Compton Scanner measurements on germanium detectors

Felix Hagemann

Virtual DPG Spring Meeting
March 15th, 2021

DPG

$\Delta p \cdot \Delta q \geq \frac{1}{2}\hbar$

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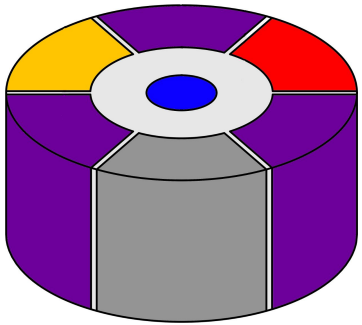
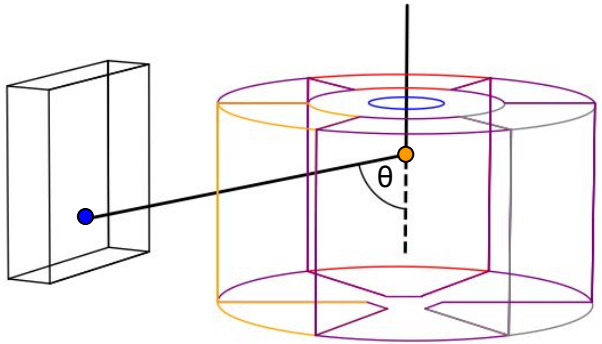
FÜR PHYSIK

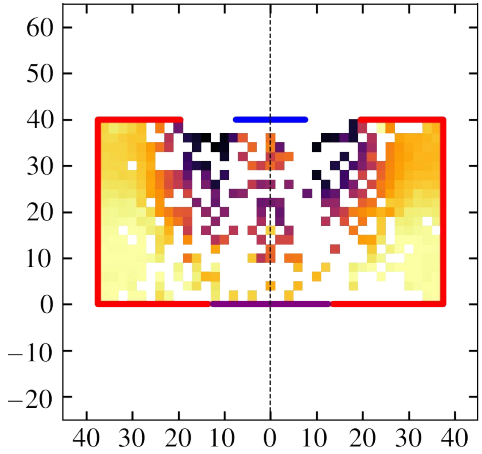
Outline



Segmented Broad Energy germanium detector



Experimental setup: Compton Scanner



Scanning the inner parts of germanium detectors

Solid State Detectors

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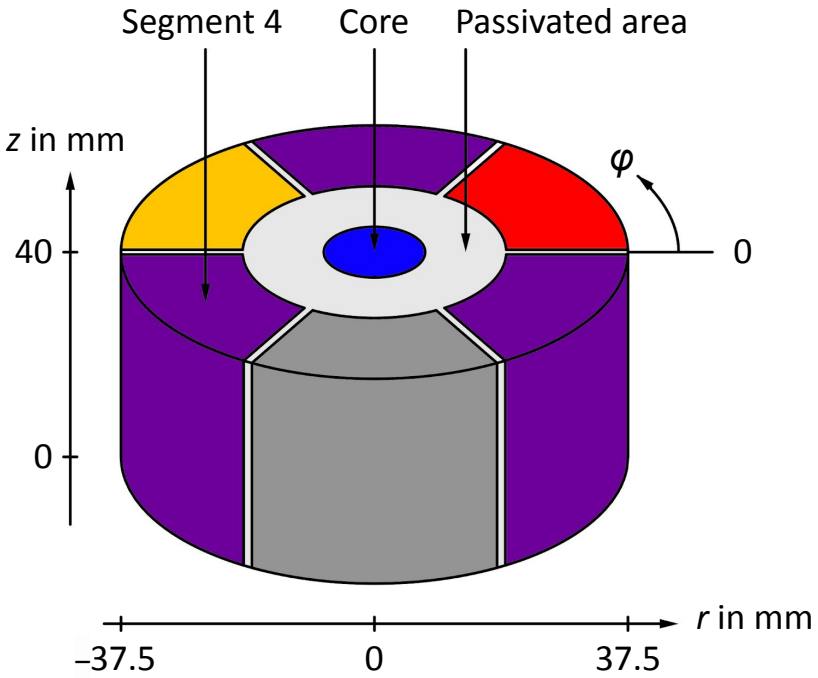
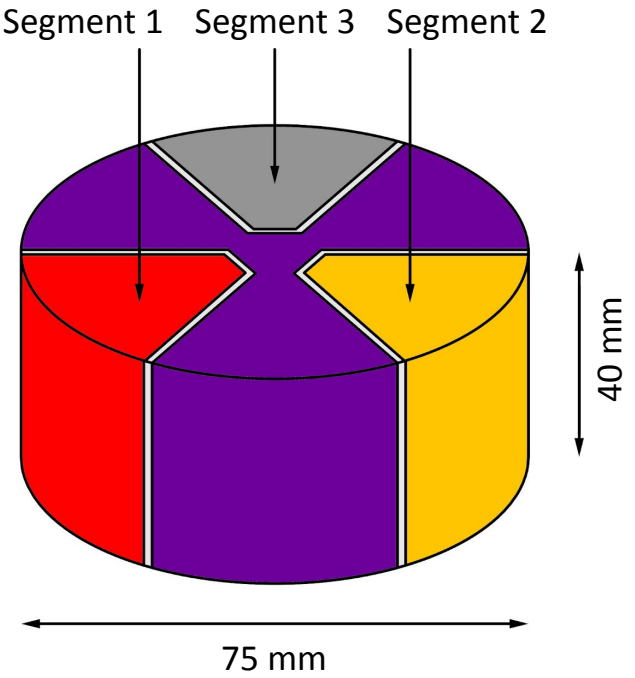
Segmented Broad Energy Germanium Detector





