Stony Brook University

Center for Frontiers in Nuclear Science

Target Shielding Redesign

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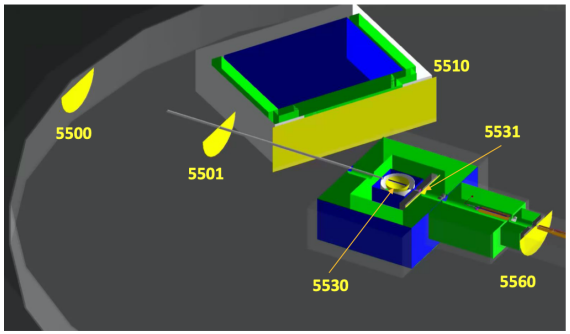
09 Mar, 2021

The updated geometry

Reminder slides from Ciprian Gal et al.

Modifications made around target



- Left all previous detectors alone
  - The hope is to remove them at some point later
- Added:
  - sphere detector around target
  - Plane DS of the target lead wall
  - Plane DS of US toroid (should be made kryptonite)
  - Plane US of the sbs bunker
  - Plane around moller and entrance of the hall (named Compton)
  - Plane detector at the moller polarimeter detector location
  - Use US outside shielding detector to evaluate harp/BPM radiation

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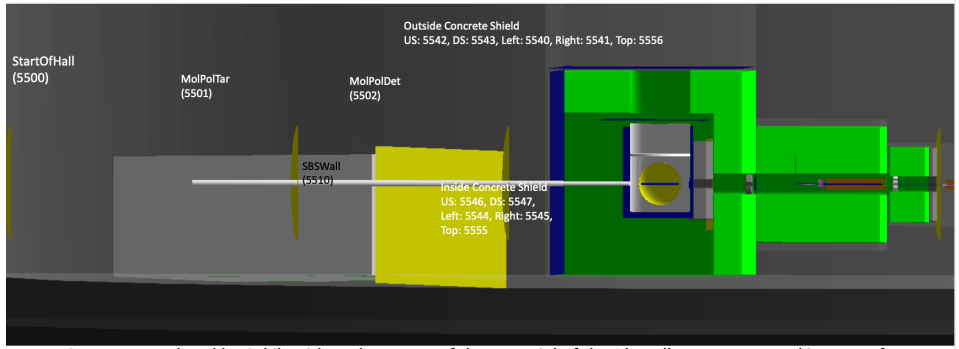
Updated geometry: Config2



- Geometry updated by Sakib with replacement of the material of the Pb wall to concrete and increase from 40cm to 65cm (maximum)
- Remove upstream wall
- 2m hole on the room

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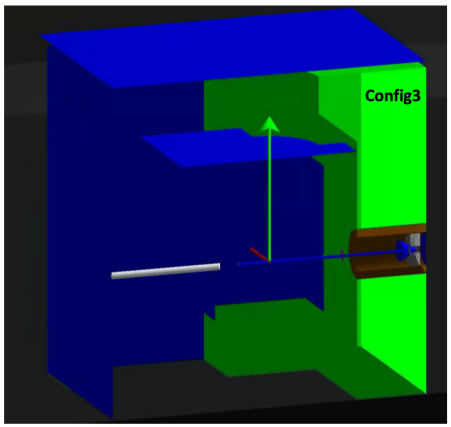
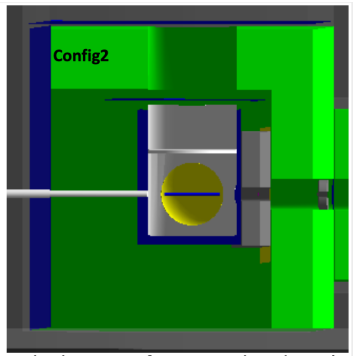
Extended change (Config3)





- Decided to take a look at a configuration that doesn't have any shielding US of the center of the target
- The (brown) inner bore of the DS concrete is barite (36-50.5 cm)
- While this may turn out unrealistic I figured it would be instructive
  - SBS bunker analysis pending

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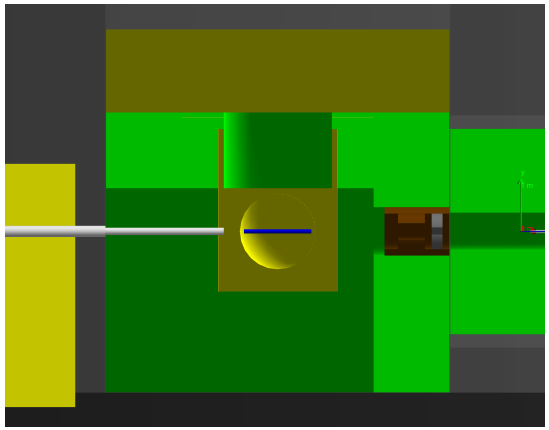
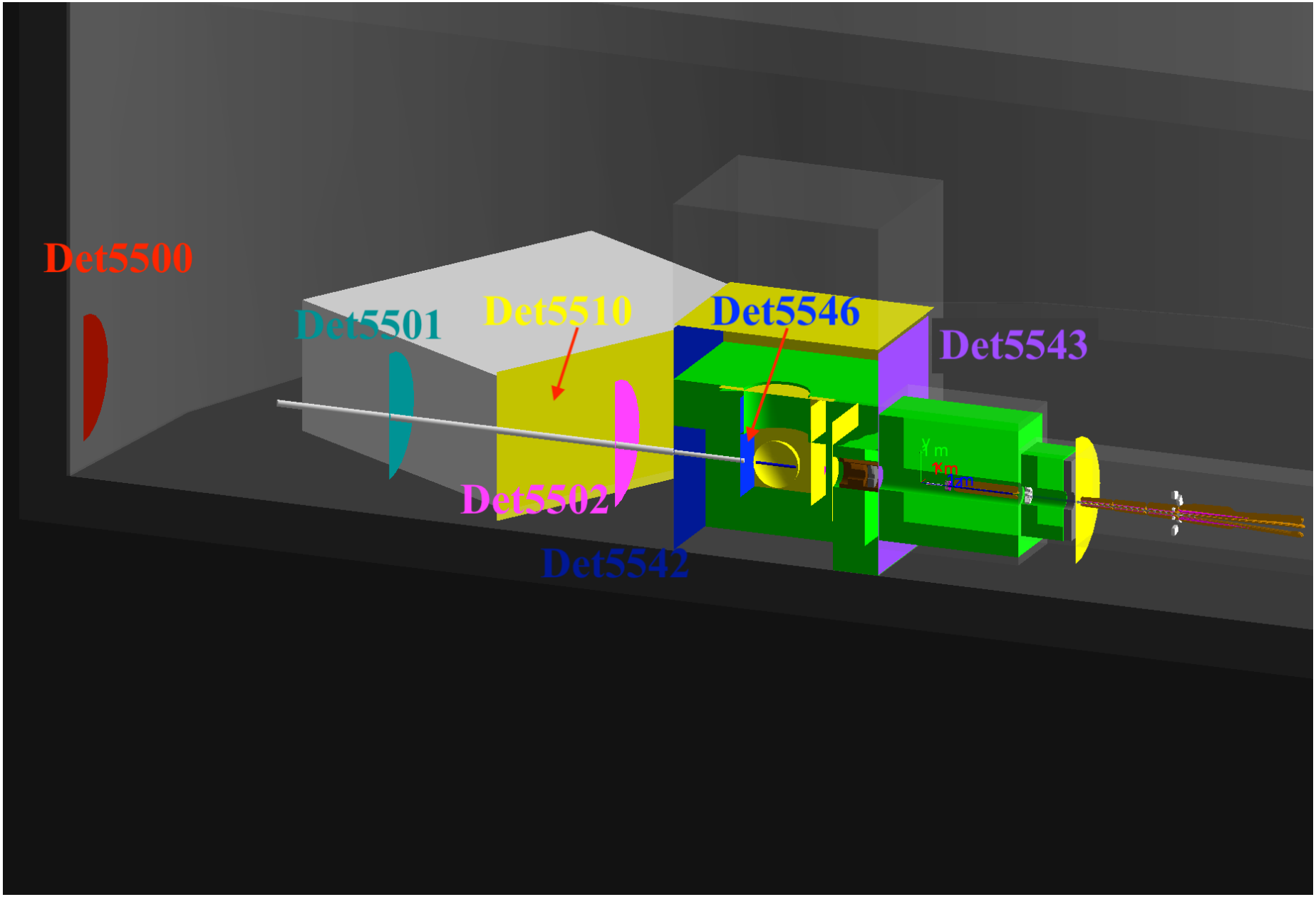
Config4

- Lowered the above wall by 1524mm and the side and DS wall are also lowered in height accordingly.
- Added an inner barite portion.

