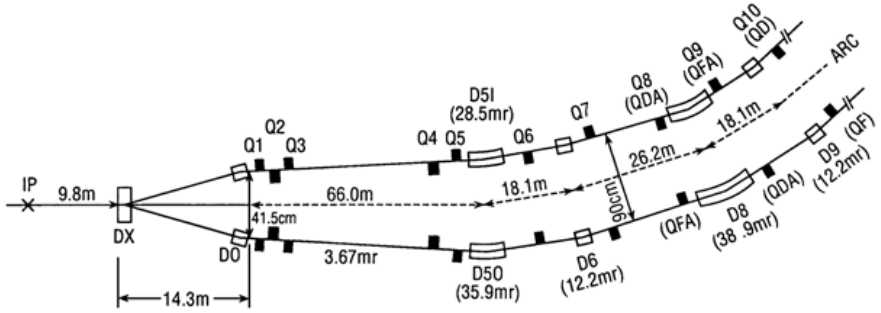
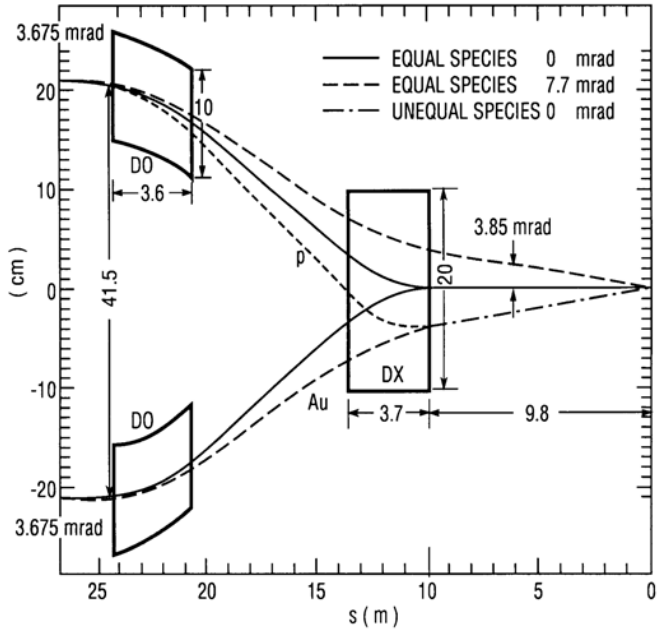
Backgrounds at sPHENIX

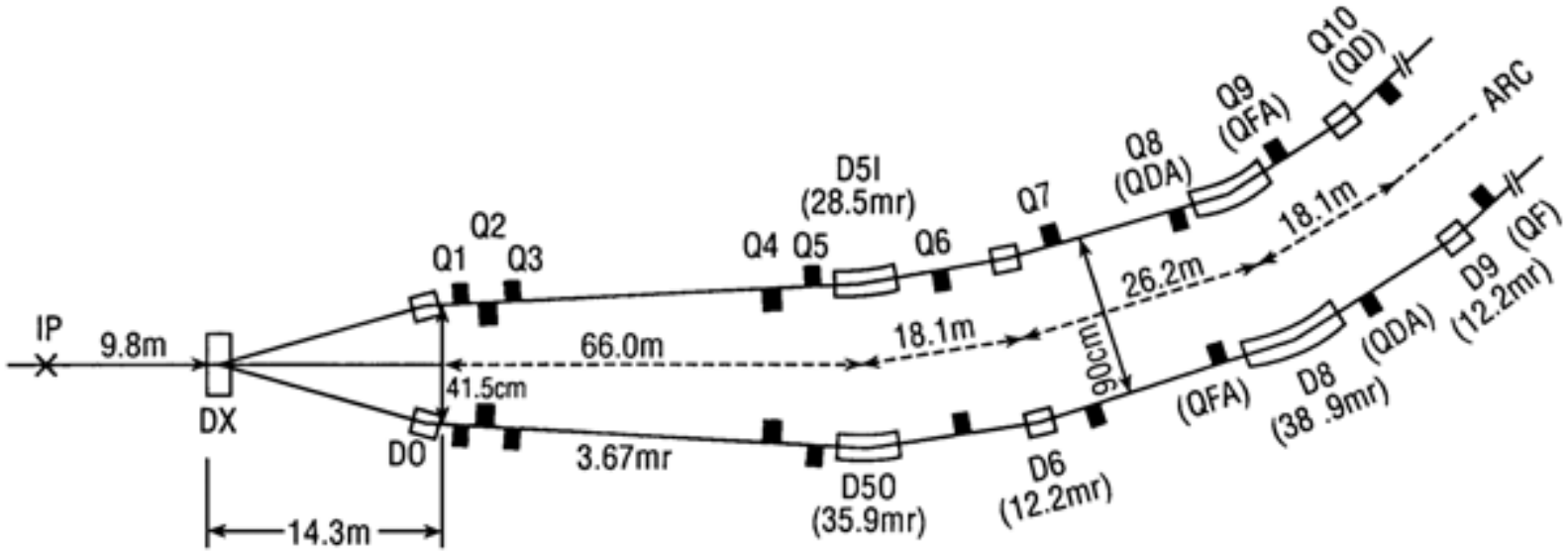
John Haggerty*

*with information from many others, including Cameron Dean, Charles Hughes, Evgeny Shulga, Tom Hemmick, Joe Osborn, Kin Yip, Jamie Nagle

RHIC IR


IP
9.8m
DX
14.3m
41.5cm
D0
Q1
Q2
Q3
66.0m
3.67mr
Q4
Q5
Q6
D5I
(28.5mr)
D5O
(35.9mr)
Q7
18.1m
90cm
Q8
(QDA)
Q9
(QFA)
Q10
(QD)
26.2m
18.1m
D6
(12.2mr)
(QFA)
D8
(38 .9mr)
(QDA)
D9
(12.2mr)
(QF)
ARC


3.675 mrad
EQUAL SPECIES 0 mrad
EQUAL SPECIES 7.7 mrad
UNEQUAL SPECIES 0 mrad
10
D0
3.6
3.85 mrad
20
41.5
(cm)
p
DX
Au
3.7
9.8
D0
3.675 mrad
s (m)


IP
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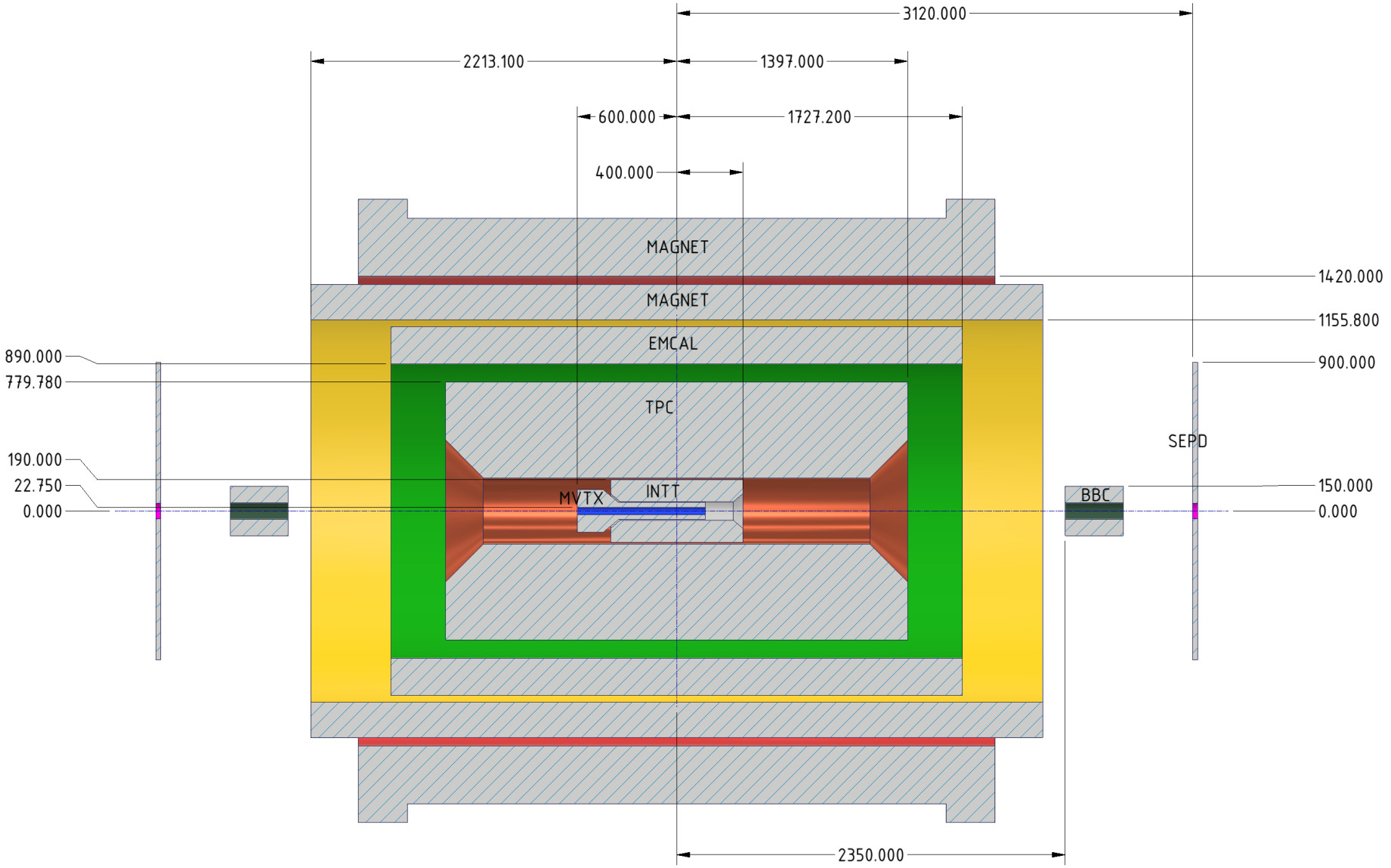
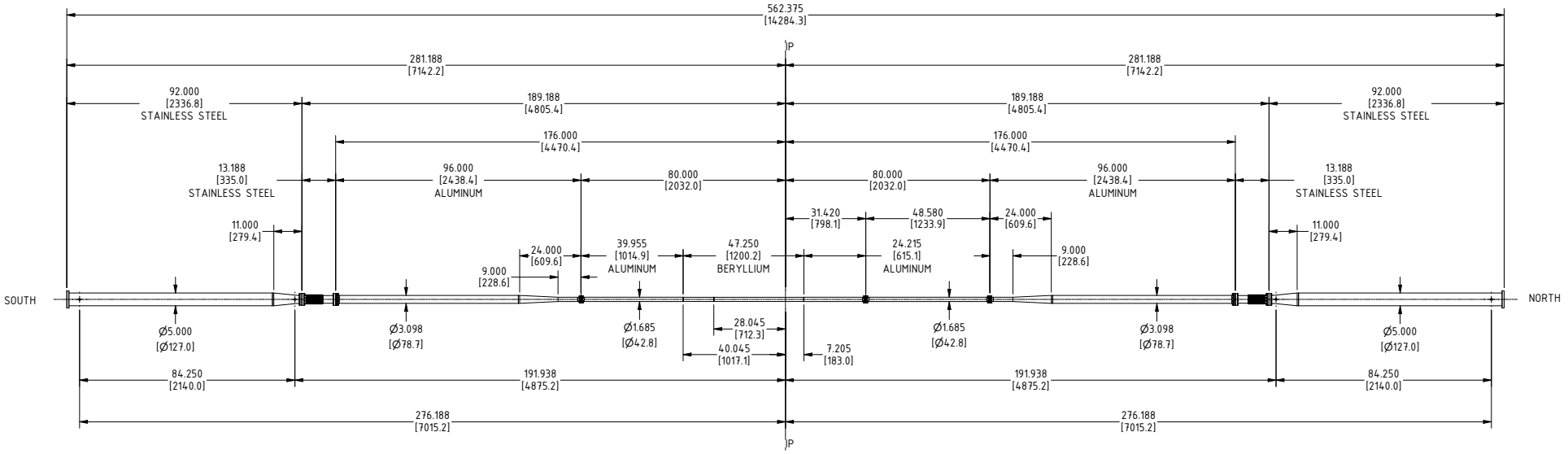
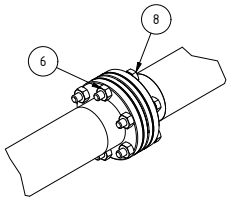
(QD)
ARC
(QDA)
D9
(12.2mr)
(QF)