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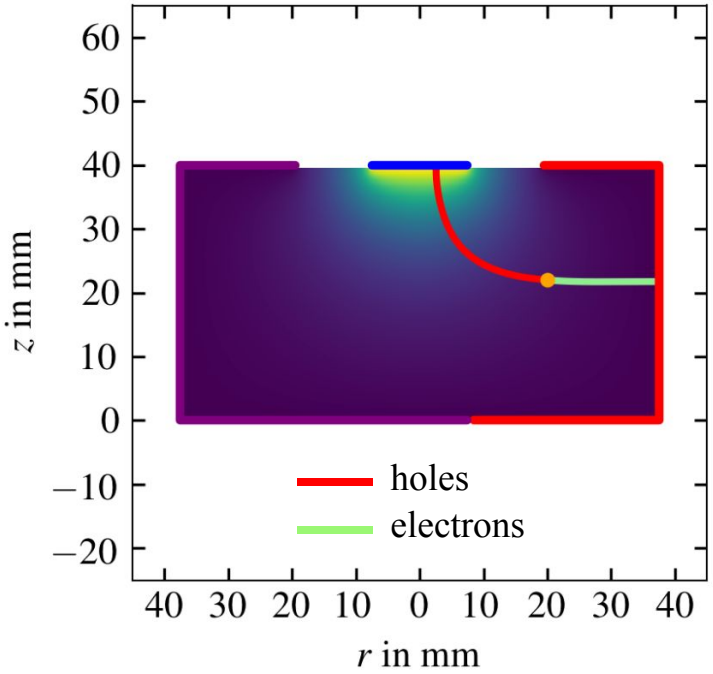
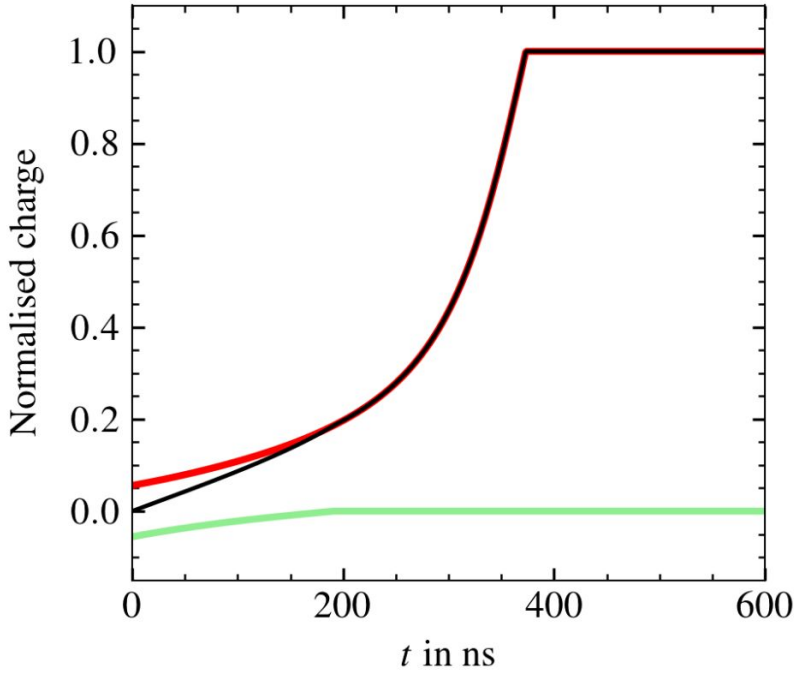
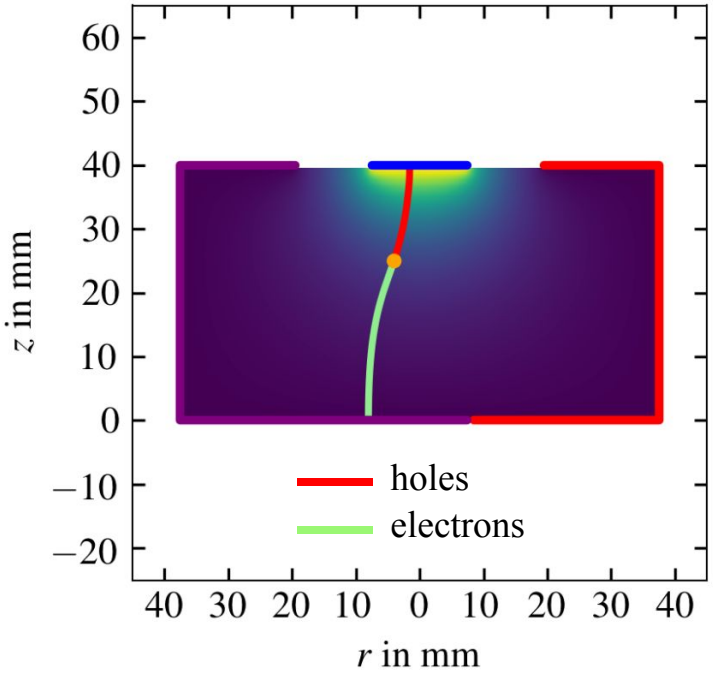
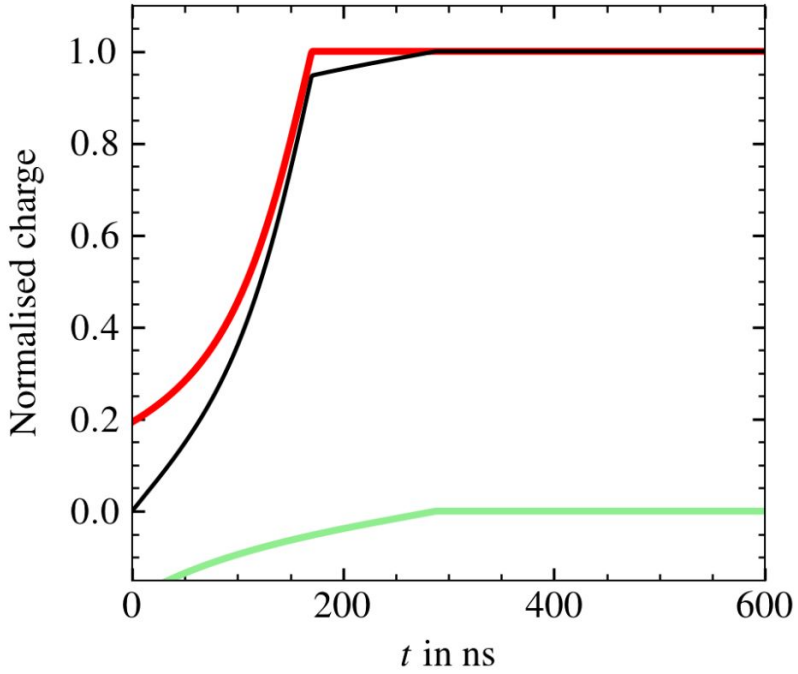
Signal Development in Germanium Detectors



