

Parametrizing the effect of dump in background sample simulation: a status update

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March 7, 2022

Goal of this study:

- At present, we only have 2 BX of FullSim background only samples and 7.45 BX of FastSim background only samples for TDR round of production.
 - For CDR, we had ~ 300 BX of FastSim background only samples.
- More BXs of background only samples needed.
 - To understand the effect of background particles in LUXE in a statistical significant way.
 - To study the background rejection power of the tracker.
- Particle simulation in dump and shielding takes most of the computation power.
 - If we can parametrize the effect of the dump and shielding,
 - in effect, know the particle energy distribution coming out of the dump/shielding.
 - if some background particles from dump/shielding do not have much effect/much energy, we can ignore them for further analysis.
 - we can reduce the computational needs to simulate the dump or shielding.
 - produce more BXs of background only samples.

- FullSim (total 2BX) \rightarrow plots normalized to 1 BX.
- FastSim (total 7.45 BX) \rightarrow plots normalized to 1 BX.
 - For FastSim, here the process stops tracking particles which hit beam dumps or shielding.
- Looked at the background particles:
 - Electrons
 - Photons
 - Positrons
 - Neutrons
- Plots from the tracks intersecting the tracker plane (not necessarily making a hit in the tracker).

- Selected particles originated from the dump, air and vacuum exit window
 - Background from dump with vertex requirement: $(6800 \text{ mm} < v_{txz} < 8300 \text{ mm})$ and $(-1700 \text{ mm} < v_{txx} < 500 \text{ mm})$
 - Background from window with vertex requirement: $(3850 \text{ mm} < v_{txz} < 3900 \text{ mm})$ and $(-600 \text{ mm} < v_{txx} < 600 \text{ mm})$
 - Background from air if vertex requirement: If vertex falls within a cylinder of radius 5cm, the axis of the cylinder being a straight line connecting window and dump.
 - The straight line is drawn from these two points
 - Window: $z_1=3925, x_1=39, y_1=0$
 - Dump: $z_2=7000, x_2=102, y_2=0$

- First layer, first stave plot (positron side)

Background electrons: FullSim

- Background electrons in first layer, first stave of tracker.

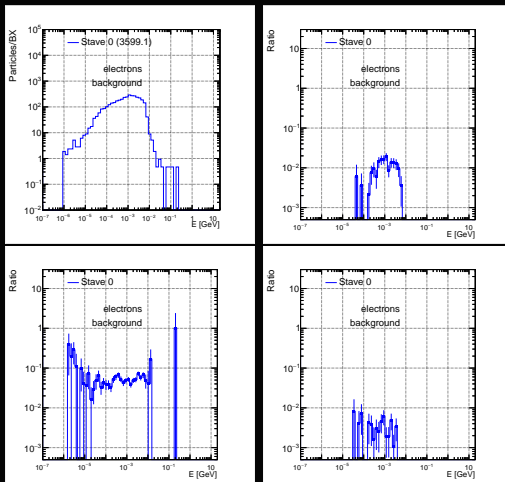


Figure: Top left: energy distribution from all sources. Top right: ratio of energy, particles from dump over particles from all sources. Bottom left: ratio of energy, particles from air over particles from all sources. Bottom right: ratio of energy, particles from exit window over particles from all sources.

Background electrons: FastSim

- Background electrons in first layer, first stave of tracker.

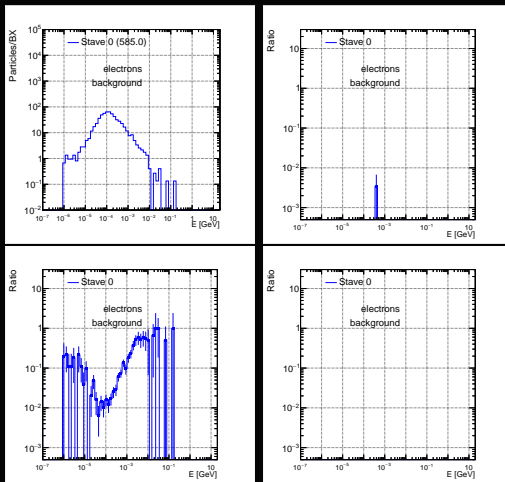


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Background positrons: FullSim