3120.000
2213.100
1397.000
600.000
1727.200
400.000
MAGNET
MAGNET
EMCAL
TPC
MVTX
INTT
BBC
SEPD
1420.000
1155.800
900.000
890.000
779.780
190.000
22.750
0.000
150.000
0.000
2350.000

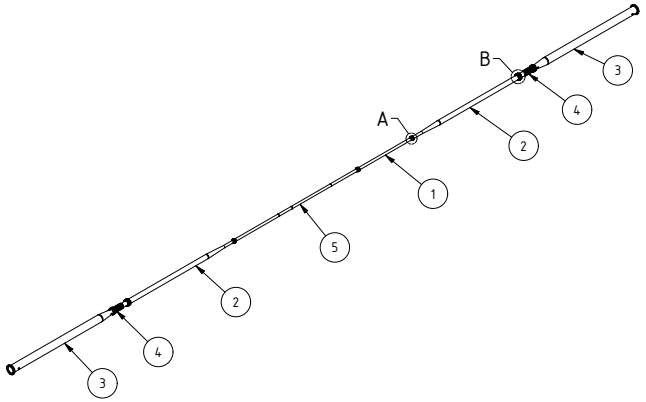
NOTES:
1. ALL DIMENSIONS ARE FOR REFERENCE ONLY.

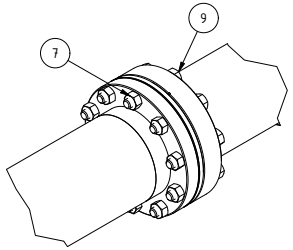
REVISION HISTORY					
REV	ECN NUMBER	ZONE	DESCRIPTION	DATE	APPROVED





DETAIL A
SCALE 1 / 2
4 PLACES





DETAIL B
SCALE 1 / 2
3 PLACES

ITEM	QTY	PART NUMBER	DESCRIPTION
9	40	ANSI/ASME B18.2.1 - 5/16-18 UNC - 2, HBI	Hex Bolt - UNC (Regular Thread - Inch)
8	18	ANSI/ASME B18.2.1 - 1/4-20 UNC - 1.5, HBI	Hex Bolt - UNC (Regular Thread - Inch)
7	40	ANSI B18.2.2 - 5/16 - 18, HNI	Hex Nuts (Inch Series) Hex Nut
6	18	ANSI B18.2.2 - 1/4 - 20	Hex Nuts (Inch Series) Hex Nut
5	1	44035019 REV A	1,7 OD STAR BP ASM
4	2	42035000-03 REV C	SS, 3 in OD, BELLOWS ASM
3	2	205-0800-0273	SS, 5 in OD, BEAM PIPE
2	2	205-0800-0272	AL, 3 in OD, BEAM PIPE
1	1	205-0800-0271	AL, 1,7 in OD, BEAM PIPE

BILL OF MATERIALS

THIRD ANGLE PROJECTION

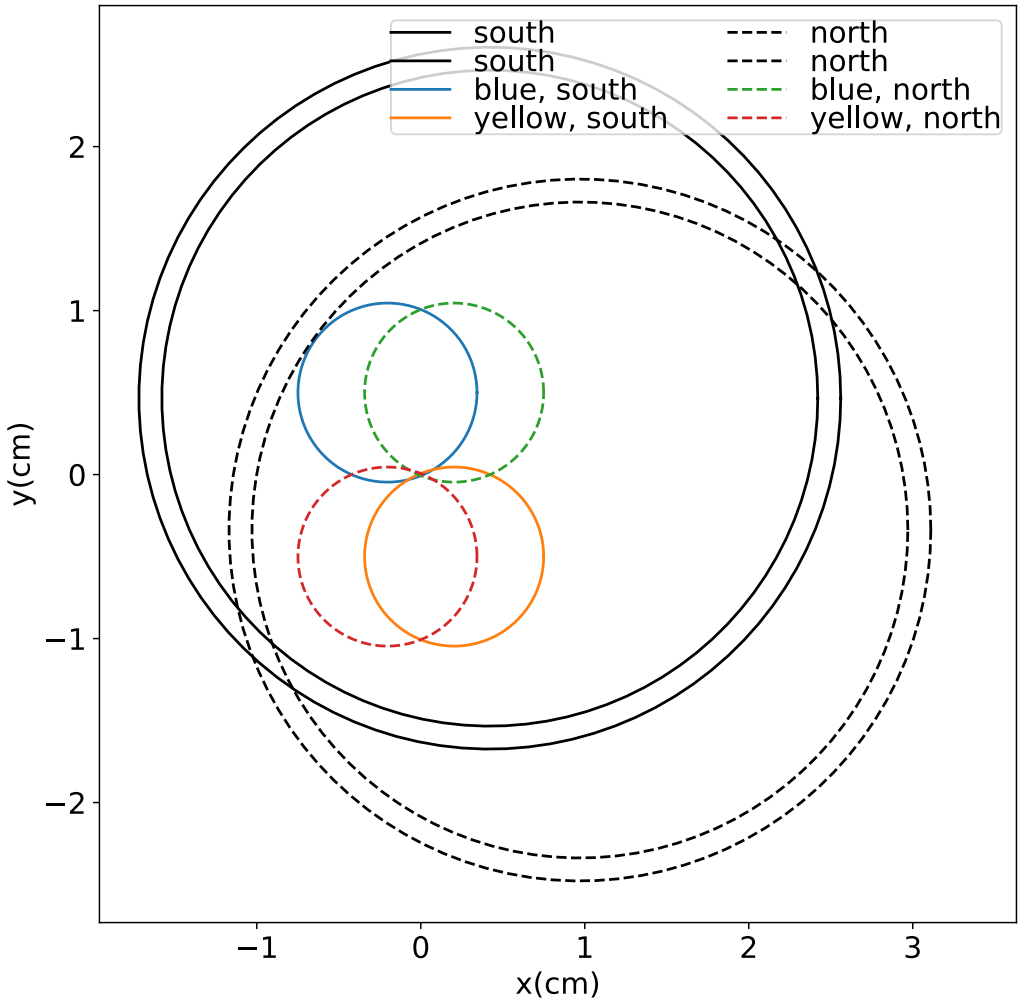
BROOKHAVEN NATIONAL LABORATORY
BROOKHAVEN SCIENCE ASSOCIATES
UPTON, NY 11973

PROJECT: Beam Pipe
DESCRIPTION: Beam Pipe ASM
SIZE: D | DRAWING NUMBER: 205-0800-0270 | REV: A
D.A. CAT. | A3 | SCALE: 1 / 20 | WEIGHT: 197 lbmass | SHEET: 1 OF 1