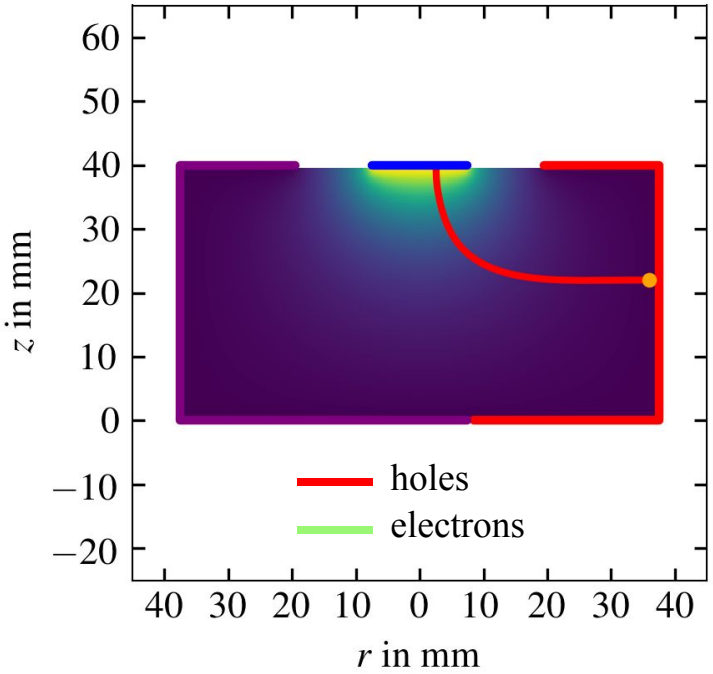


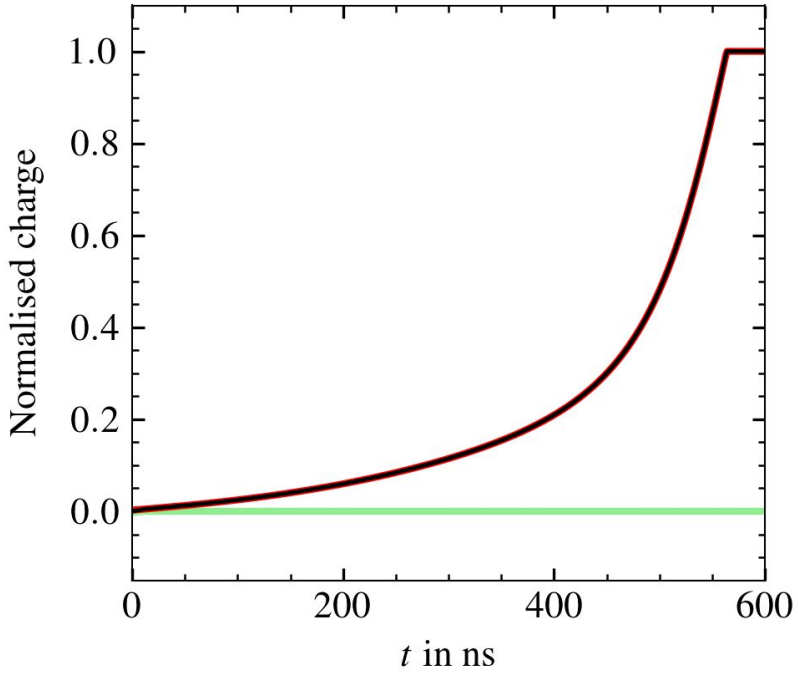
Signal Development in Germanium Detectors



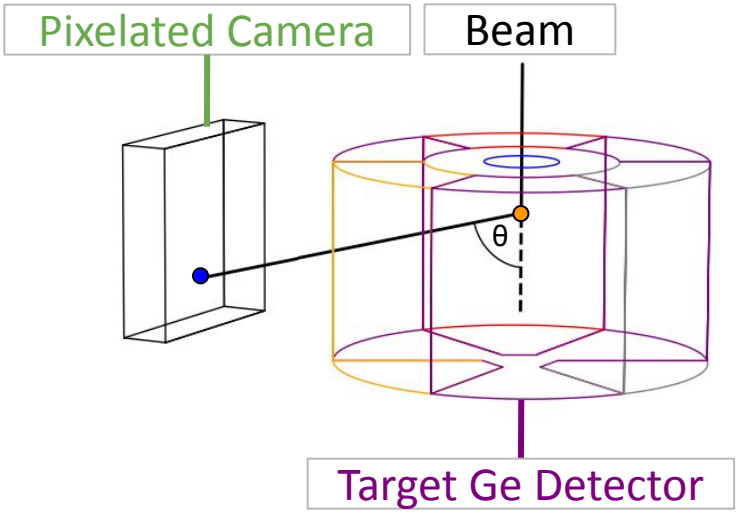


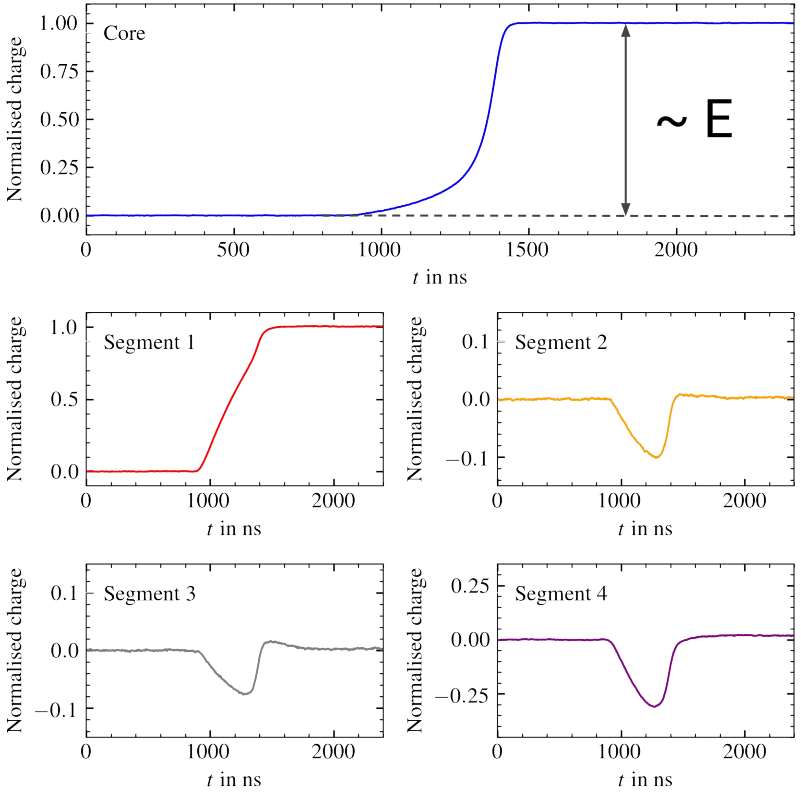
Signal Development in Germanium Detectors