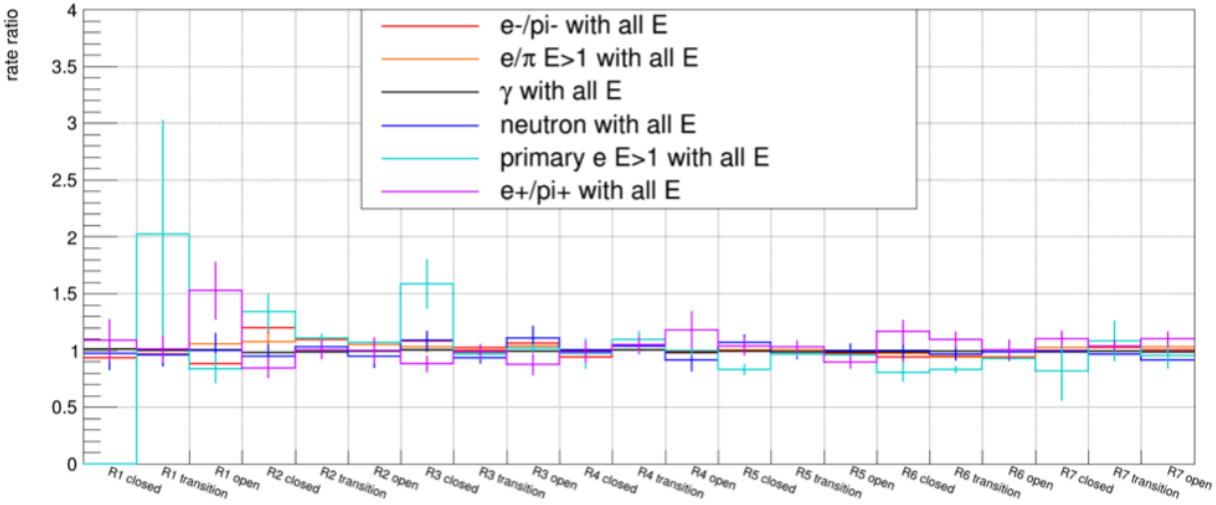


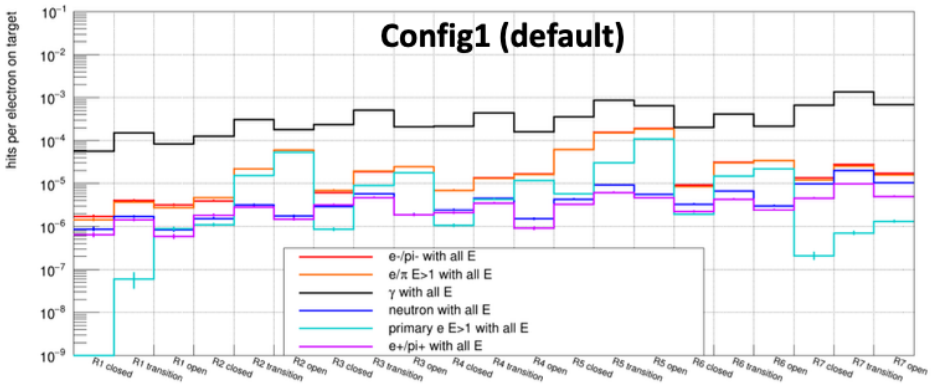
The updated geometry

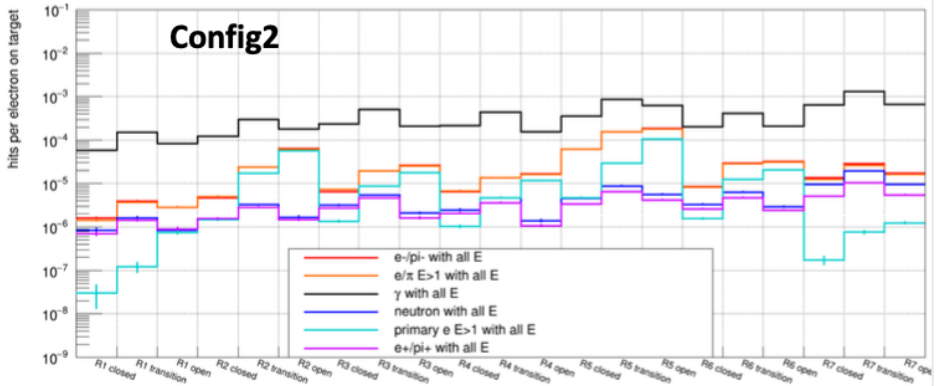


Main Detector output from V1-V2 configurations

MD comparison: C1-C2







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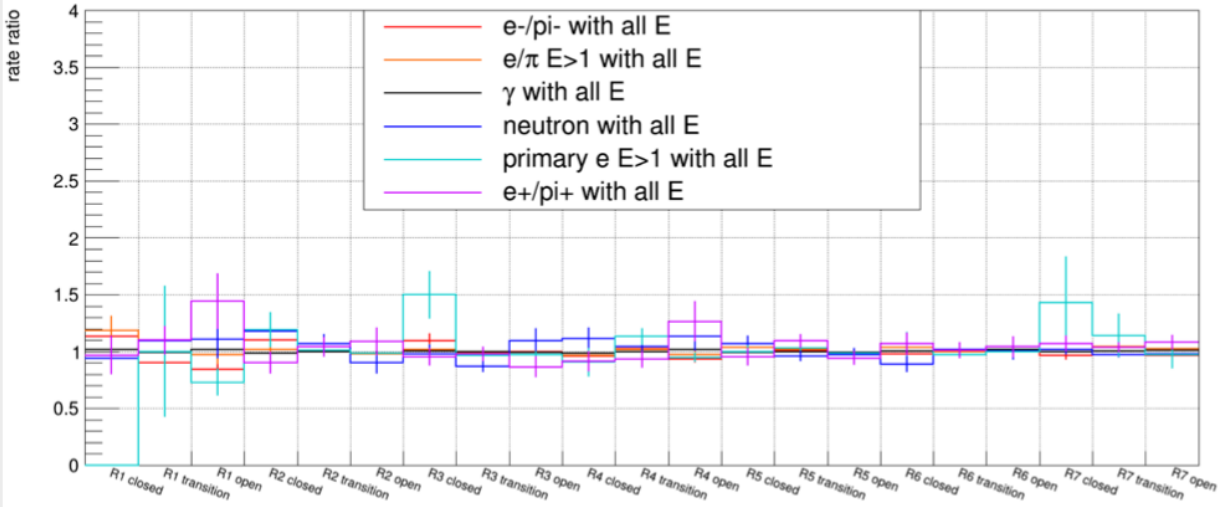
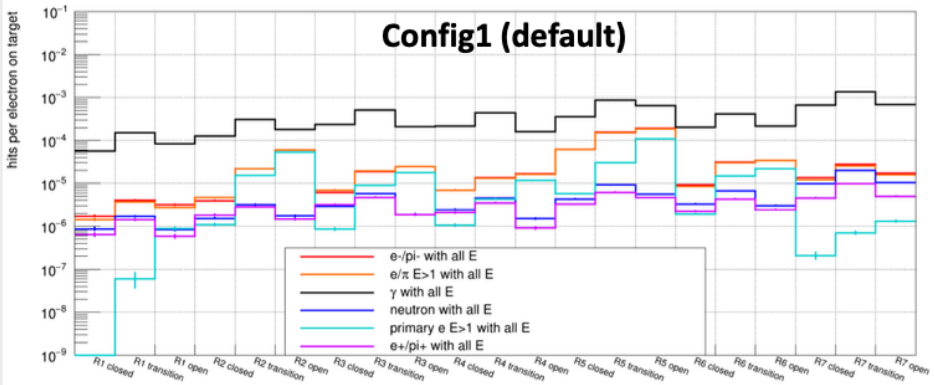
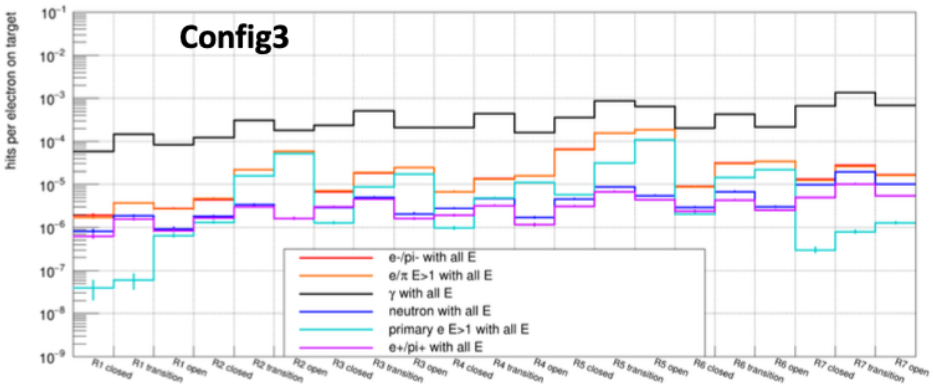
- The ratio of rates at the MD doesn't show any significant discrepancies.

Main Detector output from V1-V3 configurations

MD comparison: C1-C3







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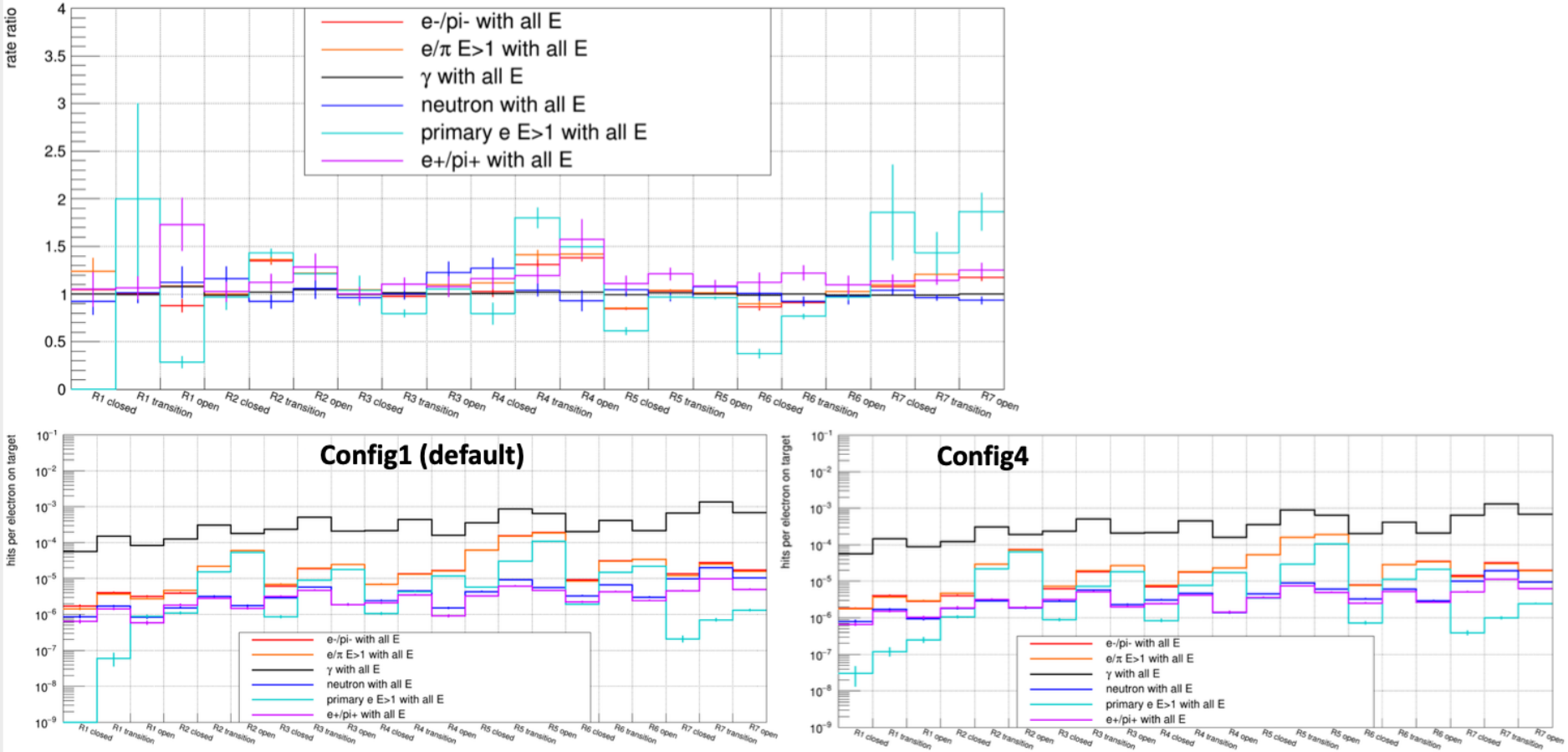
3

- The ratio of rates at the MD doesn't show any significant discrepancies.

