Updated study on Background using Bruno

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FullSim/Background Meeting

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Outline

- Many progresses on SVT side, update with beamgas for DCH
- SVT:
  - Discrepancy with BelleII bkg simulation
  - Distribution of energy released per strip to be used as input for electronics design
  - Additional plots for track origin, internal sanity checks of the code and comparison with FastSim
  - Updated background report plus beamgas contribution
  - Official version of plots for each bkg component and summed
- Geometry and software modification

Discrepancy with BelleII estimation

- Briefly: they computed final rate for 2photon using our strip rate number as track rate

- After clear definition of variables our results agree considering different luminosity and detector geometry

- Their dose estimation was much smaller than our because they were considering only neutrons

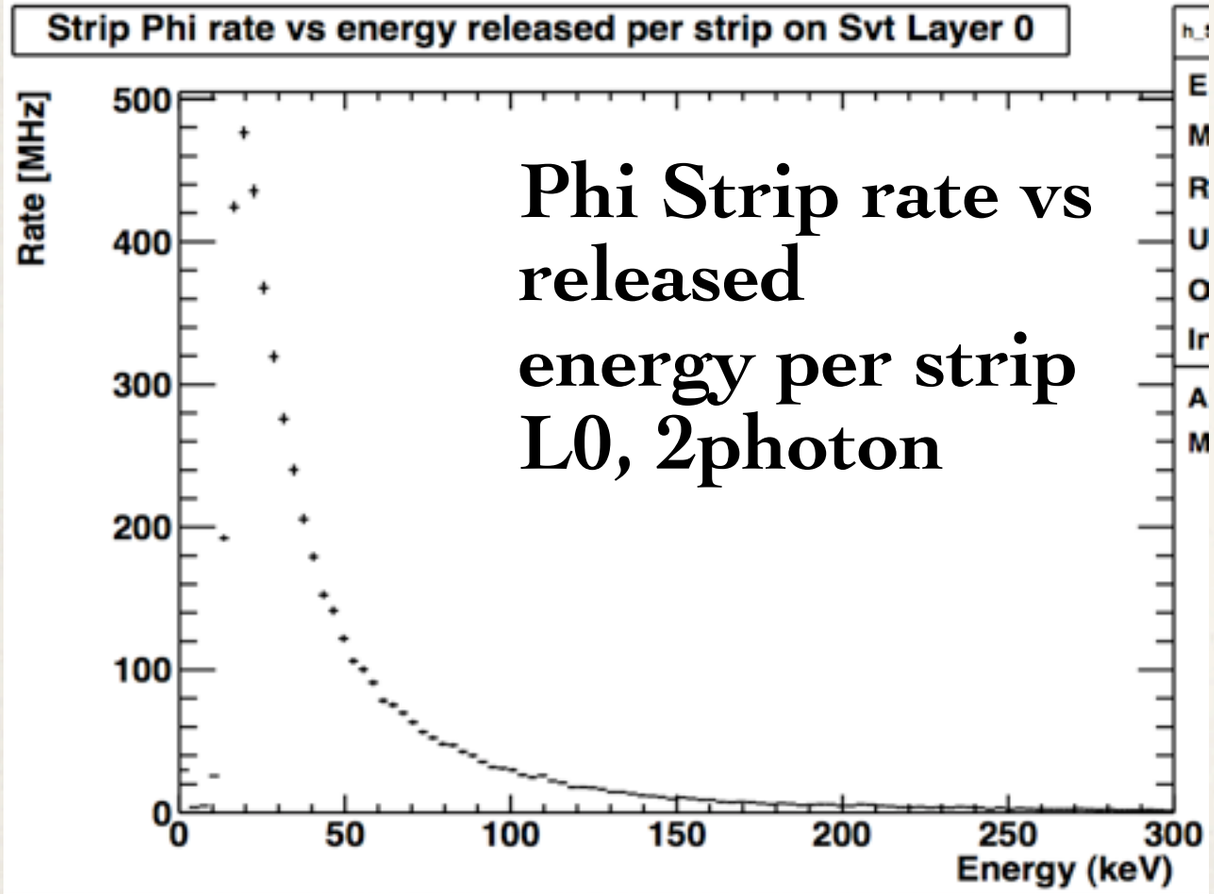
- Useful meeting in Vienna, they are now trying to reproduce most of our plots: dose, track and cluster rates

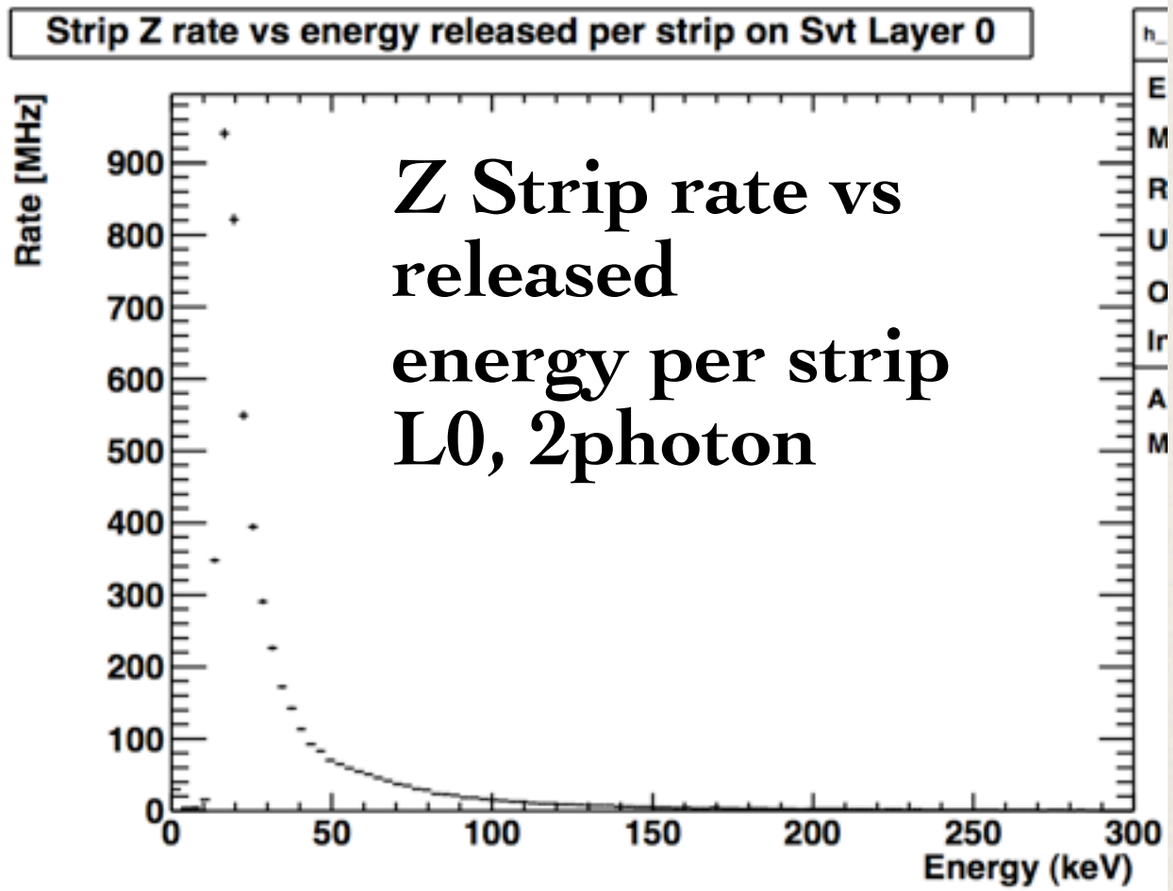
SVT

Released energy

SVT

- Request from electronics people for distribution of released energy per strip
- Plots for each bkg source
- Numerical values provided to be used in electronics simulation
- No significative change in rate if threshold at 1/4 MIP (~15 kEv)