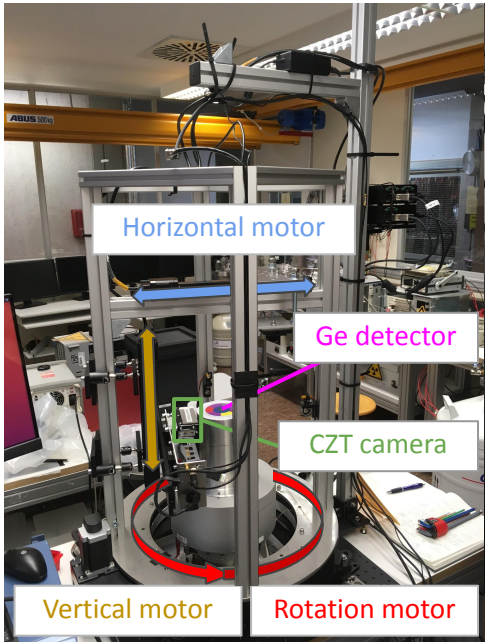


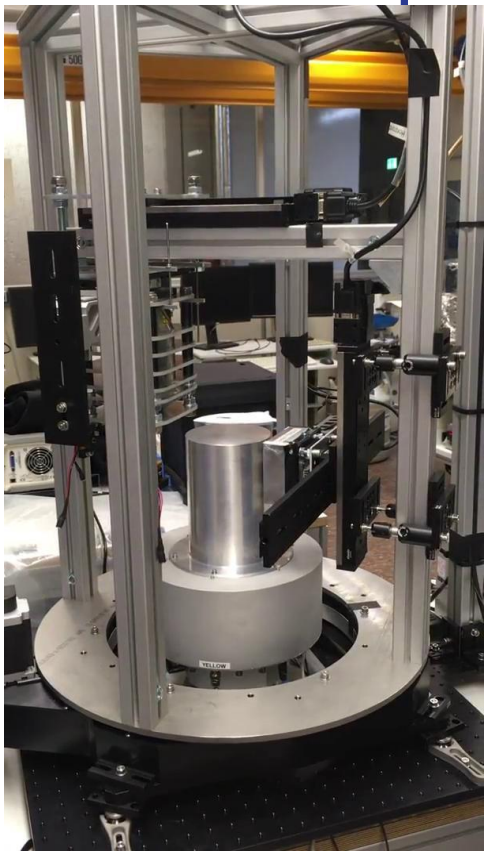
Compton Scanner

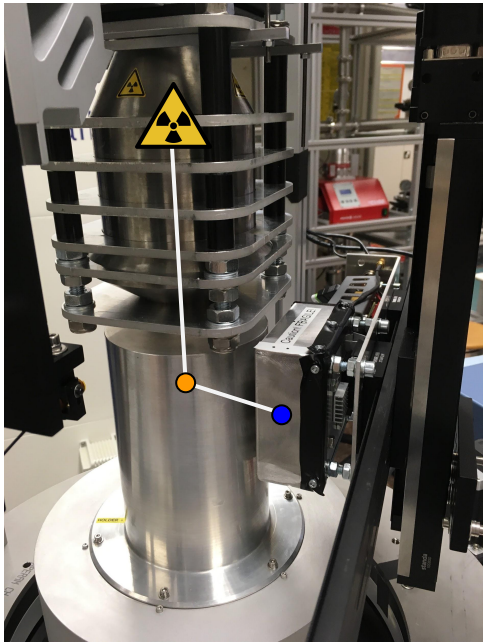




Setup and Alignment of Compton Scanner







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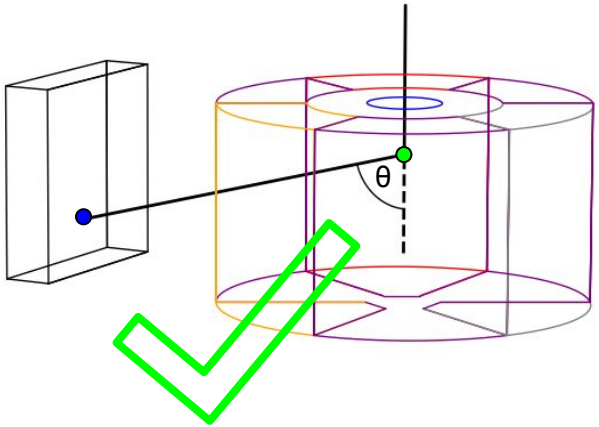
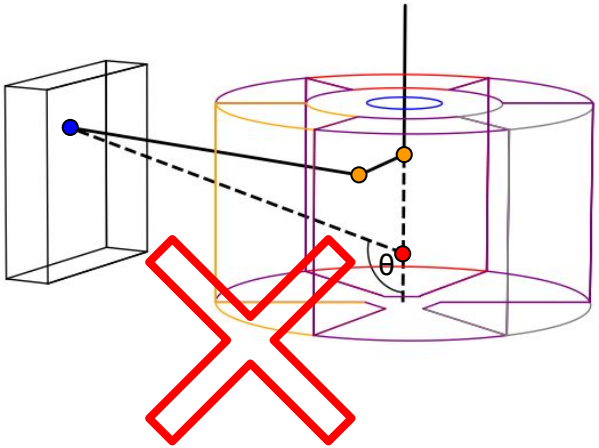
Background for Event Selection





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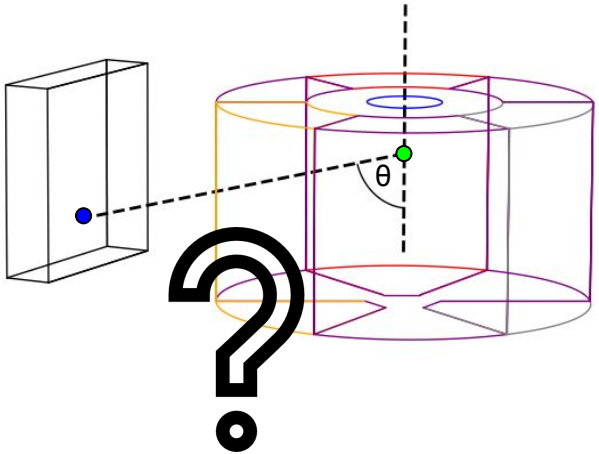
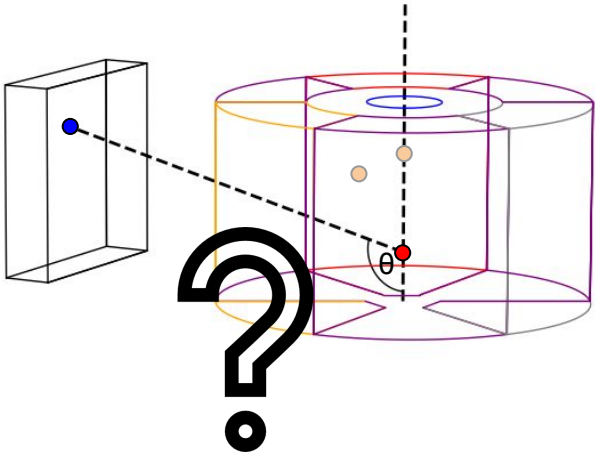
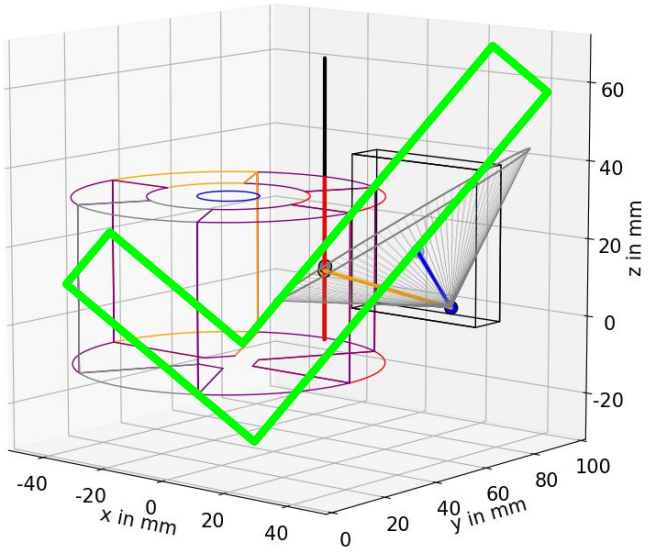
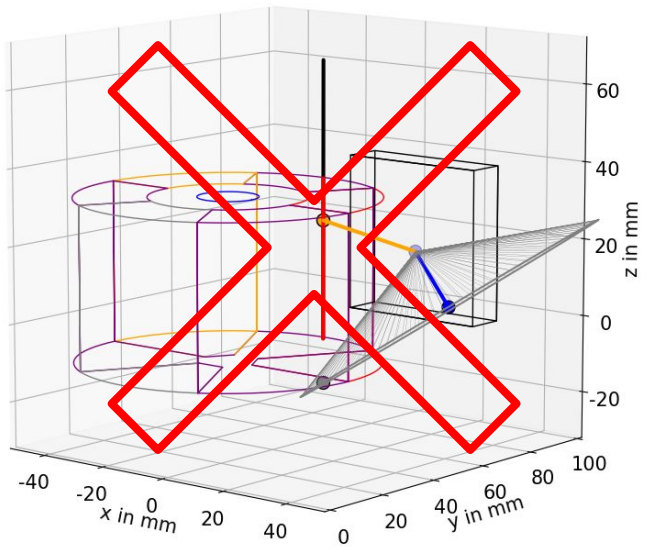