Main Detector output from V1-V4 configurations

MD comparison: C1-C4



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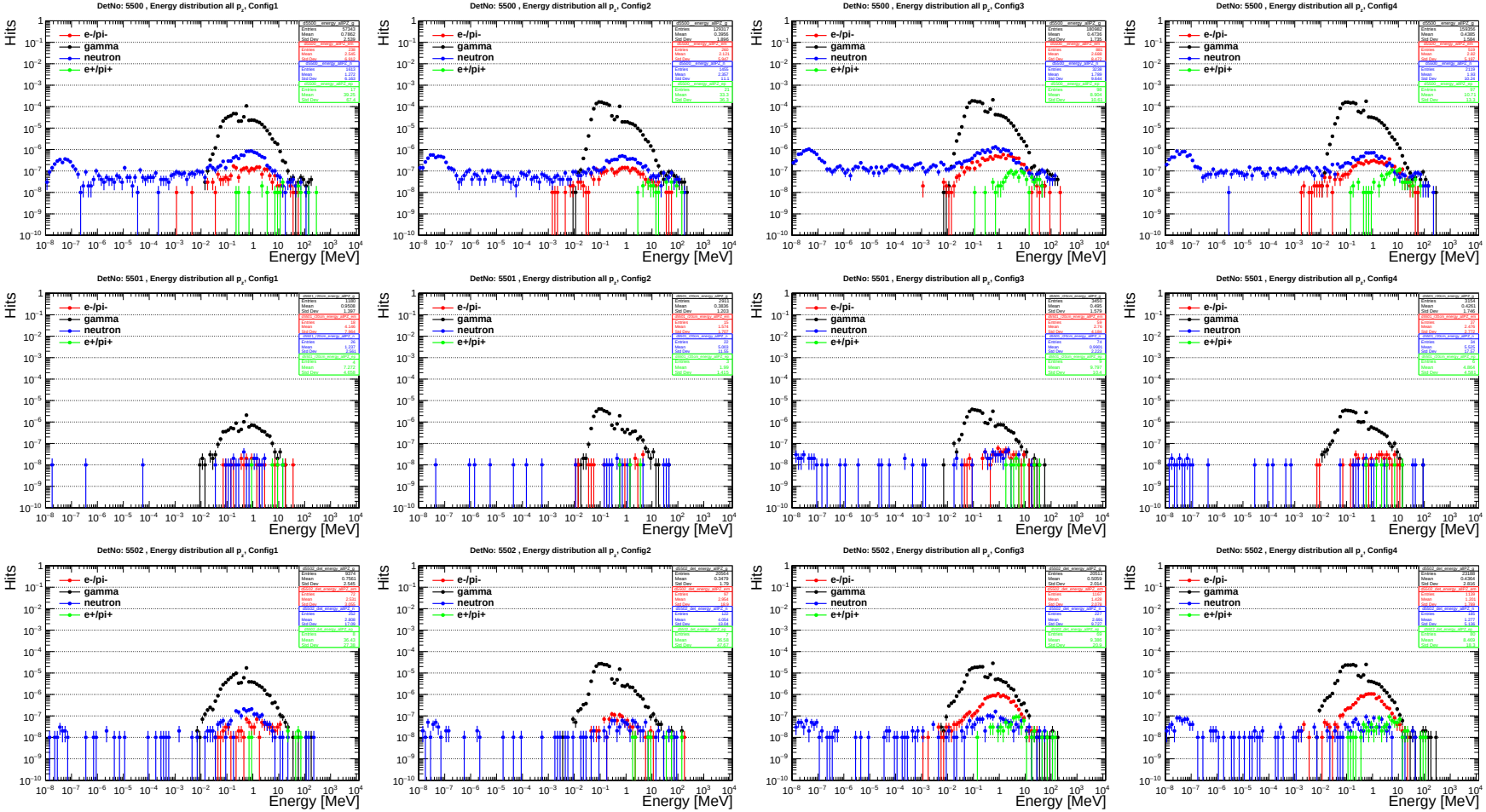
4

- Adding the US inner barite plug makes a difference for the secondaries.
  - Probably scattering from the inner bore of that component and a taper would be needed if we have to have it in.

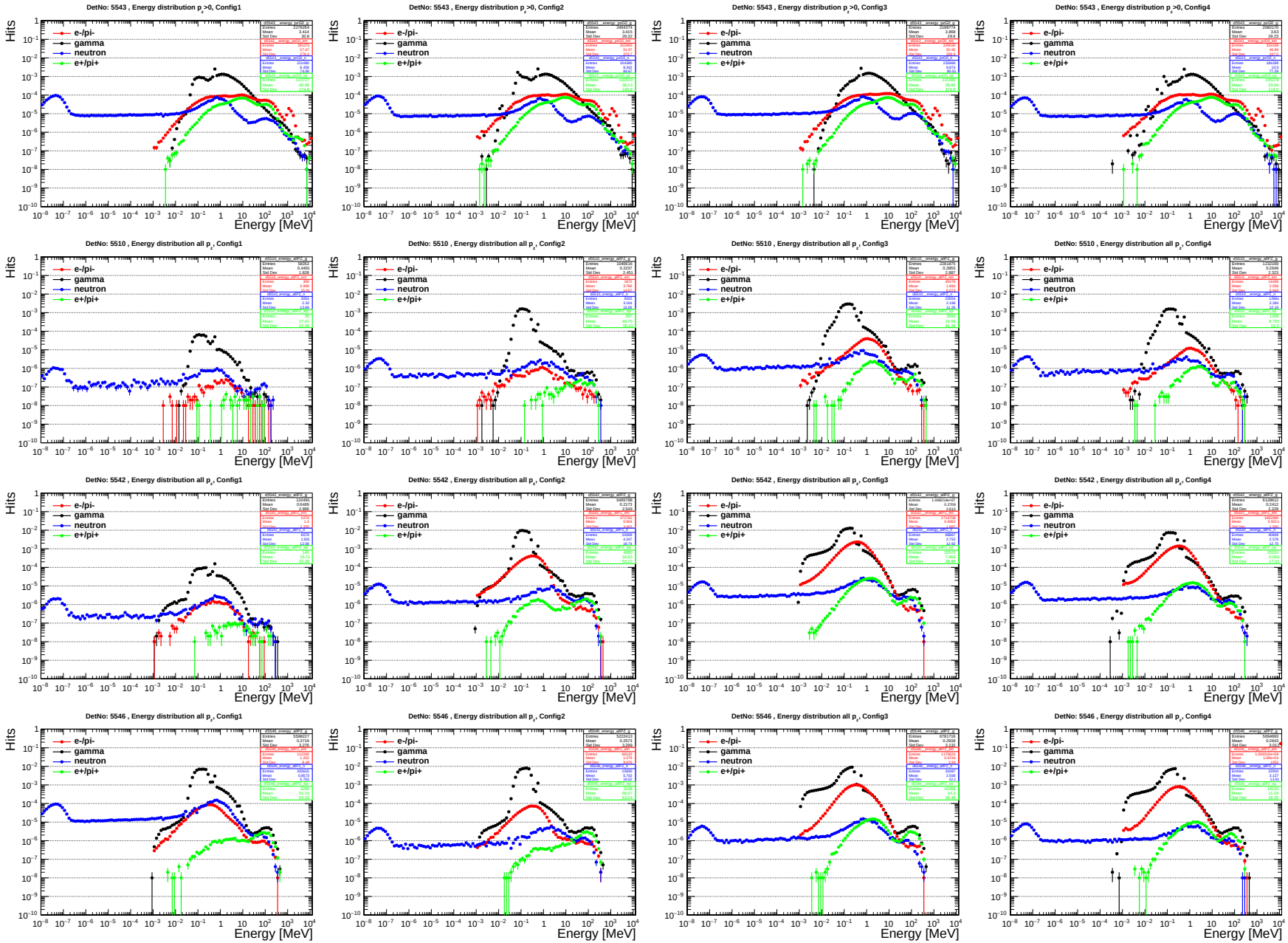
Energy Distributions for det5500, 5501 and 5502

- US electronics definitions
  - Compton: entire 1.9m disk at entrance to hall (z=-26m)
  - Moller polarimeter tgt: R<20cm at z =-16.5m
  - Moller polarimeter det: (X,Y)=(0,0)-(10,20)cm; 20cm wide 30cm tall; at z=-9.5m

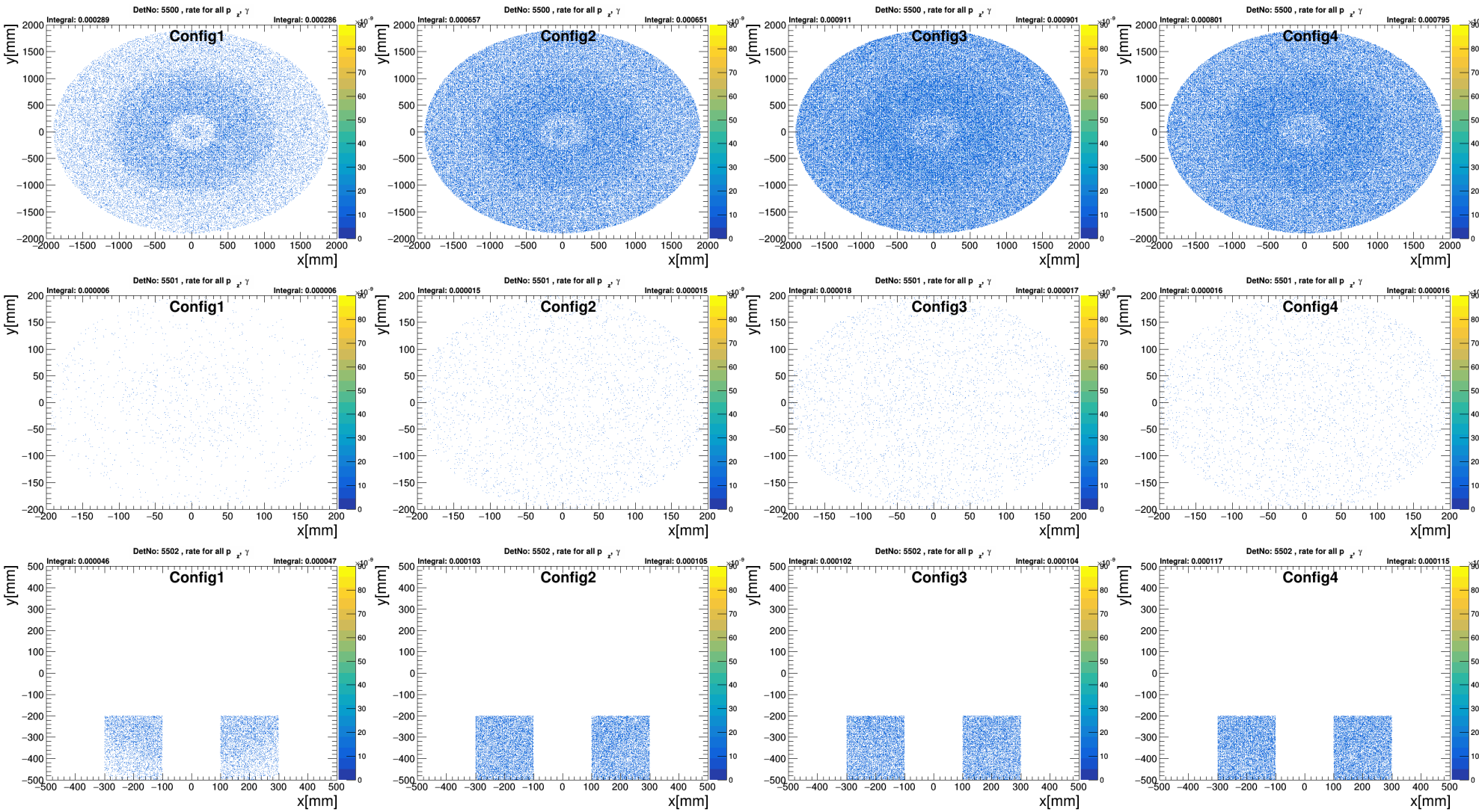


- The rates are still very small even without the US wall (increase by about factor 2)

