JÜLICH
FORSCHUNGSZENTRUM

panda

Improvement of the Implementation of the Riemann Tracking Algorithm

PANDA Meeting, GSI, March 2012

5 March 2012 | Andreas Herten

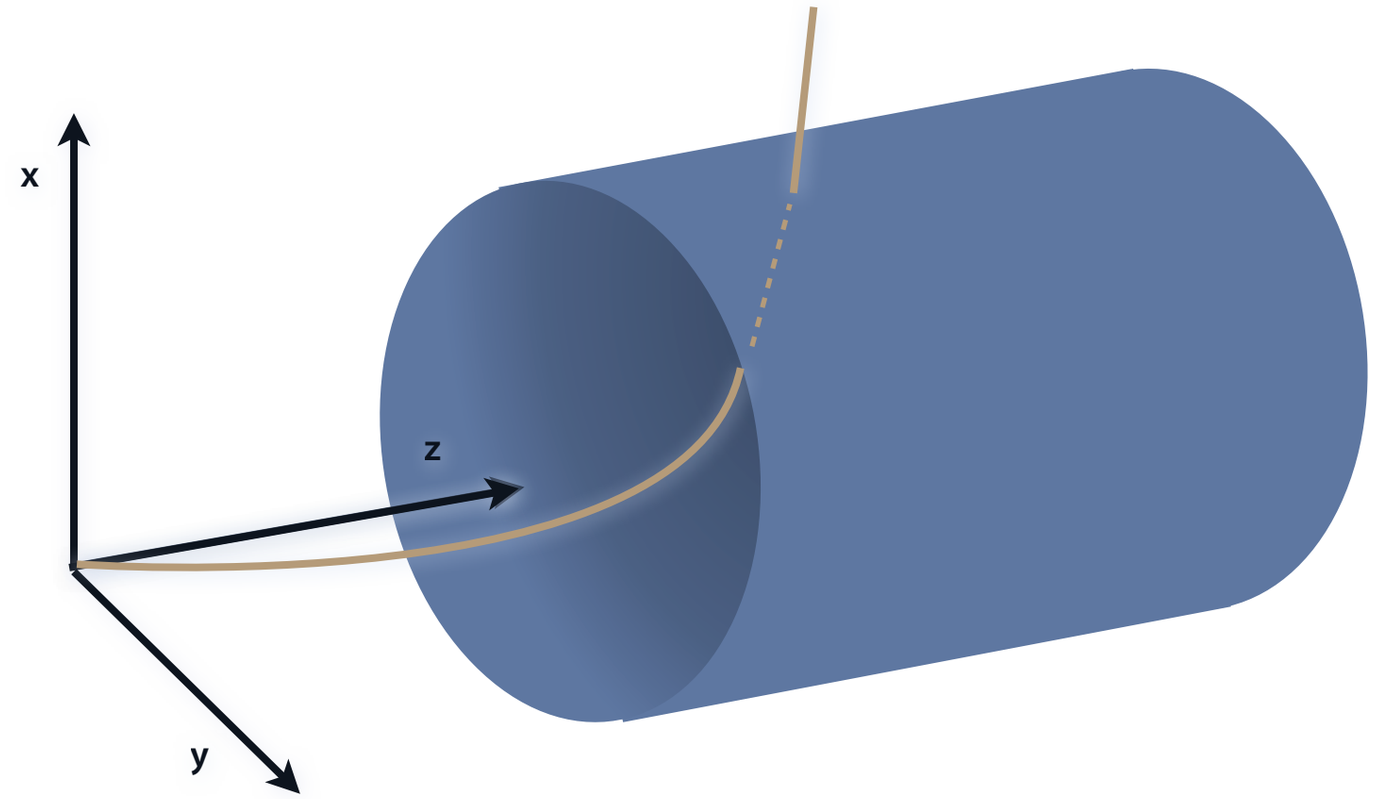
Outline

- Riemann Fit
  - Method
  - Implementation
- Improvement
- Done & To Be Done

Riemann Fit: Method

- New method (~ 15 years old)
- Mainly by R. Frühwirth & A. Strandlie
- Non-iterative fitting by mapping data points onto a Riemann Sphere
  - Fast method

