

Energy Resolution of Runge-Kutta Reconstruction of Padded Microscopically Simulated Tracks

First Successful Attempt

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Outline

- 1 Grid-like track simulation
- 2 Direction independent resolution
- 3 Direction dependent resolution
- 4 All track parameters dependence
- 5 2D cuts average bias
- 6 2D cuts average error



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Grid-like track simulation

- We use Garfield++ for track simulation
 - Primary relativistic particle simulated using Heed program [1]
 - Secondary ionization electrons simulated using microscopic tracking (uses equation of motion)
- Microscopic tracks were simulated on MetaCentrum to test the Runge-Kutta padded reconstruction
 - 2000 jobs, each 20-160 hours runtime, 20 GB RAM allocated
 - 9702 tracks were simulated (electron vs positron, 21 theta angles, 21 phi angles, 11 energies 3-13 MeV)
 - Reconstruction lasts around 40 minutes



Simulation ranges

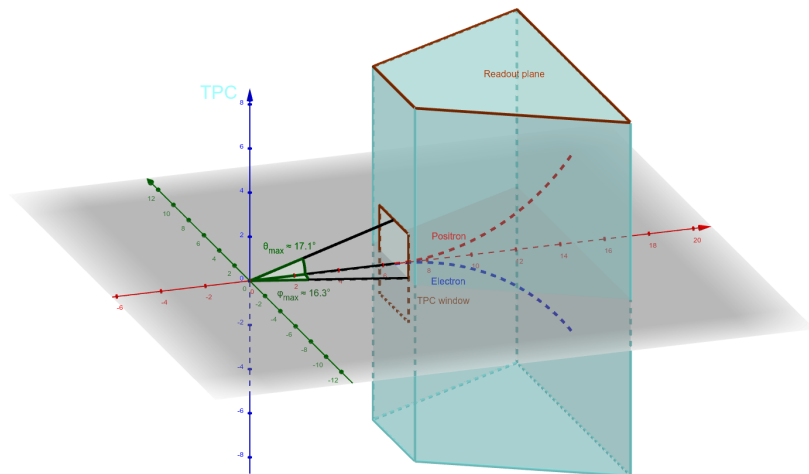


Figure: $\theta \in [-17.1^\circ, 17.1^\circ]$, $\varphi \in [-16.3^\circ, 16.3^\circ]$, $E_k \in [3, 13]$ MeV.



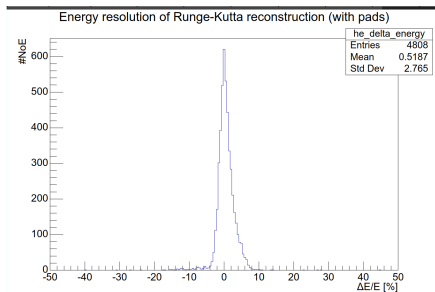
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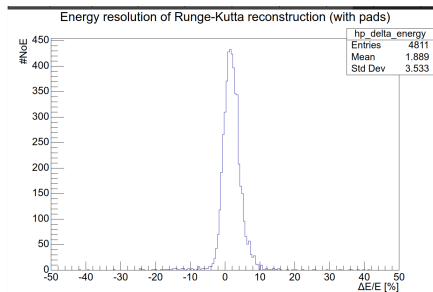