Reconstruction Algorithm





From energy ratio: $\cos(\theta) = 1 - m_e c^2 \left(\frac{1}{E_{\text{out}}} - \frac{1}{E_{\text{in}}} \right)$

$$z_\theta = z + \sqrt{(x-x_0)^2 + (y-y_0)^2}\cot(\theta)$$

From hits in CZT: $$(H_z^2 - \cos^2(\alpha))\, z_\alpha^2 + 2(c_z \cos^2(\alpha) - (\vec{H}_0 \cdot (\vec{c}_1 - \vec{x}_0))\, H_z)\, z_\alpha + (\vec{H}_0 \cdot (\vec{c}_1 - \vec{x}_0))^2 - (\vec{c}_1 - \vec{x}_0)^2 \cos^2(\alpha) = 0$$

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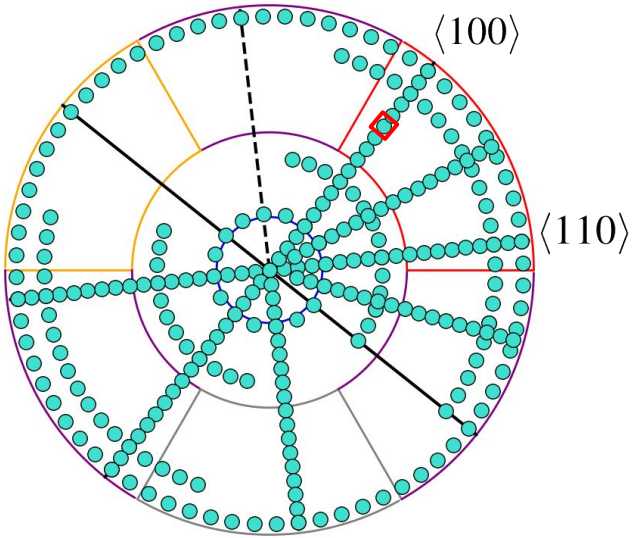
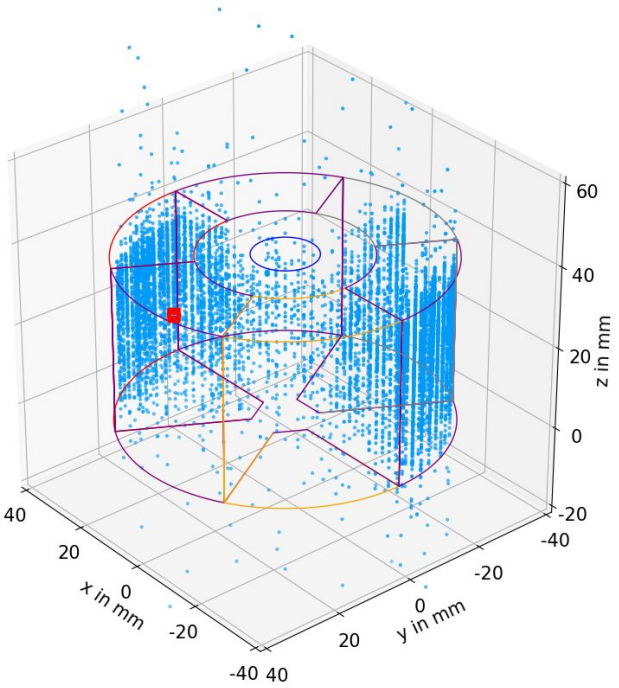
Reconstruction Algorithm Applied to Data