Riemann Fit: Method

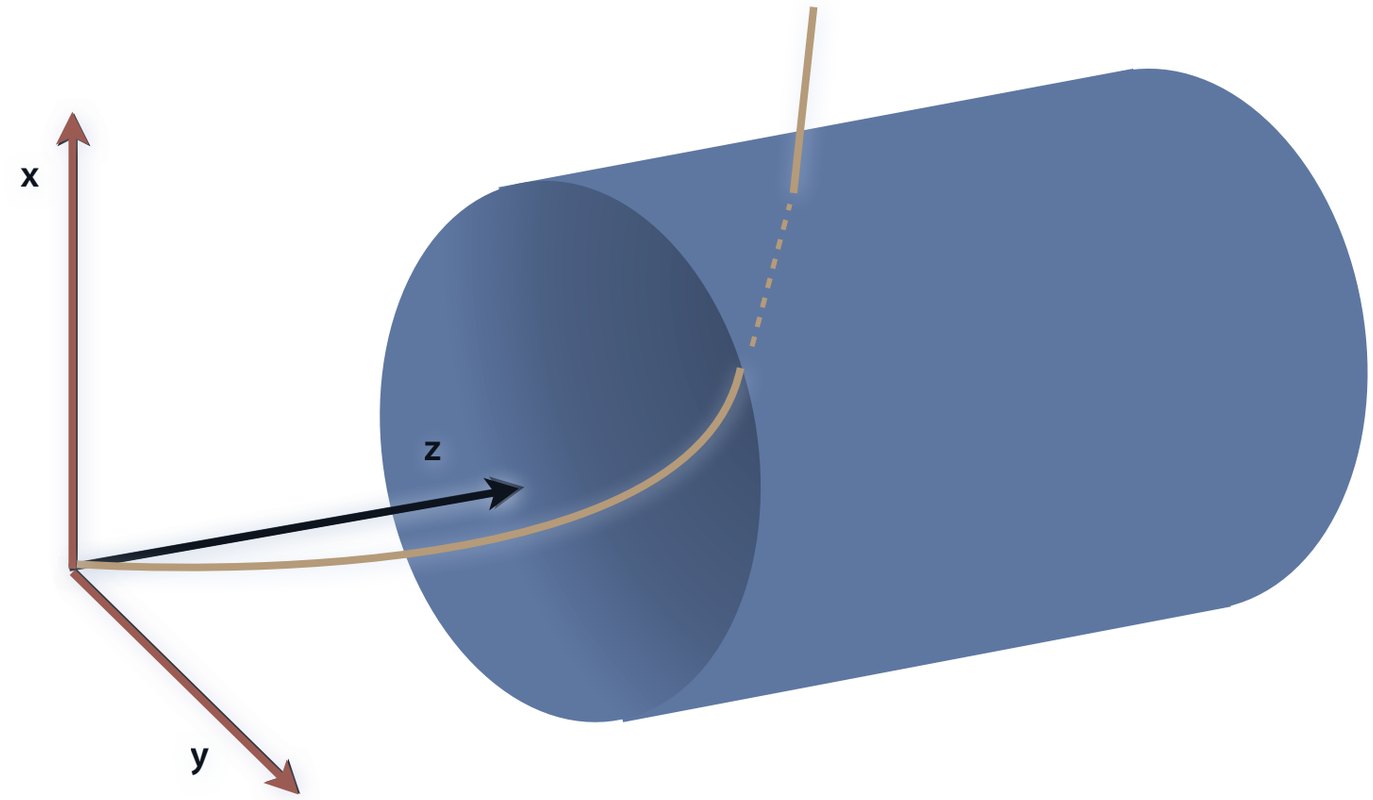


Barrel detector

3-d helix fit split up into two tasks:

- Circle → (x,y)
- Linear → z

Riemann Fit: Method



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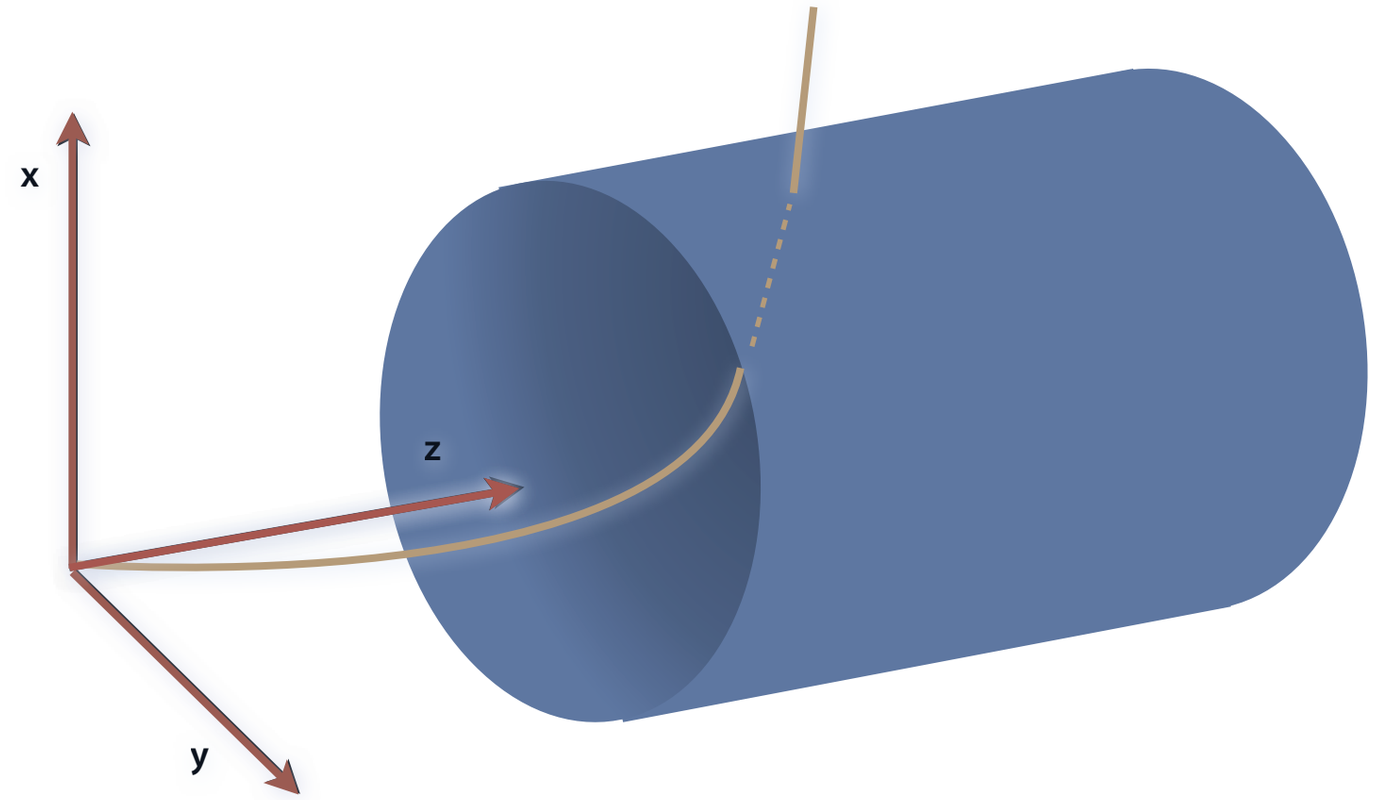

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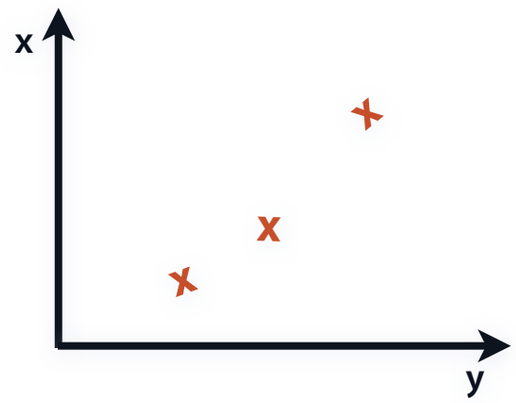
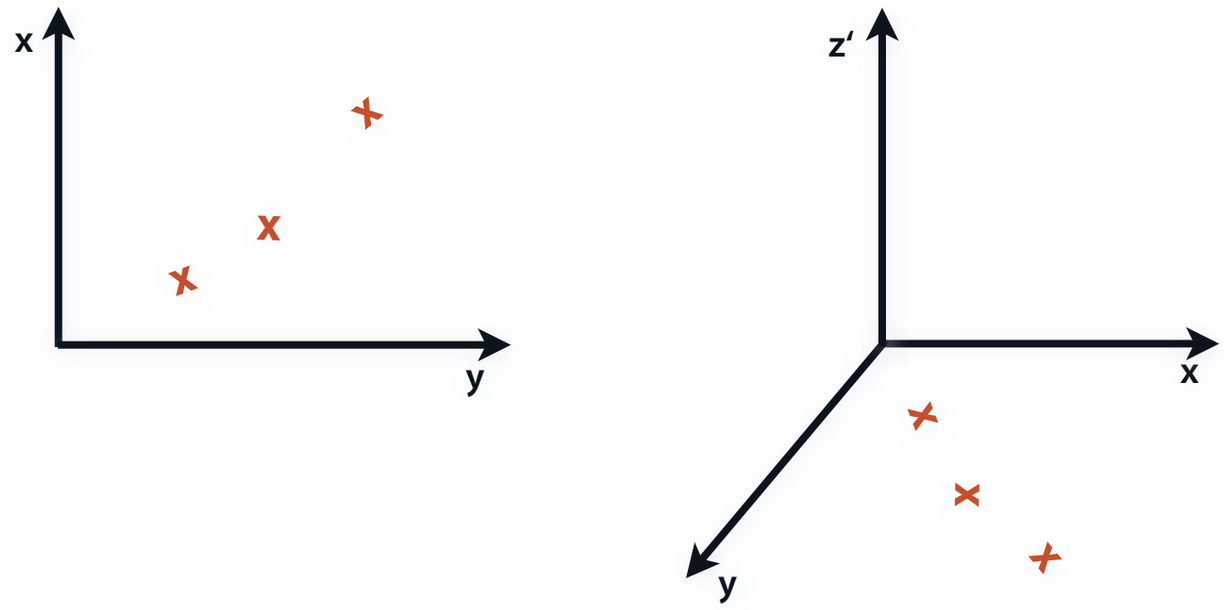