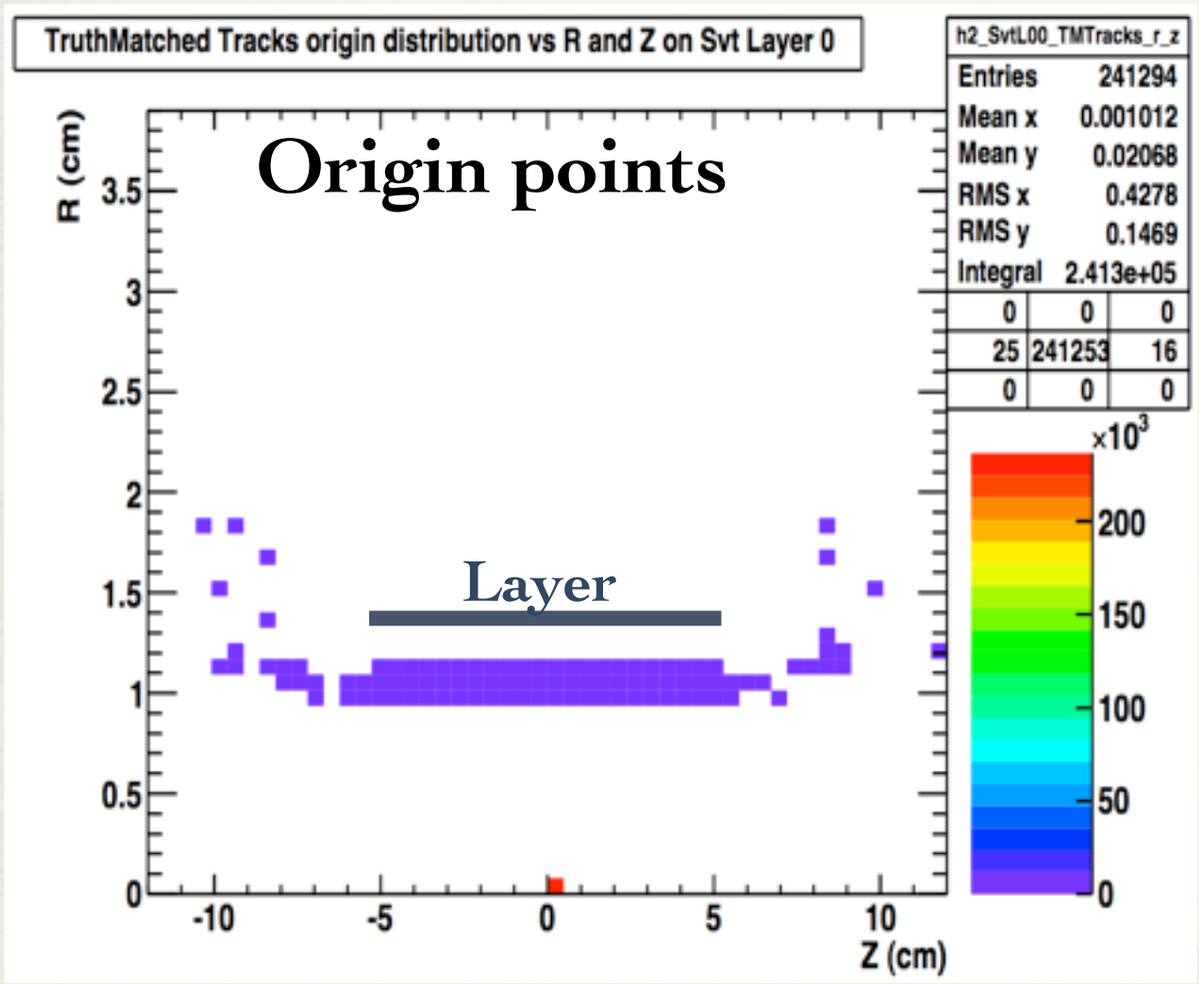
Tracks origin

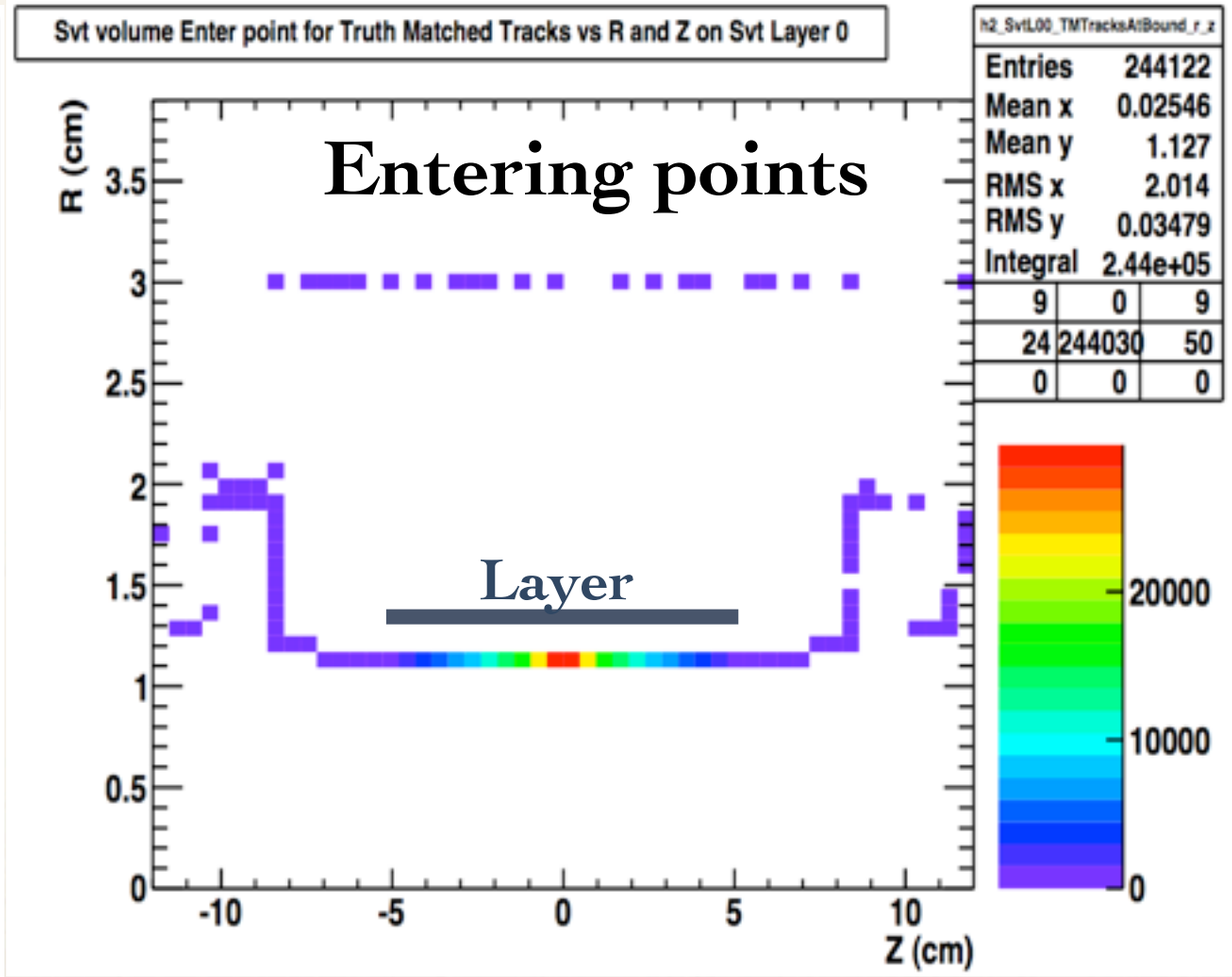
SVT

- New plots, r-z coordinates of a point related to the track that generate a cluster (one entry per cluster):
  - **Origin points**: if track is in the truth, production vertex or starting point
  - **Entering point:** entering point in Svt container volume (production vertex, if the track originates inside)
- For each layer global plots and separated in 4 areas:
  - Backward tail (0), backward (1), forward (2), forward tail (3)
  - L4-5 tails are the wedges
  - L0-1 tails are 1cm from the edge, L2 2cm, L3 3cm

Tracks origin, global plots, L0 SVT

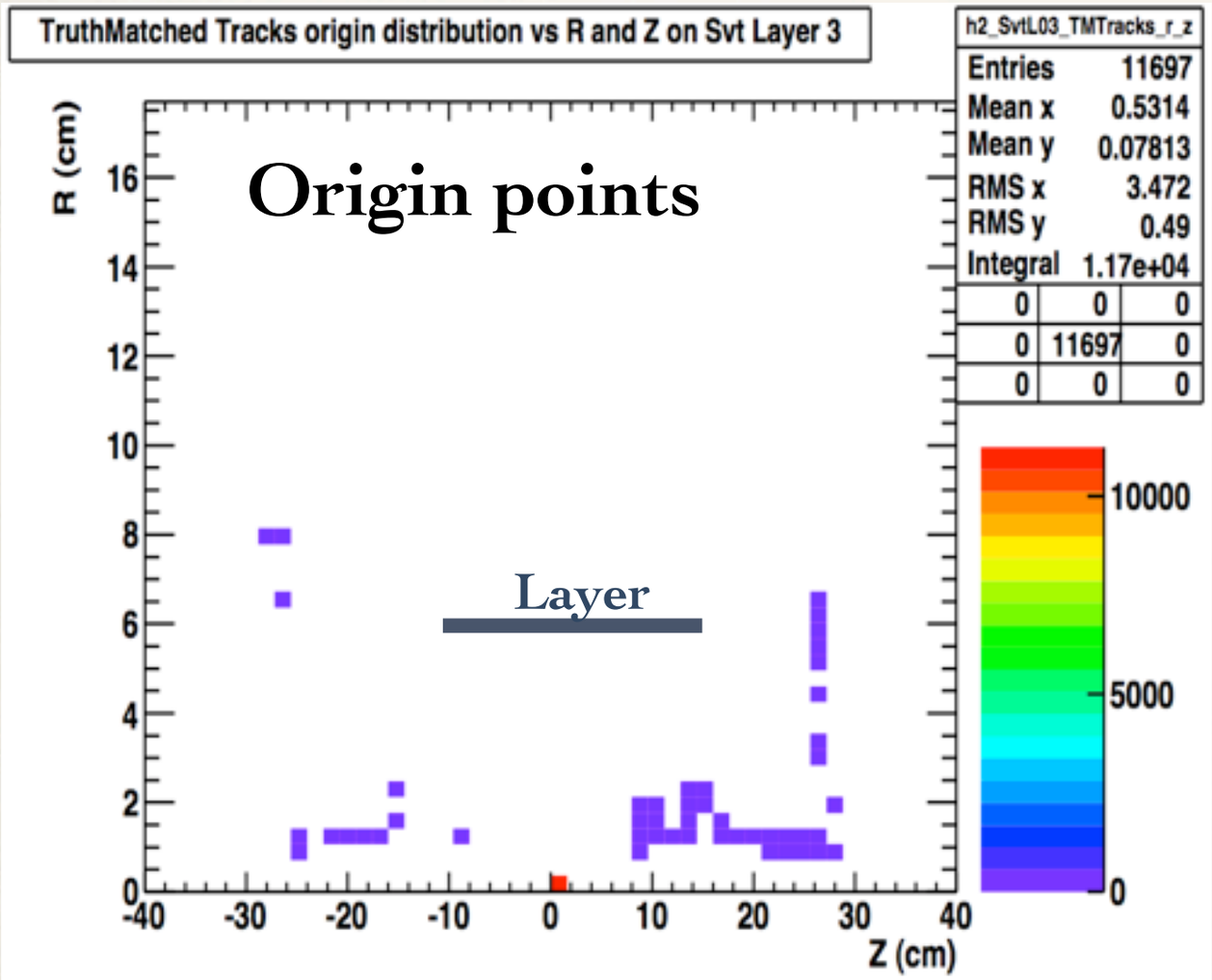
- Most tracks are the one from the IP (red bin at z=0)
- Very few tracks from bwd and fwd
- Some tracks coming backward