Energy Distributions for det5510, 5542, 5543 and 5546

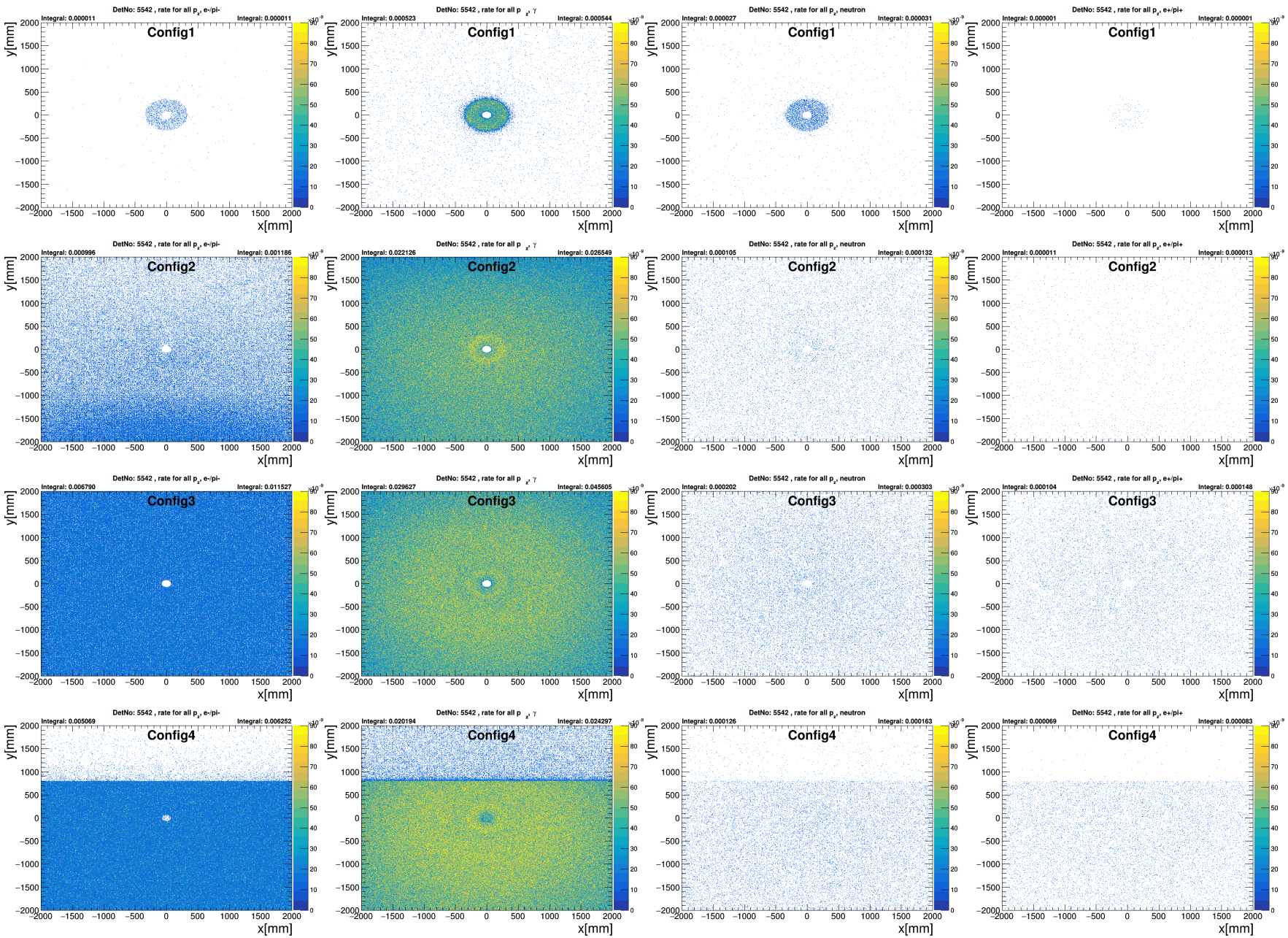


2D Hit Distributions weighted by rate for all p_z, config1/2/3/4 (Det5500 & Det5501 & Det5502)

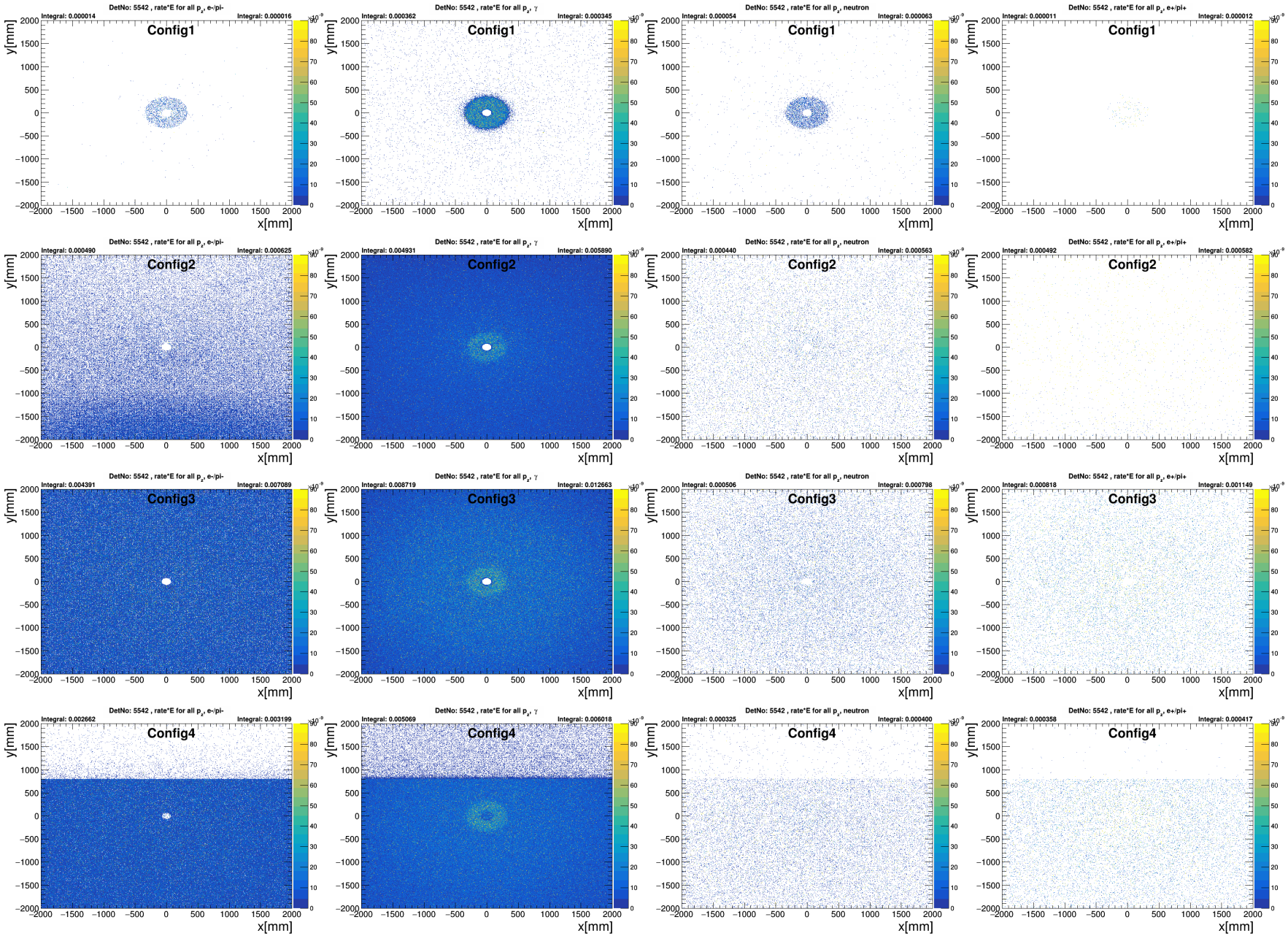


- Removing the US wall produced an increase in radiation at the entrance of the hall.
  - The increase is ~3 for the entrance of the hall if we look at the integral values.

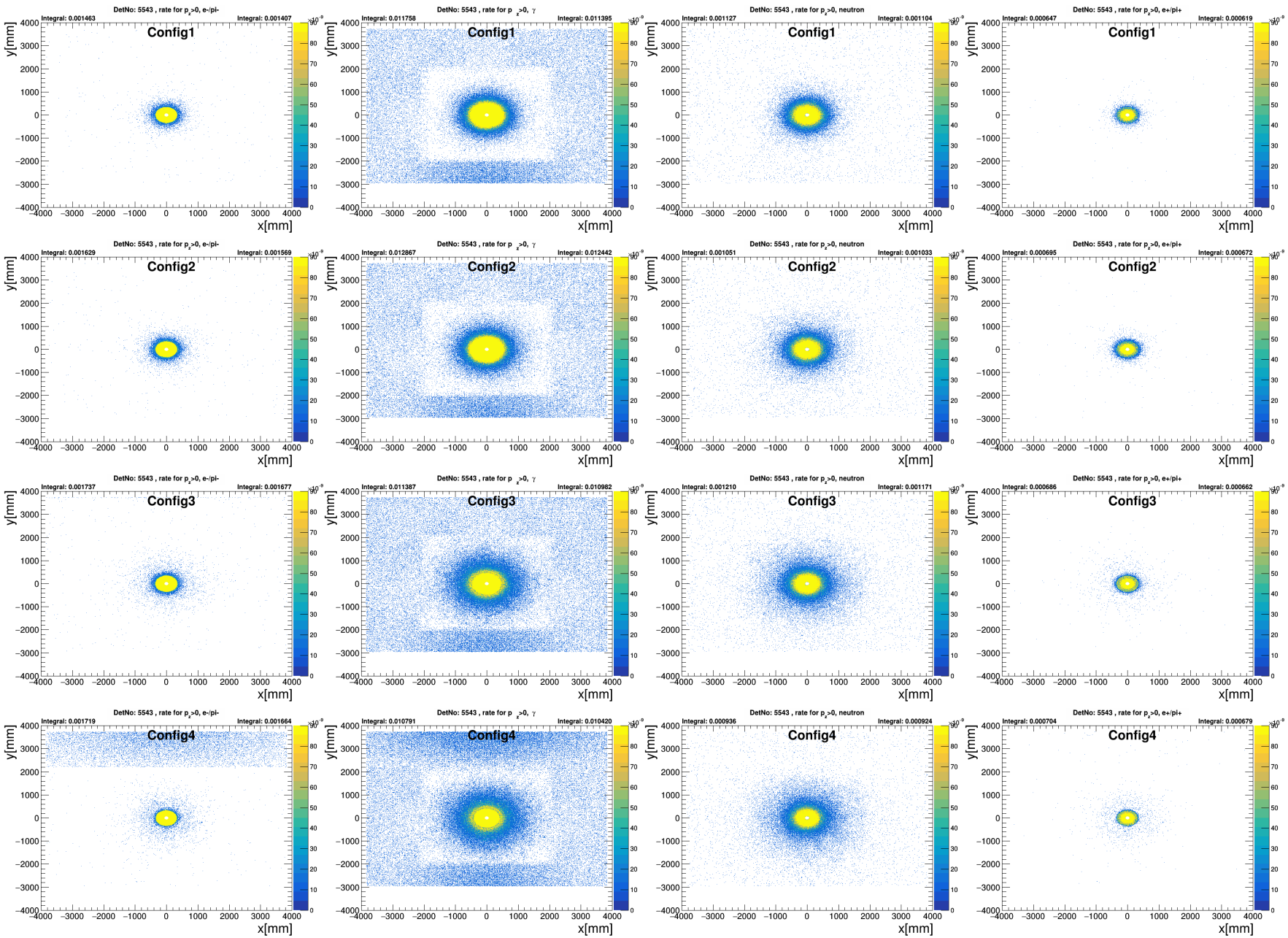
2D Hit Distributions weighted by rate for all p_z, config1/2/3/4 (Det5542)