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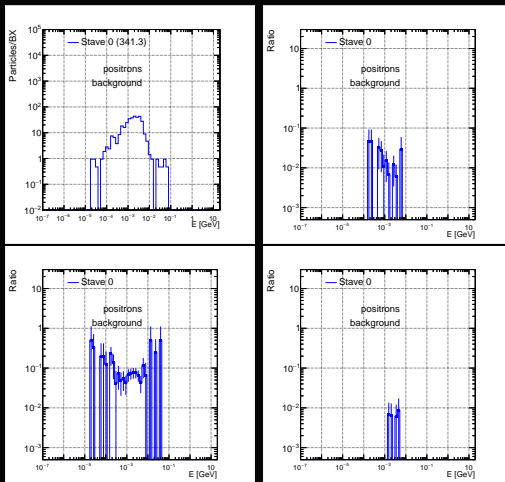


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Background positrons: FastSim

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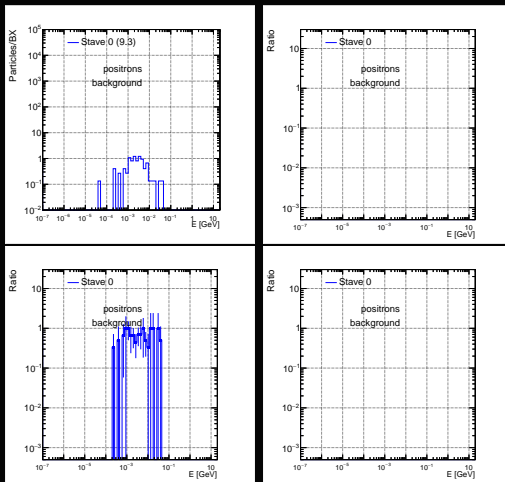


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Background gamma: FullSim

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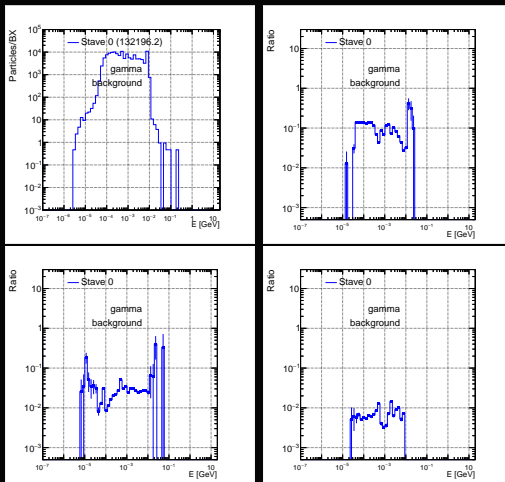


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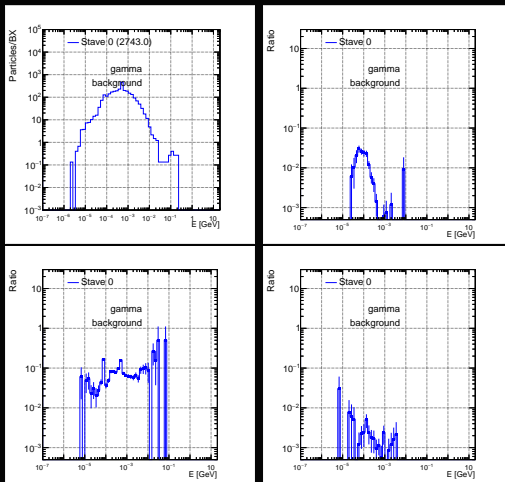


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Background neutrons: FullSim

- Background neutrons in first layer, first stave of tracker.