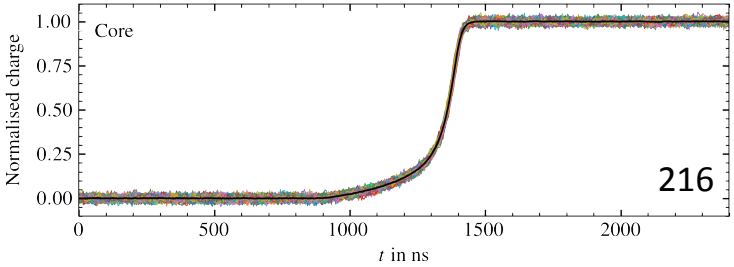


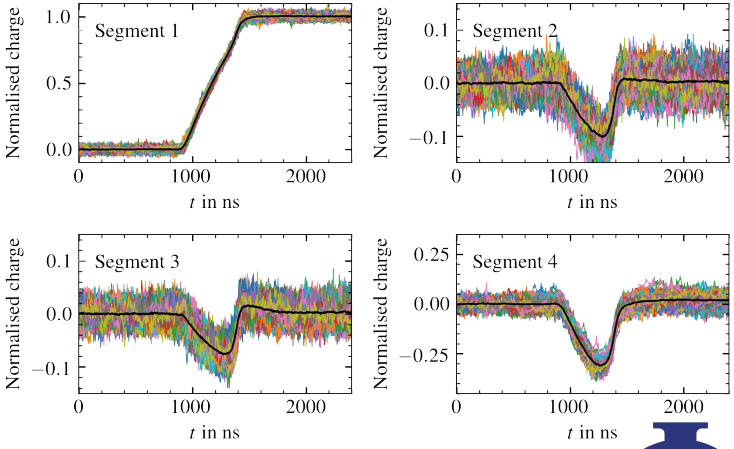


Beam spot

Pulse Shape Selection

Waveforms from data at R = 25.5mm, φ = 50.8°, z = 20mm





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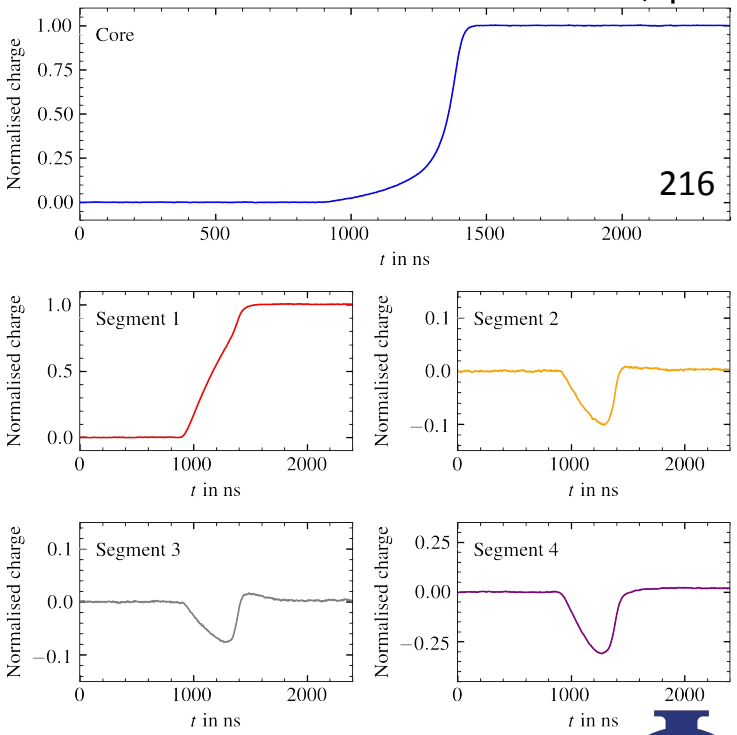
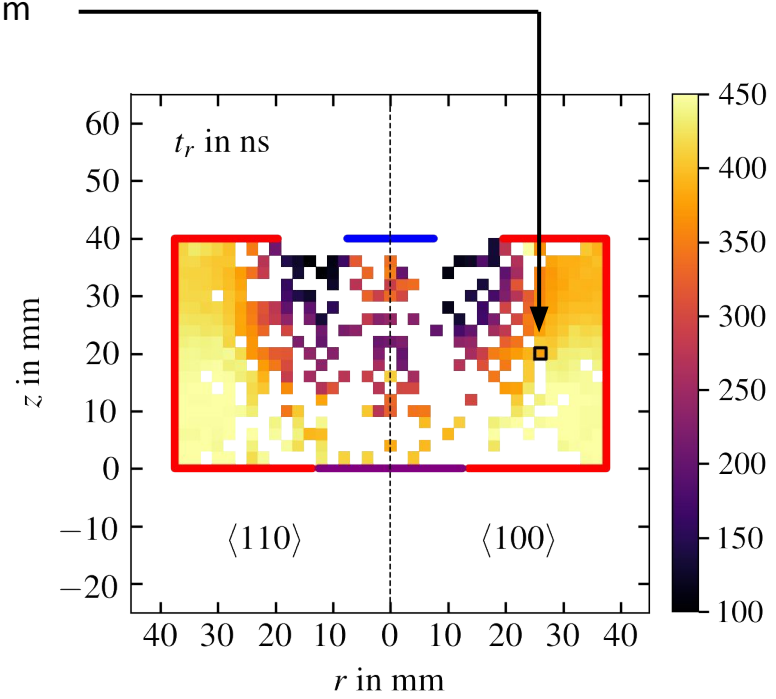
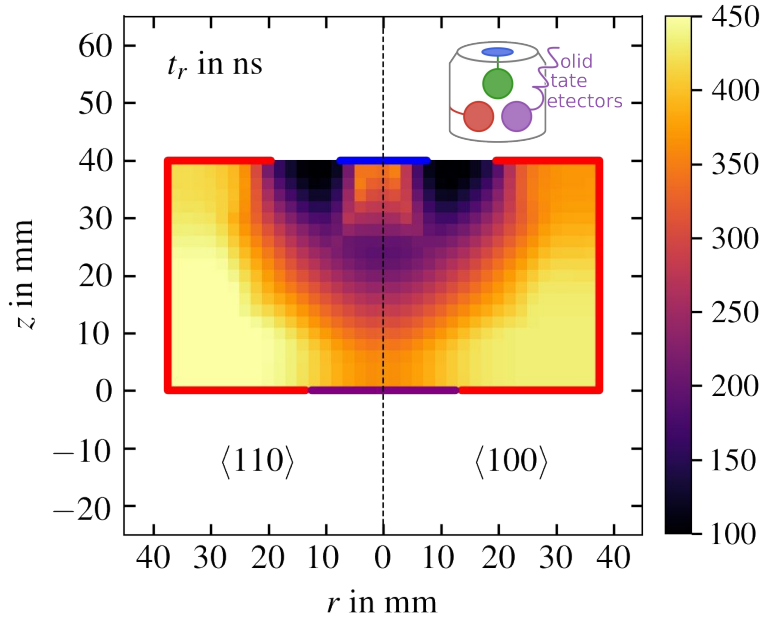
Pulse Shape Library

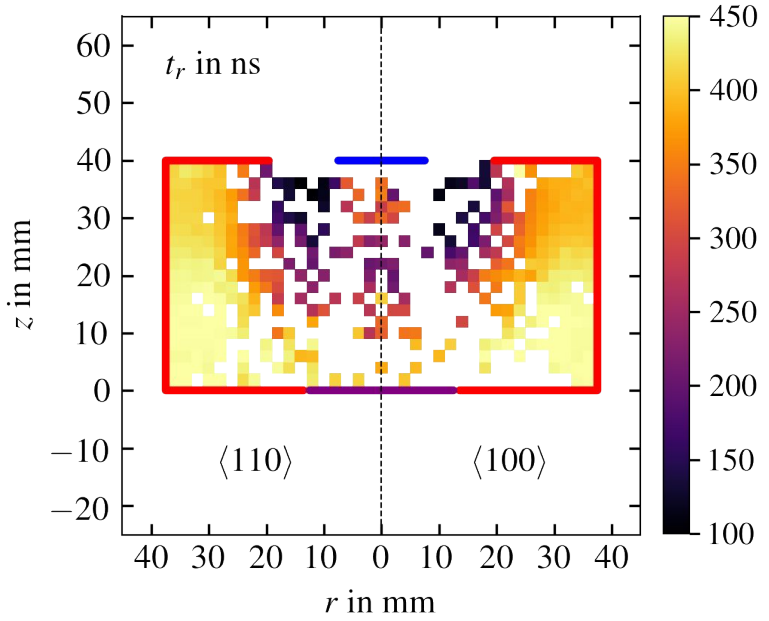
Waveforms from data at R = 25.5mm, φ = 50.8°, z = 20mm