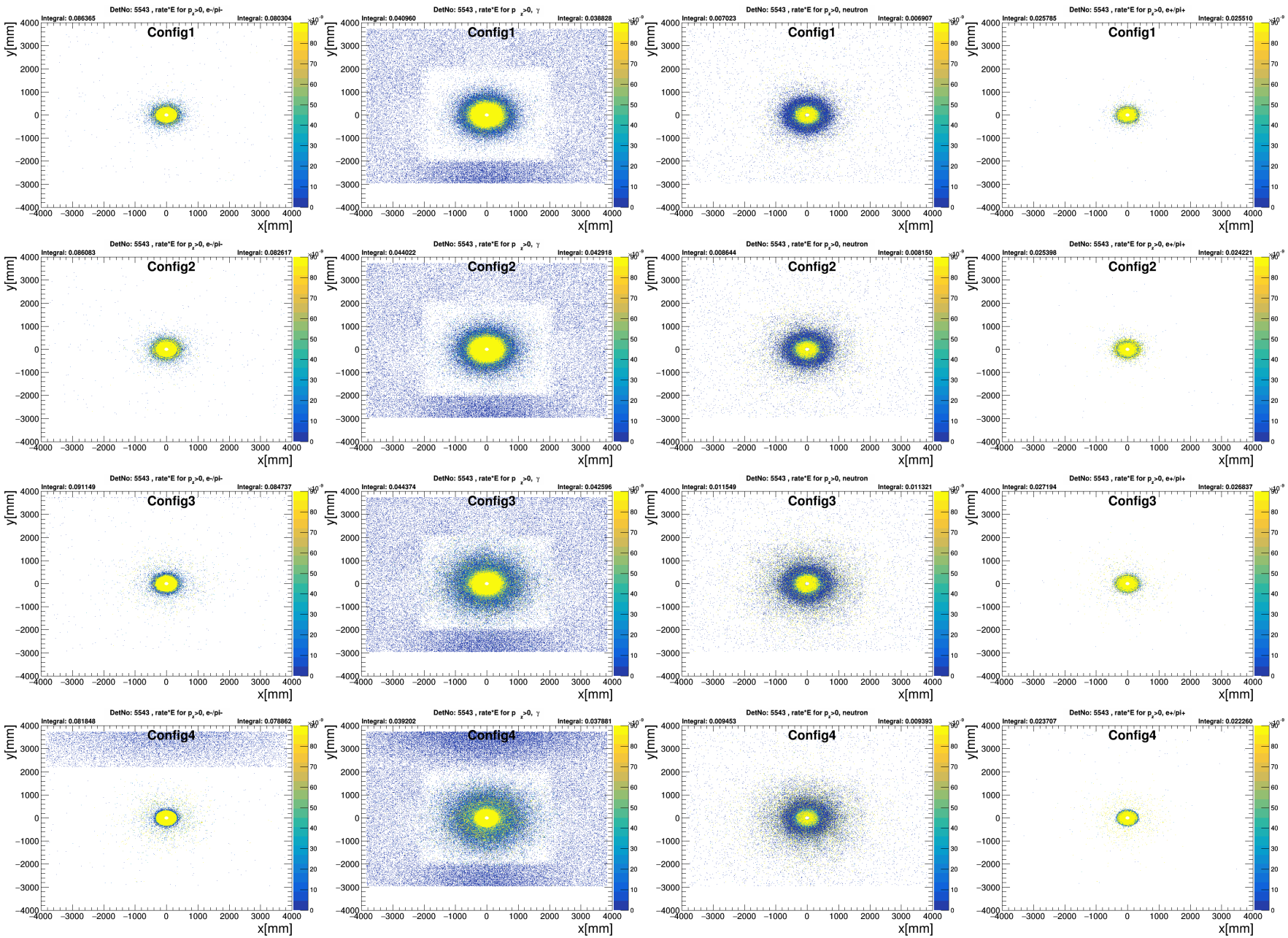
2D Hit Distributions weighted by rate*E for all p_z, config1/2/3/4 (Det5542)



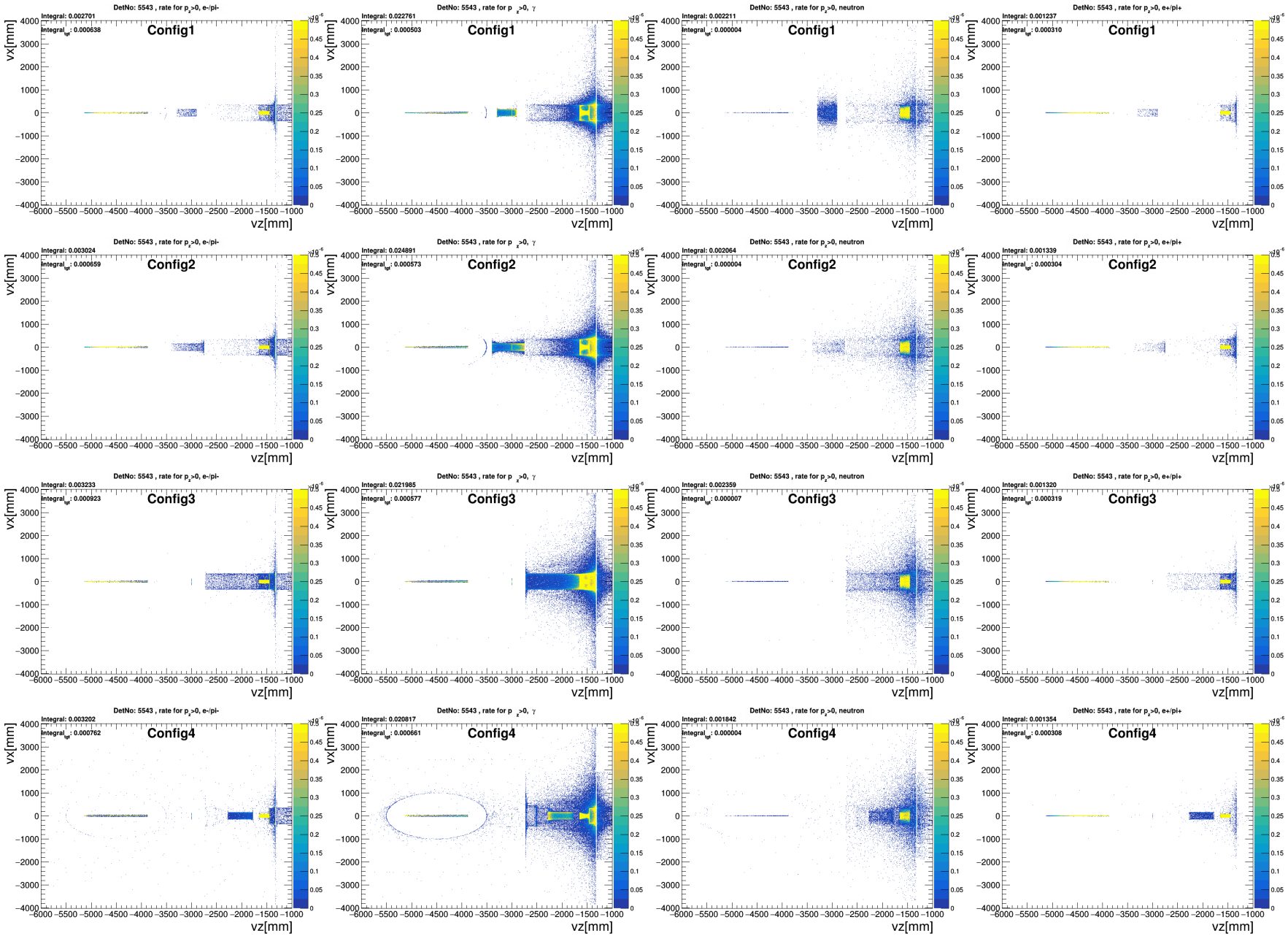
2D Hit Distributions weighted by rate for $p_z > 0$, config1/2/3/4 (Det5543)



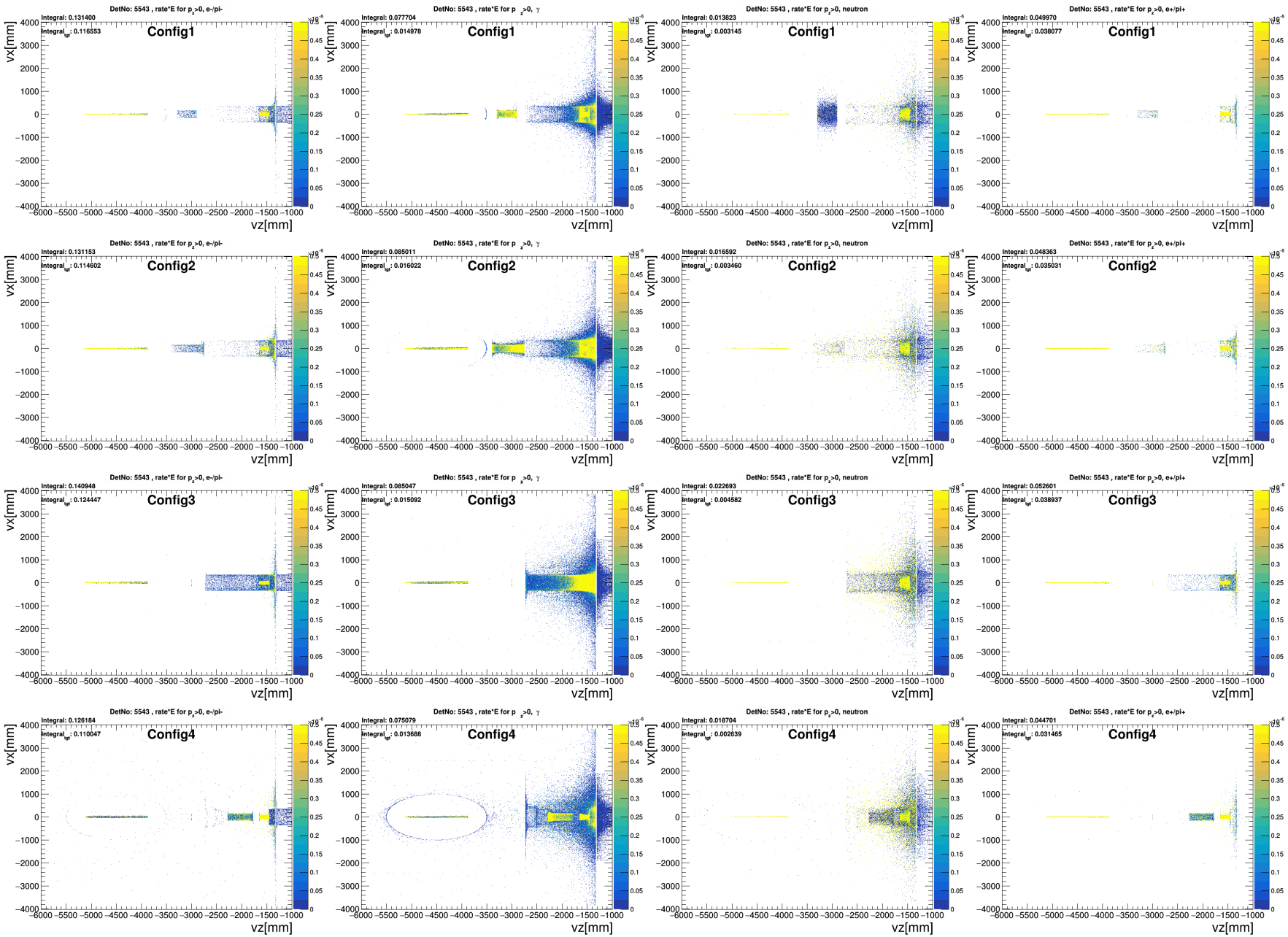
2D Hit Distributions weighted by rate*E for $p_z > 0$, config1/2/3/4 (Det5543)



Vertex positions v_x vs v_z weighted by rate for $p_z > 0$, config1/2/3/4 (Det5543)



Vertex positions v_x vs v_z weighted by rate*E for $p_z > 0$, config1/2/3/4 (Det5543)



Summary

- The ratio of the different configurations at the main detector does not show any significant discrepancy.
- Removing the US wall produced an increase in radiation at the entrance of the hall for photons and neutrons.
- We are producing some particles by adding the additional barite plug but it seems like more of them can be stopped in the US area.