I

Hits in (x,y)

Riemann Fit: Method – (x,y)



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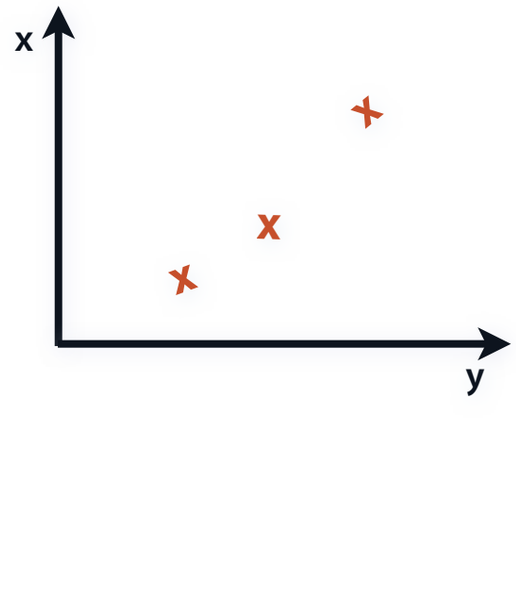
Hits in (x,y)

II

Expand to z‘

Riemann Fit: Method – (x,y)



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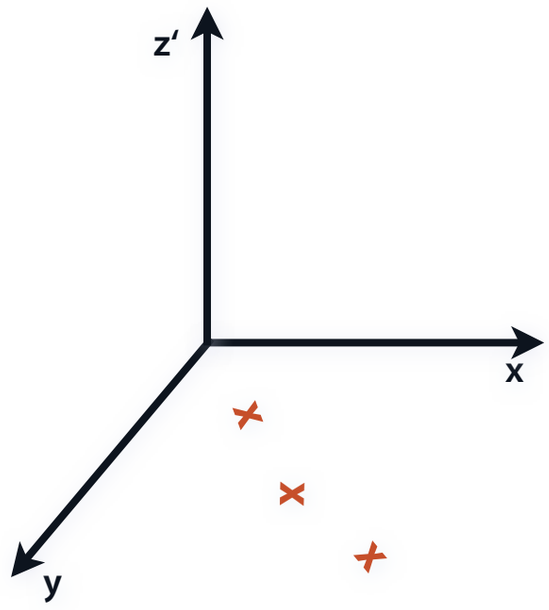