Scanning the Inner Parts of the Detector





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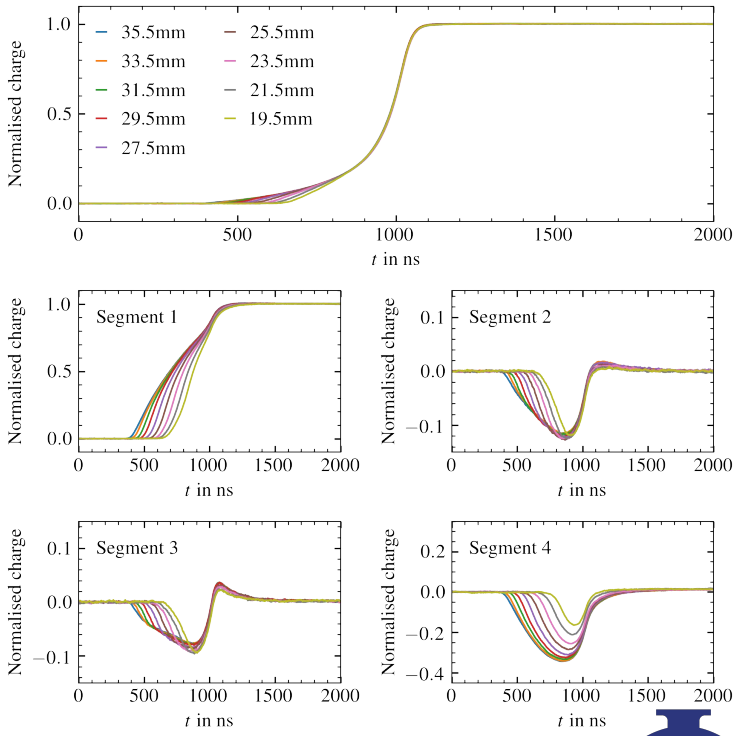

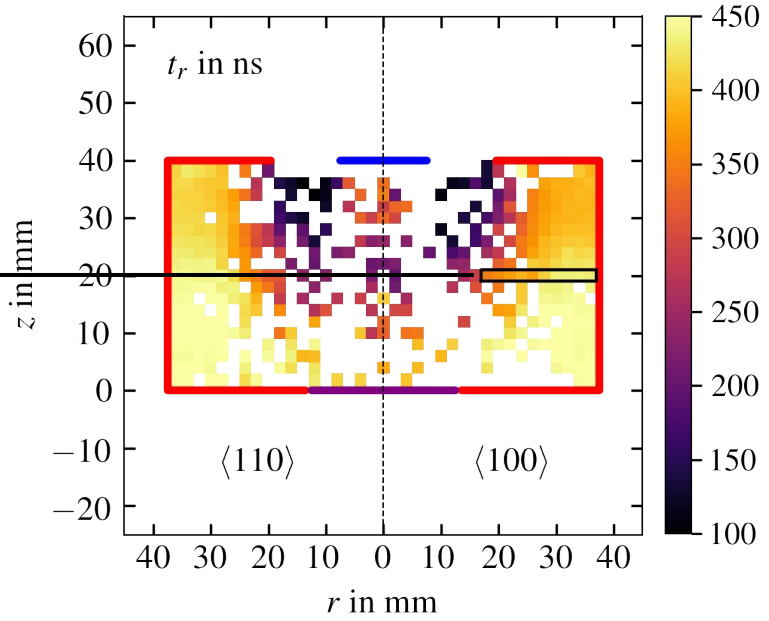

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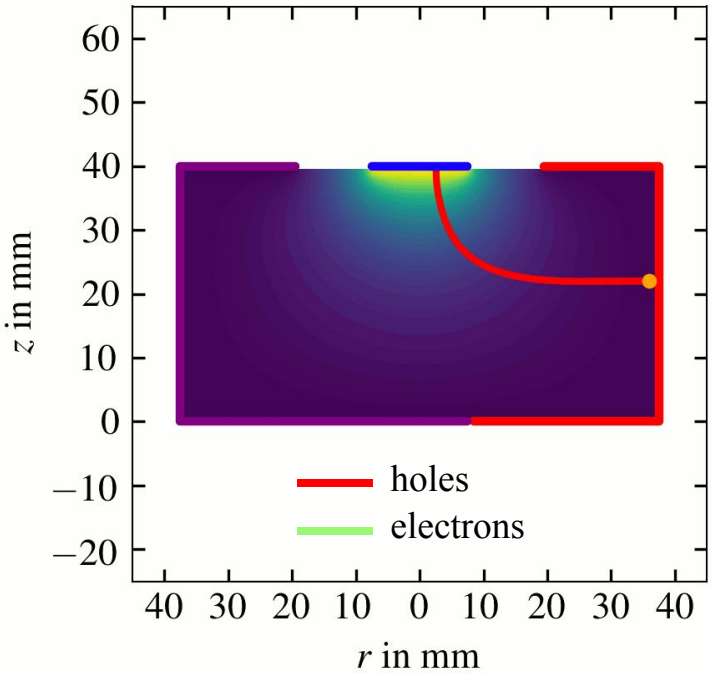
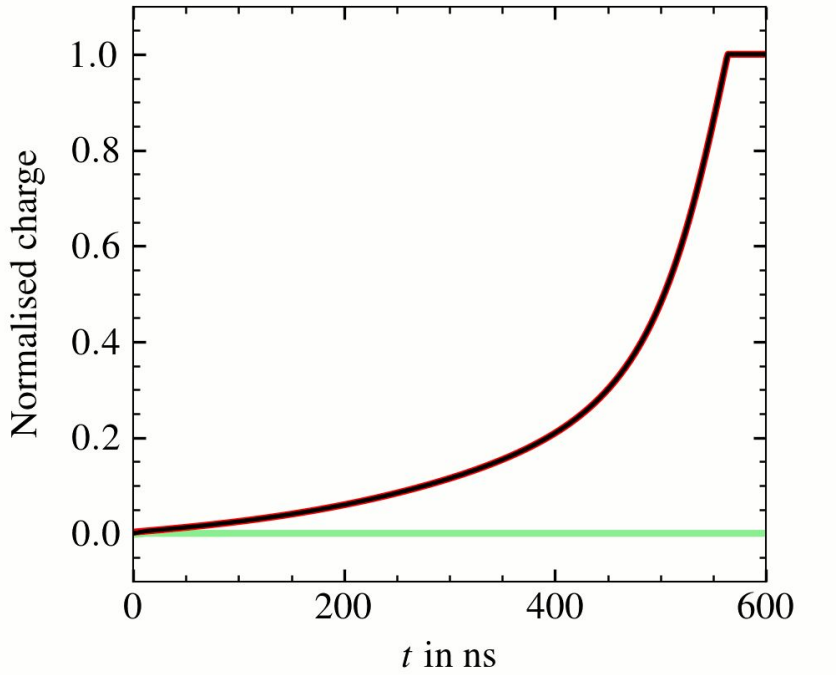
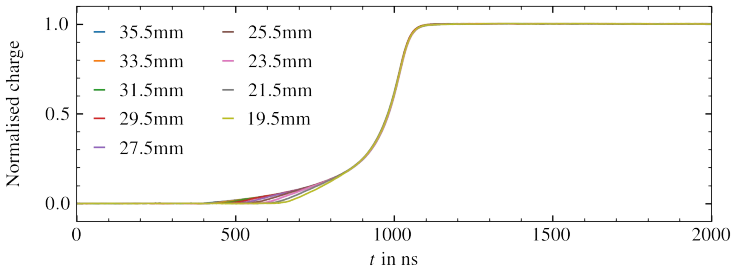
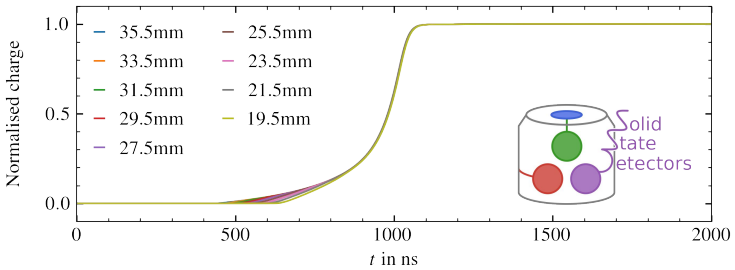
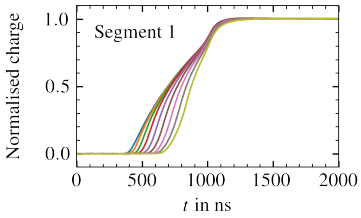


