Status report - Thursday

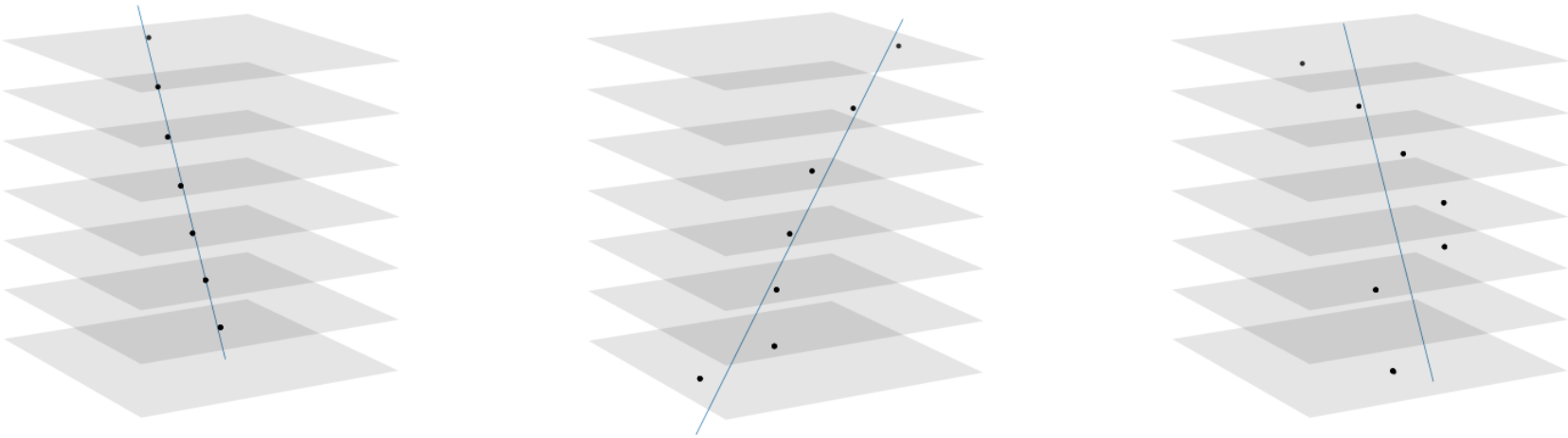
χ^2-Distribution and Track Analysis

Maurice Donner

July 30, 2020

Tracking

Implemented a 3D-Fitting algorithm in python:



Using numpy's Singular value decomposition `np.linalg.svd`

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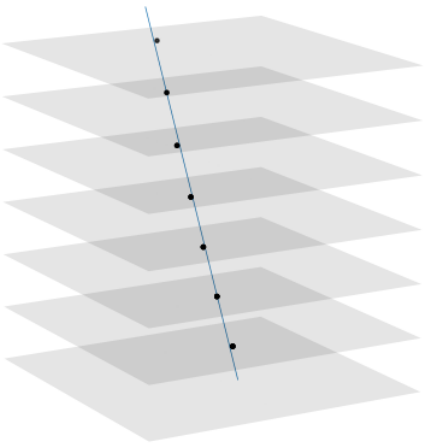
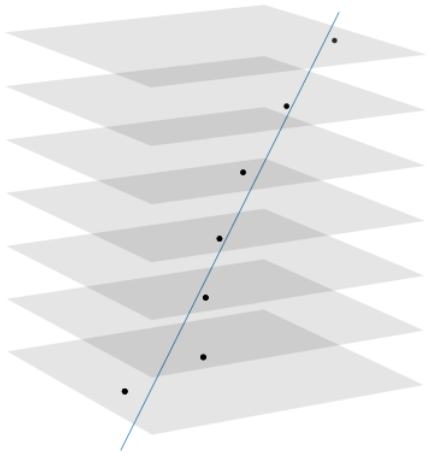
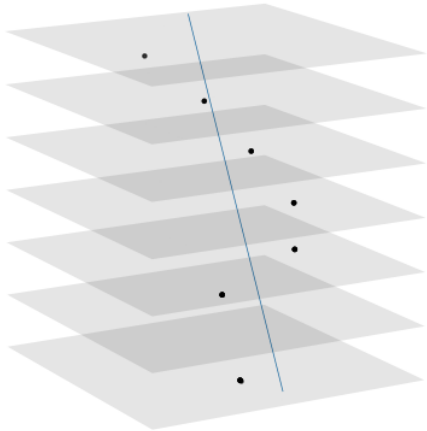
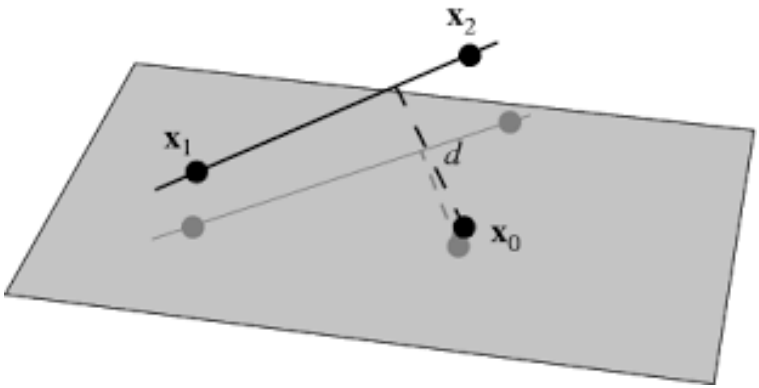