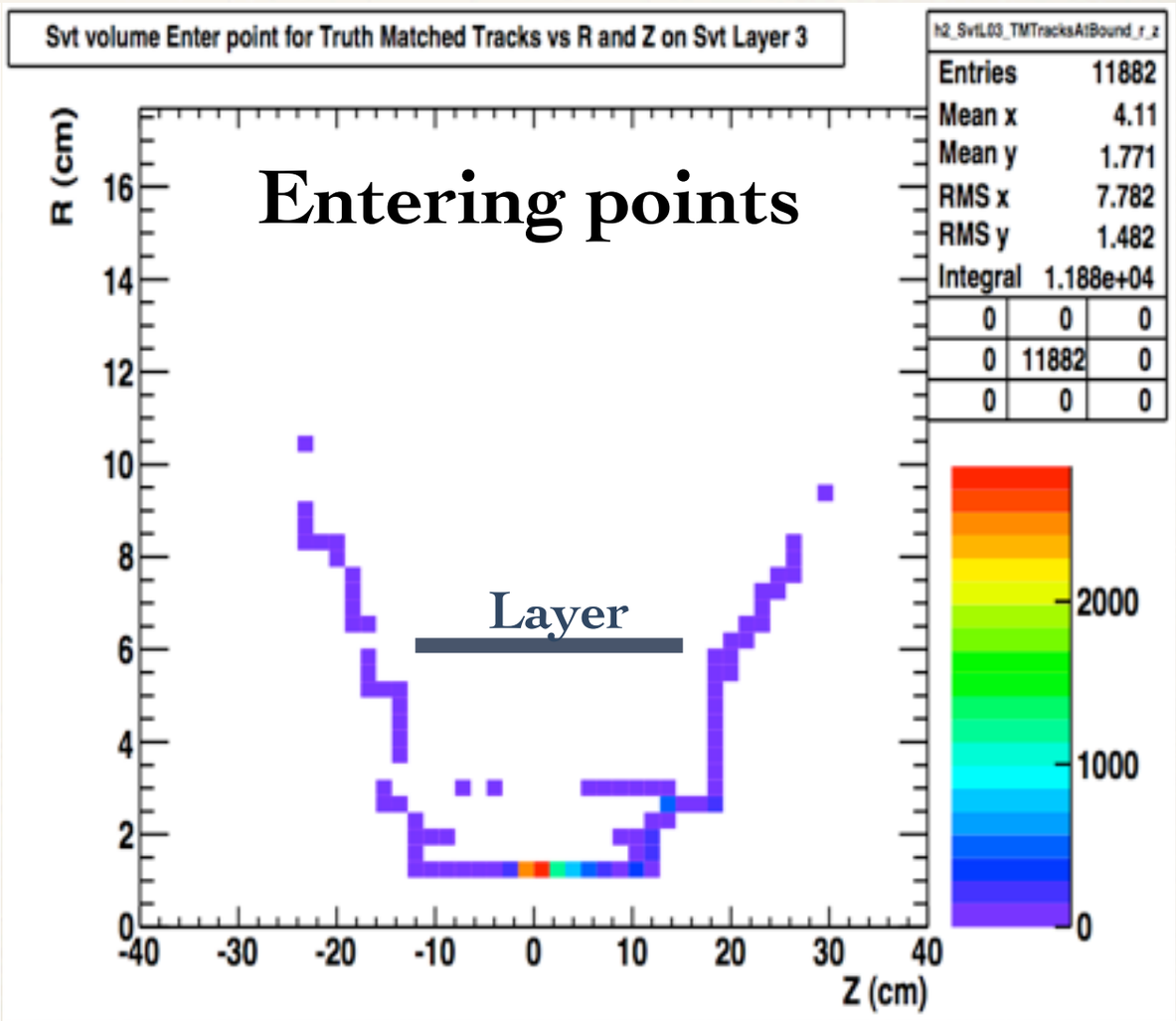




Tracks origin, global plot, L3 SVT

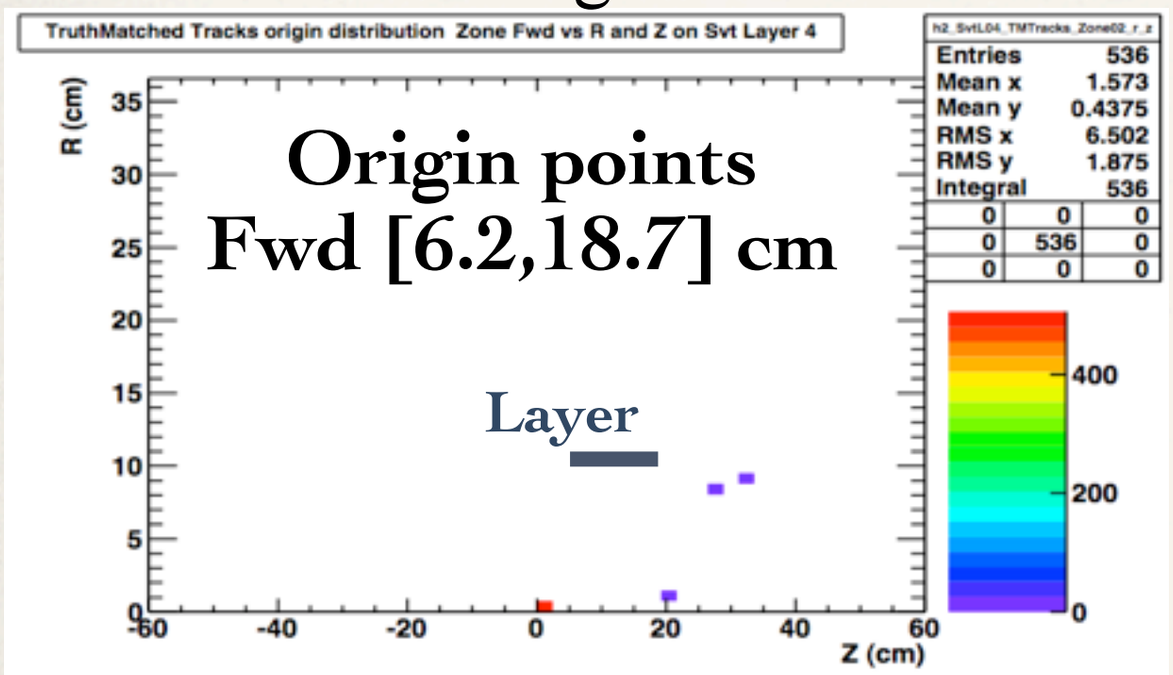
- Some of the tracks that originate in the final focus then enter from fwd and bwd
- Some structure can be seen on the left (tungsten shielding, pipe splitting)