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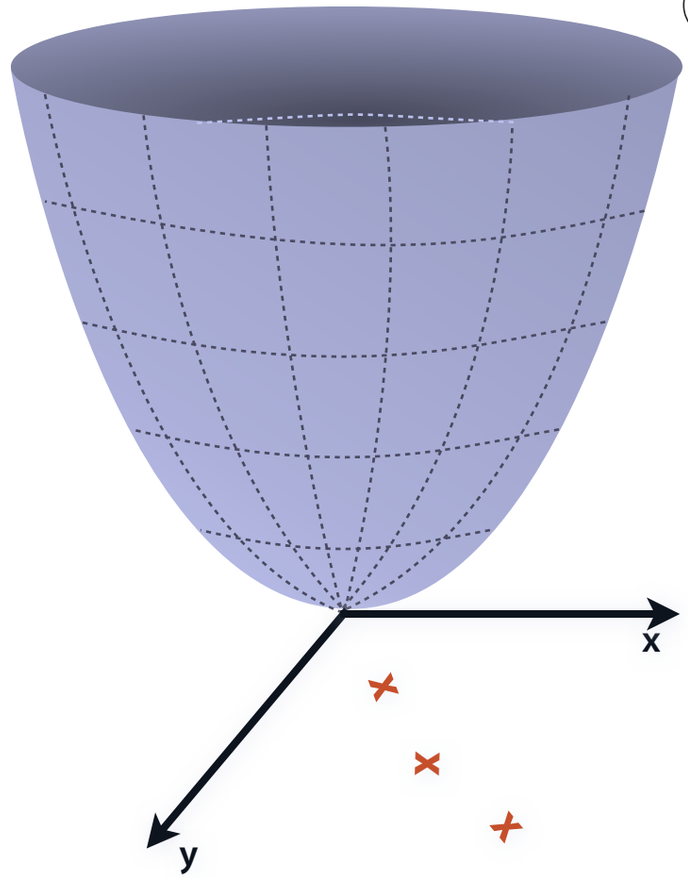
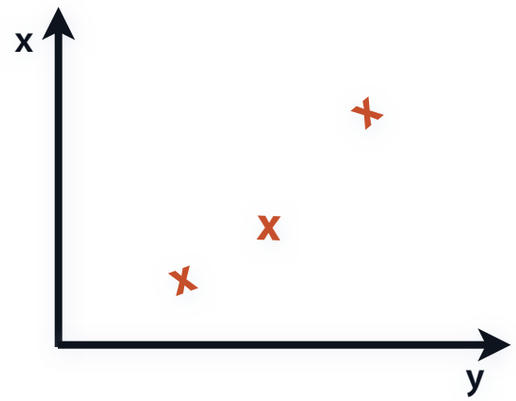
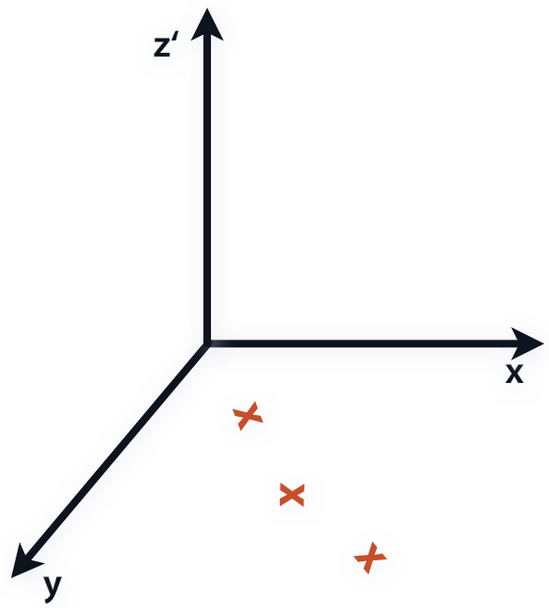


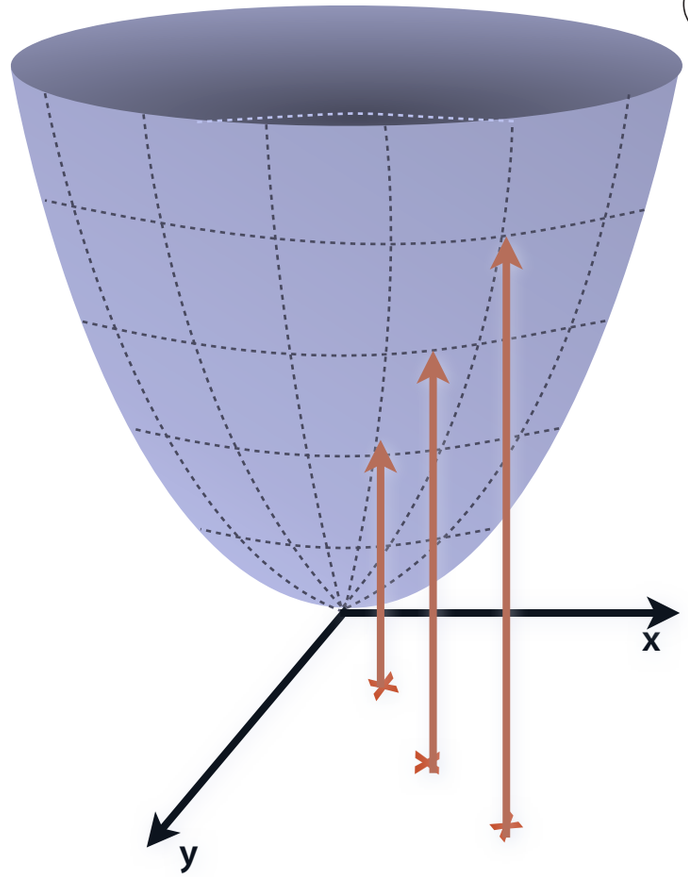
III

Riemann Surface (paraboloid)

Riemann Fit: Method – (x,y)







I

II

III

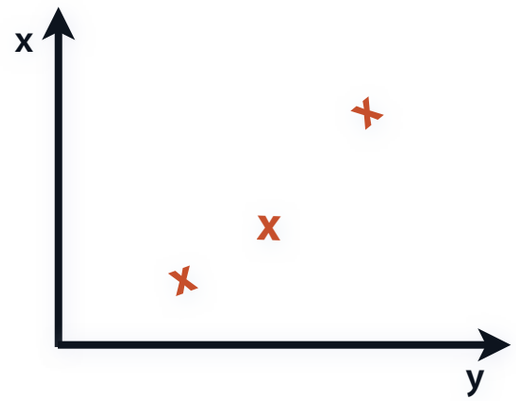
Hits in (x,y)