OUTSTANDING ECN NUMBERS

Aperture at 1008

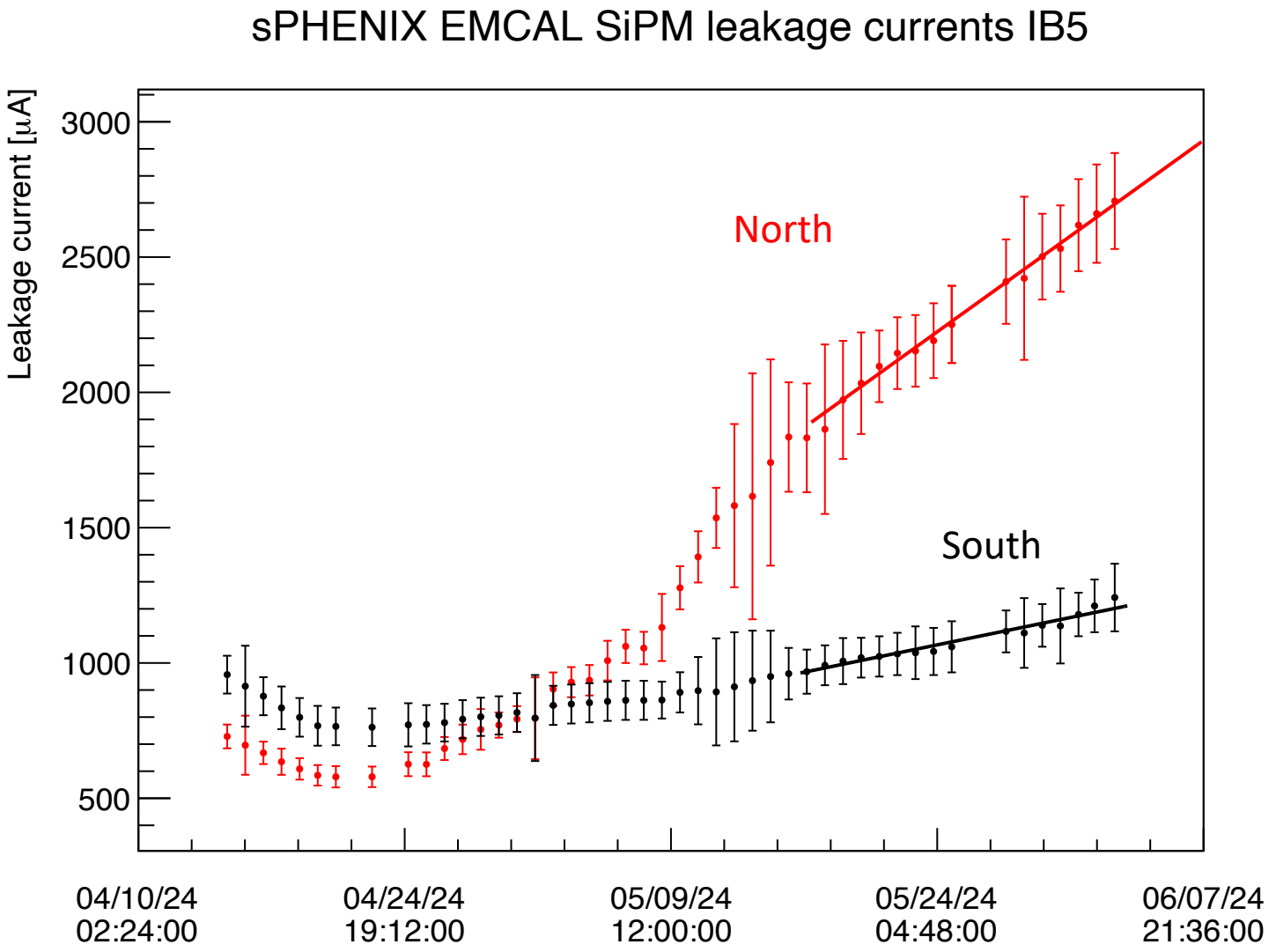
- In addition to the crossing angle, we were unable to align the beam pipe perfectly
- Kiel's drawing of aperture limits shows the beam at injection



EMCAL radiation damage to SiPM's

- The photodetectors on the calorimeters are little dosimeters (3mm x 3mm)
  - 100k in a cylinder about 90 cm in radius
  - Increased leakage current with rad damage, making them noisier
  - Damage known to be mainly from ~1 MeV neutrons
  - We supply 64 towers (256 SiPM's) with a supply up to 100 mA
  - Initial currents were 0.1 mA before 2023, 1 mA at the beginning of 2024

