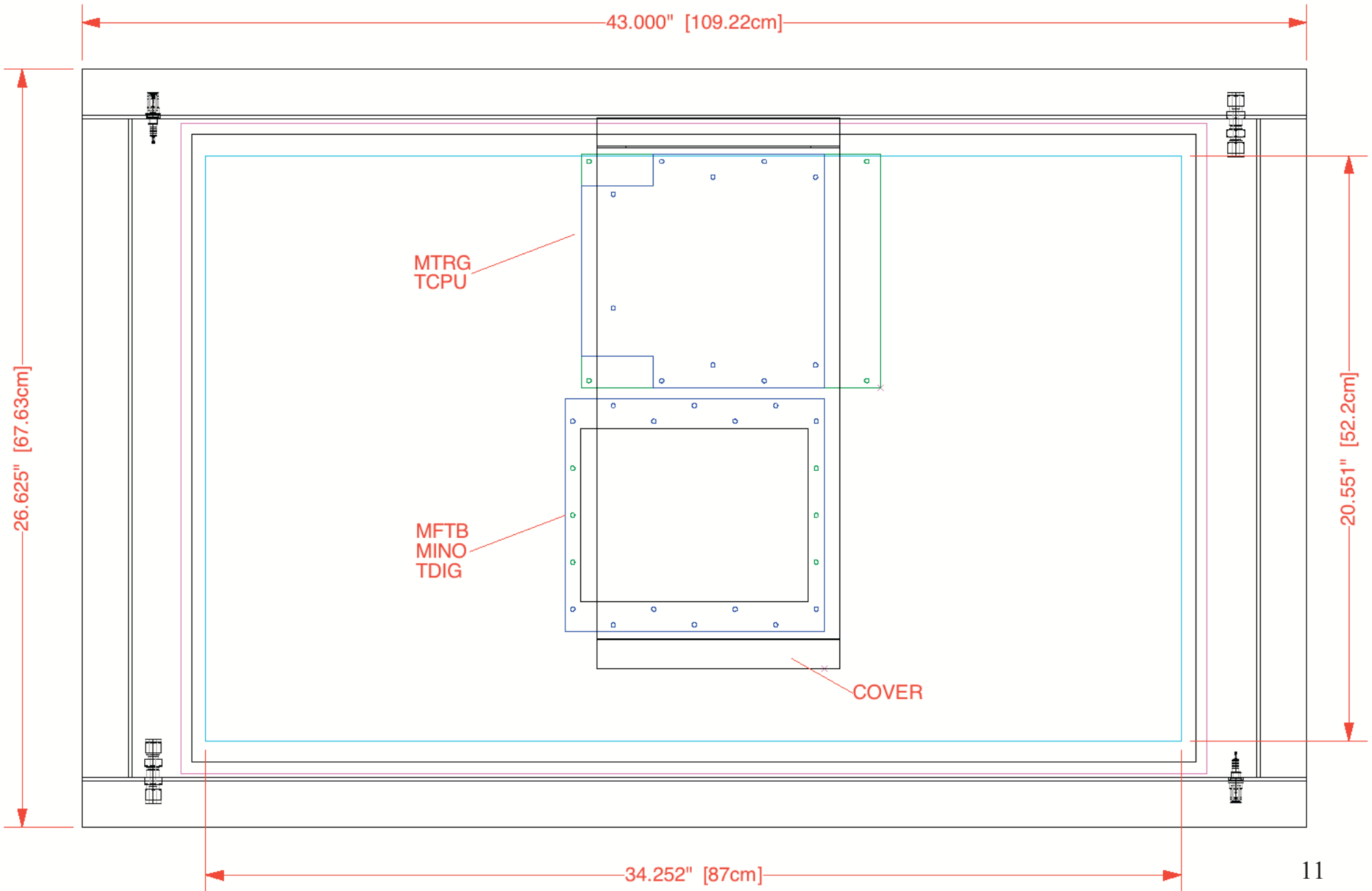


lower layer of trays bolt to Unistrut
(through holes in the short channels)
upper layer of trays bolt to lower layer
(through holes in the long channels)