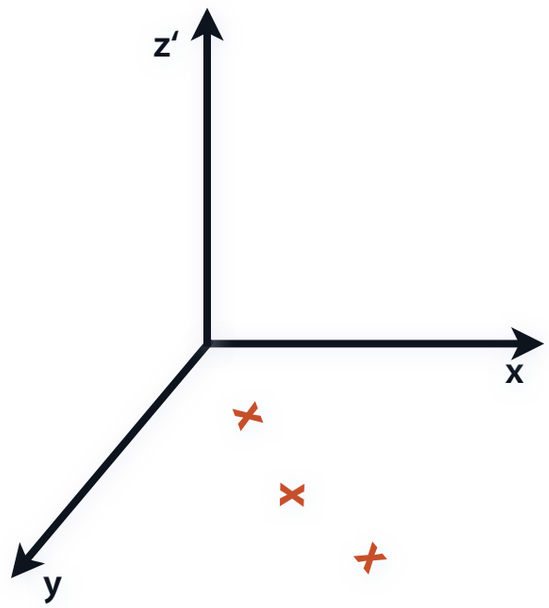
Expand to z‘

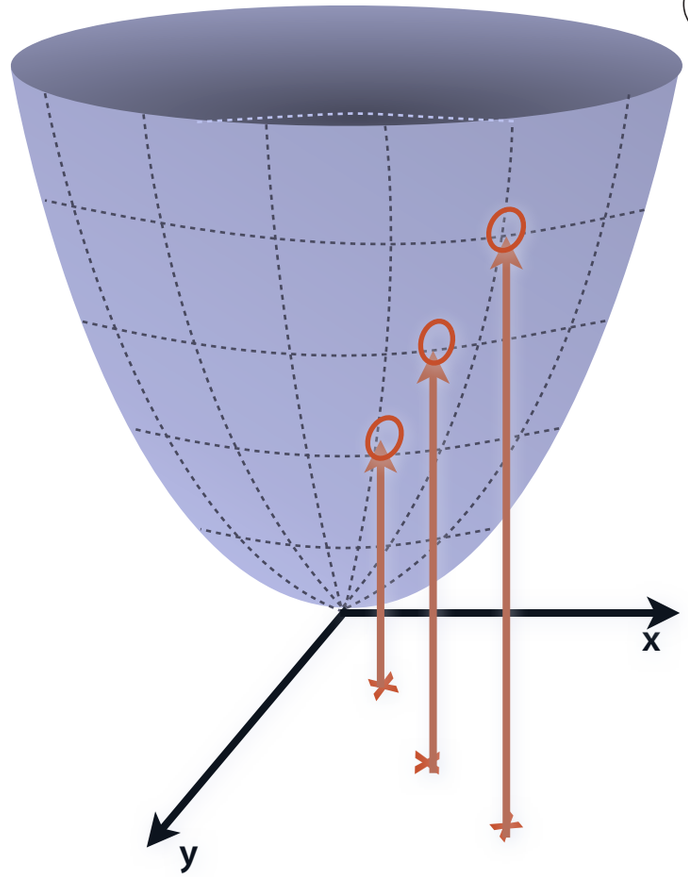
Riemann Surface (paraboloid)

Map

Riemann Fit: Method – (x,y)







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Hits in (x,y)

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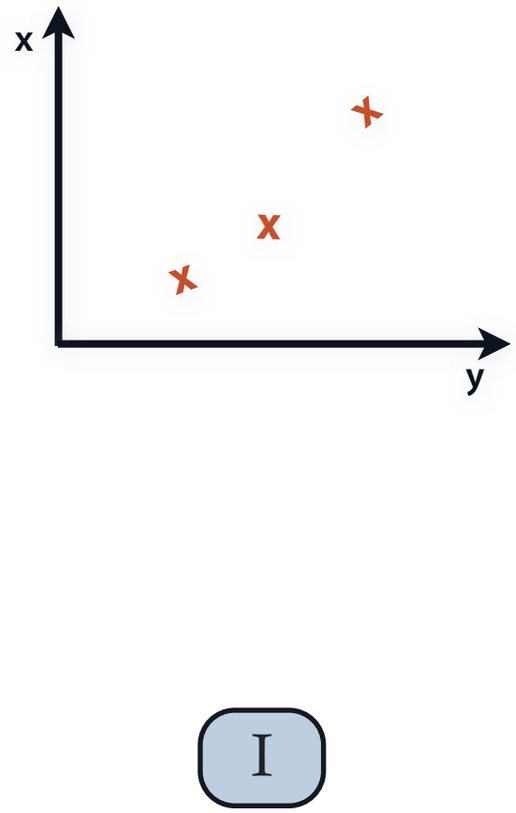
Riemann Surface (paraboloid)