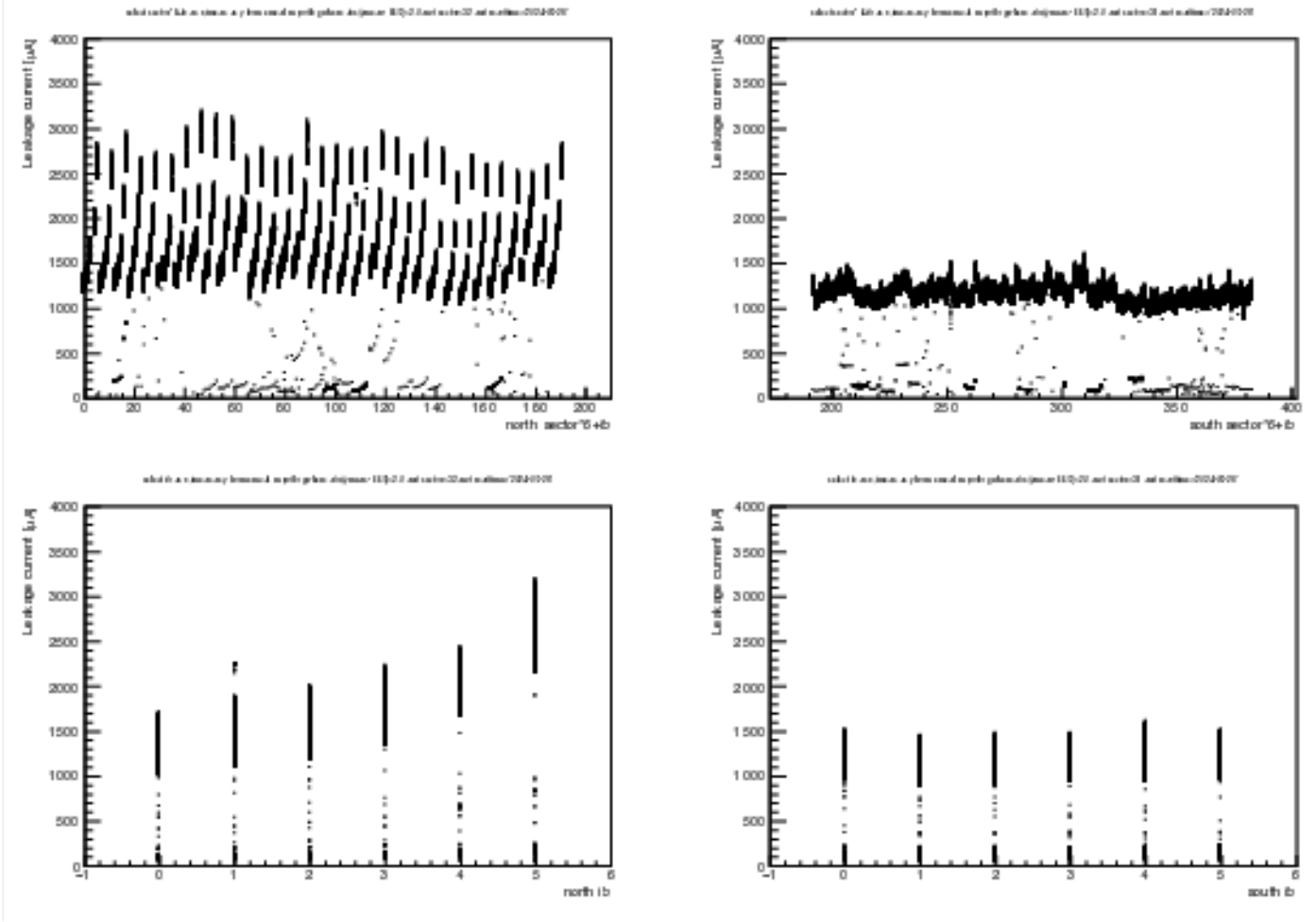
EMCAL rad damage



EMCAL rad damage

North

South



z ~ 0

z ~ 1.5 m

z ~ 0

z ~ -1.5 m

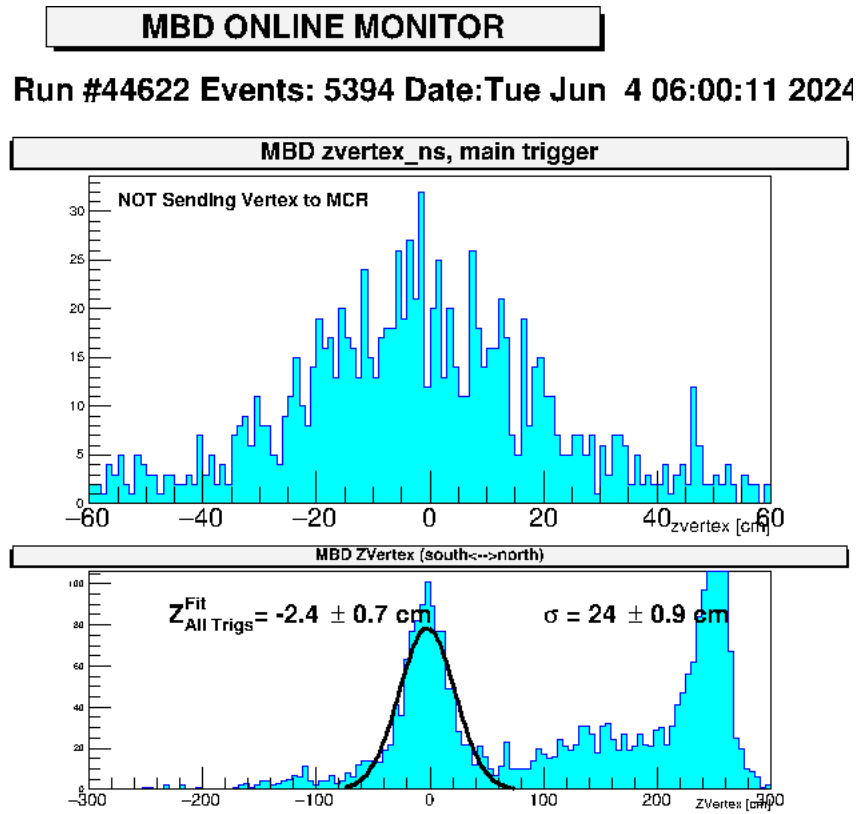
EMCAL rad damge

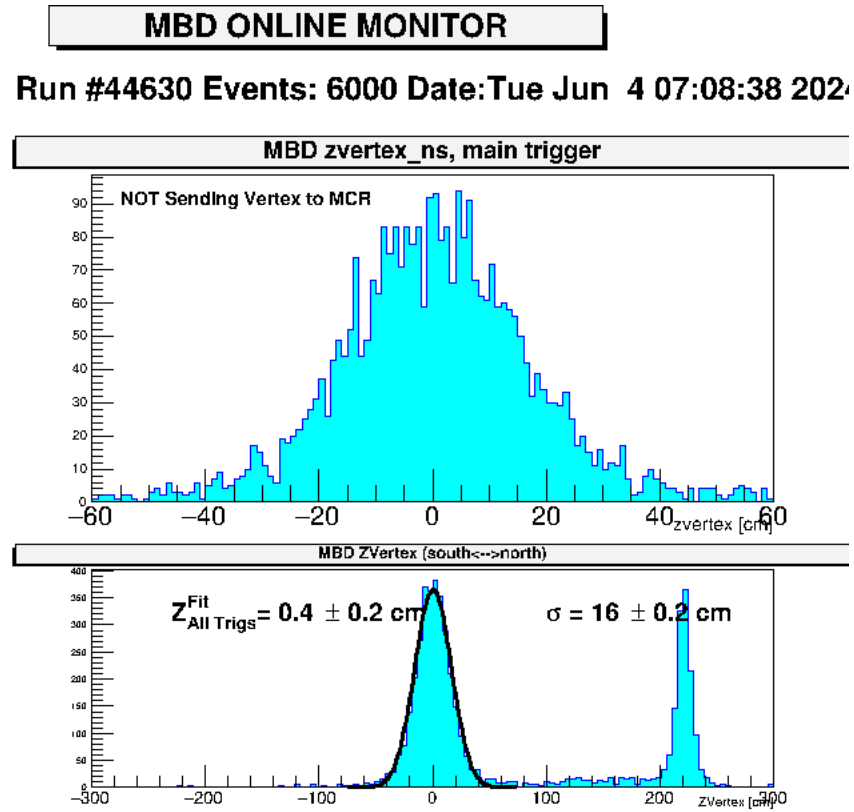
- The northernmost SiPM’s are being damaged at 3-4 times the rate of the south
- North and south started to diverge during scrubbing, but never went back to their earlier rate of increase

MBD sees background in the vertex distribution

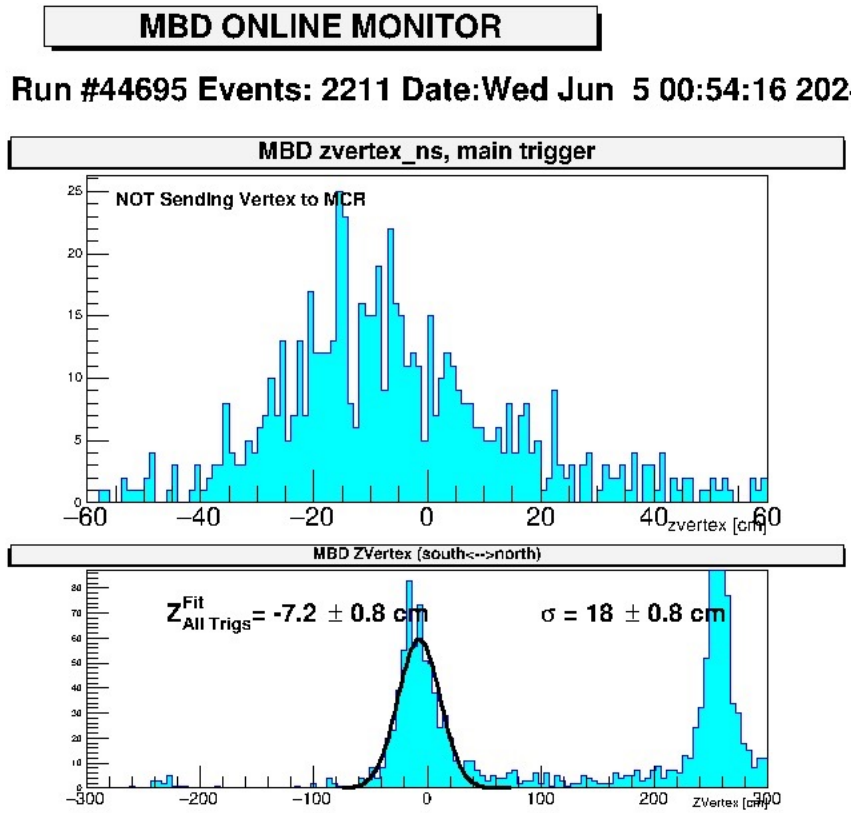
- The MBD is small (30 cm diameter with a 10 cm hole) and right outside the beam pipe
- We sometimes see a spurious vertex distribution which comes from particles parallel to the beam pipe which go through both MBD's
- More aggressive collimation generally eliminates them
  - …but Angelika can tell you more

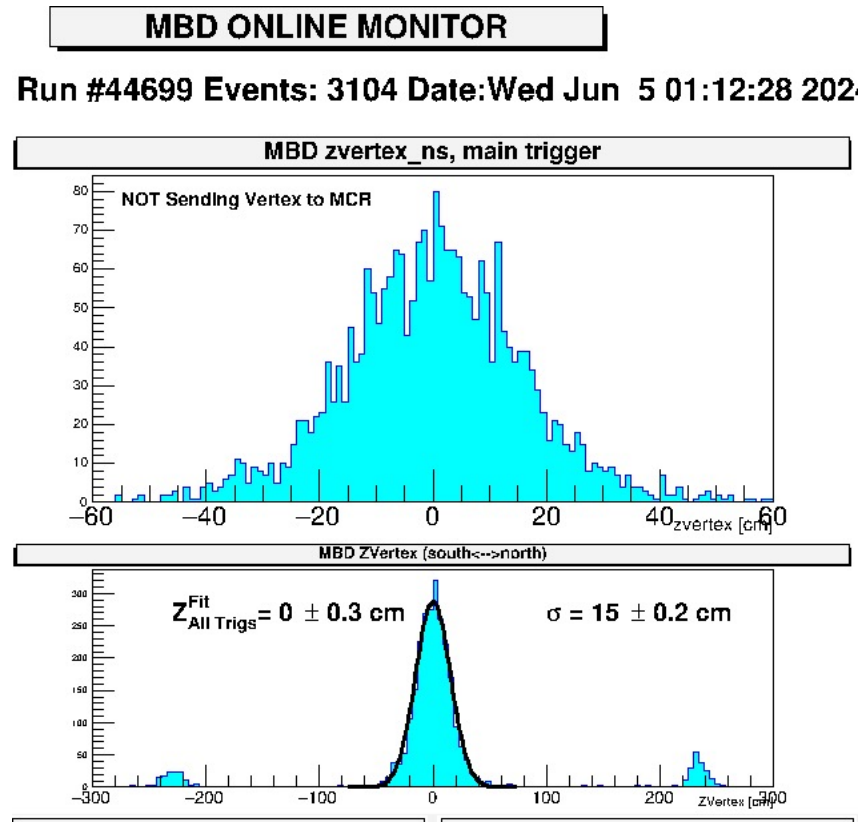
June 4: Before and After MCR intervention





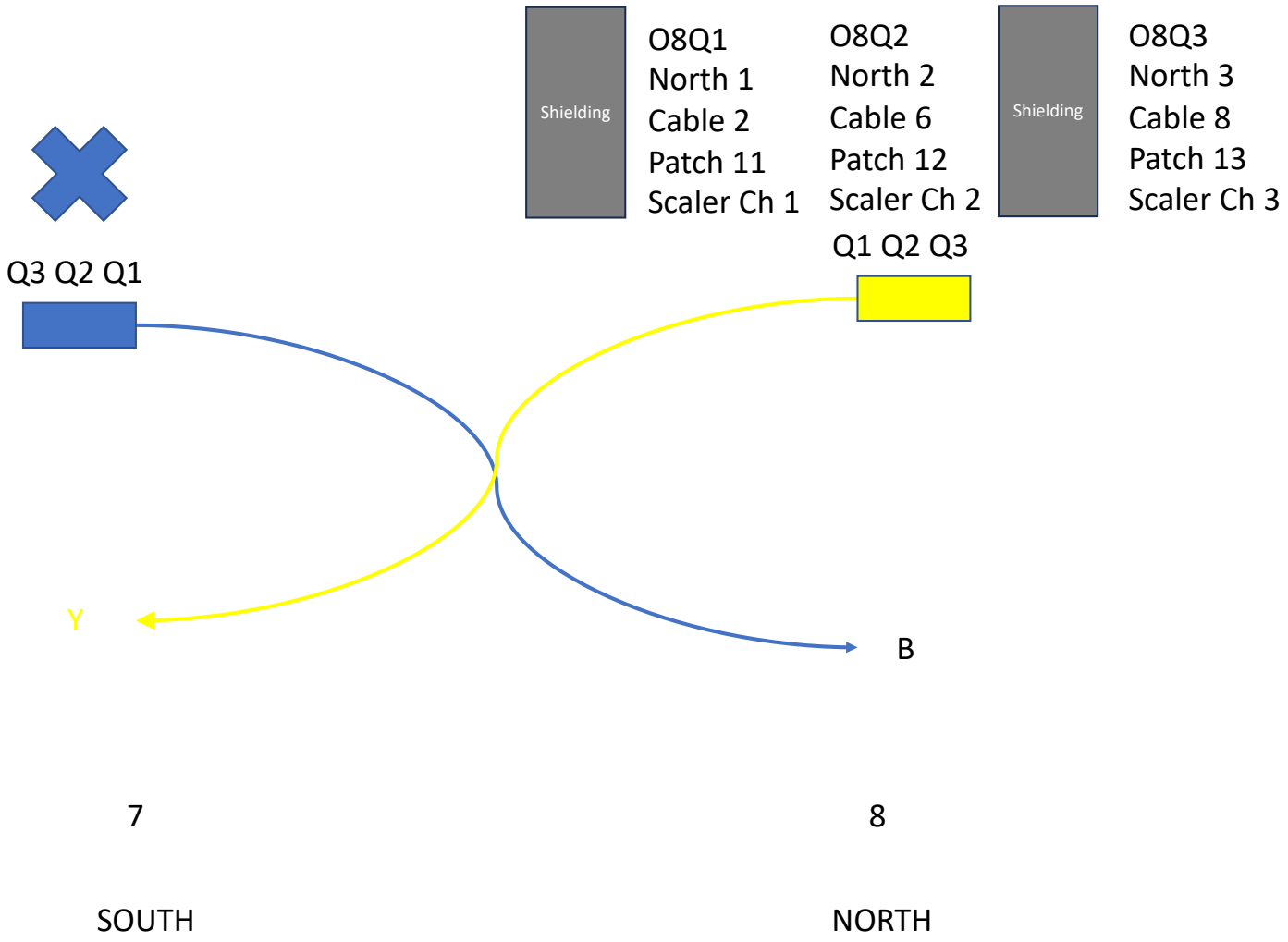
June 5: Before and After MCR intervention