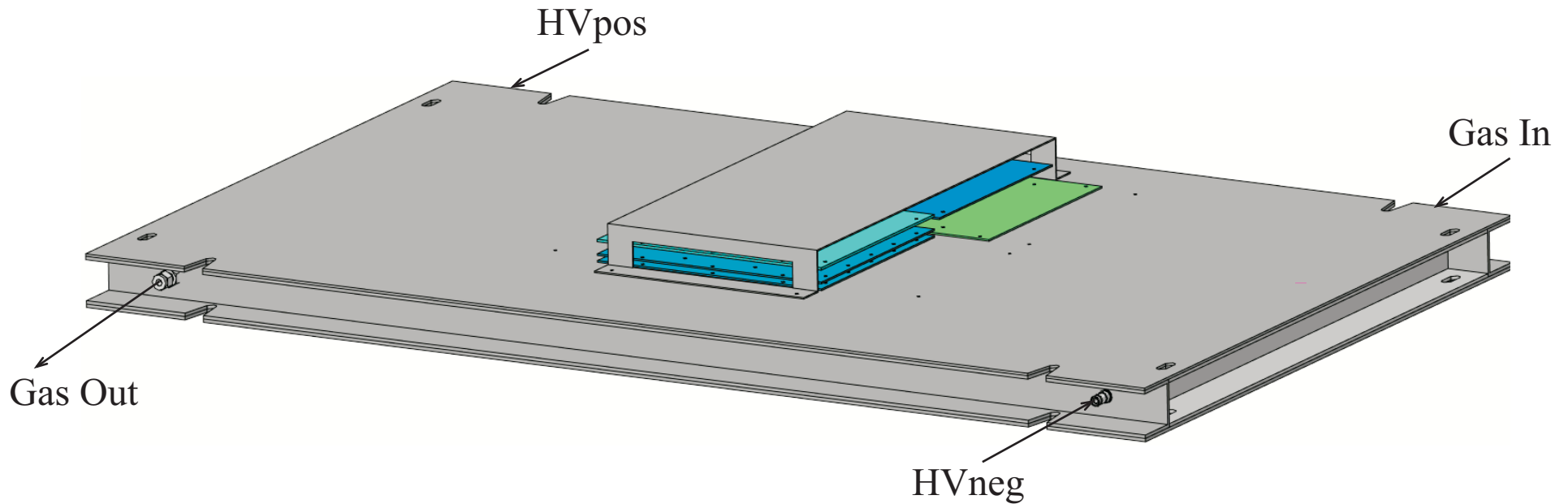
HV & Gas F/Ts on long sides

no internal gas tubing

delrin spacers in 3D to hold WMRPC w.r.t. tray box



A “center” tray (installed at $Z=0$) has 5 boards (MFTB, MINO, TDIG, MTRG, and TCPU)...
Other trays on the same backleg do not have MTRG or TCPU