Using numpy's Singular value decomposition `np.linalg.svd`

$\rightarrow$ Now interested in χ^2 (goodness of fit)



$$d^2 = \frac{|x_1 - x_0|^2 |x_2 - x_1|^2 - [(x_1 - x_0) \cdot (x_2 - x_1)]^2}{|x_2 - x_1|^2}$$

Goodness of Fit

$$\chi^2 = \sum_{\mathrm{i}=0}^{6} \frac{\left(x_{i,\mathrm{hit}} - x_{i,\mathrm{track}}\right)^2}{\sigma_{i,\mathrm{hit}}}$$

i = index of plane

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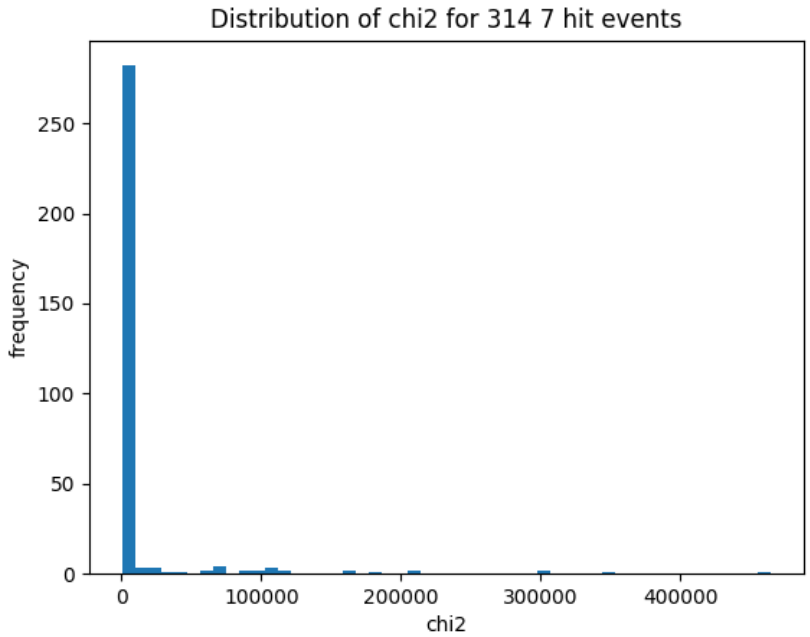
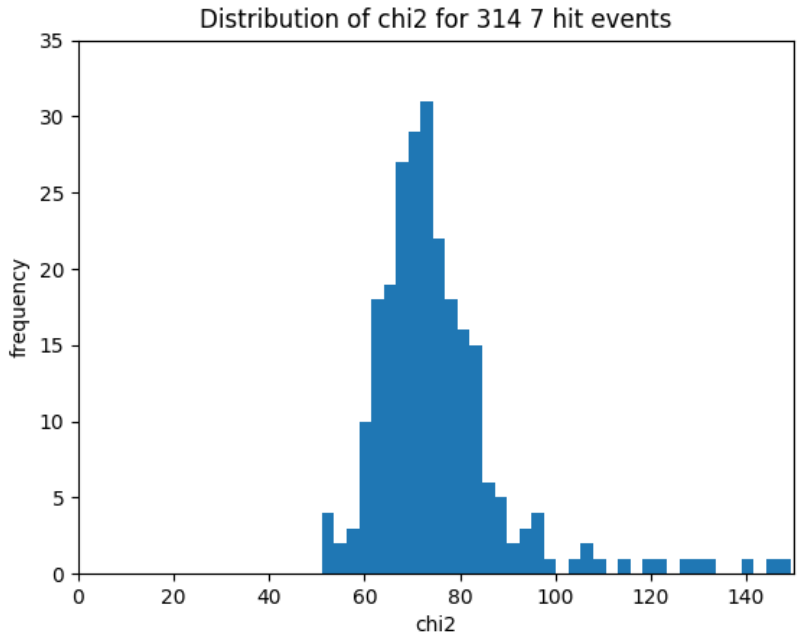
First look of χ^2:





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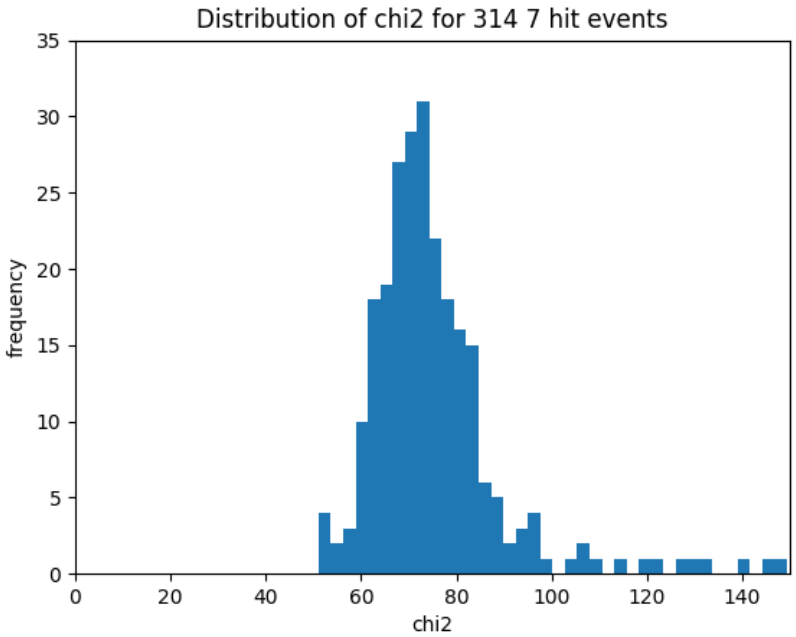

- Most of the hits are 1 or 2 pixel ($\sigma = 0.5$)
- Assume same deviation for all planes

$\chi^2 = 100 \rightarrow \sqrt{100/6 \cdot 0.5} < 3$ Pixel (90µm)

Goodness of Fit

$$\chi^2 = \sum_{\text{i}=0}^{6} \frac{\left(x_{i,\text{hit}} - x_{i,\text{track}}\right)^2}{\sigma_{i,\text{hit}}}$$