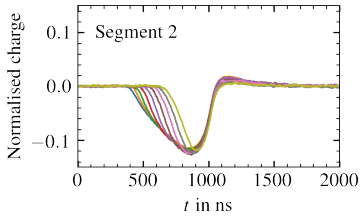


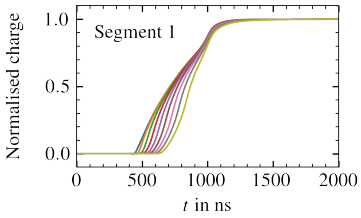
Comparison to Simulation

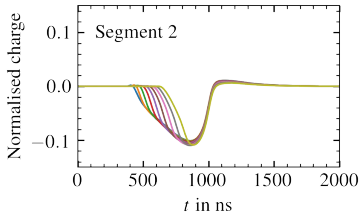


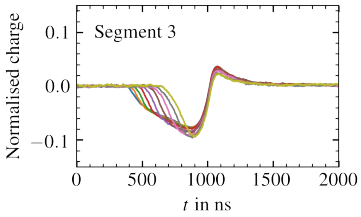


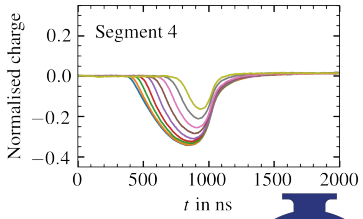


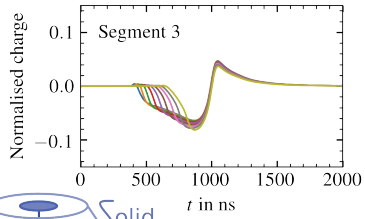


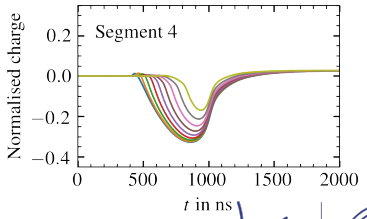


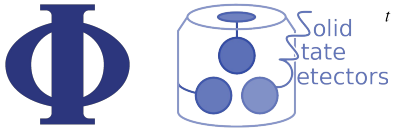












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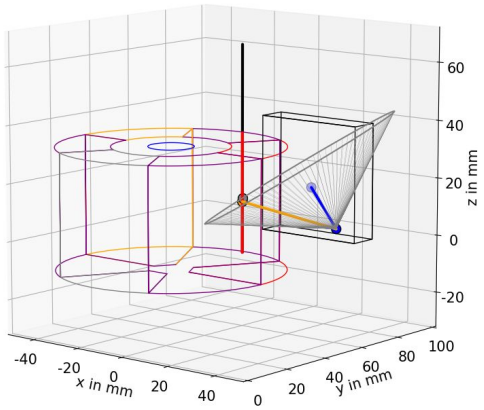
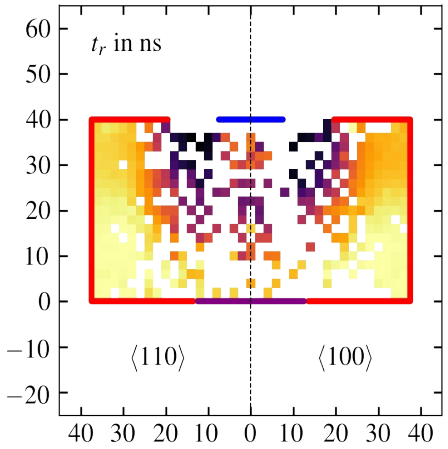
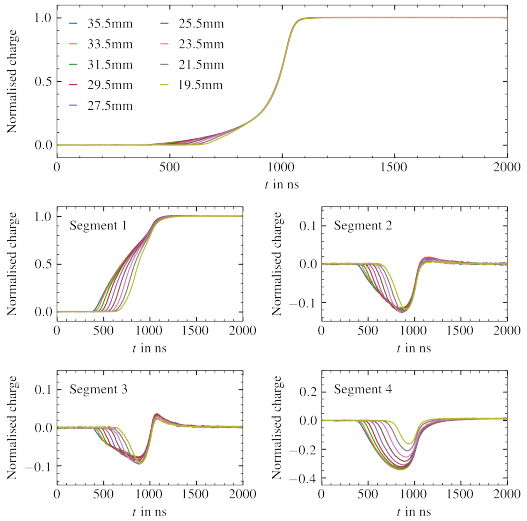
Summary



Compton Scanner
with segBEGe detector



Created first pulse
shape libraries



Results can be used to better
understand the charge drift

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