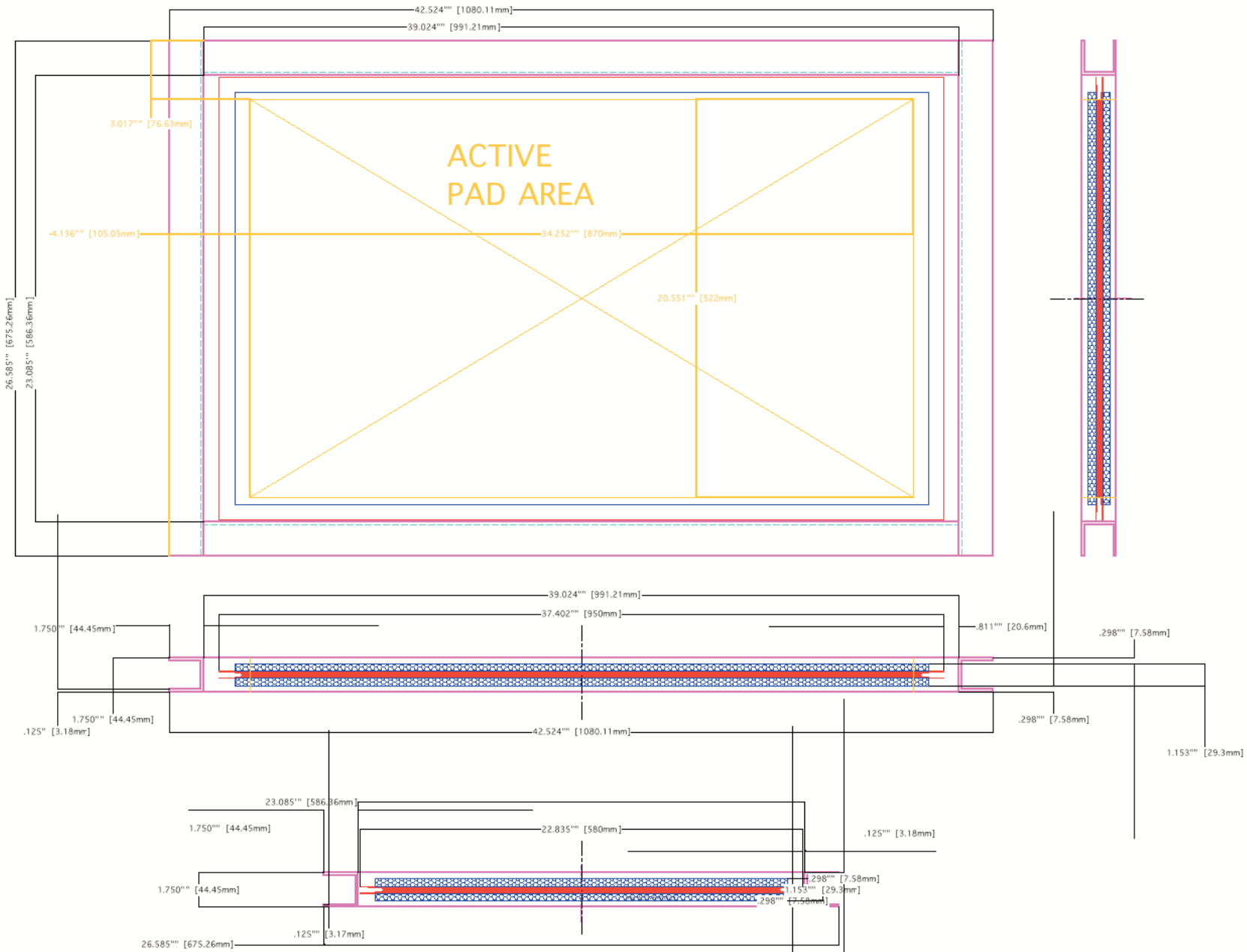
All Trays are mechanically:
 exactly the same
 perfectly symmetric (can be rotated 180 in-plane if necessary)
i.e. each tray can be installed “anywhere”

Parallel Design Effort (Llope & John Scheblein)