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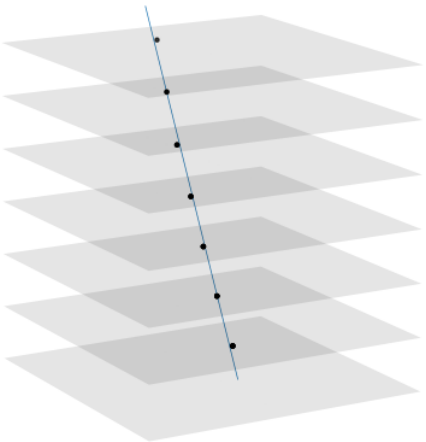
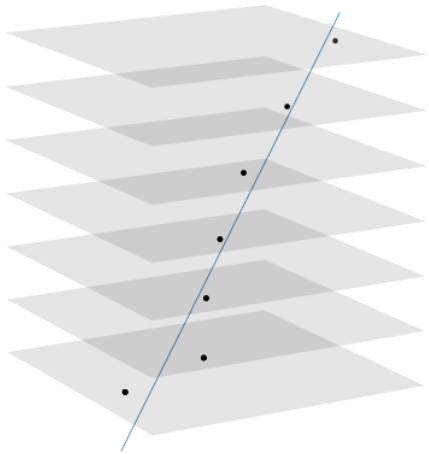
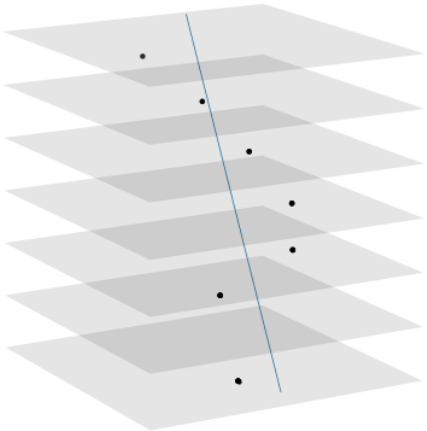
Second look of χ^2:



$\chi^2 = 1459$

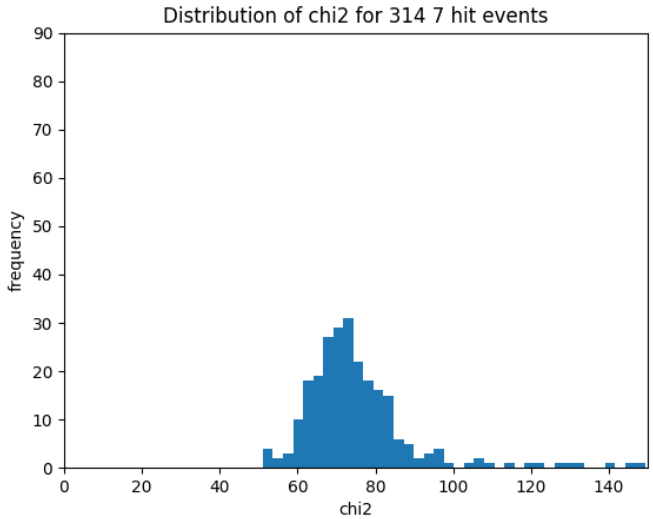


$\chi^2 = 112000$



$\chi^2 = 290252$

Taking a closer look at 5+ Events



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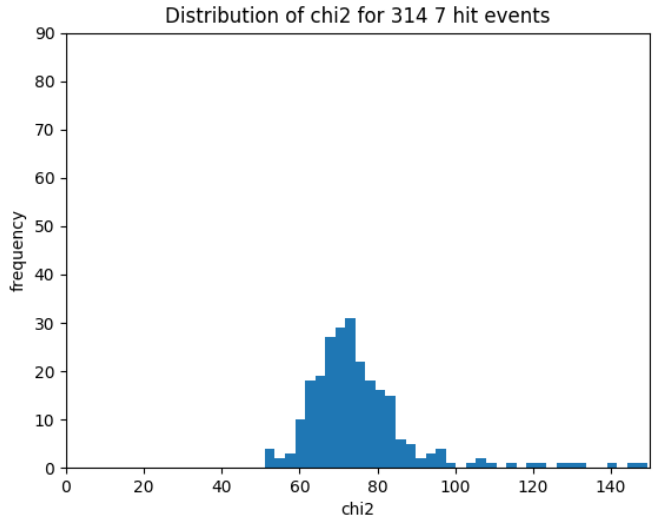