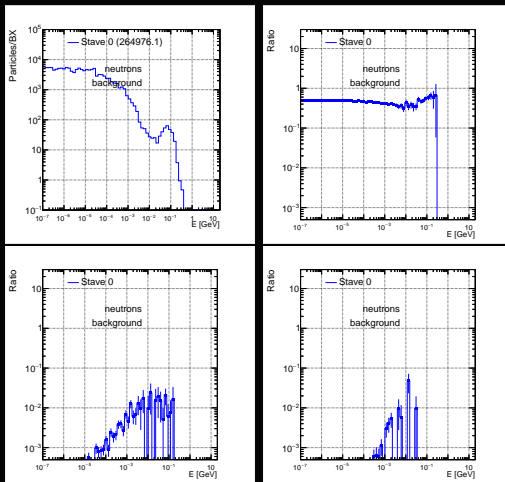


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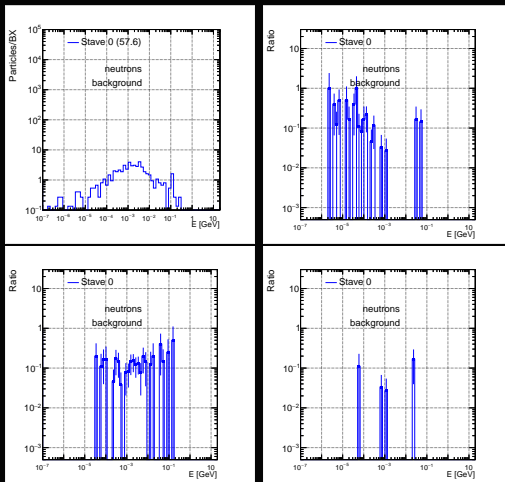


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Summary and to do:

- In the tracker first layer first stave:
 - Most of the neutrons are coming from the dump, as expected.
 - Around $\gtrsim 10\%$ photons are from the dump.
 - Electron and positrons from dump are negligible in number ($\sim 1\%$) compared to that from the air.
- Similar conclusion can be drawn from tracker last layer last stave plots (in backup).
- How do we include this information in our next fast simulation?

- Last layer, last stave plots (positron side)

Background electrons: FullSim

- Background electrons in last layer, last stave of tracker.

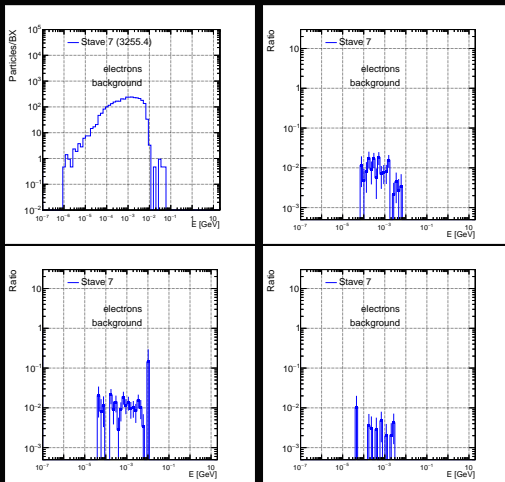


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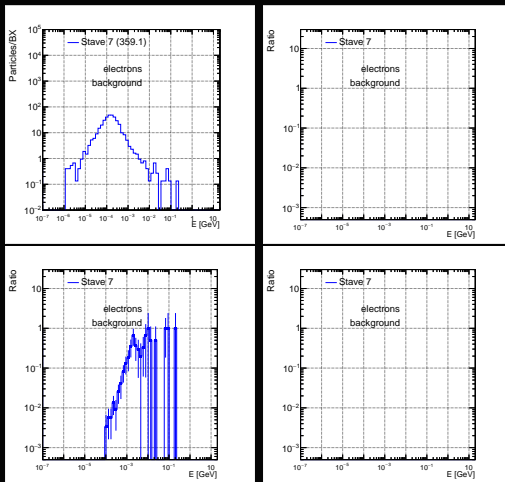


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Background positrons: FullSim

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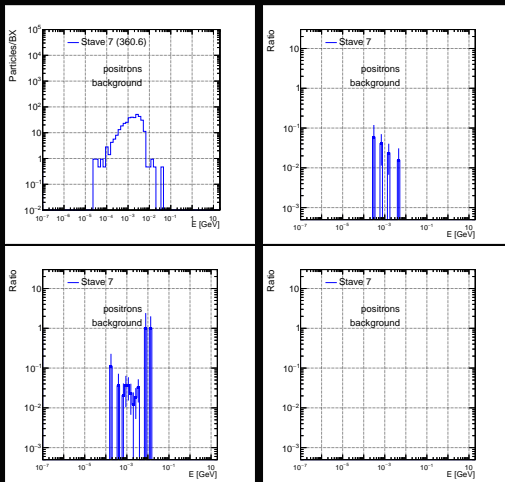


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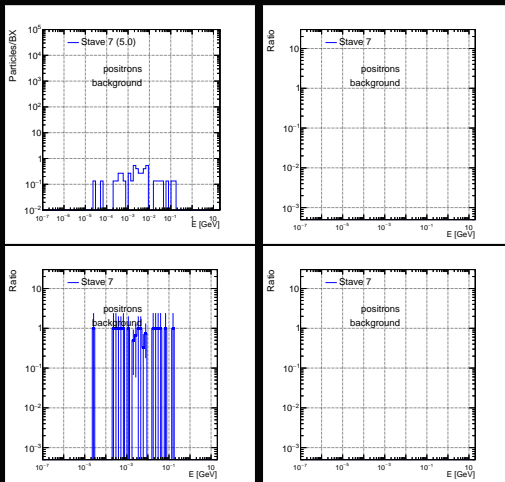


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Background gamma: FullSim

- Background gamma in last layer, last stave of tracker.