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Full System Tray Placement

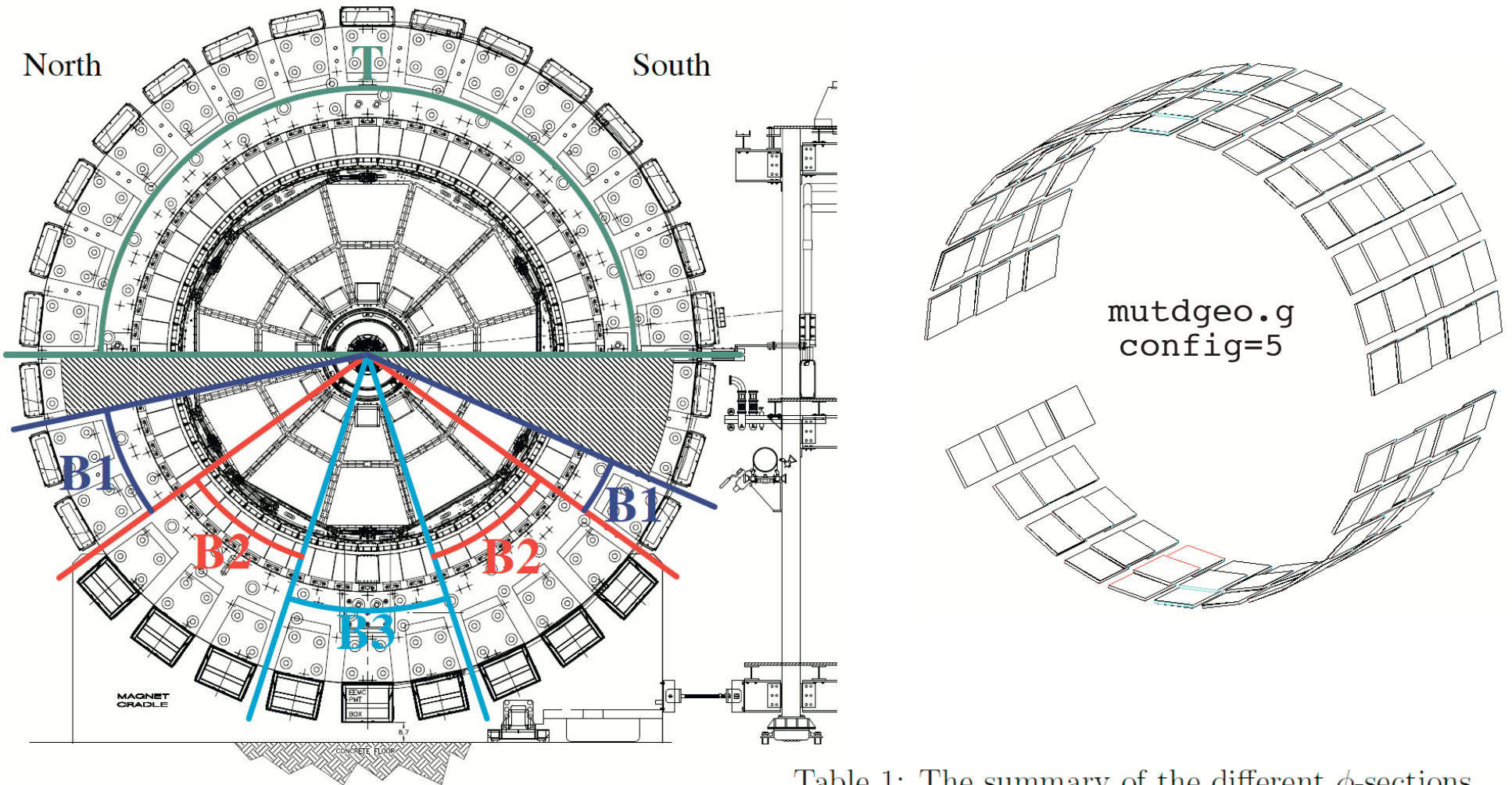


Table 1: The summary of the different ϕ -sections.

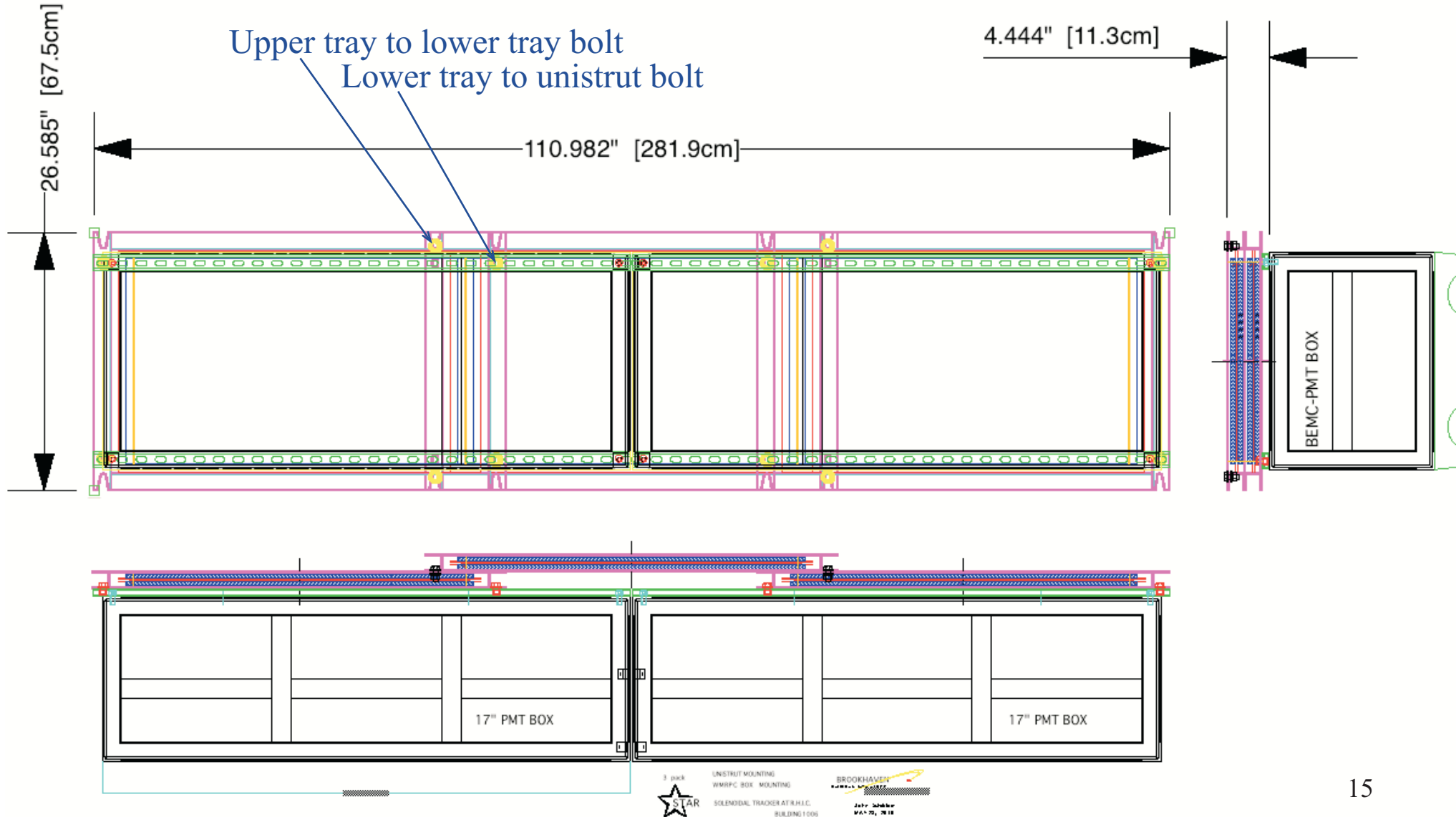
ϕ -section	Backlegs	Trays/Backleg	Trays Total
T	15	5	75
B1	3	5	15
B2	6	3	18
B3	3	3	9
Total	27		117

