Rates

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Rates

- Brief recap:
  - First evaluation of SVT hit and data rates including synchrotron radiation backgrounds at the SVT working meeting past Summer in SBU, c.f. https://indico.bnl.gov/event/28216/contributions/109926/ and https://indico.bnl.gov/event/28216/contributions/109415/
  - The SBU evaluation was specific to the **18** x 275 GeV beam-energy combination,
  - Updated in August 2025 to correct a sampling frequency error in the ePIC production – rates increased, c.f. https://indico.bnl.gov/event/29303/
  - Tracking performance evaluated for the ePIC and EIC Physics Readiness Workshop in London past September, c.f. https://indico.global/event/15249/contributions/133822/
  - Synchrotron radiation rates for 5 GeV and 10 GeV electron beams evaluated more recently by Andrii Natochi, c.f. https://indico.bnl.gov/event/30244/
  - Verbal discussion yesterday of a recent **10** x 275 GeV hit rate evaluation,
    - Expected to present the worst case (for synchrotron radiation),
    - Tracking performance being studied,
    - 5 GeV hit rates not yet evaluated,
    - Ion beams – no ePIC simulations other than protons so far,

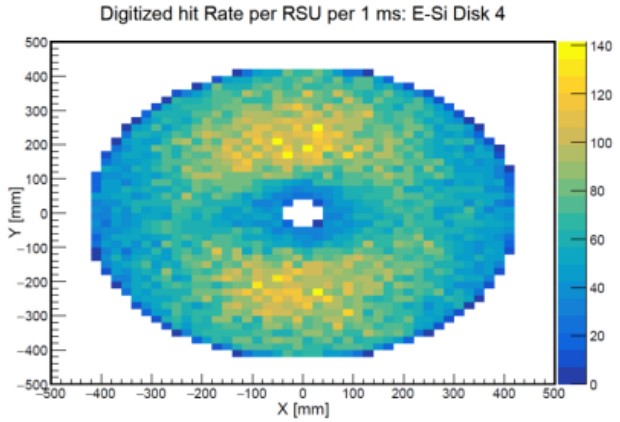
Rates

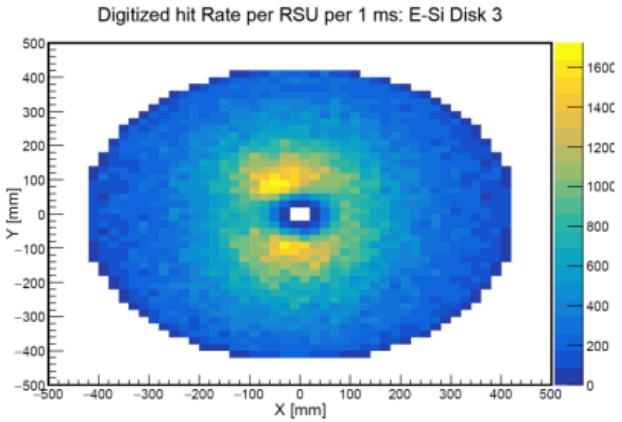
Electron beam-gas rates consider larger region of -5 to +15 meters along the IP, hadron beam-gas rates consider region of -5.5 to +5 meters.

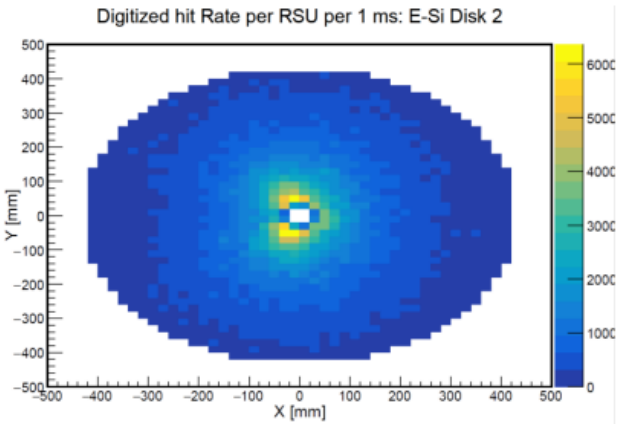
rates in kHz	**10x275 GeV**	**18x275 GeV**
	2.5A@10kAhr	0.227A@10kAhr
DIS eA	/	/
electron SR	36608 MHz	3324 MHz
electron beam gas (Bremsstrahlung scatterings)	3177.25 kHz	316.94 kHz
electron beam gas (Coulomb losses,)	29 kHz	1.3 kHz
electron intrabeam (Touschek losses)	240 kHz	0.72 kHz
hadron beam gas	32.6kHz	22.5kHz