Map • Mark

Riemann Fit: Method – (x,y)



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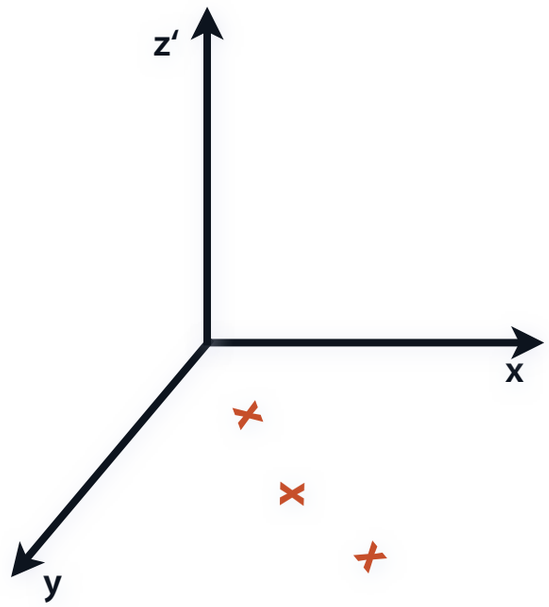

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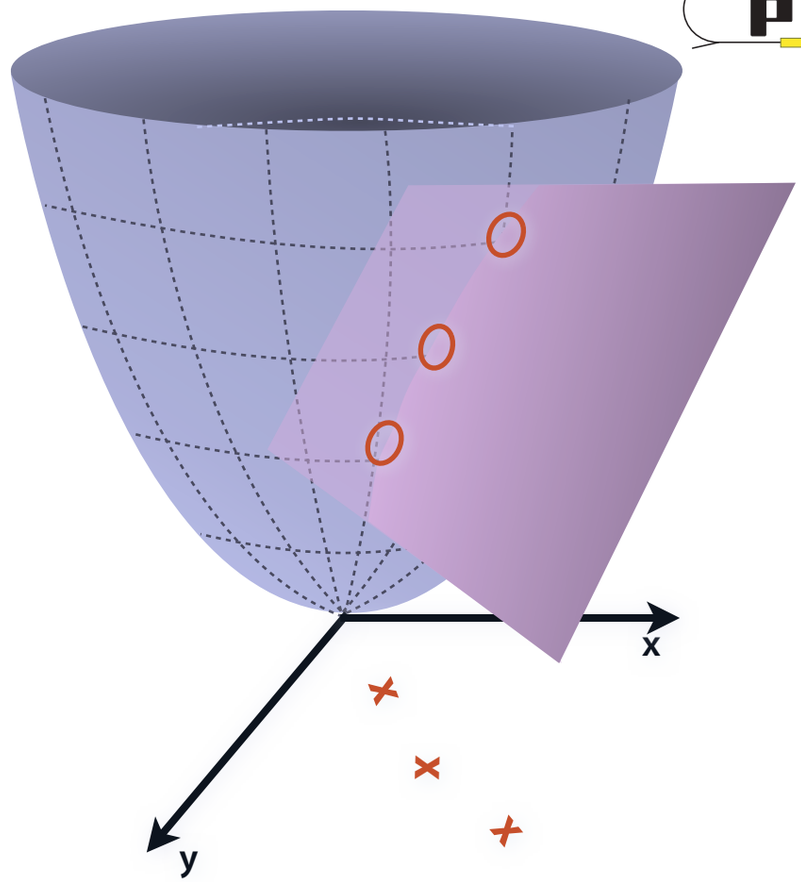

III

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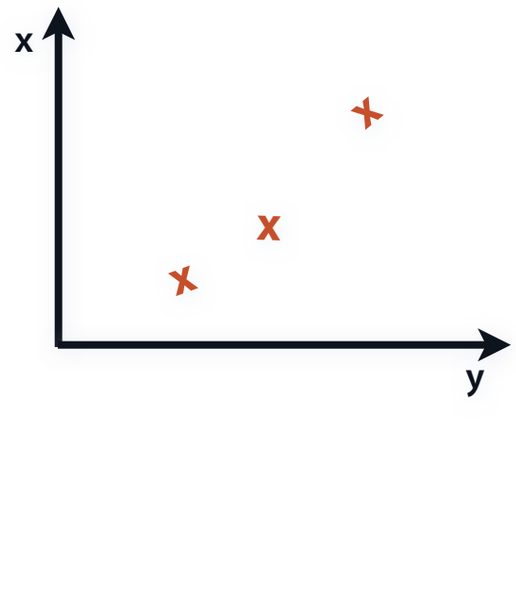
Riemann Surface (paraboloid)