<http://wjlllope.rice.edu/~MTD/MTDIntegration.pdf>

3-Tray Backleg Layout

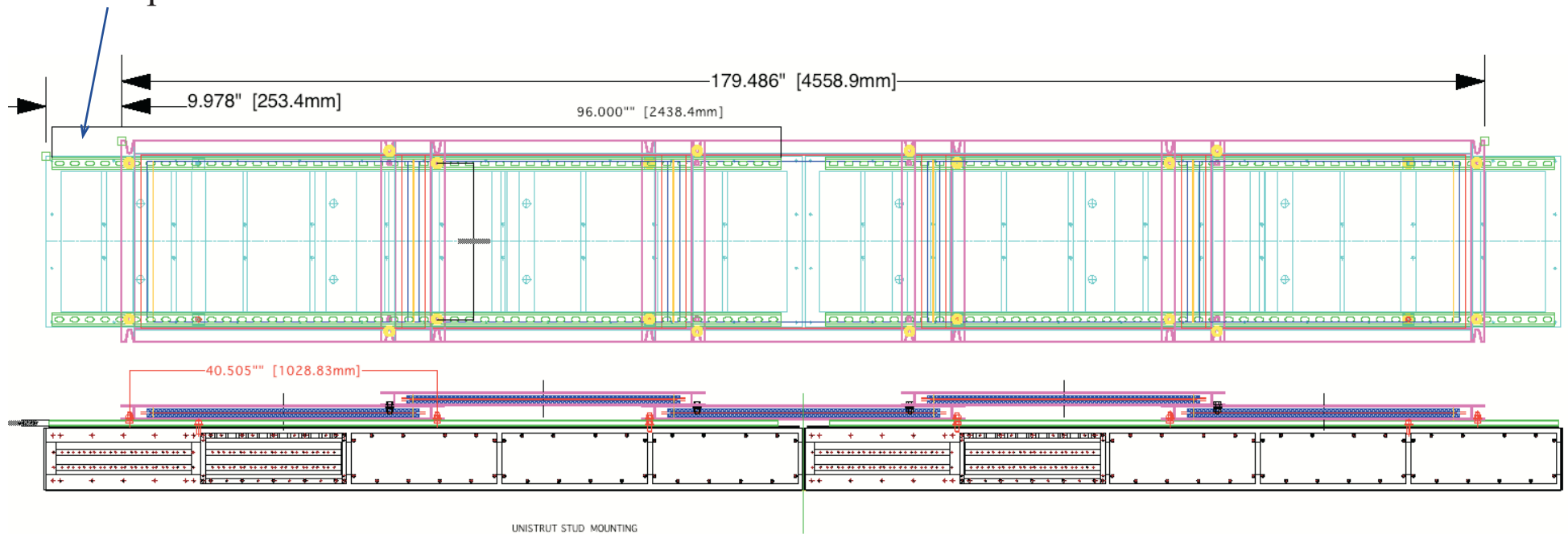
Unistrut channel bolts to BEMC box.
 Lower row of MTD trays bolts to unistrut
 Upper row bolts to lower row.