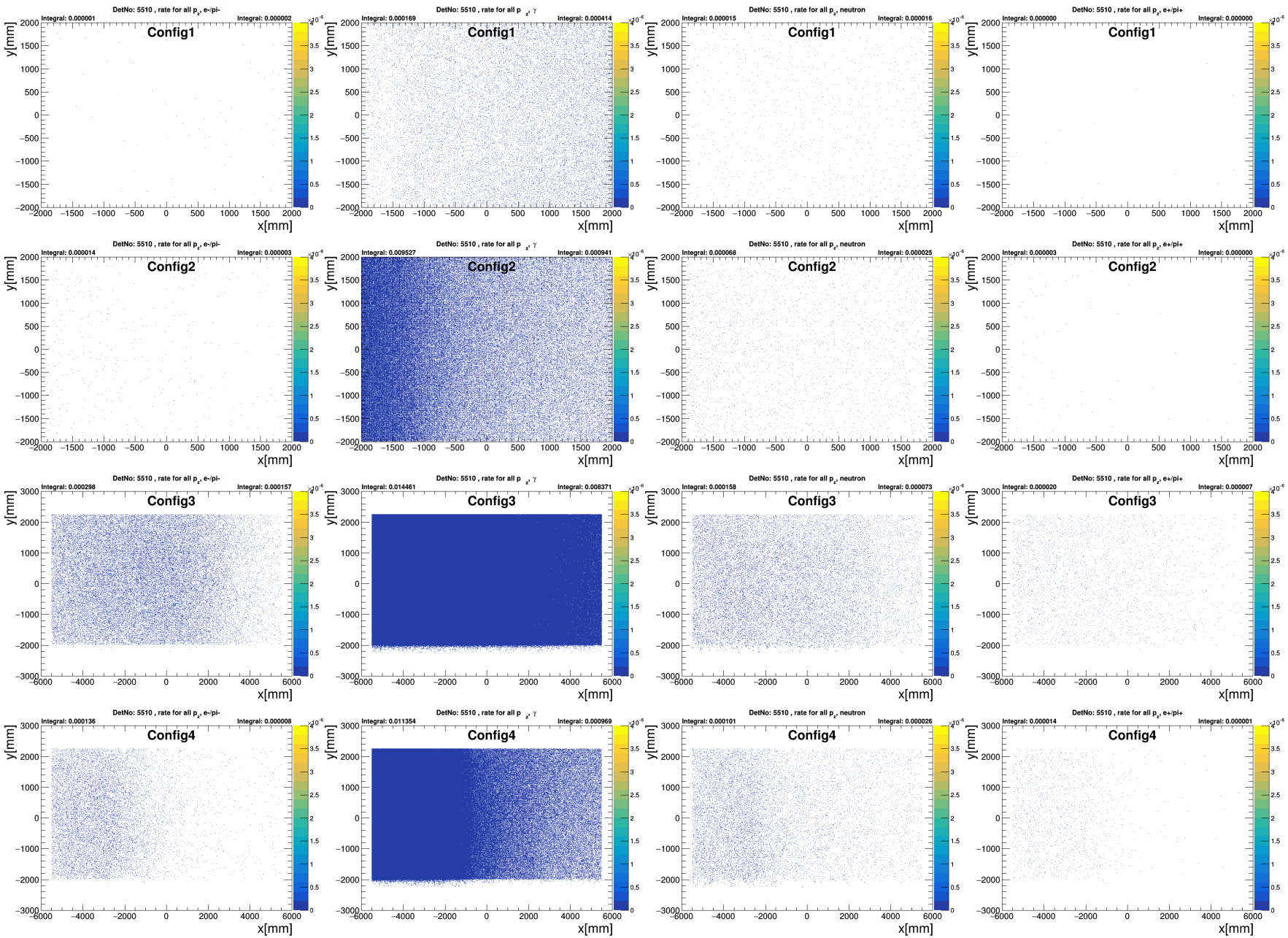
To do list

- Look at "stopping power" for the roof, SBS bunker, and DS wall with a look towards optimizing the thickness.
- Update geometry from the engineering team.
- Start looking collimator 1/2 region.

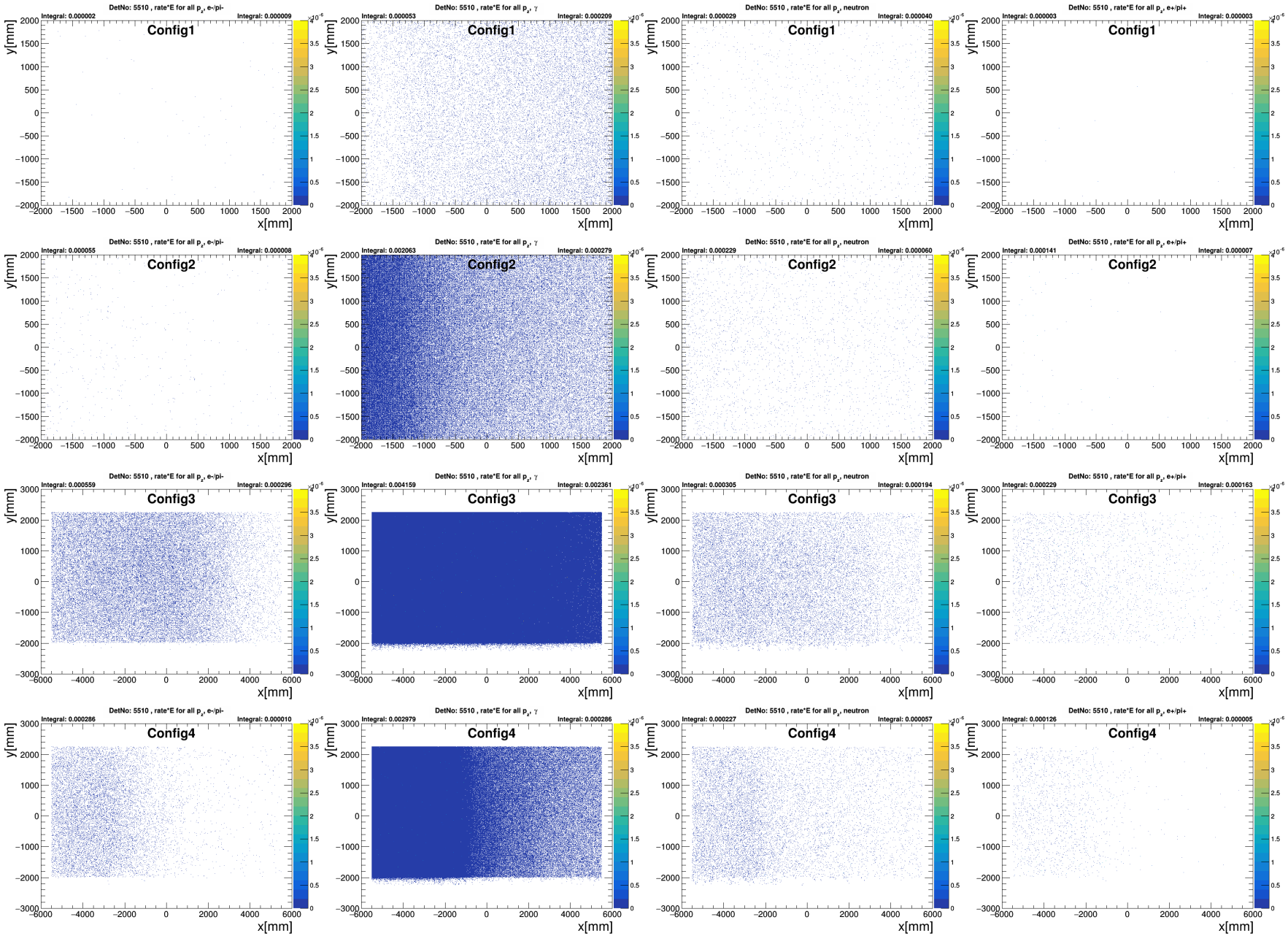
Thank you!

Backup

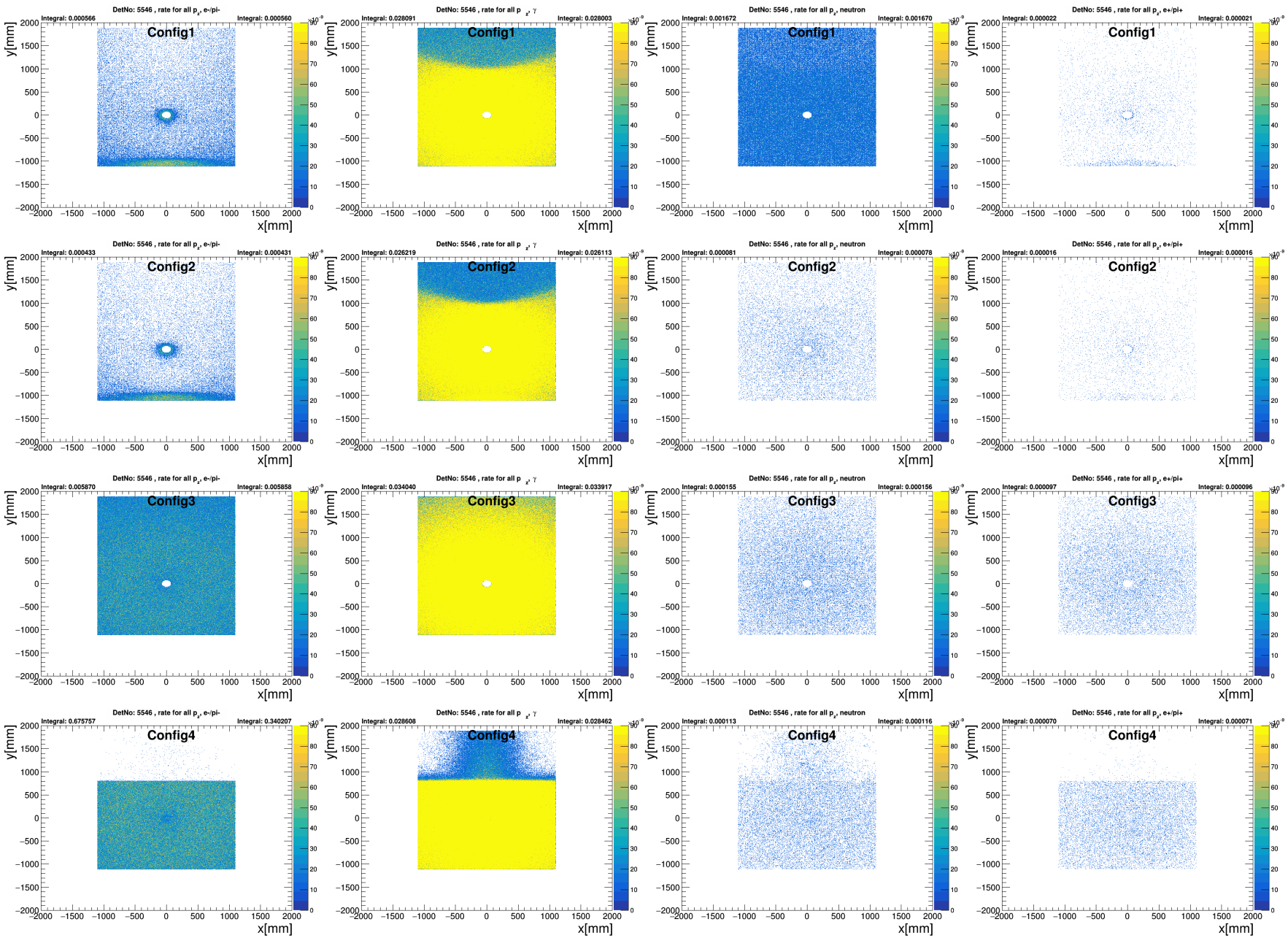
2D Hit Distributions weighted by rate for all p_z, config1/2/3/4 (Det5510)