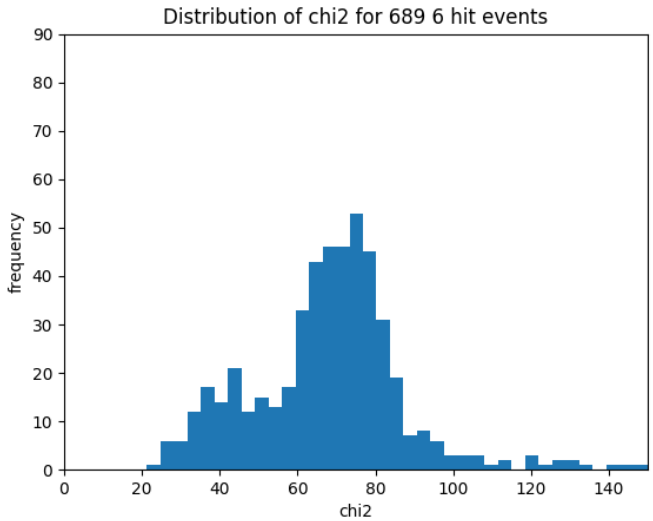

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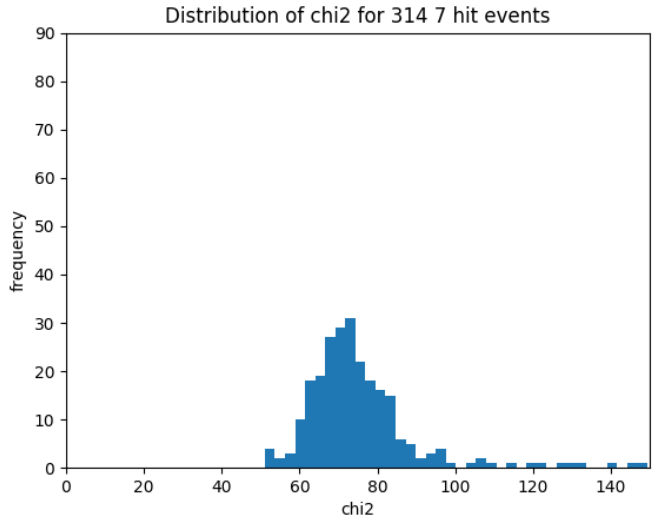