Center Tray "high"
 MTRG and TCPU boards on center tray



5-Tray Backleg Layout (draft - still making small changes to tray length etc)

“foot space” at end of BEMC boxes

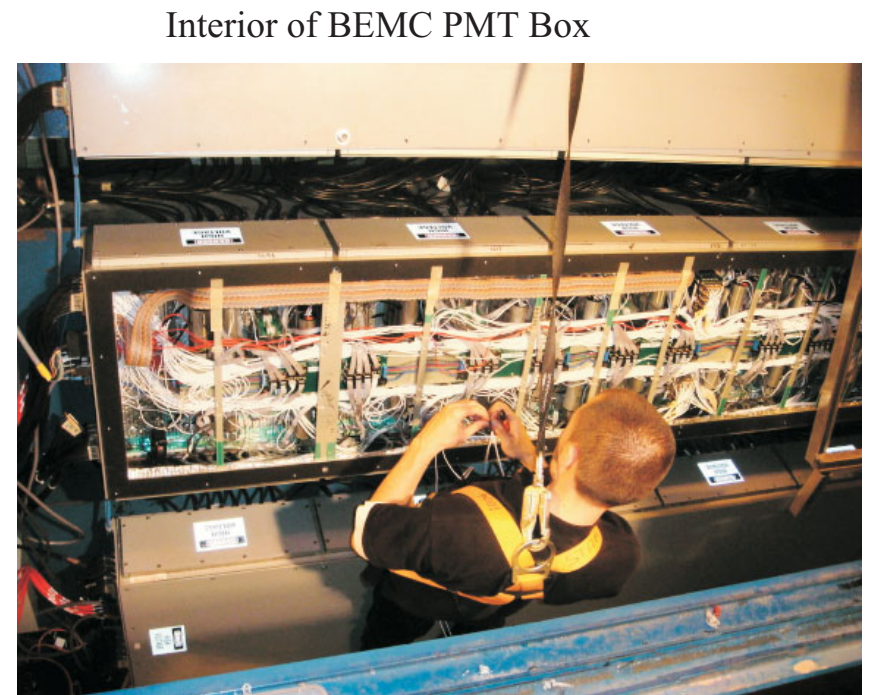
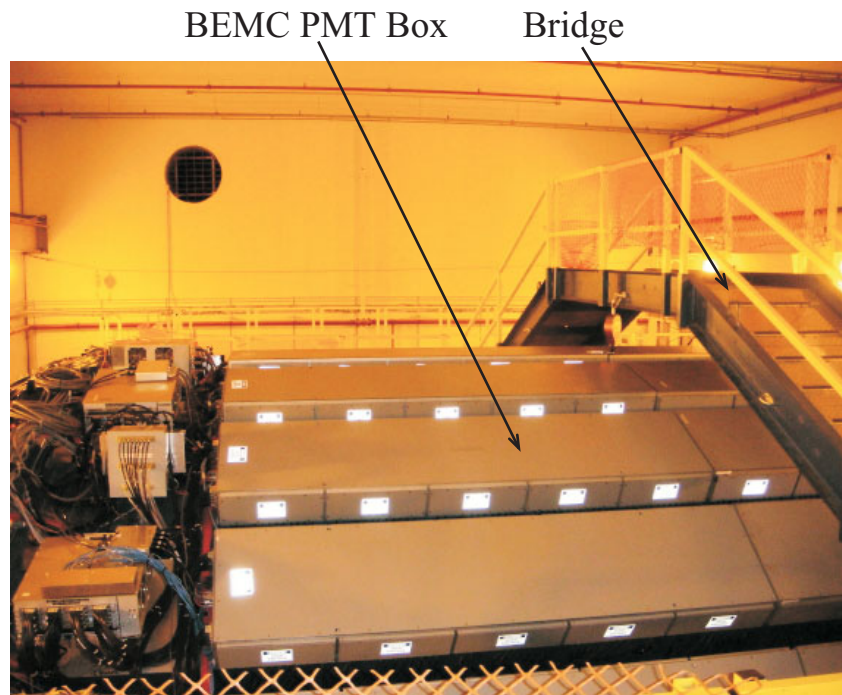


Unistrut channel bolts to BEMC box.
Lower row of MTD trays bolts to unistrut
Upper row bolts to lower row.