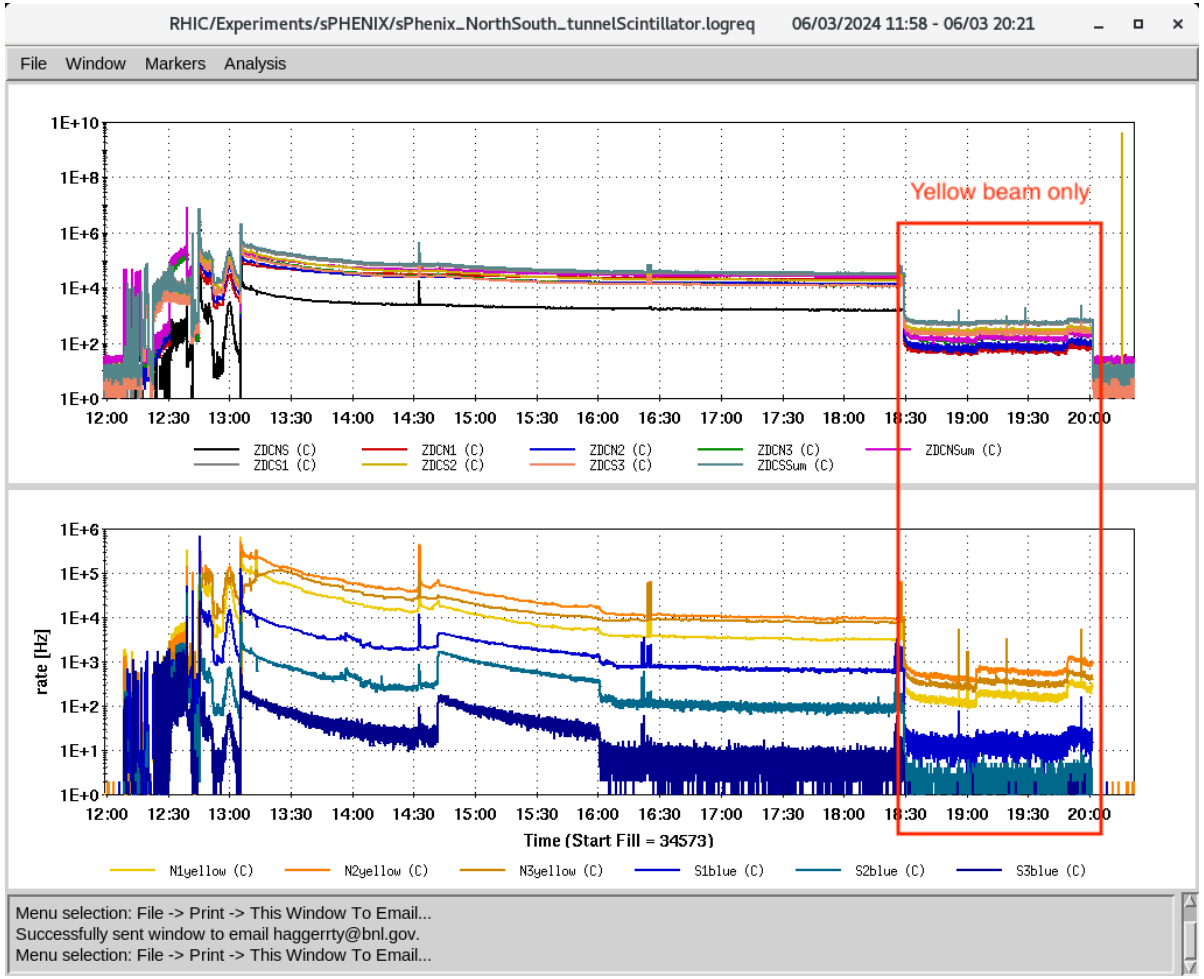


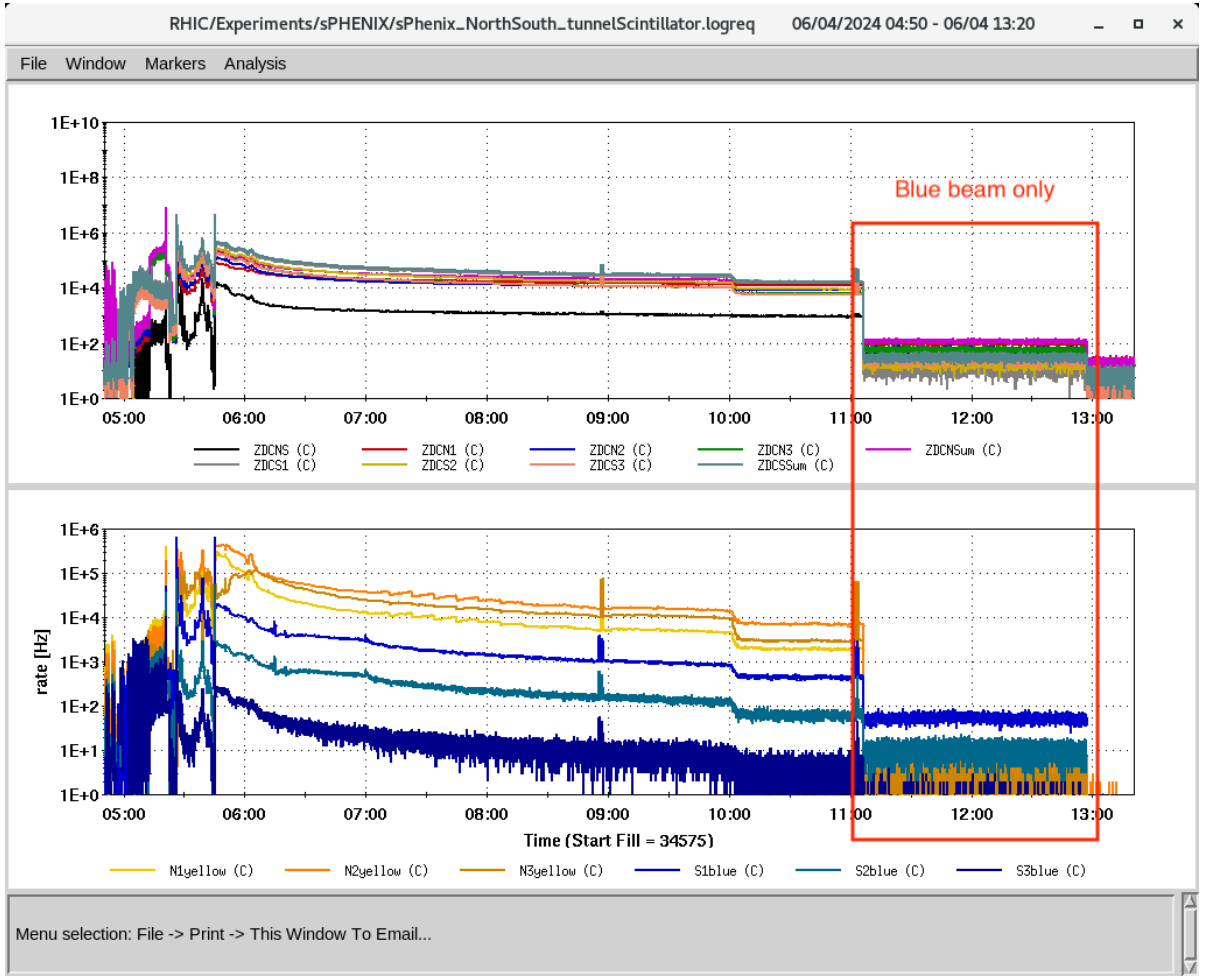
Backgrounds from one beam

- Drop blue, leave yellow
  - Monday June 3 19:30 fill 34573
  - ~1 kHz ZDCNS before the dump
- Drop yellow, leave blue
  - Tuesday June 4 11:00 fill 34575
  - ~1 kHz ZDCNS before the dump

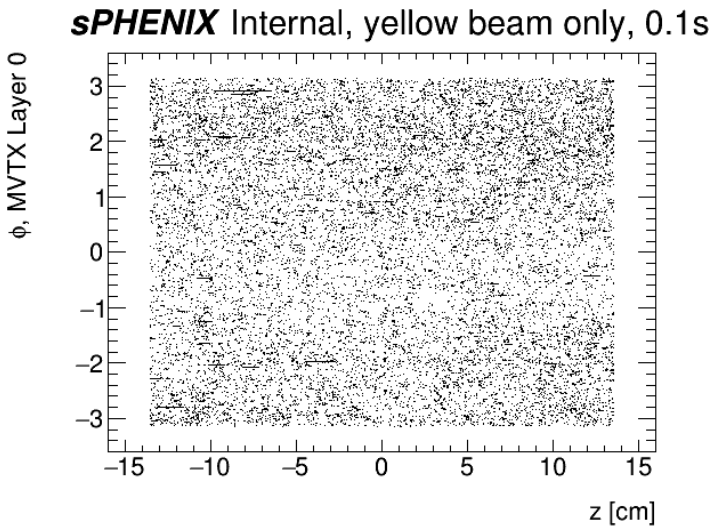

Shielding
O8Q1
North 1
Cable 2
Patch 11
Scaler Ch 1
O8Q2
North 2
Cable 6
Patch 12
Scaler Ch 2
Shielding
O8Q3
North 3
Cable 8
Patch 13
Scaler Ch 3
Q3 Q2 Q1
Q1 Q2 Q3
Y
B
7
8
SOUTH
NORTH