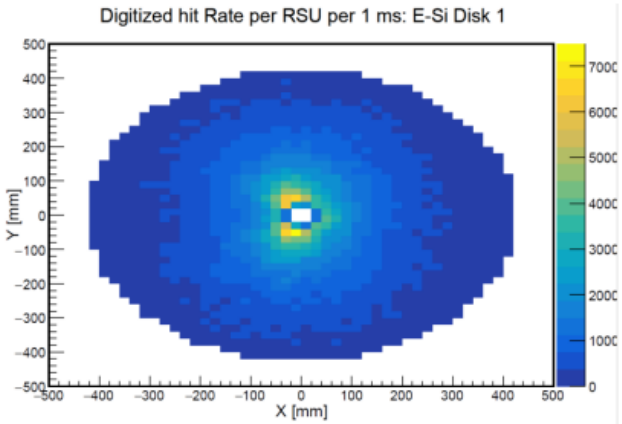
Rates – distributions

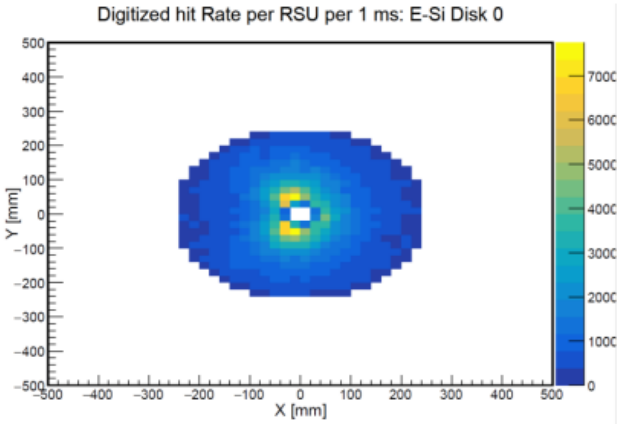
All SVT E-side disks: 10x275 GeV (forced DIS configuration)











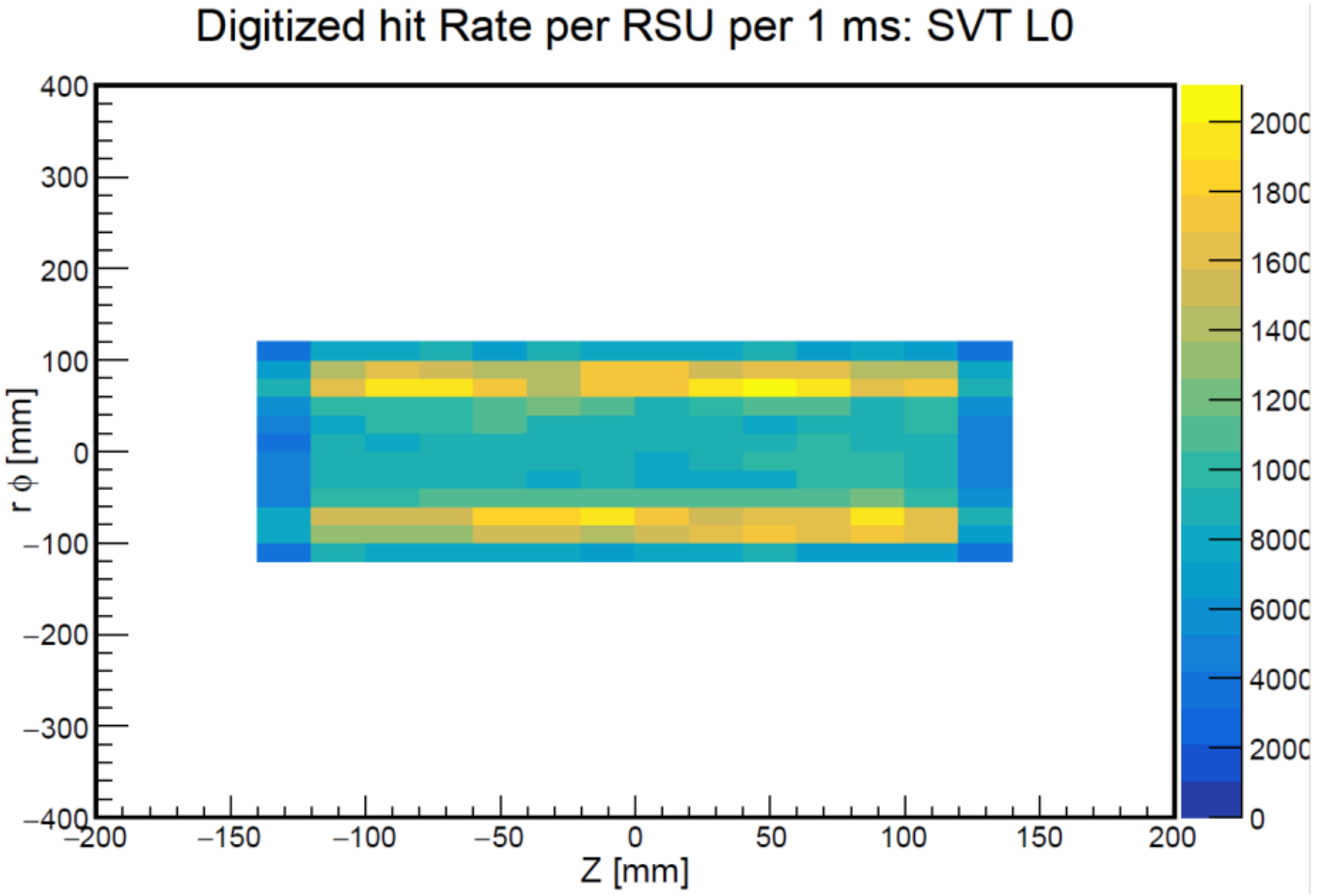
c.f. https://indico.bnl.gov/event/30466/