Energy resolution for all tracks

Electrons

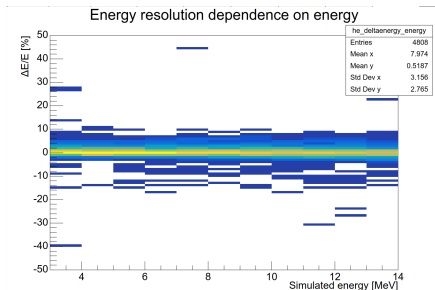


Positrons

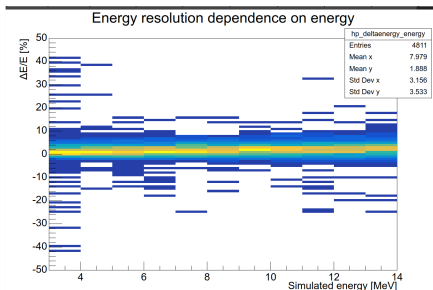


Energy resolution dependence on simulated energy

Electrons



Positrons



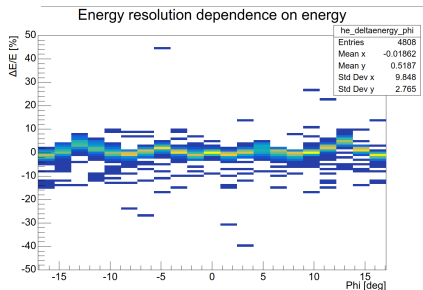
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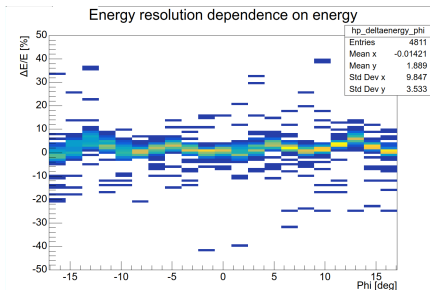


Energy resolution dependence on phi

Electrons

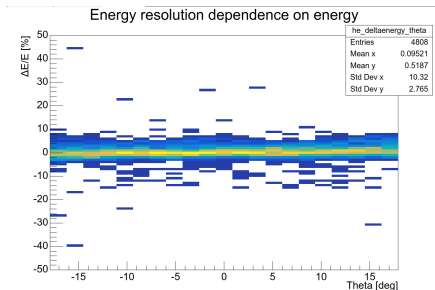


Positrons

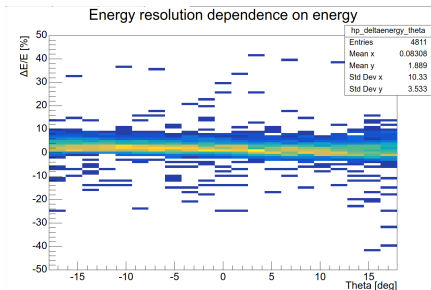


Energy resolution dependence on theta

Electrons



Positrons



Outline

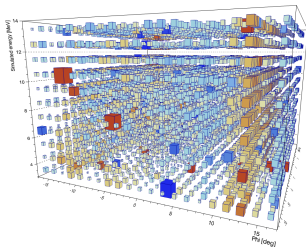
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All track parameters (phi, theta and simulated energy)

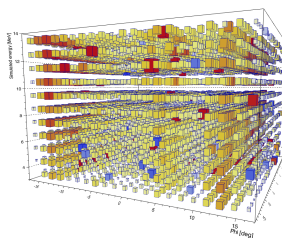
Electrons

Energy resolution ($\Delta E/E$)



Positrons

Energy resolution ($\Delta E/E$)



Outline

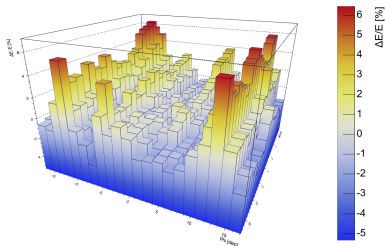
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Theta-Phi cut average bias

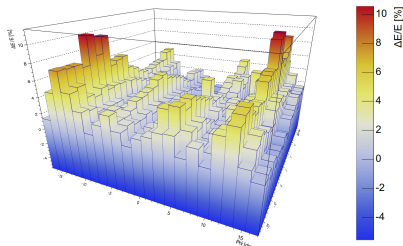
Electrons

Energy resolution ($\Delta E/E$)



Positrons

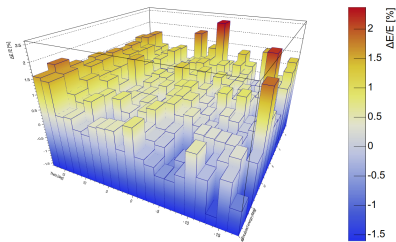
Energy resolution ($\Delta E/E$)



