SVT rate with Background

Shujie Li

ePIC Tracking++ meeting

Aug 7, 2025

New background Merged Sample

1000 forced DIS background events with:

- Same 18x275 DIS event sample and mixing frequency (**forced to have 1 signal per 2us slice**)
- same proton/electron beam gas background event sample and frequencies
- Same SR simulation file (see Andrii's talk), freq. From 14MHz → **3.3 GHz** (6.6k events / 2us slice)

Charged primary particle distribution
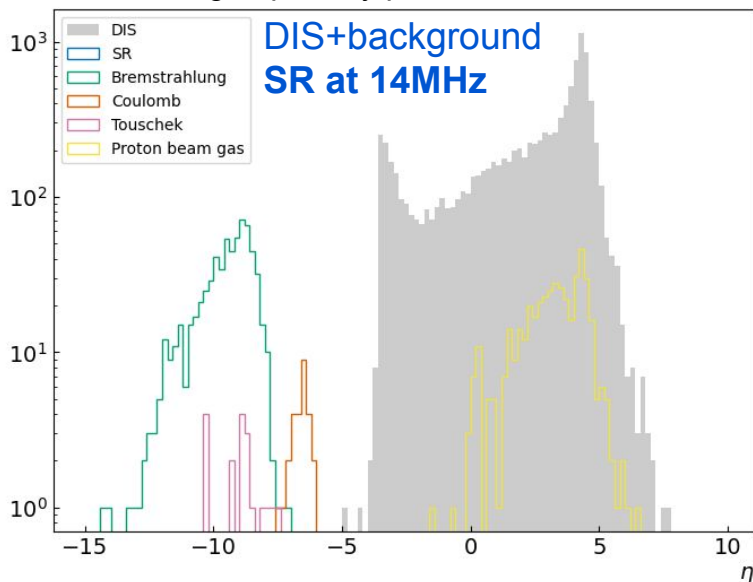
Charged primary particle distribution
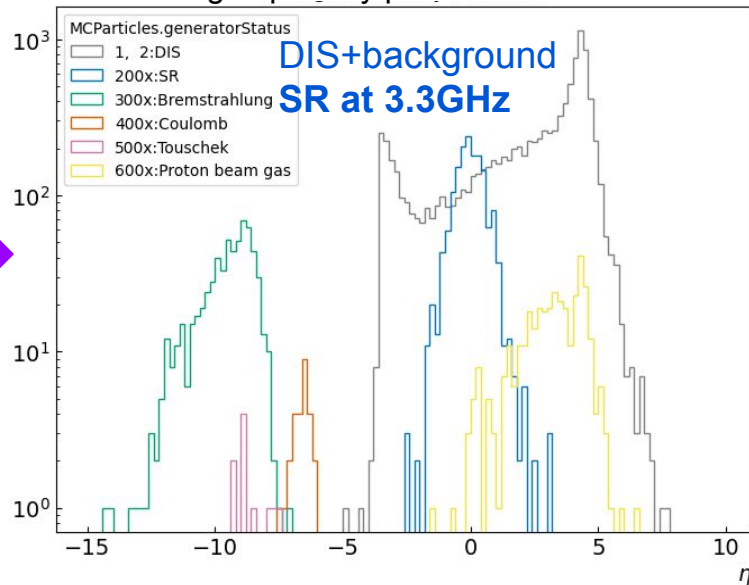
Beam Background Impact at **Hit** Level

Hits from charged beam particles:
plot digitized hits (edep > 0.54 keV) for
each SVT surface
→ check number of hits per 2cm x
2cm square (roughly size of one RSU)

→ show result in **ms** (500 x 2us slices)

Hits distribution on Barrels:
- Rphi v.s. Z
- L0, L1, L2, L3, L4 : max hits / ms /square
  =**2365** , 958, 197, 45, 9

L0 (SR@3.3GHz)