Rates – distributions

SVT L0: 10x275 GeV (forced DIS configuration)

In latest geometry, r = 38 mm for L0.

So, rϕ should span ±120mm.



c.f. https://indico.bnl.gov/event/30466/

Rates – the spreadsheet of hits

10x275 GeV setting **All counts are per millisecond (ms)**

1ms of mixed data = 1000 events x (one DIS collision at Q2 >1 GeV2 per 2us + beam background per event) /

source file:	bgmerged_forced_10x275_scaled_SR_n1000 (all b			**Shujie**: /25.10.4/epic_craterlake/Bkg_1SignalPer2usFrame/DIS/NC/10x100/minQ2=1/		
Layer name	**Total hits**	**single RSU**	**(9.8x3.5mm)**	**Total hits**	**single RSU**	**(9.8x3.5mm)**
E-Si Disk 4	95759	141.5		97019	158	29
E-Si Disk 3	616153.5	1721.5		618422	1830	259
E-Si Disk 2	943527.5	6361.5		940608	6518	790
E-Si Disk 1	975762	7482		976195	7358	1010
E-Si Disk 0	538274	7749		538309	7651	1072
H-Si Disk 0	436240	6378		438216	6471	825
H-Si Disk 1	623590.5	5709		624534	5788	907
H-Si Disk 2	163522.5	297		165565	306	78
H-Si Disk 3	12764	152.5		14334	162	42
H-Si Disk 4	5766.5	82		7064	118	20
L0	1790734.5	21032		1791732	21185	2301
L1	1090676.5	8778.5		1095604	8731	959
L2	596813.5	1921		600729	1967	227
L3	1644427.5	2127.5		1645551	2102	297
L4	889449	562.5		888591	551	96

Rates – hit rates to data rates

- Evaluation at SBU (Jo, Joao):

  ~ 4 pixels per hit
  32 bits per pixel
  So, multiply by 128 bits to go from hit rates to data rates

  40, 80, or 160 MHz clock defines the bandwidth from the tiles; 12 per RSU, 5 or 6 RSUs per EIC-LAS

  Single aggregate 5 or 10 Gbps EIC-LAS data link out of the LEC; we have seen yesterday that 10 Gbps is challenging

  Joao briefly discussed the ~4 pixels per hit yesterday, or at least the dependence on incident angle,

- SR originates primarily from large positive z, i.e.
  ~ orthogonal to the disks (~ 4 pixels per hit is likely an overestimate),
  ~ tangential to the barrel (~ 4 pixels per hit may be optimistic),

Rates – hit rates and data rates

1ms of mixed data = 1000 events x (one DIS collision at Q2 >1 GeV2 per 2us + beam background

source file:	Shujie: /25.10.4/epic_craterlake/Bkg_1SignalPer2usFrame/DIS/NC/10x100/minQ2=1/					
Layer name	Total hits	single RSU	(9.8x3.5mm)	Total data rate (Gbps)	Max avg. RSU rate (Gbps)	Max avg. tile rate (MHz)
E-Si Disk 4	97019	158	29	12.4	0.02	3.7
E-Si Disk 3	618422	1830	259	79.2	0.23	33.2
E-Si Disk 2	940608	6518	790	120.4	0.83	101.1
E-Si Disk 1	976195	7358	1010	125.0	0.94	129.3
E-Si Disk 0	538309	7651	1072	68.9	0.98	137.2
H-Si Disk 0	438216	6471	825	56.1	0.83	105.6
H-Si Disk 1	624534	5788	907	79.9	0.74	116.1
H-Si Disk 2	165565	306	78	21.2	0.04	10.0
H-Si Disk 3	14334	162	42	1.8	0.02	5.4
H-Si Disk 4	7064	118	20	0.9	0.02	2.6
L0	1791732	21185	2301	229.3	2.71	294.5
L1	1095604	8731	959	140.2	1.12	122.8
L2	600729	1967	227	76.9	0.25	29.1
L3	1645551	2102	297	210.6	0.27	38.0
L4	888591	551	96	113.7	0.07	12.3
				1336.6		

Note: conversion from hit to data rates uses the ~naïve 128 bits per hit for simplicity