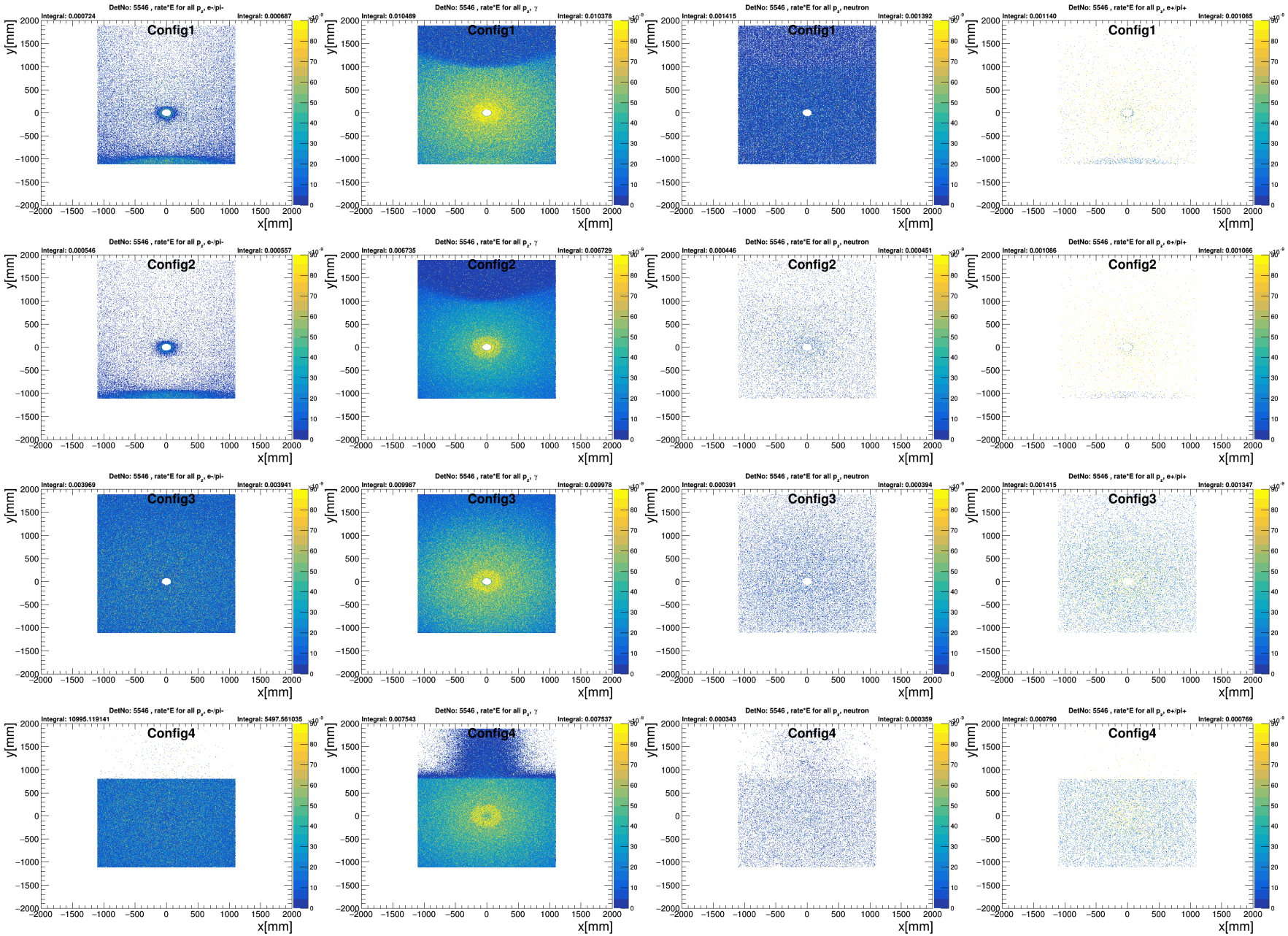
2D Hit Distributions weighted by rate*E for all p_z, config1/2/3/4 (Det5510)



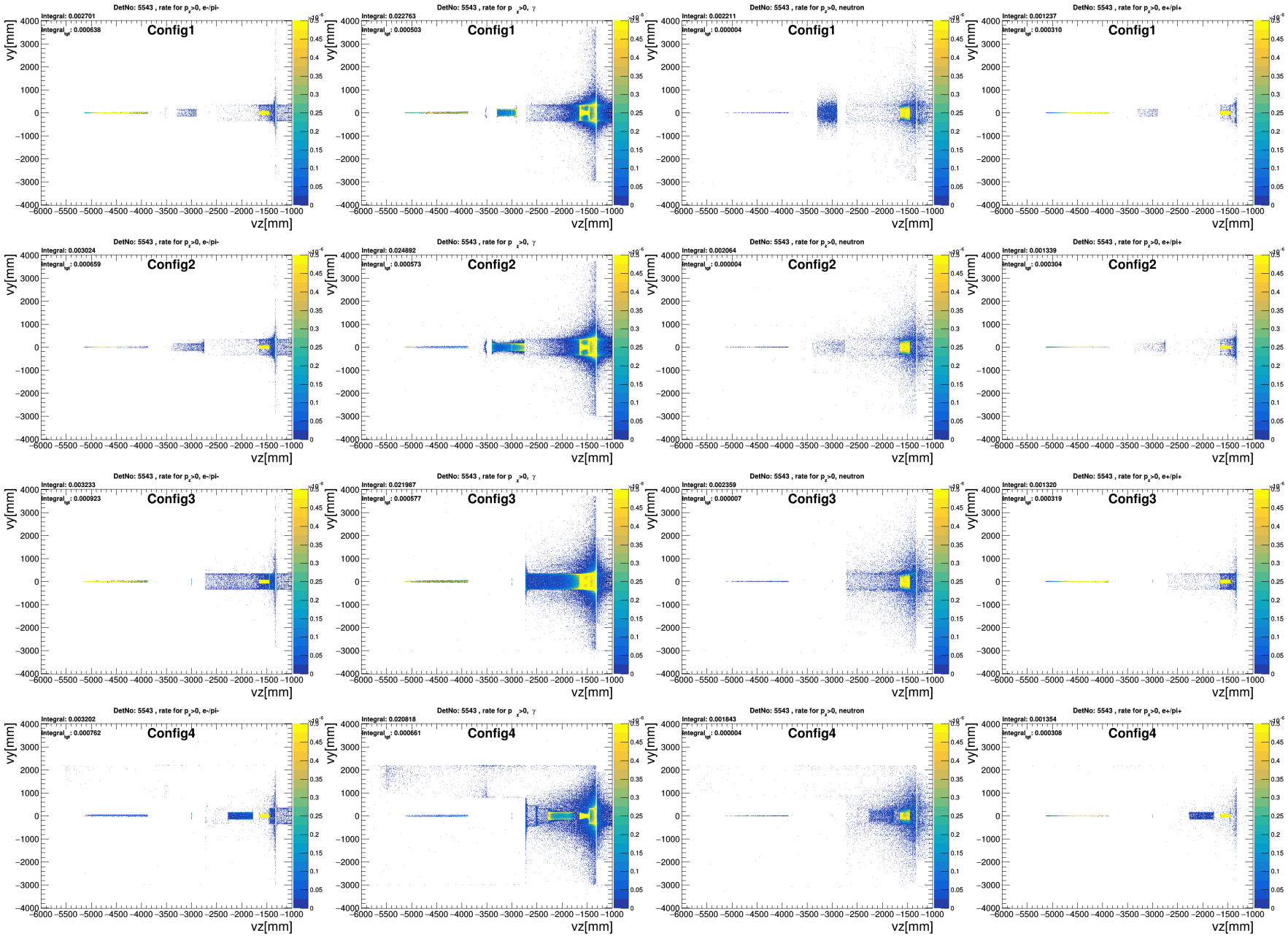
2D Hit Distributions weighted by rate for all p_z, config1/2/3/4 (Det5546)



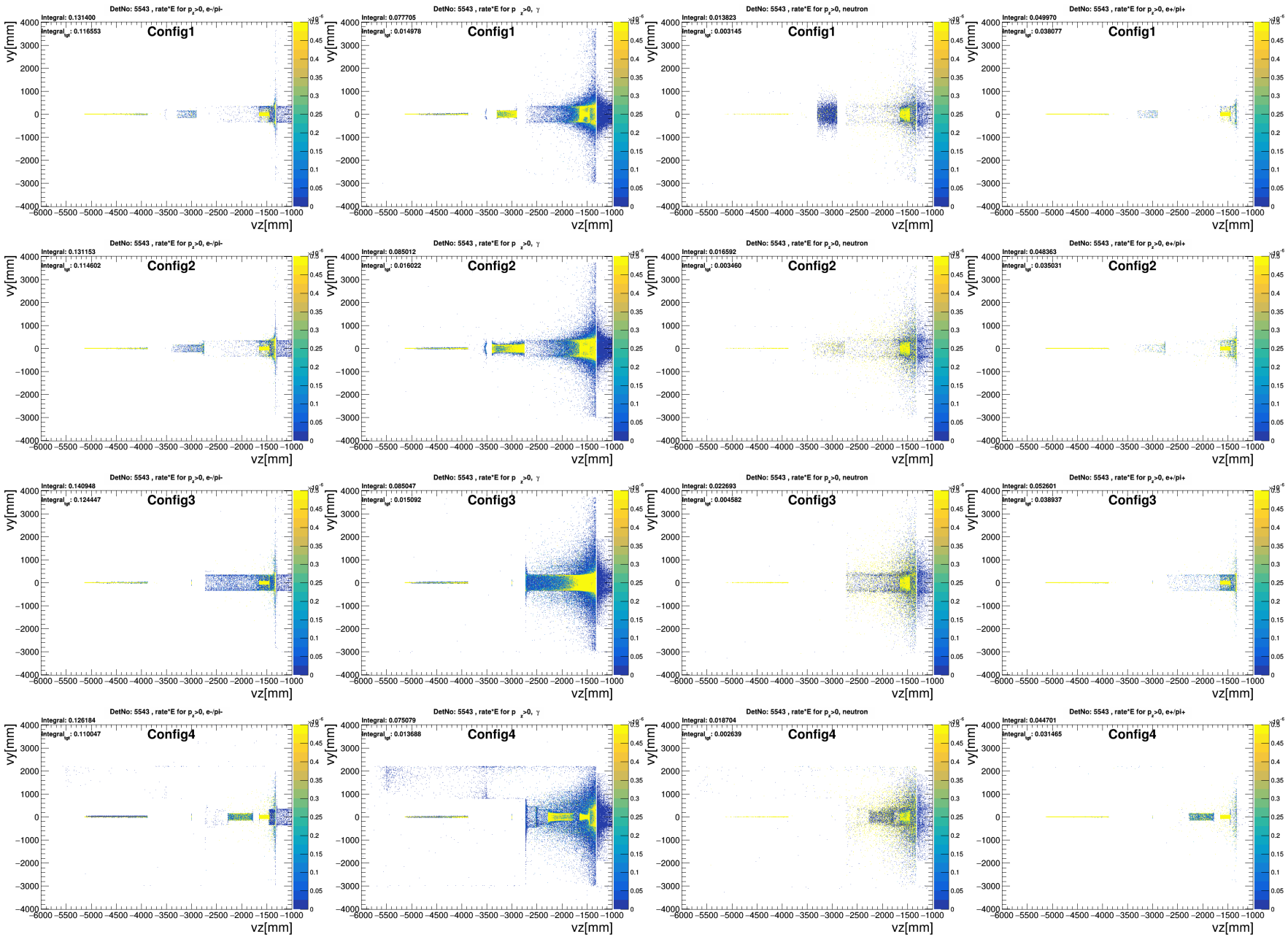
2D Hit Distributions weighted by rate*E for all p_z, config1/2/3/4 (Det5546)