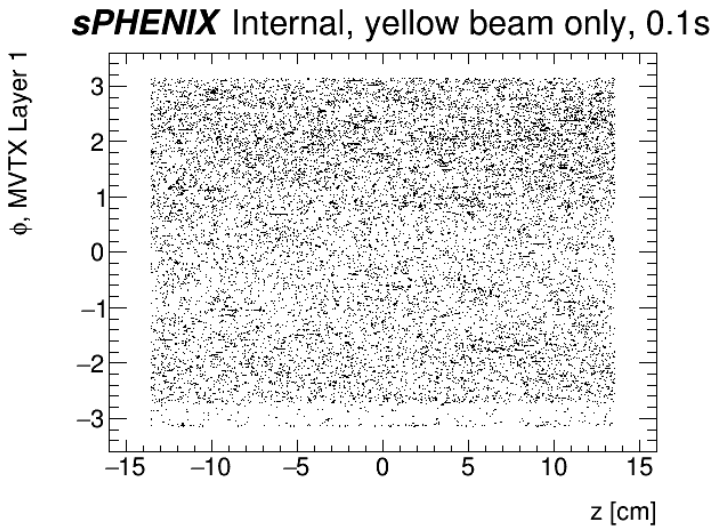
One beam

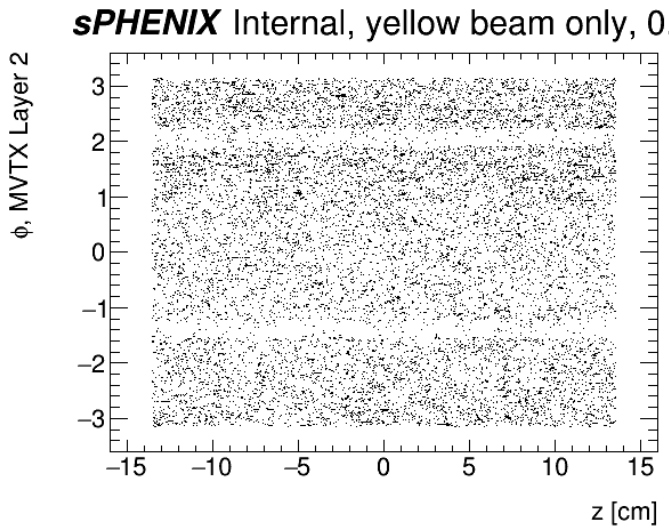

RHIC/Experiments/sPHENIX/sPhenix_NorthSouth_tunnelScintillator.logreq 06/03/2024 11:58 - 06/03 20:21
File Window Markers Analysis
Yellow beam only
ZDCNS (C)
ZDCS1 (C)
ZDCN1 (C)
ZDCS2 (C)
ZDCN2 (C)
ZDCS3 (C)
ZDCN3 (C)
ZDCSSum (C)
ZDCNSum (C)
rate [Hz]
Time (Start Fill = 34573)
N1yellow (C)
N2yellow (C)
N3yellow (C)
S1blue (C)
S2blue (C)
S3blue (C)
Menu selection: File -> Print -> This Window To Email...
Successfully sent window to email haggerrty@bnl.gov.
Menu selection: File -> Print -> This Window To Email...


RHIC/Experiments/sPHENIX/sPhenix_NorthSouth_tunnelScintillator.logreq 06/04/2024 04:50 - 06/04 13:20
File Window Markers Analysis
Blue beam only
ZDCNS (C)
ZDCS1 (C)
ZDCN1 (C)
ZDCS2 (C)
ZDCN2 (C)
ZDCS3 (C)
ZDCN3 (C)
ZDCSSum (C)
ZDCNSum (C)
rate [Hz]
Time (Start Fill = 34575)
N1yellow (C)
N2yellow (C)
N3yellow (C)
S1blue (C)
S2blue (C)
S3blue (C)
Menu selection: File -> Print -> This Window To Email...