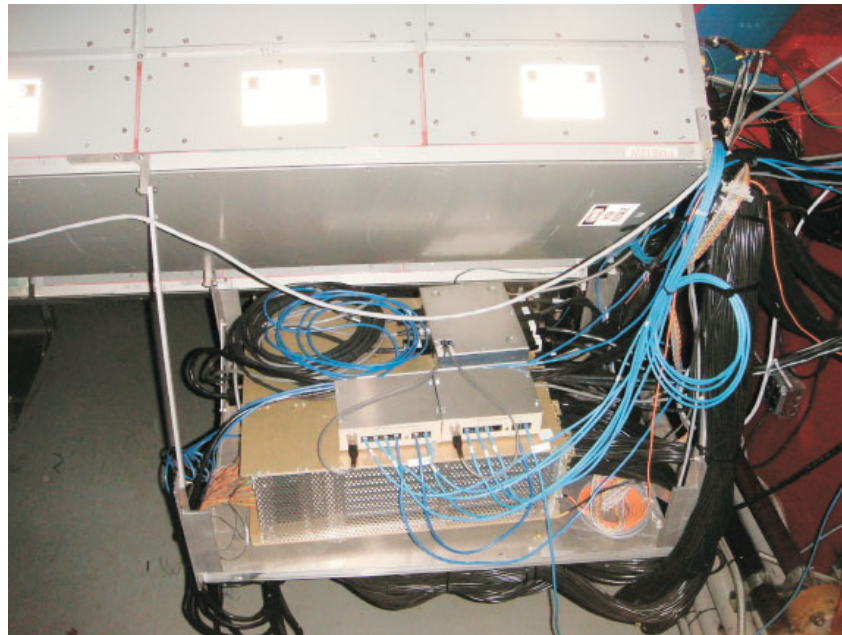
Center Tray “low”
MTRG and TCPU boards on center tray

Two general integration issues..

1. Access to MTD trays and BEMC Boxes underneath:



2. Mounting to Boxes “underneath” STAR...



Bridge does roll East/West
Discussions are continuing

present idea is to build a support “bed”
and
modify hanger brackets

Gas System

Proposal: MTD trays are “additional” TOF trays

Now: Separate MTD system

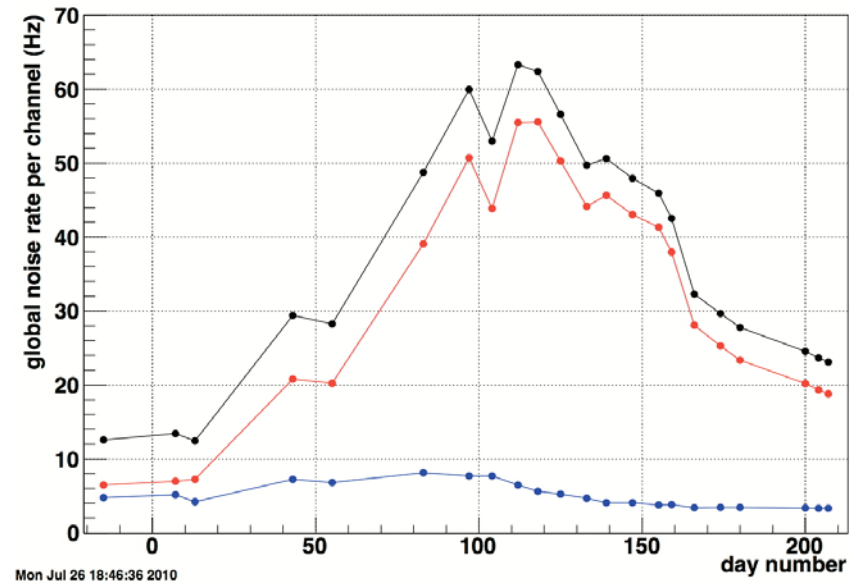
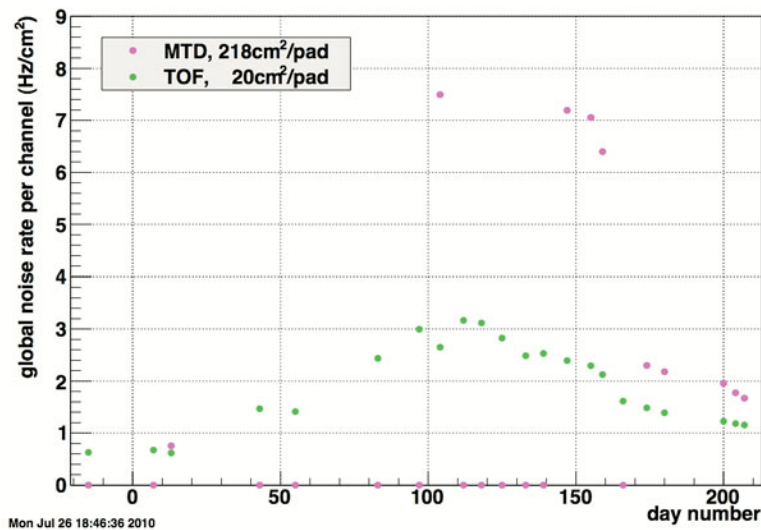
Clean triggering is crucial for this system