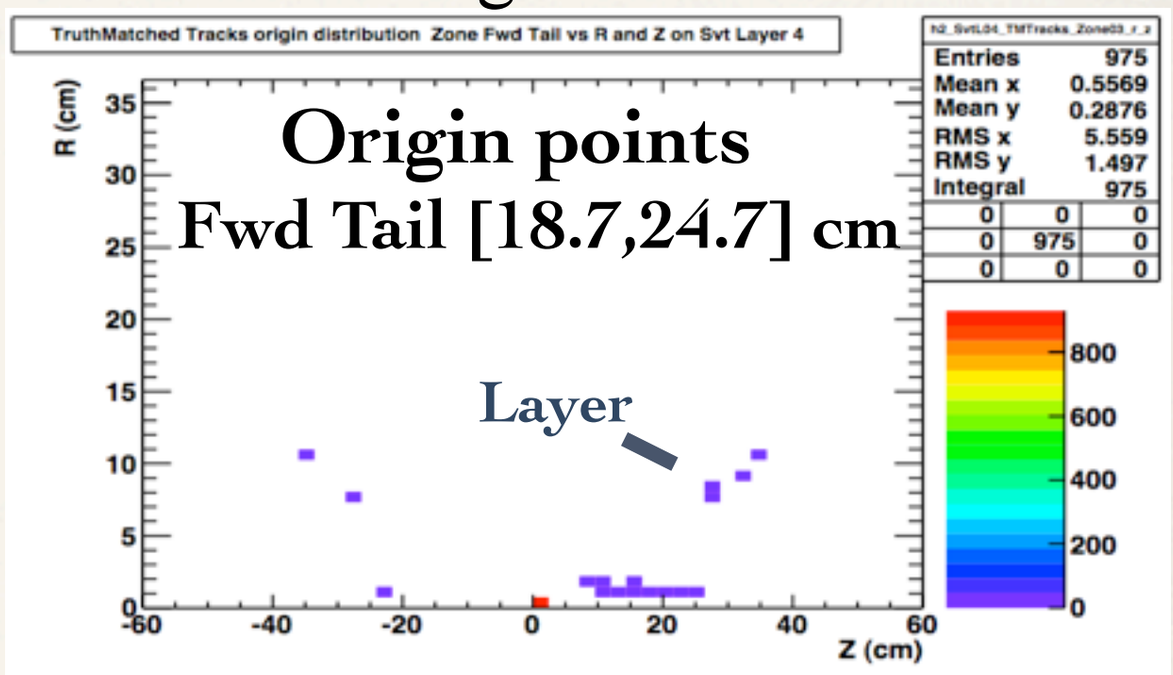


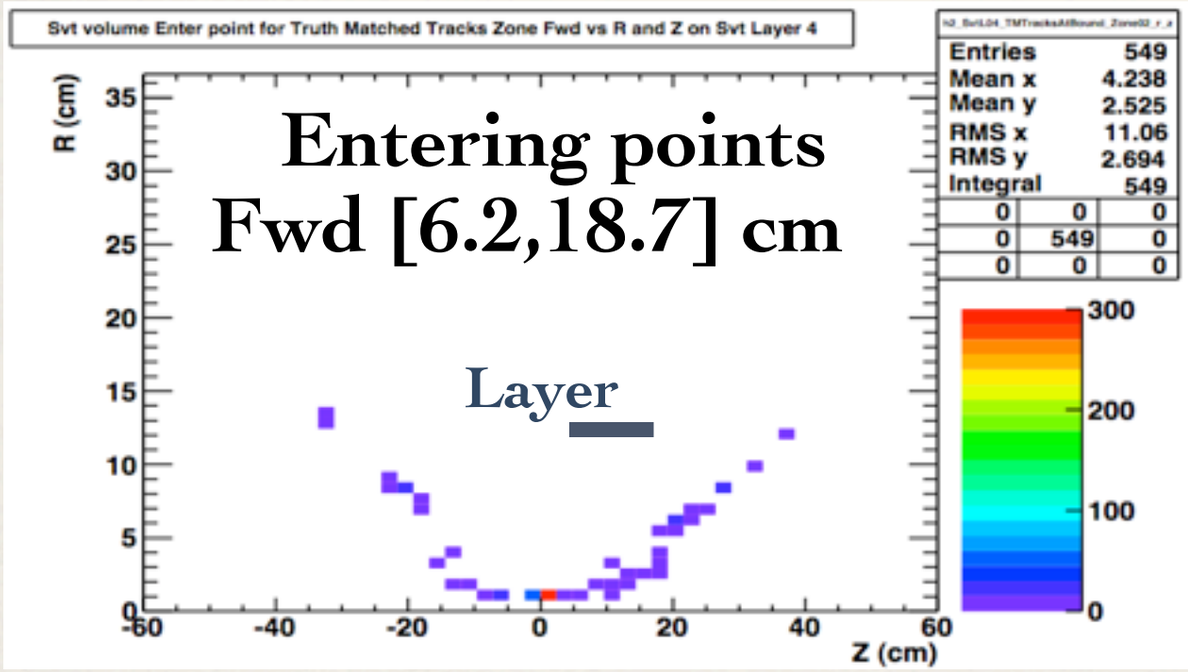


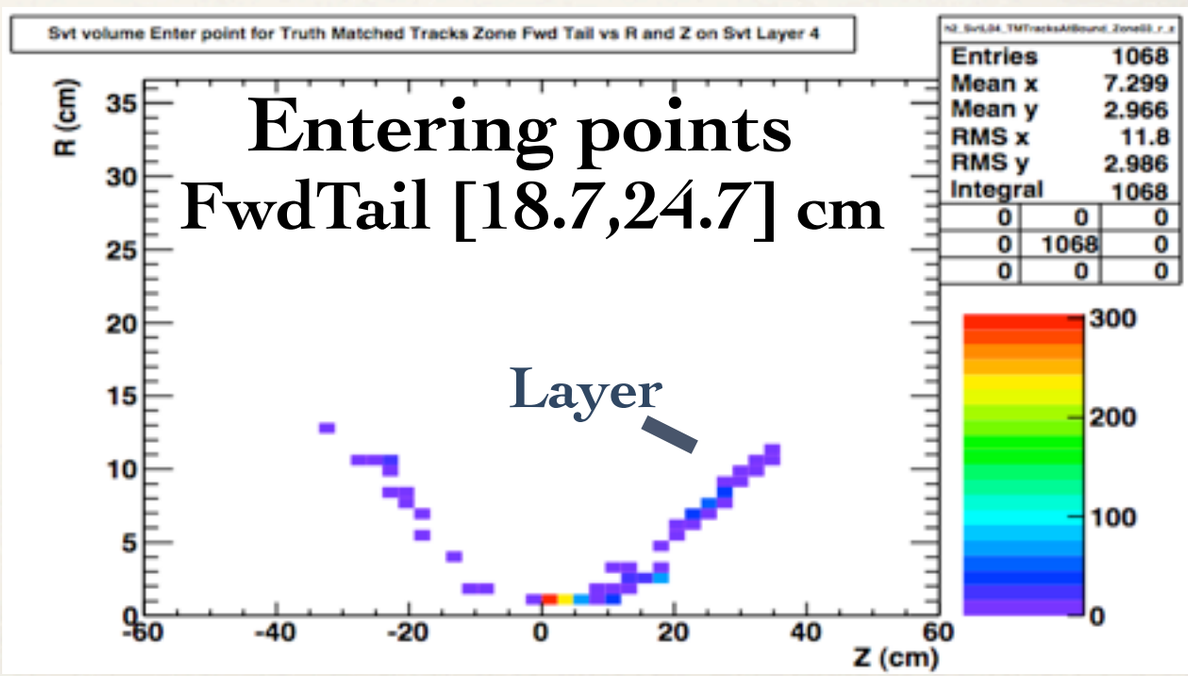
Tracks origin, separated plot, L4 SVT

- For fwd tail large contribution from fwd entering tracks









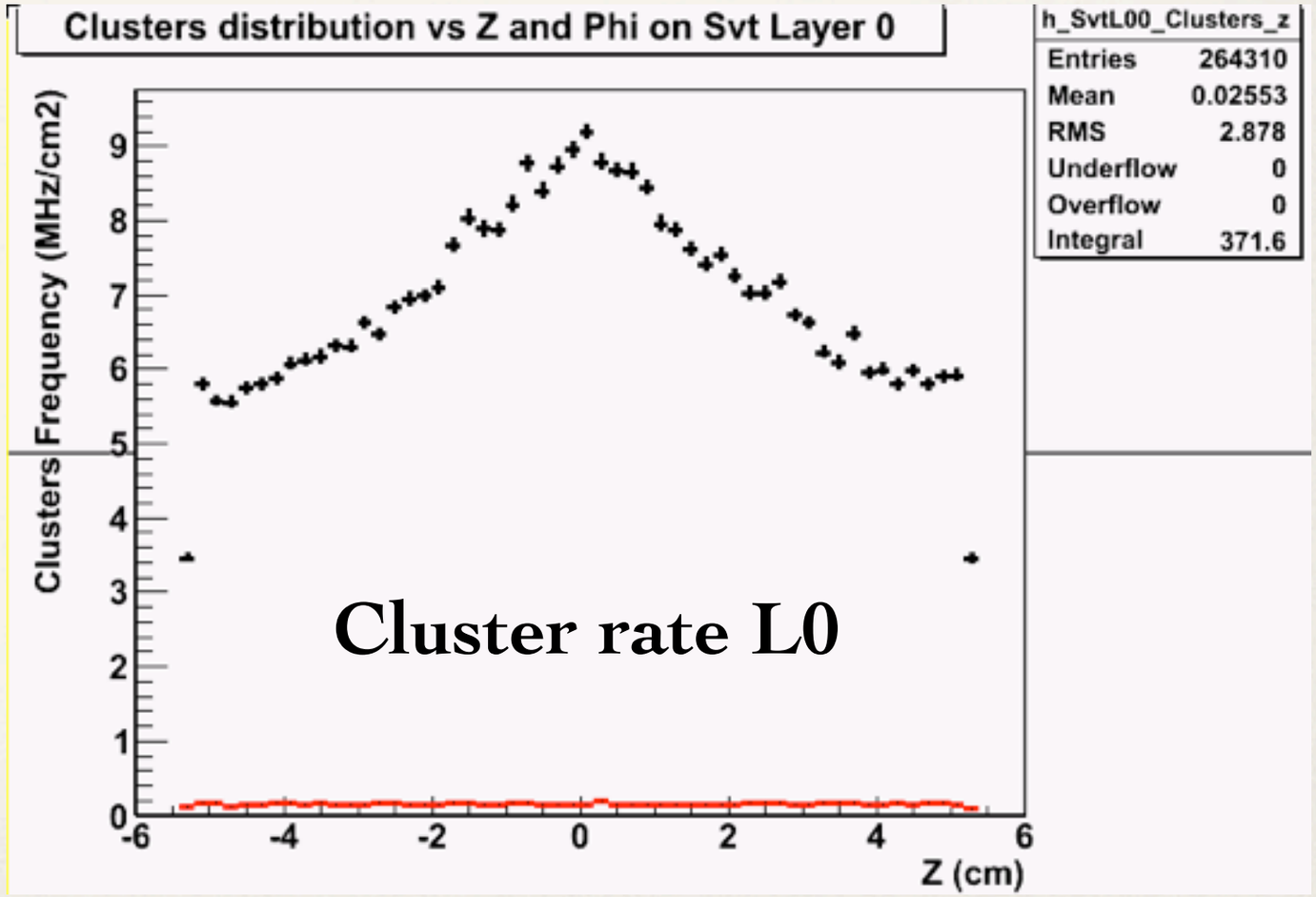
Delta rays

- Delta rays are simulated by Geant and included in the rate

- Are they significant? No, **0.16** vs *7* MHz/cm2

- Delta rays: electron with momentum < 300 keV and generated inside the silicon volume