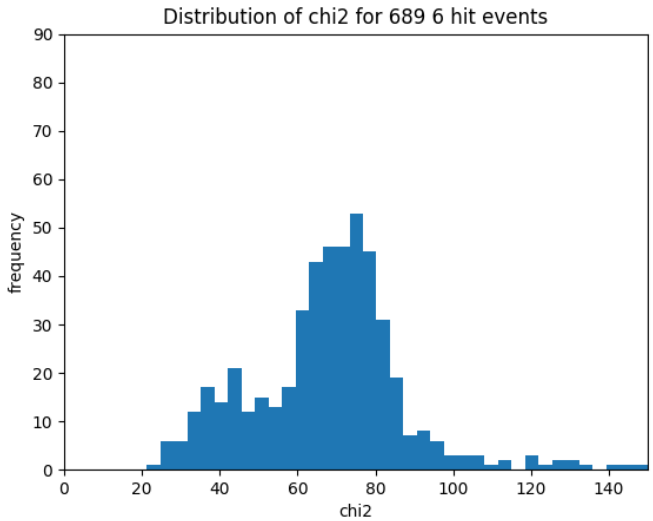

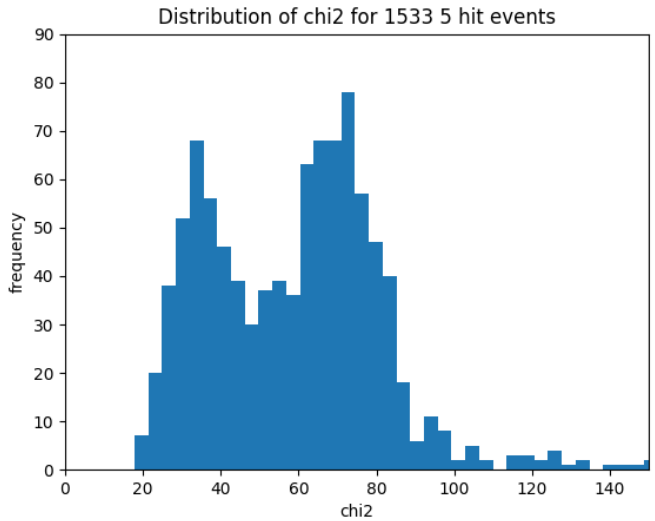

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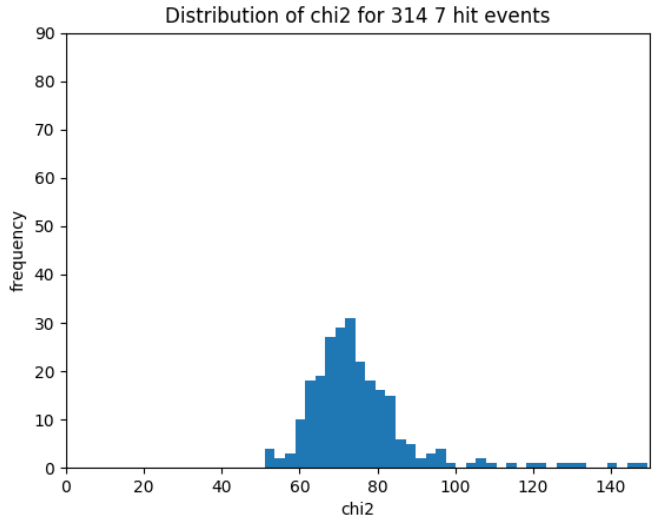
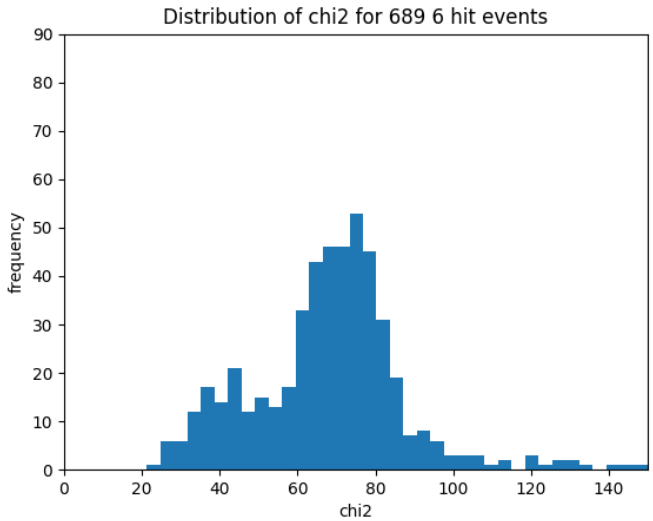
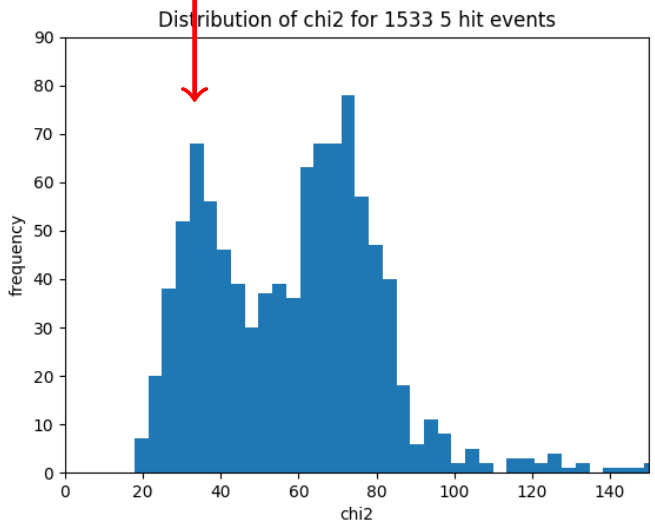


Where does this come from?





Second peak in χ^2-Distribution - What's going on?

Suspicion

One or more planes is misaligned more than the others, resulting in a 'higher' Fit-Accuracy for tracks, where that plane is missing