Will push to include 0.5% SF₆ in the gas mixture

Cannot do this in a gas path that includes TOF trays

MTD gas system proposed to operate in purge mode

- simple system to build and operate



build-up of impurities in the gas

increased noise rates

might etch glass over long terms

should not join TOF & MTD gas systems!

HV System

Perfect copy of TOF’s approach - simply an expansion of this system

All components are already BNL safety-approved

Space for 2x2 additional supply cards exists in TOF mainframe...

Spare mainframe already in hand

Controls and monitoring interface already in place, simple extended for more channels

Same TOF-style “Long cables” from supply to distribution boxes...

Ten TOF-style HV distribution boxes (5 east and 5 west)...

Same TOF-style “Short cables” from distribution boxes...

Tray Assembly and Test at UT

experienced team, proven expertise with MRPC assembly and full-tray testing
existing assembly space with all of the necessary tables and tools
large machine shop with many craftsmen

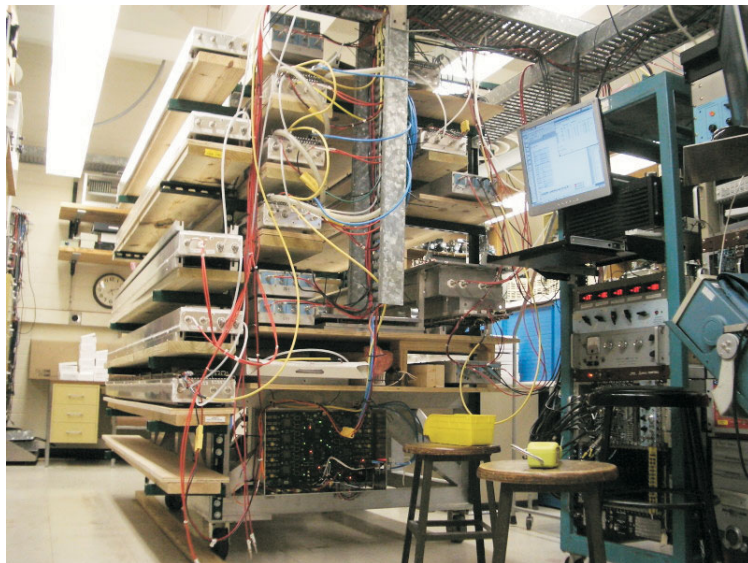
large assembly room with custom tables



tables with TOF trays



full tray test stand



storage racks and tray leak testing



Summary

Successful design and integration of MTD7 and MTD9 detectors in STAR
same design and integration team involved for the full system

MTD11 project is funded and on track to install 3 full-size prototypes before Run 11
Verify successful operation of these MRPCs in STAR
Commission triggering interfaces and implement MTD triggers
Develop fixtures and gain experience installing/removing the detectors

Design of final system trays will be very similar to that for the MTD11 trays
Finalize design of full system trays by March 2011

HV system is simply an extension of the existing TOF system
System is well known to the shift crews, simple turn-key operation

Gas system is much simpler than TOF's
Purge mode (no recirculation)
Some components are already in place

Experienced and expert assembly team in place at UT
Floor space, tooling, fixtures, and excellent machine shop already in place

Detectors and final electronics tested as complete units in Texas
Delivered to BNL, and quickly retested before installation in STAR