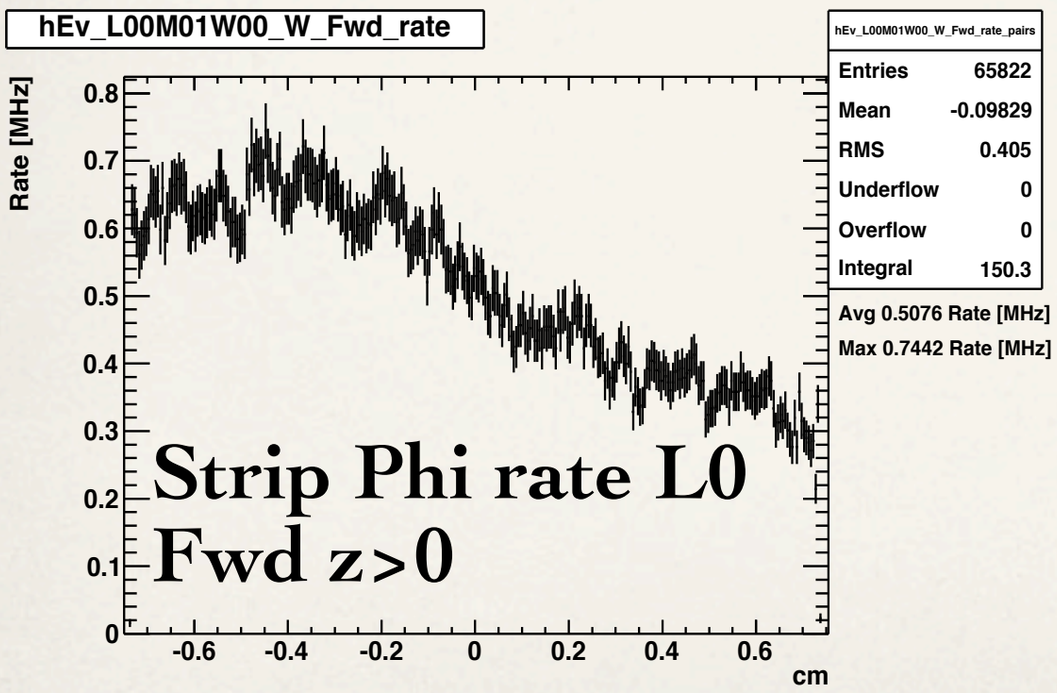
- All of them do not travel enough to fired more than **one** strip

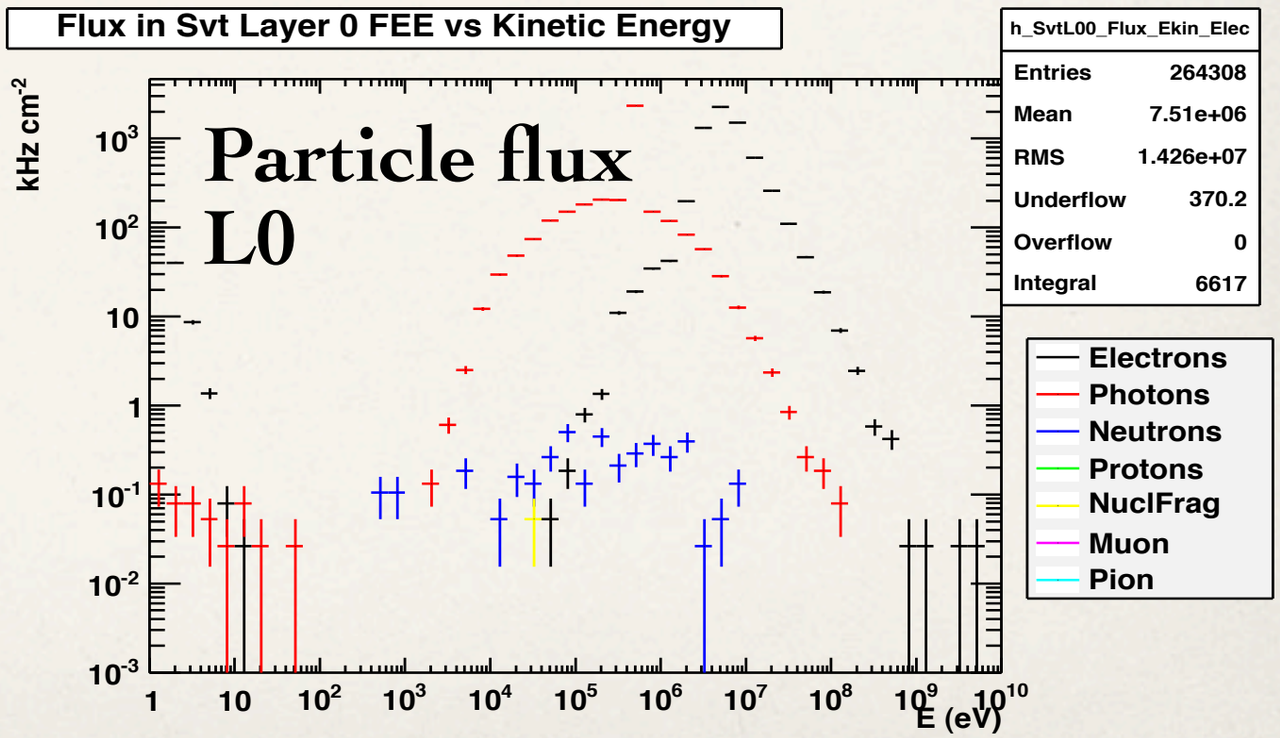


Background analysis (1)

SVT

- From September 2011 bunch crossing frequency has changed, 266 -> 226.73 MHz. Still using the old number, all numbers are now lower by **~15%**
- Strip rate (local coordinates) on phi is now calculated separately for Bwd and Fwd module. Fwd rates are from clusters with z > 0, as it would be in the new SVT design, so estimations can be used to optimize the electronics design
- Particle fluxes are available for silicon detectors, other than electronics

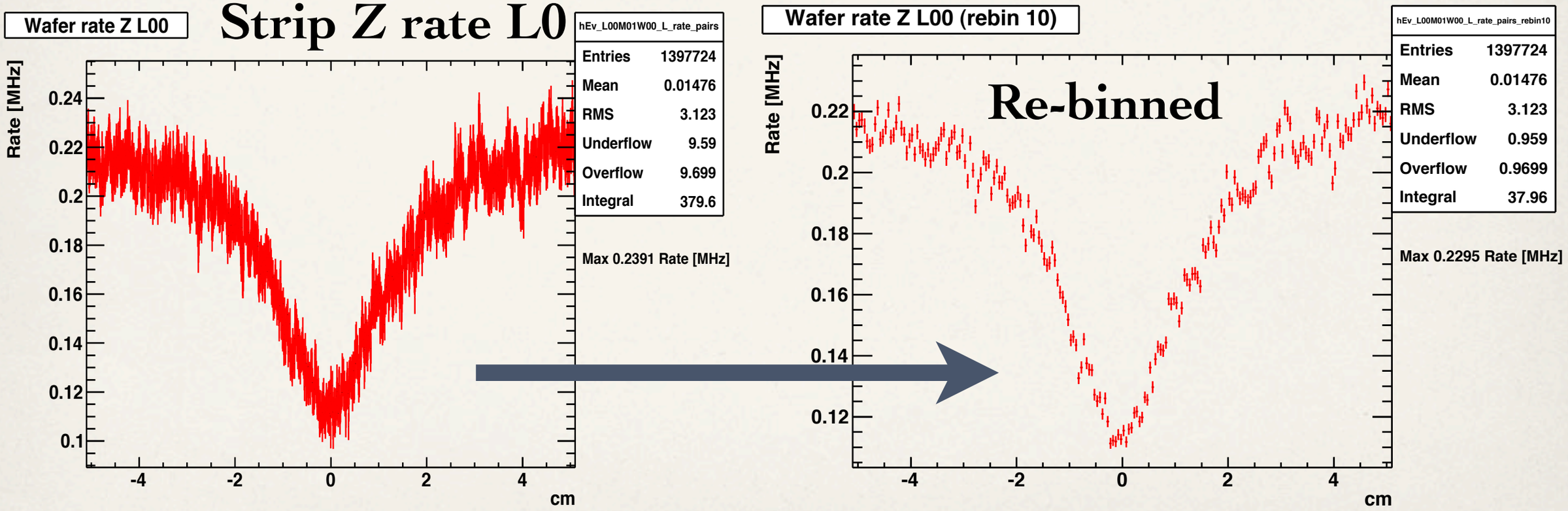




Background analysis (2)

SVT

- Plots of strip rate per module were re-binned (10 strips) to reduce errors and improve readability
- Pdf files automatically generated with significant plots for each sources plus summary. Last version www.pi.infn.it/cenci/bruno/svt/plotV3



Productions

- 2011 official productions (solenoidal field limited in z, **±20 cm**):
  - **2photons** (~100k evts, 372us): first official production, 1 evt = 1 bunch xing, normalization like RadBhabha
  - **RadBhabha** (~10k evts, 37us)
  - **Touschek**: (~84k evts HER, ~188k LER, weighted evts)
- 2011, additional productions (solenoidal field limited in z, **±40 cm**):
  - **2photons** (~100k evts, 372us)
  - **2photons** (~25k evts, 372us), L0 Bus copper(1% X_0) -> aluminum (0.15% X_0)
- 2012 production (solenoidal field limited in z, **±20 cm**):
  - **Beamgas** (~275k evts HER, weighted evts) ← **NEW**