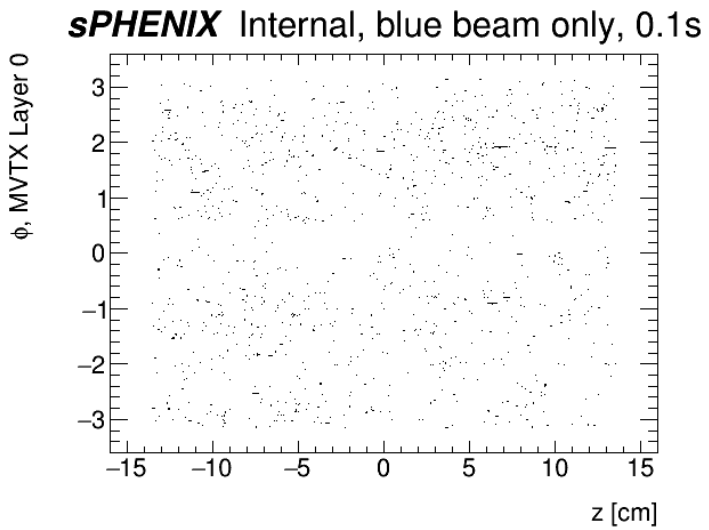
MVTX yellow beam only

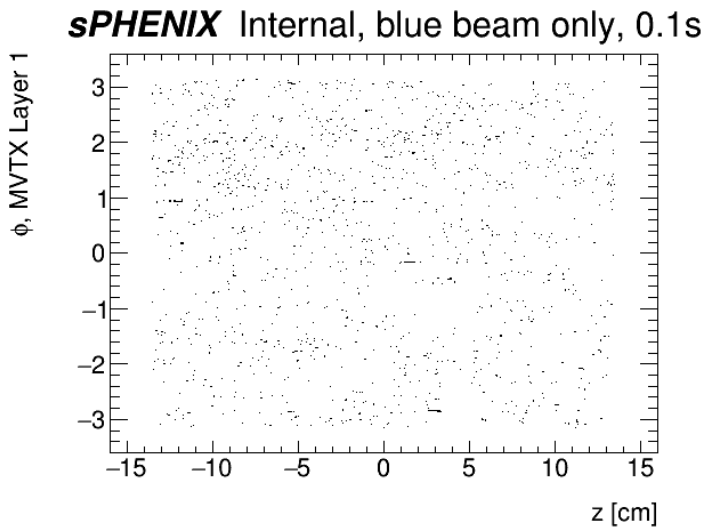


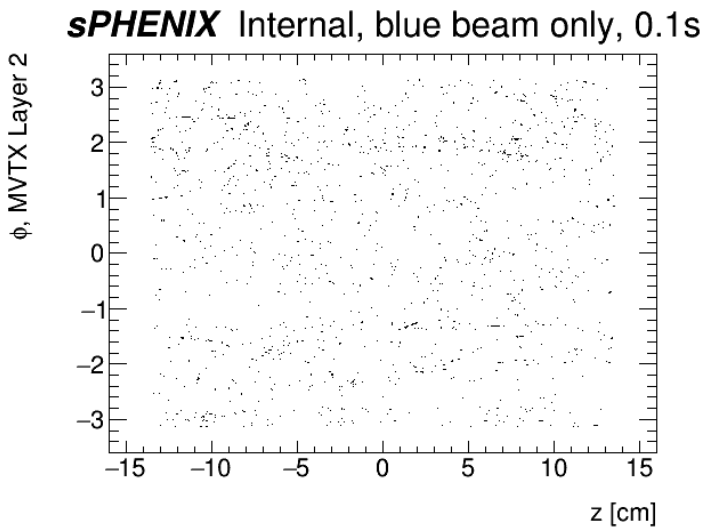




MVTX blue beam only



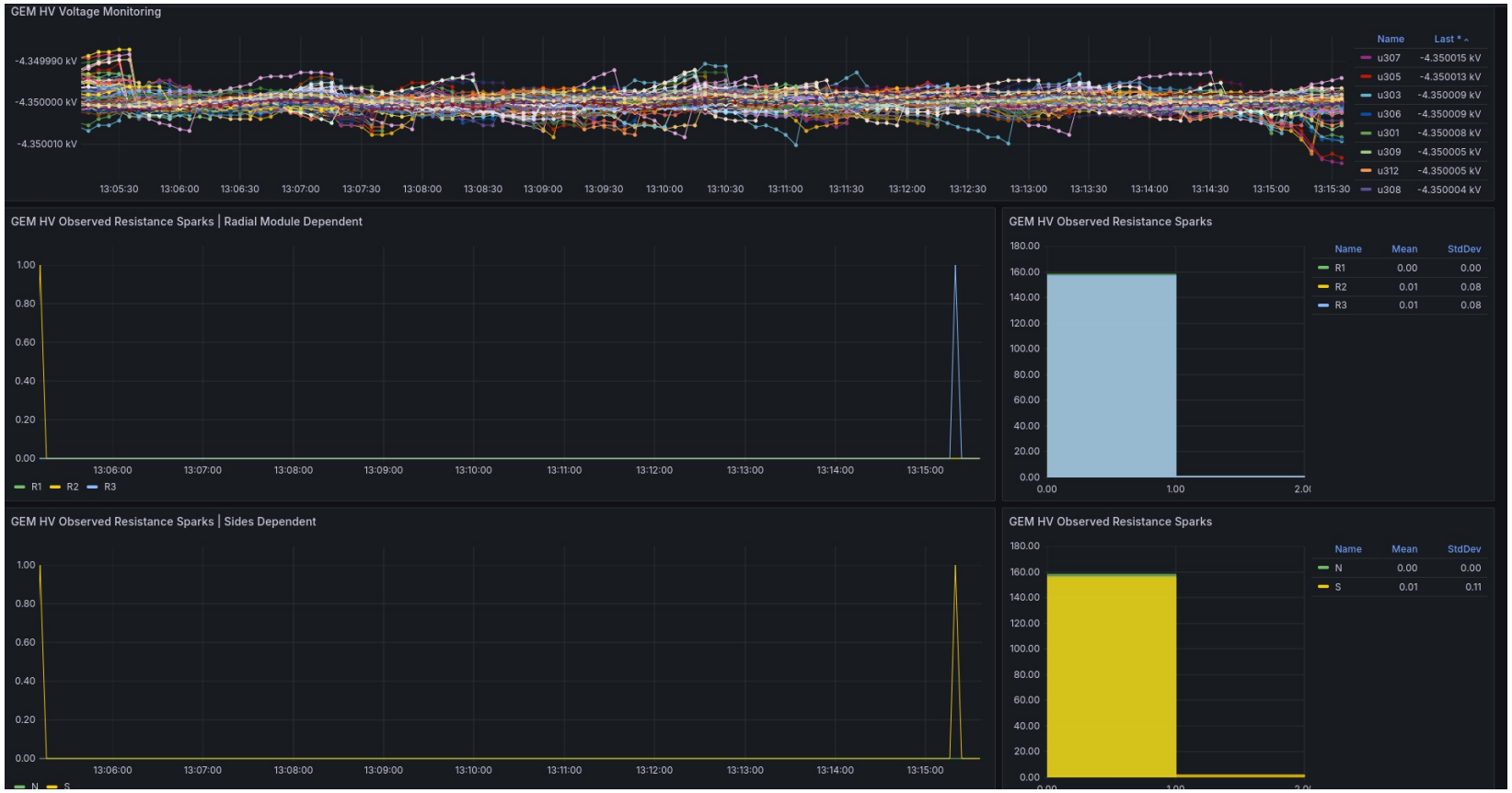




The TPC problem

- After rebuilding the HV distribution for the TPC GEM's (Nov-Feb), we were able to go to full operating voltage (4350V) for hours at a time with minimal sparking and little damage [can we quantify this?]
- With the beam on, we have never been able to keep the TPC GEM's at full operating voltage without destructive damage which causes a loss of acceptance

Sparks detected without beam

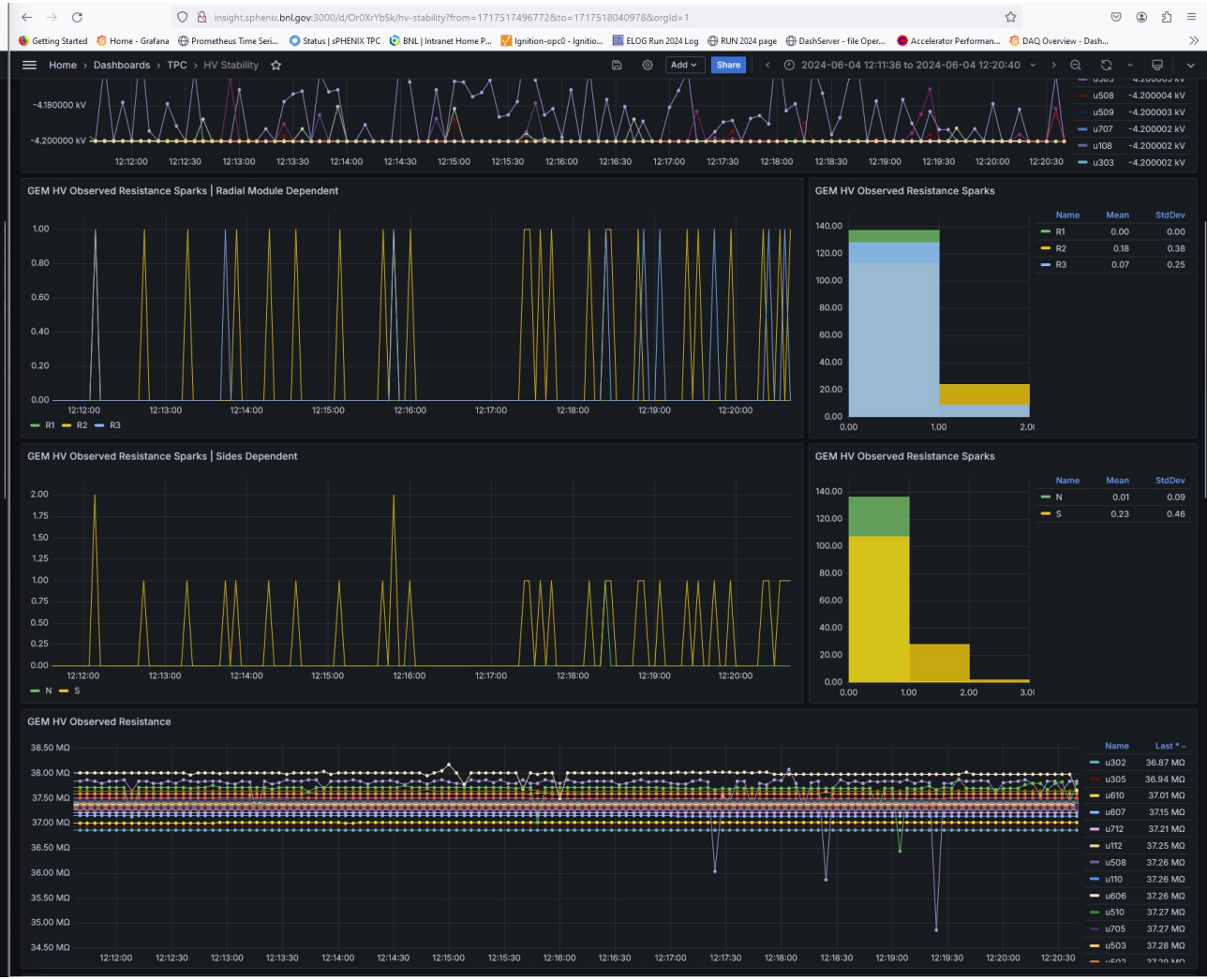


- Few sparks detected during testing Feb-April
- Still true now without beam (this was 10 minutes with 1 spark on Tuesday)