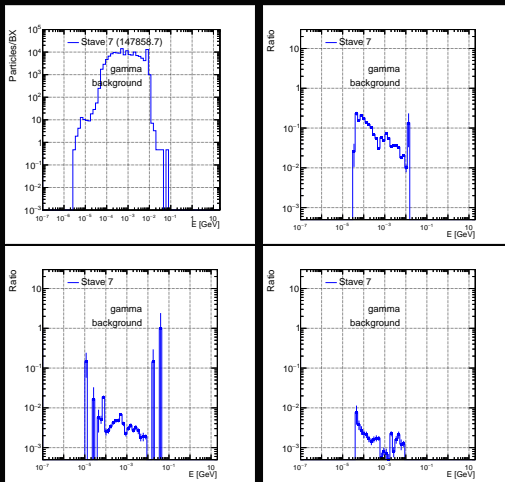


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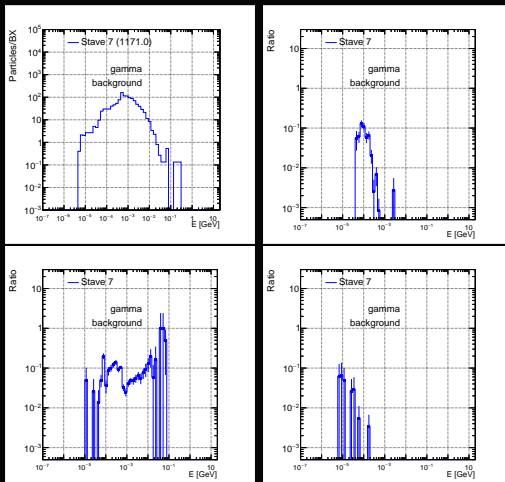


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Background neutrons

- Background neutrons in last layer, last stave of tracker.

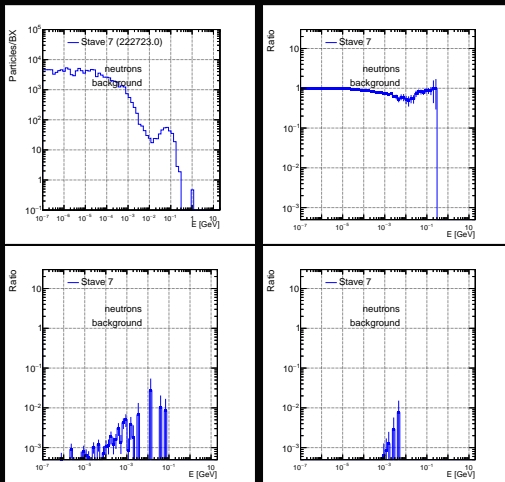


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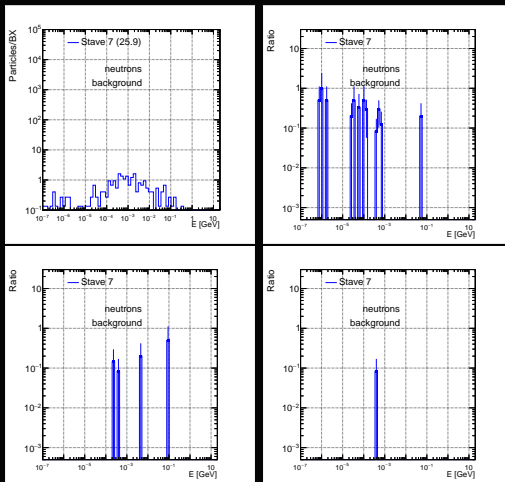


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Summary: tracker last layer last stave

- In the tracker last layer last stave:
 - Almost all of the neutrons are coming from the dump.
 - Around $\gtrsim 10\%$ photons are from the dump.
 - Electron and positrons from dump are negligible ($\sim 1\%$) in number compared to that from the air.

The LUXE design