Theta-Energy cut average bias

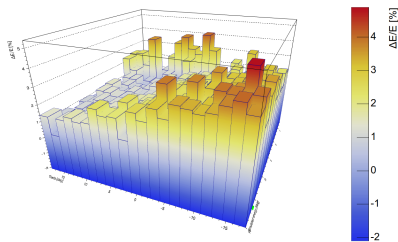
Electrons

Energy resolution ($\Delta E/E$)



Positrons

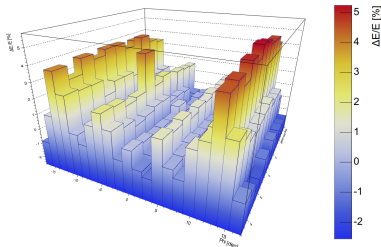
Energy resolution ($\Delta E/E$)



Phi-Energy cut average bias

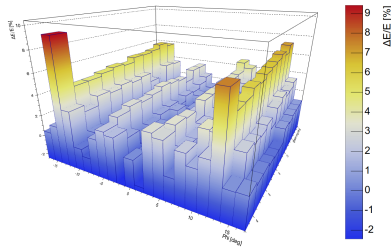
Electrons

Energy resolution ($\Delta E/E$)



Positrons

Energy resolution ($\Delta E/E$)



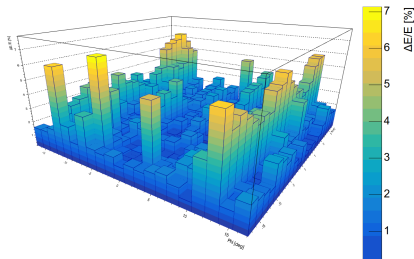
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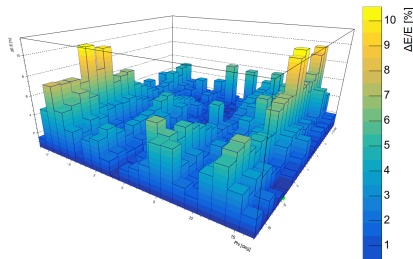
Electrons

Energy resolution ($\Delta E/E$)



Positrons

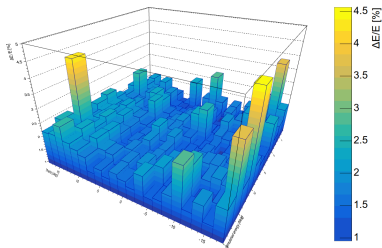
Energy resolution ($\Delta E/E$)



Theta-Energy cut average error

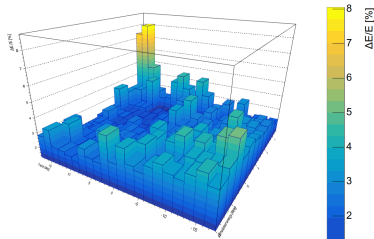
Electrons

Energy resolution ($\Delta E/E$)



Positrons

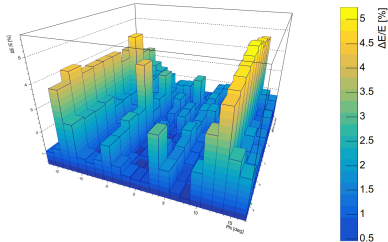
Energy resolution ($\Delta E/E$)



Phi-Energy cut average error

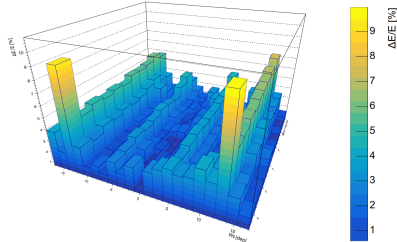
Electrons

Energy resolution ($\Delta E/E$)



Positrons

Energy resolution ($\Delta E/E$)



Thank you for your attention.



[1] I. B. Smirnov.

Modeling of ionization produced by fast charged particles in gases.
Nucl. Instr. Meth. A, 554:474–493, 2005.