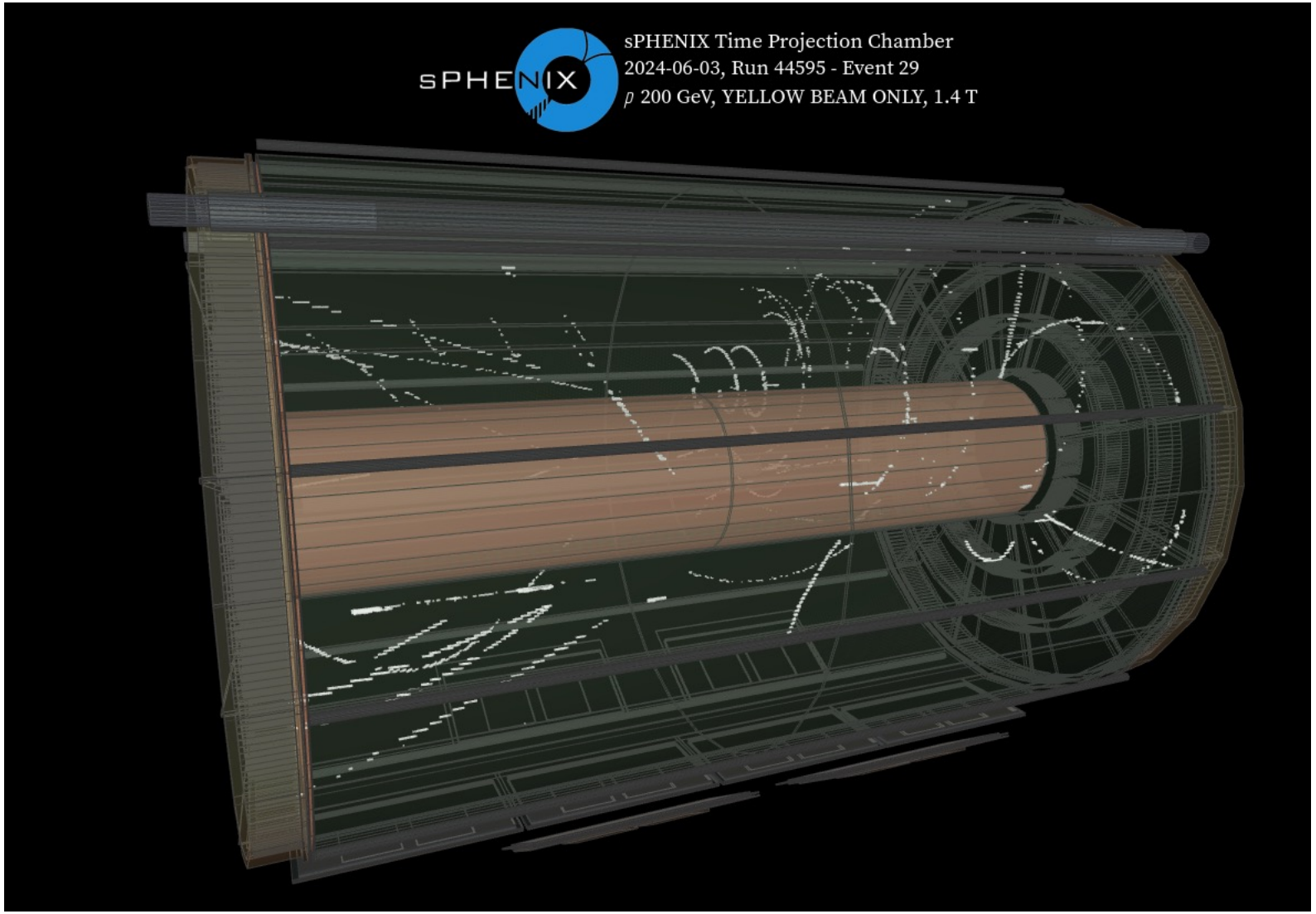
TPC

yellow beam only

blue beam only



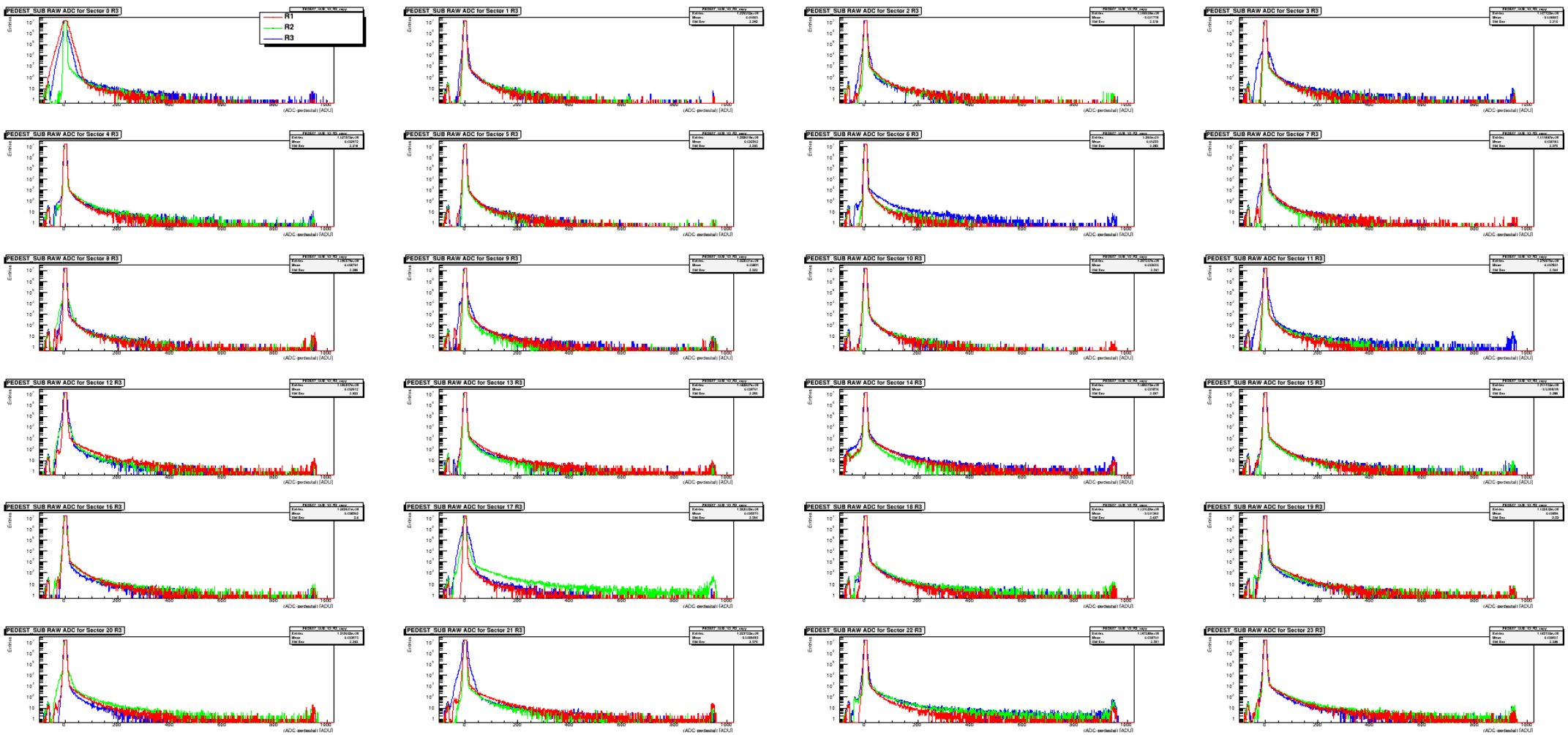
What a background event looks like in the TPC

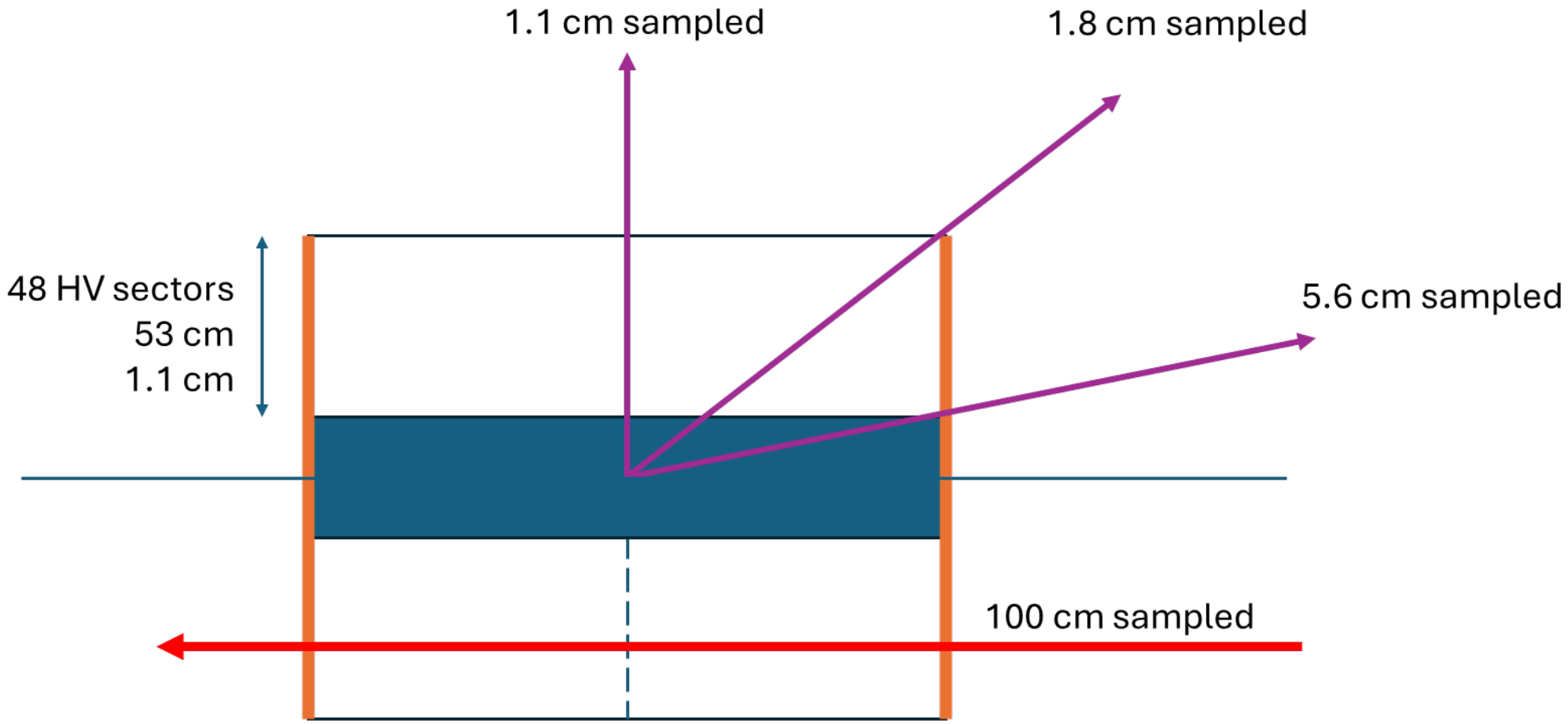


Highly ionization in the TPC with one beam

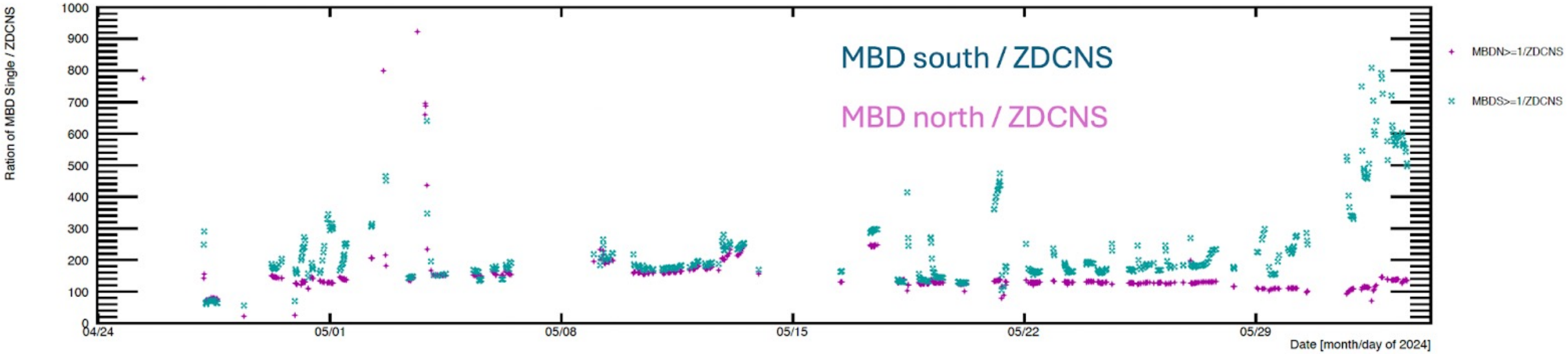
- Even with one beam, we see a lot of ionization in the TPC GEM’s
- Concentrations of ionization in the GEM’s is the seed for sparks

4.1 kV yellow beam only clock triggers




1.1 cm sampled
1.8 cm sampled
5.6 cm sampled
48 HV sectors
53 cm
1.1 cm
100 cm sampled

Change around May 29?



There is a lot of background at the start of the last few days of stores…
Jamie Nagle (SCM 2024-06-04)