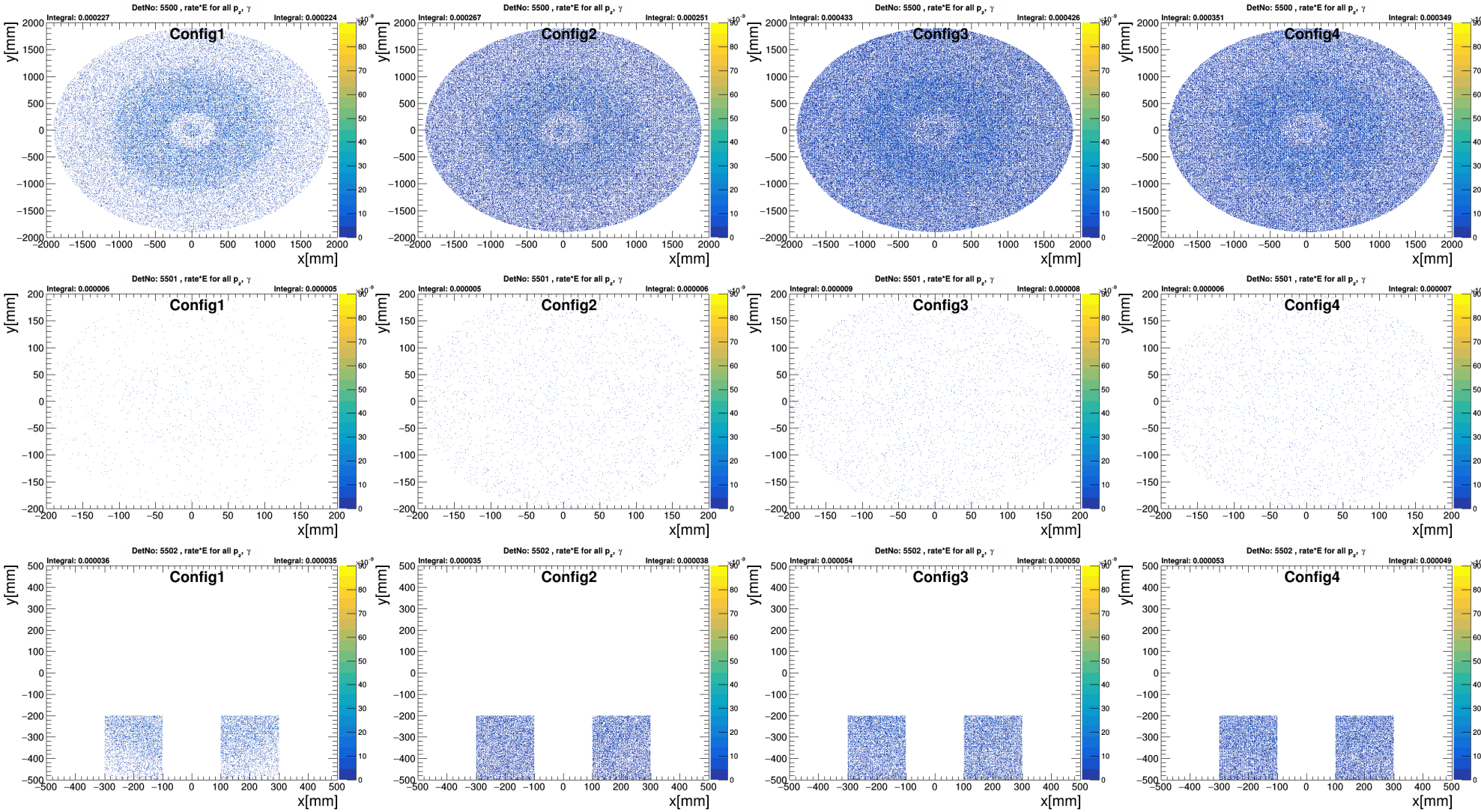
Vertex positions v_y vs v_z weighted by rate for $p_z > 0$, config1/2/3/4 (Det5543)



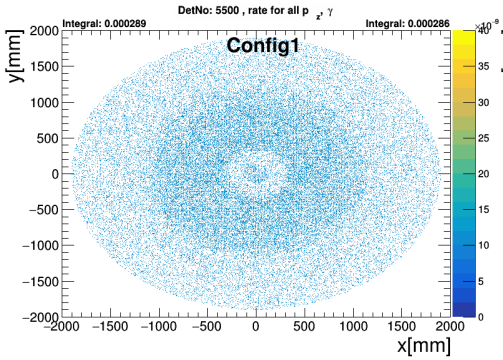
Vertex positions v_y vs v_z weighted by rate*E for $p_z > 0$, config1/2/3/4 (Det5543)

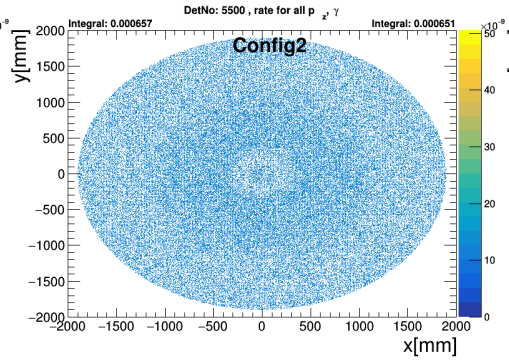


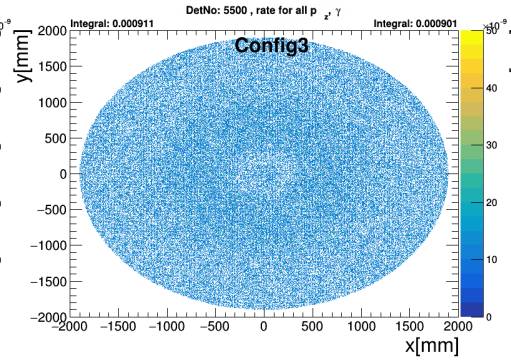
2D Hit Distributions weighted by rate*E for all p_z, config1/2/3/4 (Det5500 & Det5501 & Det5502)

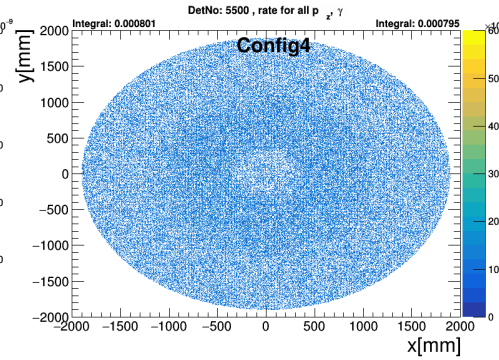


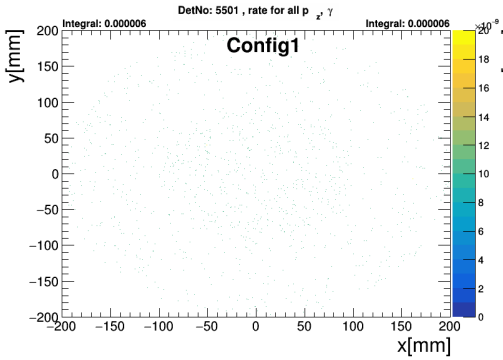
2D Hit Distributions weighted by rate for all p_z, config1/2/3/4 (Det5500 & Det5501 & Det5502)

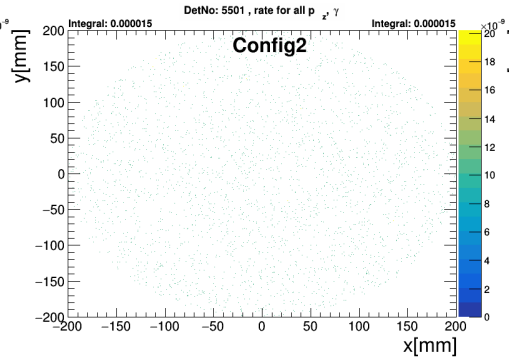


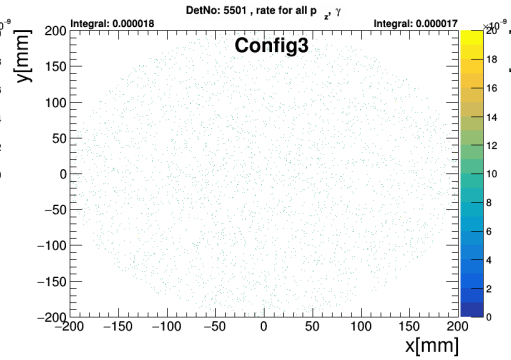


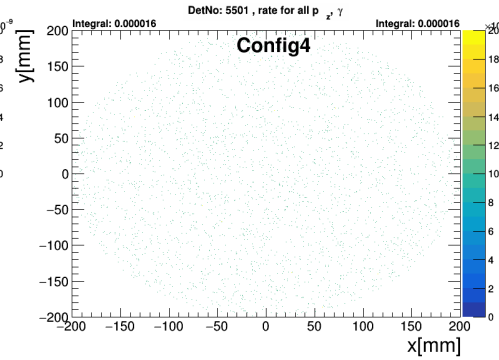


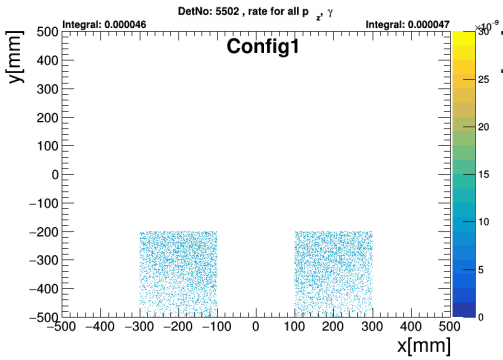


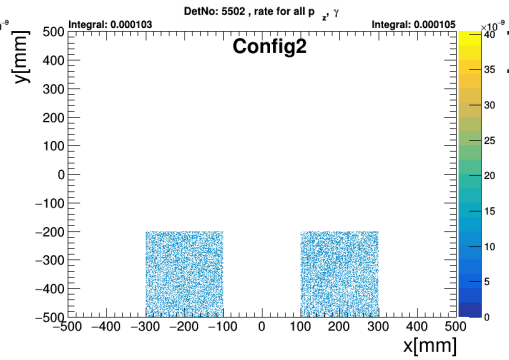


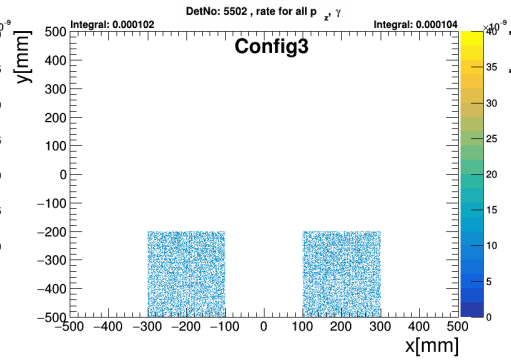


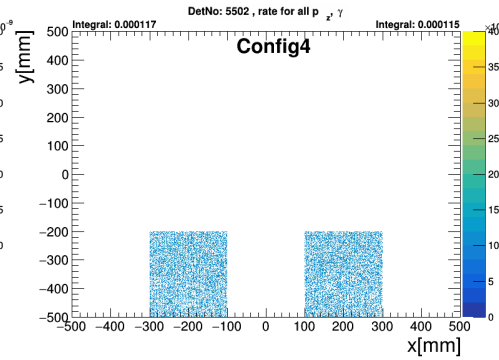












Radial distributions for $p_z > 0$, config1/2/3/4 (Det5543)