- To verify, look at tracks that have a specific χ^2 Value

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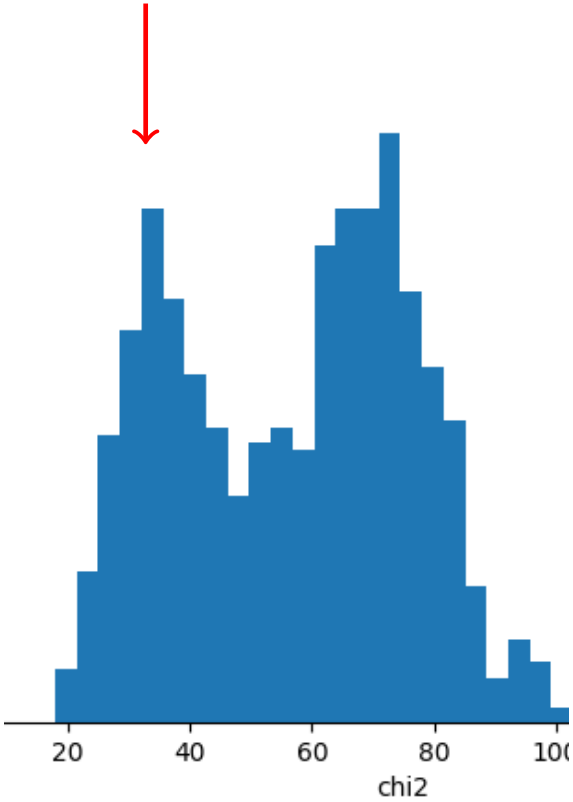

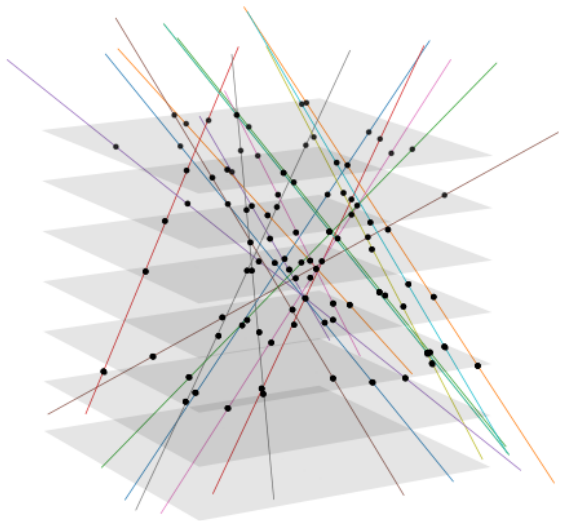

Only little hits on Plane 0 and 1

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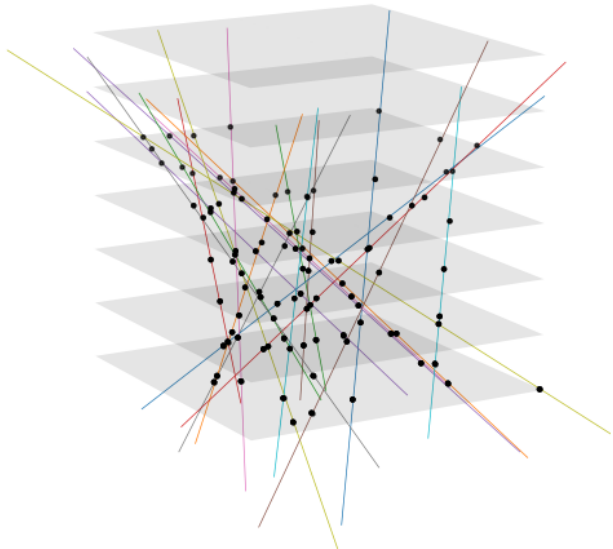

Only little hits on Plane 5 and 6

Second peak in χ^2-Distribution - What's going on?

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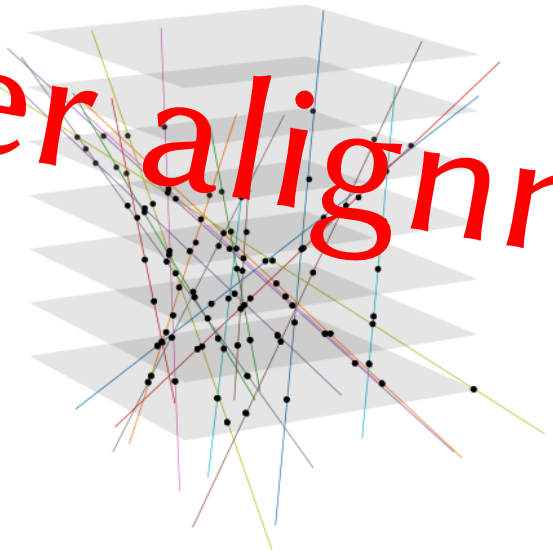
Need better alignment...



Only little hits on Plane 5 and 6