Rate comparison, updated

SVT

- Extended B field does not affect L0-2 rates, but L3-5 rates drop by 50%
- Only first 100k evts for beamgas HER (queue too short)

LAYERS	May2011 2photons	Dec 2011 2photons	Dec 2011 2photons Extend B	Dec 2011 2photons ExtB-Alum	Dec 2011 Bhabha	Dec 2011 Touschek HER	Dec 2011 Touschek LER	Mar 2012 BeamGas HER
L0 phi	23.3	27.4	29.4	31.9	0.87	0.52	1.73	0.32
L0 z	29.9	34.5	37.2	39.0	1.42	1.45	4.37	0.91
L1 phi	1.5	1.45	1.56	1.54	0.12	0.18	0.74	0.12
L1 z	0.7	0.72	0.74	0.73	0.077	0.19	0.77	0.13
L2 phi	0.72	0.75	0.78	0.79	0.078	0.12	0.56	0.086
L2 z	0.35	0.38	0.40	0.39	0.059	0.14	0.61	0.098
L3 phi	0.194	0.37	0.14	0.15	0.047	0.055	0.31	0.022
L3 z	0.097	0.23	0.13	0.13	0.051	0.055	0.29	0.036
L4 phi	0.012	0.042	0.022	0.02	0.0135	0.004	0.019	0.0025
L4 z	0.0076	0.026	0.014	0.014	0.0078	0.003	0.013	0.0019
L5 phi	0.006	0.016	0.012	0.011	0.0057	0.002	0.009	0.0014
L5 z	0.0041	0.012	0.0082	0.0082	0.0038	0.0016	0.007	0.0011

Radiation dose on Electronics

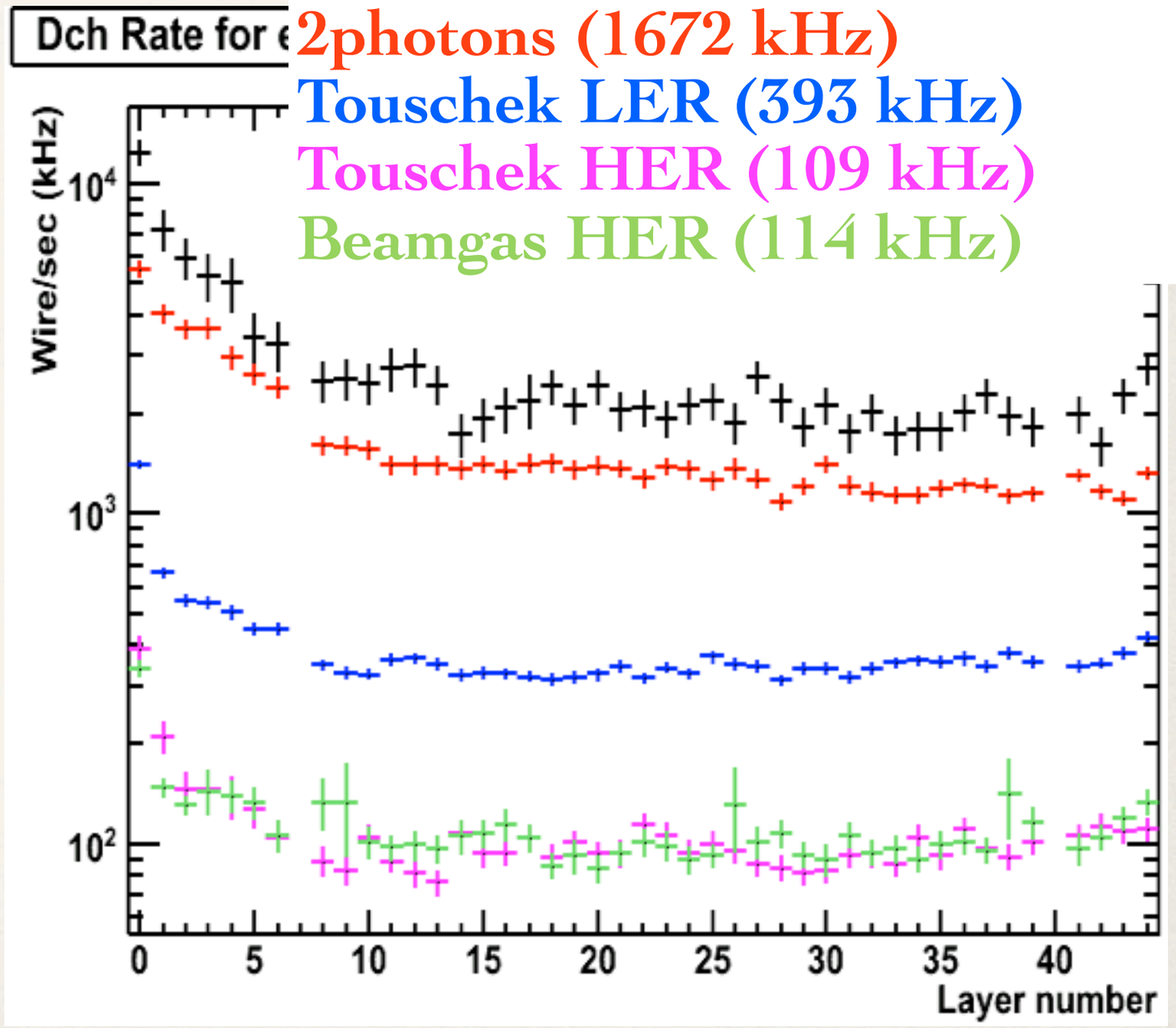
SVT

- Max values accumulated in 1 year (10^7 sec)

Max. Dose (krad)	0	1	2	3	4	5
Pairs	442	60	72	81	41	6.8
RadBhabha	81	13	12	19	9	1.7
Touschek HER	57	12	14	7.5	3	1.2
Touschek LER	180	52	64	29	8.2	3.9
Beam-gas HER	78	17	20	8.4	3.4	1.3
TOTAL	838	154	182	145	64.6	15