395	529	564	597	494	654	608	553	537	654	518	613	517	361
825	1239	1271	1276	1238	1267	1344	1410	1257	1320	1282	1198	1173	1115
1535	1864	2338	2185	1909	1591	1955	2093	2300	2252	2279	1680	2046	1560
788	1055	953	1110	1149	1269	1167	946	1023	1240	1212	1065	1182	915
677	836	974	988	1141	962	919	953	890	903	1005	901	1038	726
688	922	912	919	1031	1004	984	995	962	1025	1074	1003	1030	776
697	912	935	909	852	957	905	914	943	985	1139	1086	882	717
744	1016	910	937	925	884	871	853	916	812	1097	989	886	725
727	1100	1118	1073	1189	1210	1133	1235	1158	1185	1142	1214	1089	1010
1437	1669	1694	1578	2039	2011	2365	1790	1767	1798	1771	2137	1893	1419
1002	1274	1212	1152	1325	1222	1202	1294	1374	1593	1365	1503	1396	827
425	608	625	584	531	651	500	554	639	650	558	469	491	441

* Hits/ms/square plots available for all SVT layers.
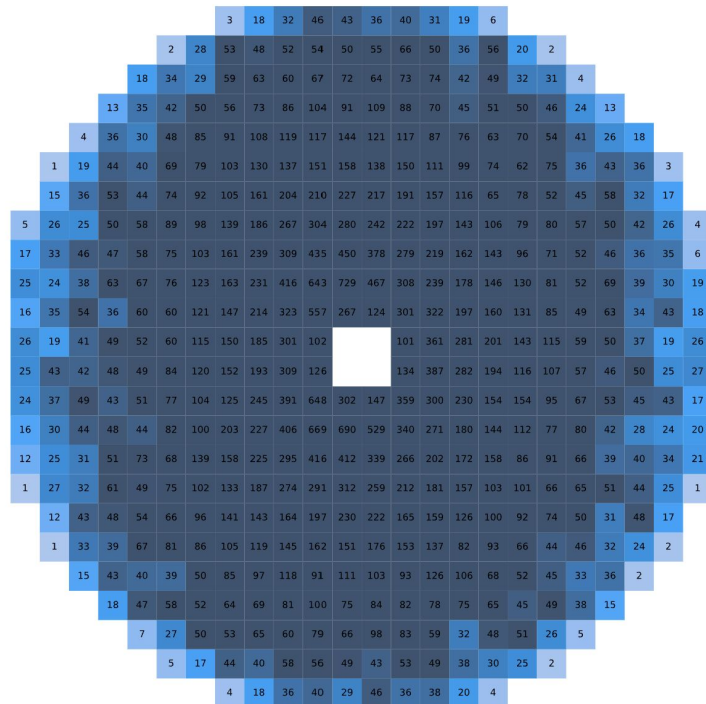Check the other attachments.

Beam Background Impact at Hit Level

Hits from charged beam particles:
plot digitized hits (edep > 0.54 keV) for
each SVT surface
→ check number of hits per 2cm x
2cm square (roughly size of one RSU)

→ show result in **ms** (500 x 2us slices)
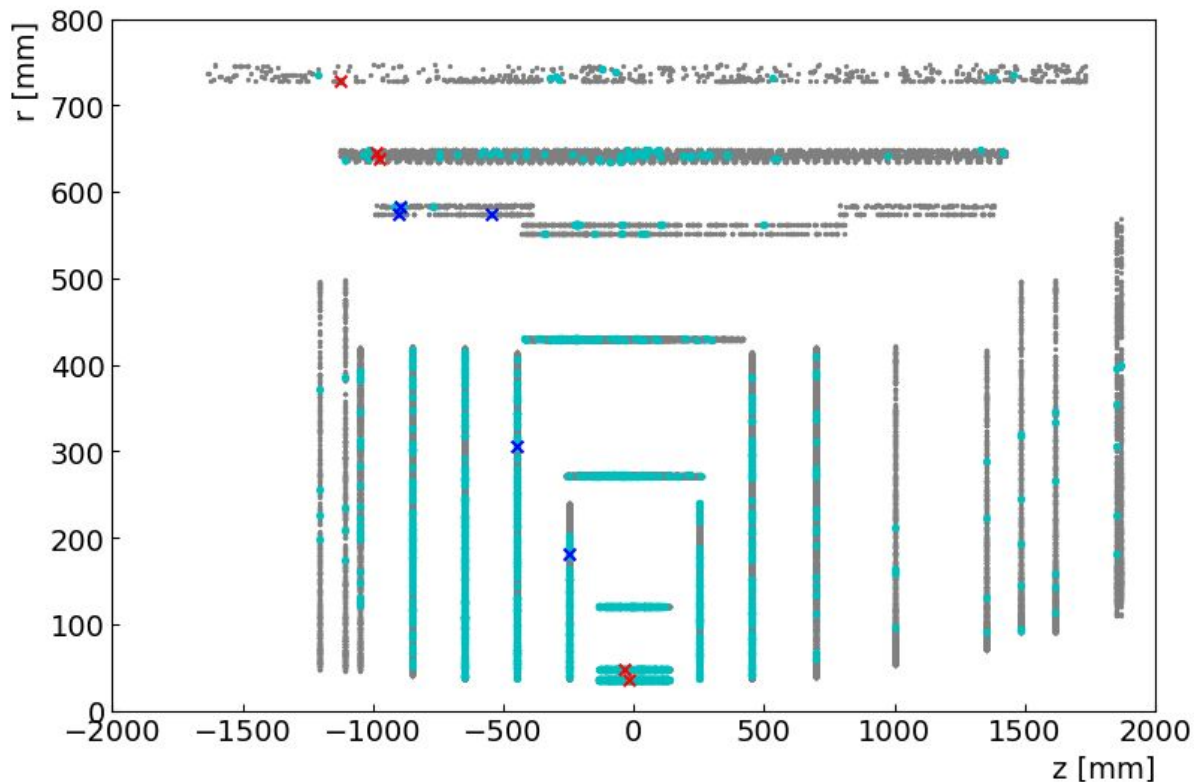
Hits distribution on Disks:
- X v.s. Y
- E-Disk 1,2,3,4,5 : max hits / ms /square
  =**729** , 657 , 620 , 176 , 23
- H-Disk 1,2,3,4,5 : max hits / ms /square
  =553 , 541 , 110 , 132 , 79

E-Disk 1 (SR@3.3GHz)

Beam Background Impact on Track Finding

Cyan: all hits from a given event
Red: good measurements used in tracking
Blue: outliers (didn't pass chi2 cut)

Pixel noise v.s. Beam background

# of hits are shown in per 2us slice

Detector name	Barrel layers	# of noise hits FHR = 5e-7/pixel/event	# of bkgrd hits (18x275) new SR at 3.3GHz, Aug 05, 2025
VertexBarrel	L0	76	371
	L1	102	221
	L2	254	113
SagittaSiBarrel	L3	1,145	42
OuterSiBarrel	L4	2,639	10

Detector name	Disks	# of noise hits	# of bkgrd hits (18x275)
InnerTrackerEndcapN	E-Disk1	405	100
MiddleTrackerEndcapN	E-Disk2	1,442	175
OuterTrackerEndcapN	E-Disk3	1,442	170
	E-Disk4	1,440	113
	E-Disk5	1,435	18
InnerTrackerEndcapP	H-Disk1	405	93
MiddleTrackerEndcapP	H-Disk2	1,442	116
OuterTrackerEndcapP	H-Disk3	1,441	34
	H-Disk4	1,429	9
	H-Disk5	1,414	8

Hits on IB: 3e8 hits/sec → 600 total hits / 2us on 3 layers → consistent with this study
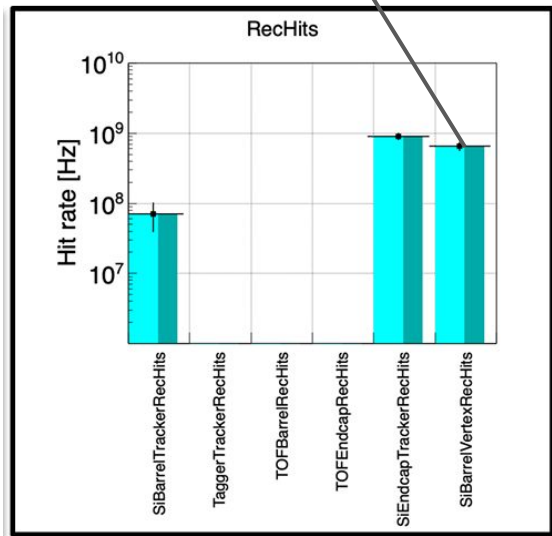
ePIC detector RecHit rate

from Andrii's simulation

6

Summary

- New DIS+background event sample with updated SR frequency

- Saw significant impact on number of hits on trackers.

- Ongoing: understand the impact of noise + background in tracking

  - Optimize seeding + track finding algorithm parameters

  - Revisit chi2 cut / pull distributions

Thanks!