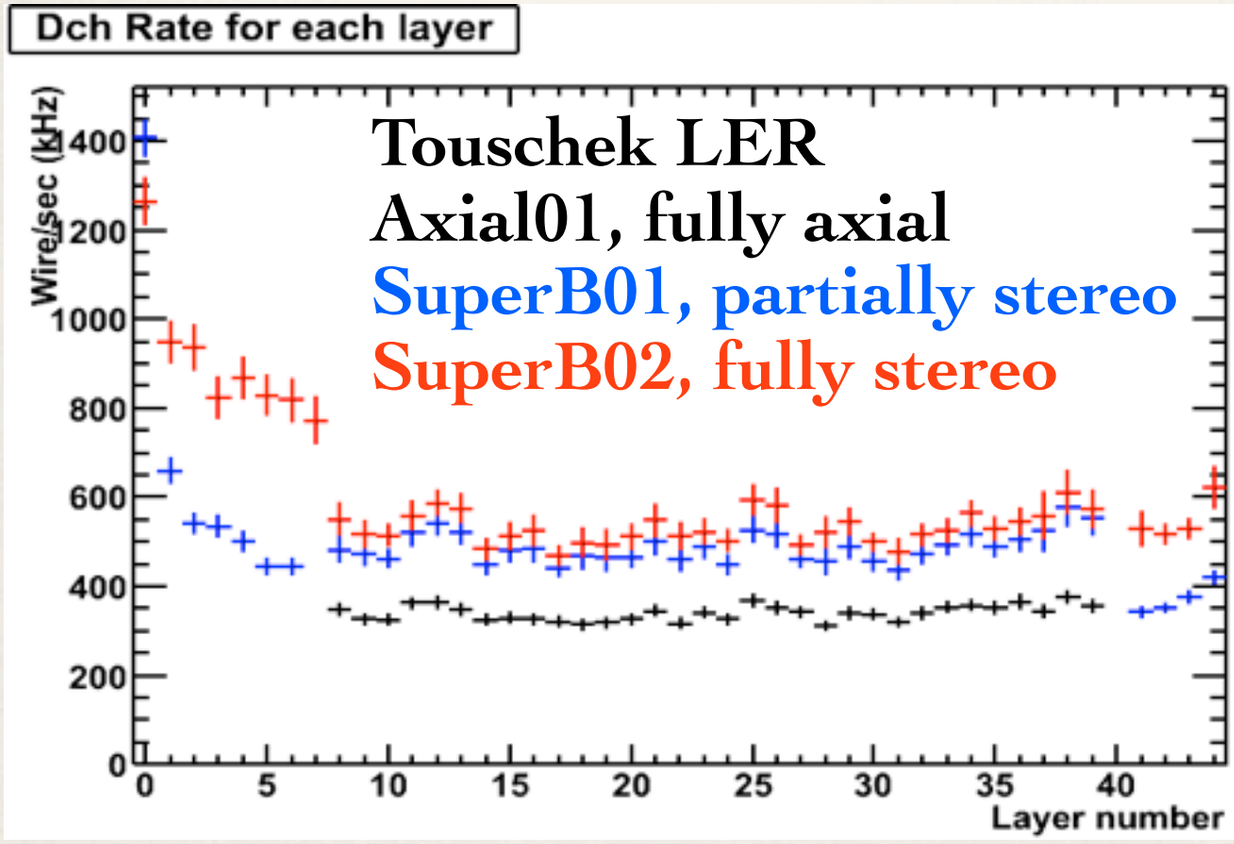
Dch Rate

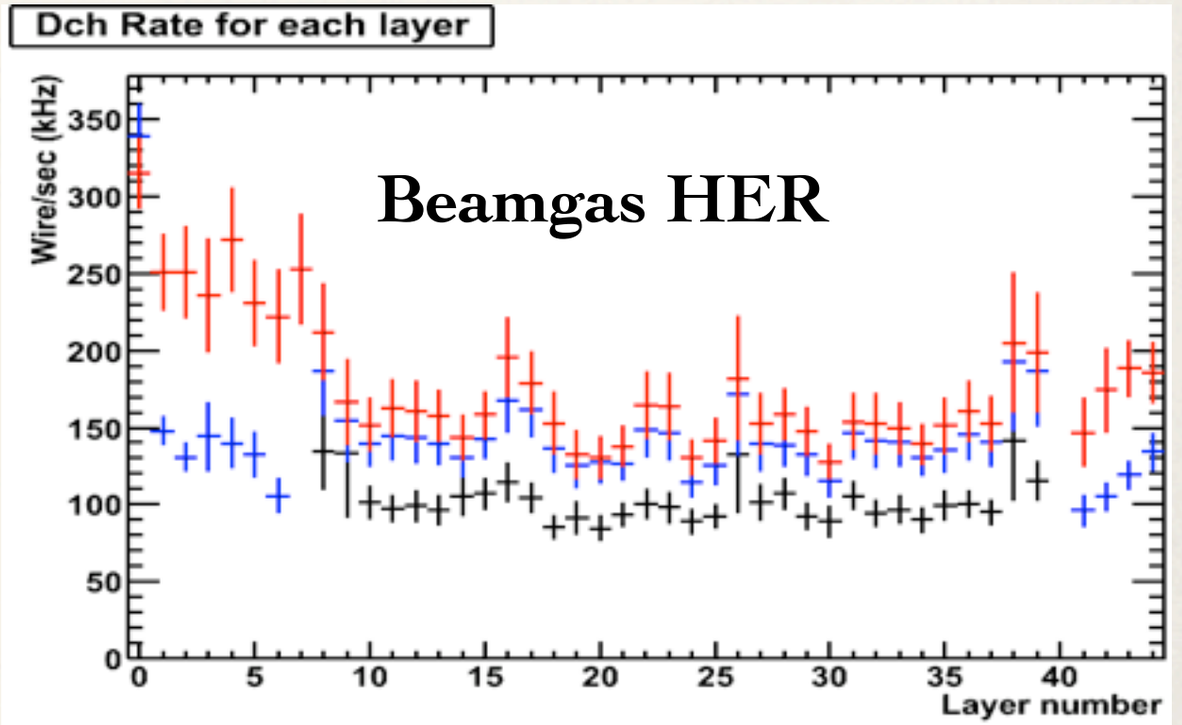
- Rate on each layer separately for each background contribution, fully axial configuration
- 2photon is now lower than Radiative Bhabha due to recent simulation with extended B field (±40cm)
- 2photon and RadBhabha are 20% smaller than shown due to normalization error
- Beamgas HER similar to Touschek HER
- No occupancy value because needs to have separate bunch xing, not weighted events

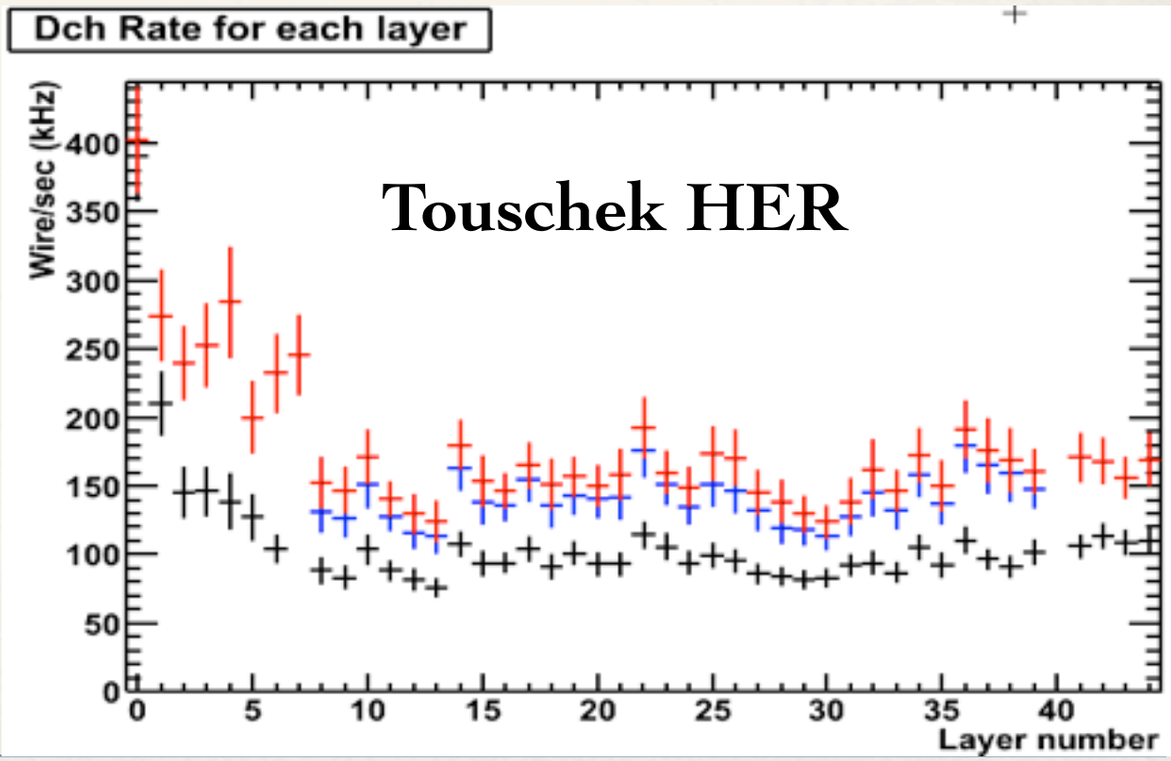


Dch Occupancy, stereo

- Significant increase in rate for stereo layers configuration, but same order or smaller than RadBhabha
- First layer has lower occupancy for SuperB02 due to larger radius compared to Axial01/SuperB01 (+0.6cm)







Dch Rate, stereo

DCH

- Updated table, including normalization correction

Avg. Rate [kHz](Occ.)	Axial01	SuperB01	SuperB02
Pairs	1421	1680	1927
RadBhabha	2366	3250	3929
Touschek HER	109	144	176
Touschek LER	393	503	601
Beamgas HER	114	144	177
TOTAL	**4403**	**5721**	**6810**

Dch Electronics

DCH

- No significant variation for dose on electronics
- Beamgas HER contribution similar to Touschek HER
- Total dose around 1krad

Dose [krad] (1y)	Plate 1	Plate 2	Plate 3
Pairs	0.16	0.16	0.16
RadBhabha	0.68	0.78	0.99
Touschek HER	0.005	0.003	0.003
Touschek LER	0.16	0.18	0.21
Beamgas HER	0.005	0.004	0.002
TOTAL	**1.01**	**1.13**	**1.37**

Comparison with FastSim

- Technical note: average tracks, clusters and strip rates per area are calculated using cylindrical area with minimum radius. This is called **cylindrical rate** and is an approximation introduced from the beginning, also strips are computed using a cylindrical surface

- Instead of remove this approximation we decided to compute the rate using the wafer coordinates (**wafer rate**): more reliable and independent from geometry. This rate should be used for any estimation

- Comparison with FastSim in order to simulate occupancy and track efficiency using background rates corrected for cylindrical approximation made in FastSim geometry

Comparison with FastSim

SVT

Simulation	Track rate (MHz cm^{-2})	Track rate (MHz cm^{-2})
FastSim (Cyl L0 @ 1.4cm)	2.04	4.72
FullSim (Cyl L0 @ 1.4 cm)	2.23	5.89
FullSim (pinwheel L0 @ 1.29cm min, 1.4cm ave) Real area	1.88	4.82
FullSim (pinwheel L0 @ 1.29cm min, 1.4cm ave) Cylindrical area	2.72	6.98

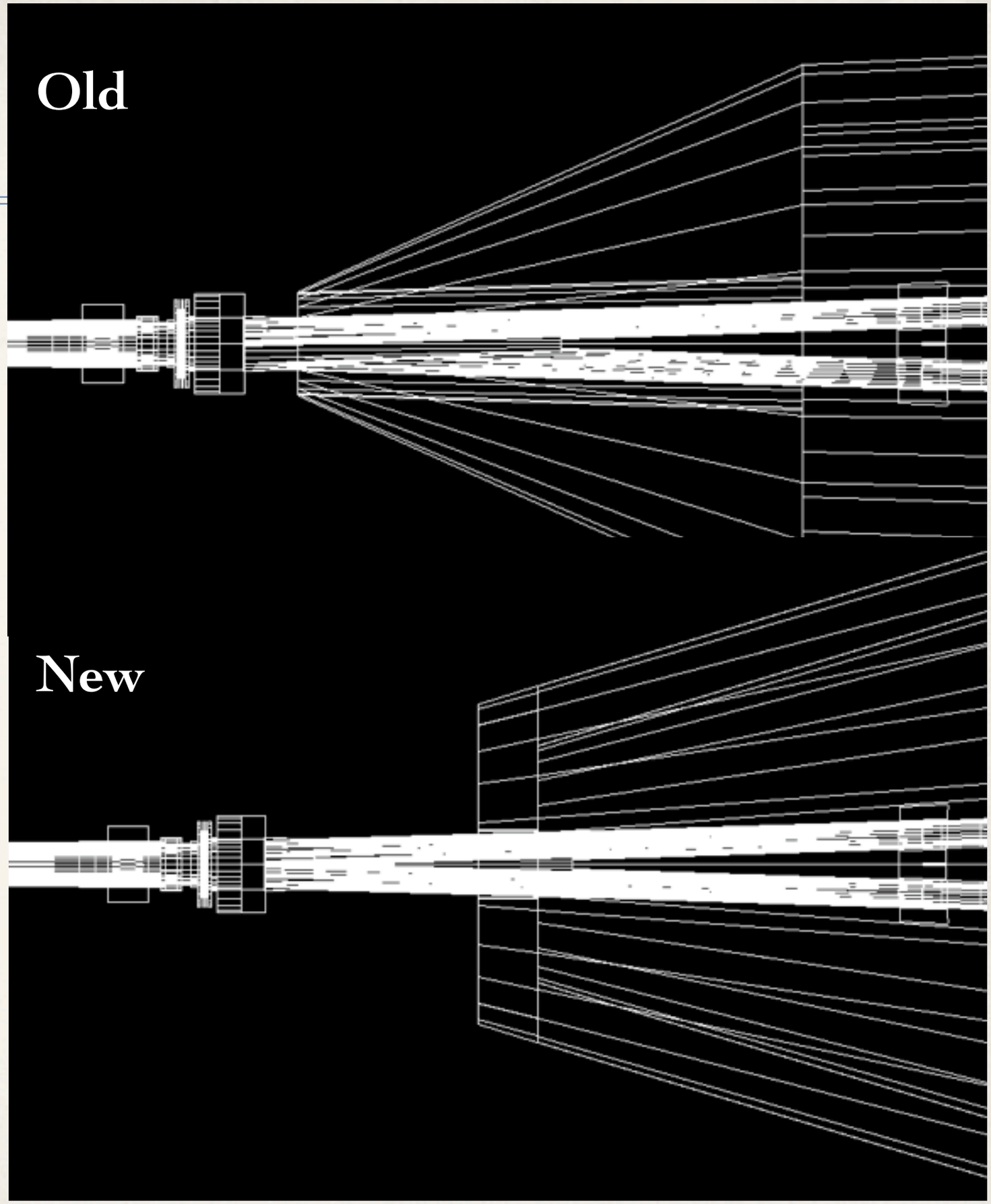
- Discrepancy between FastSim and FullSim with same geometry: issue with limited physics process simulation in FastSim?
- Average rate from FullSim pinwheeled is lower than cylindrical, but L0 is highly asymmetric and maximum strip rate (minimum radius area) is 40% (20%) higher than average for Phi (Z) strips
- L0 rates show big variations, do we want to test average or worst case scenario?

SVT issues

- Ingredients for estimation of offline occupancy:
  - strip rates on forward region, with 5x safety factor
  - electronics specifications
  - Occupancy should be less than 5%, but it is not easy to fix a threshold because SuperB reconstruction algorithm is not yet finalized
- All the rate should be reduced by 50%
- Beamgas from HER (first 100k evts) similar to Touschek HER
- Beamgas from LER is still missing, hopefully same or less than Touschek from LER
- Outer layers rates (pairs+Touschek): improved geometry (missing magnets, new shields), magnetic fields and collimators should reduce them
- Layer0: still 20% more than May 2011 estimation. No handle to reduce 2photon particles coming directly from IP. Need to check if it could still work when combined with outer layers at low occupancy

Geometry

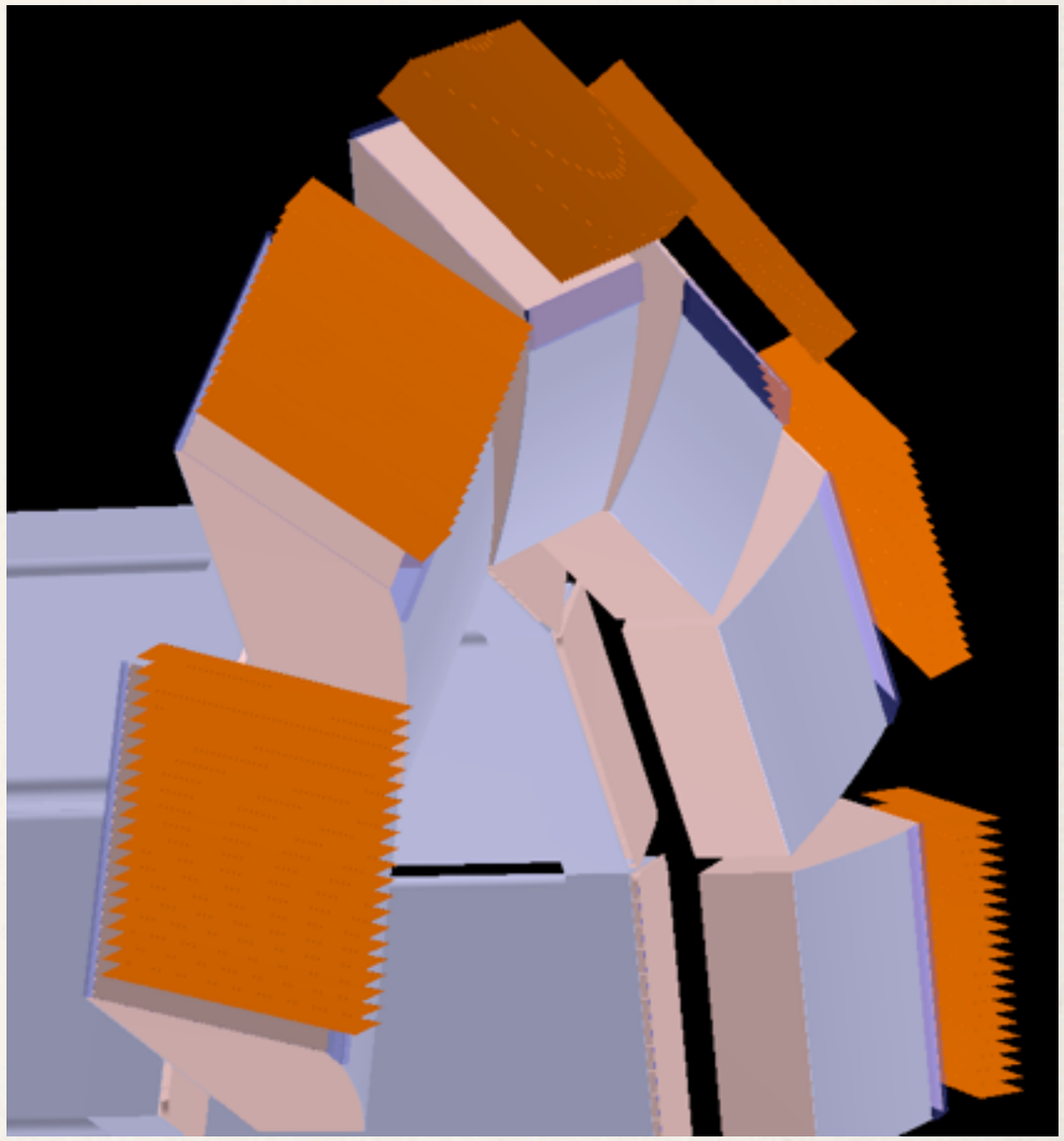
- Eugenio spot an overlap between SVT and final focus container volume
- Overlap itself should be not a problem, but rates can change due to different shape, specially for outer layers. New area around pipes is now un-shielded
- Overlap fixed by Alejandro, plus implementation of permanent magnets, ready for next production
- Next step: implementing striplets last geometry by Filippo B.



Code development

DRC

- Bug fix: hits in DRCHits and SOBHits are missing some additional information, like the vector momentum of the tracks. Fixed and old class **BrnSensitiveDetector** is now obsolete. If you need please use **BrnSensDet** to fill your new hit collections
  - This information is needed to extract the incident angle of a track on the bars and obtain the plot of # optical photons vs track angle. Macro to produce those plot are ready, need to wait for the new production
- Request from Drc people for instrumenting FDRC electronics. **Silicon plate,** behind the FDRC pixels, similar to engineer's design. Volumes have been sensitized, new hit collection **DRCFEEHits**. Dose and fluxes will be provided
- Minor fix in BrnRootHit to remove a warning when compiling bkg analysis macro with Bruno shared library



Conclusions

- Many progresses in bkg understanding and checks
- SVT:
  - Significant amount of work for a more organic report on background rates (track, cluster, strip) plus improved plots for particle fluxes. Easy to use as input for other tests and simulations
  - Comparison with FastSim
- Updated background report including beamgas contribution. Waiting for Beamgas from LER
- 2photons bkg estimation is affected by magnetic field around IP and generator cuts
- **Bkg rate for SVT is still pretty high and can create serious problems in reconstruction**
- DCH: Rate increase due to stereo layers is similar for different contributions, larger when contribution has tracks coming through the endplates
- Significative changes in shields shape between the present production and the previous one
- New production should be ready in a month or so, code improvement already committed

Future developments

- Svt L0 geometry: a new design is ready for L0 with striplets. Some modification to the beampipe and split pipe are possible. Hopefully to be included in the next production
- Strip rate estimation for L0 with 45 degree striplets inside official macro's (Trieste, pending funding for PhD student)
- Low priority: Svt geometry for outer layers. Outer layers are the Babar ones, but SuperB acceptance is wider. Need symmetric fwd/bwd modules