Map • Mark • Create plane

Riemann Fit: Method – (x,y)



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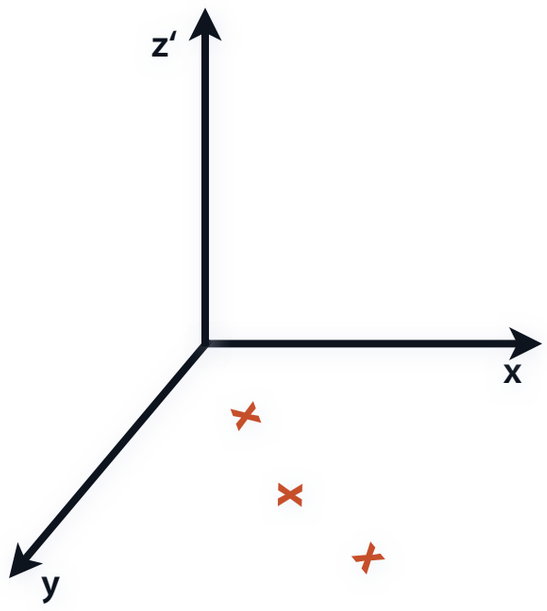

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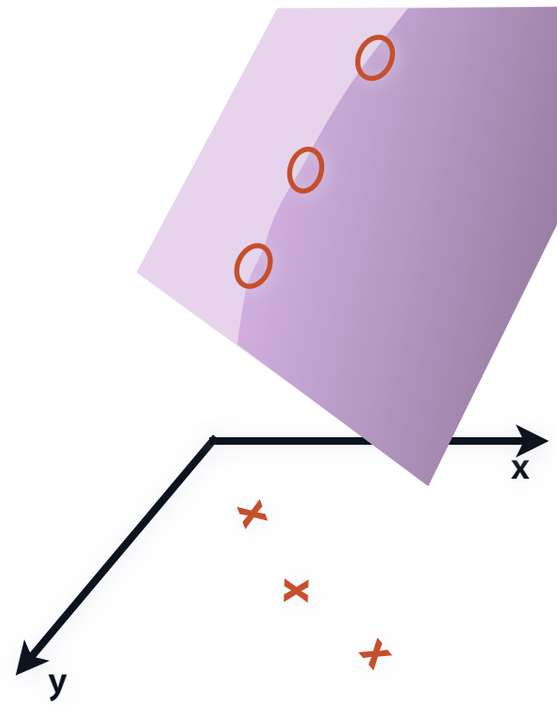

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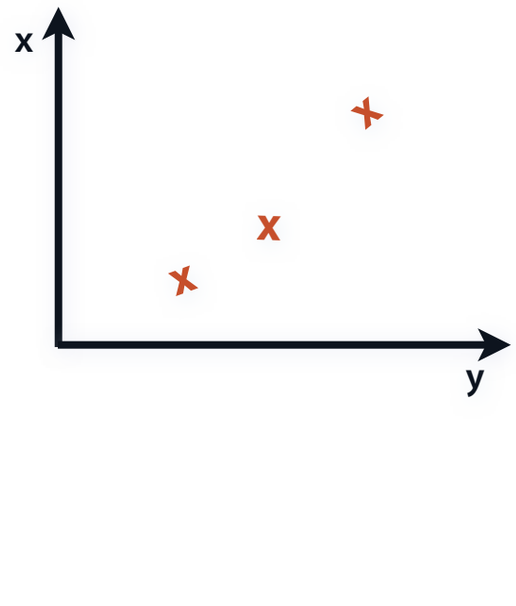

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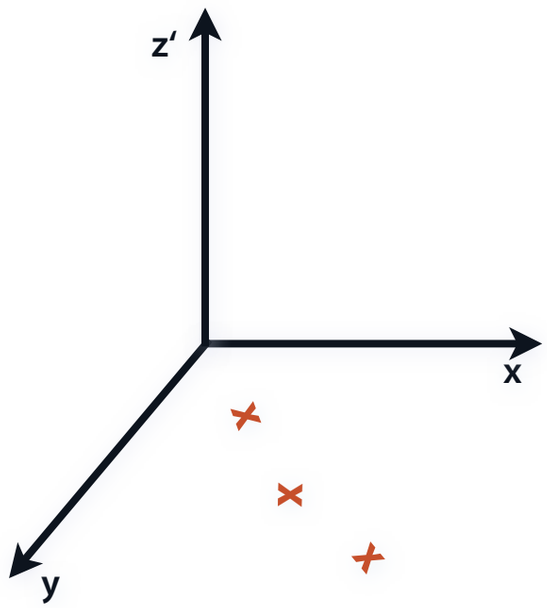

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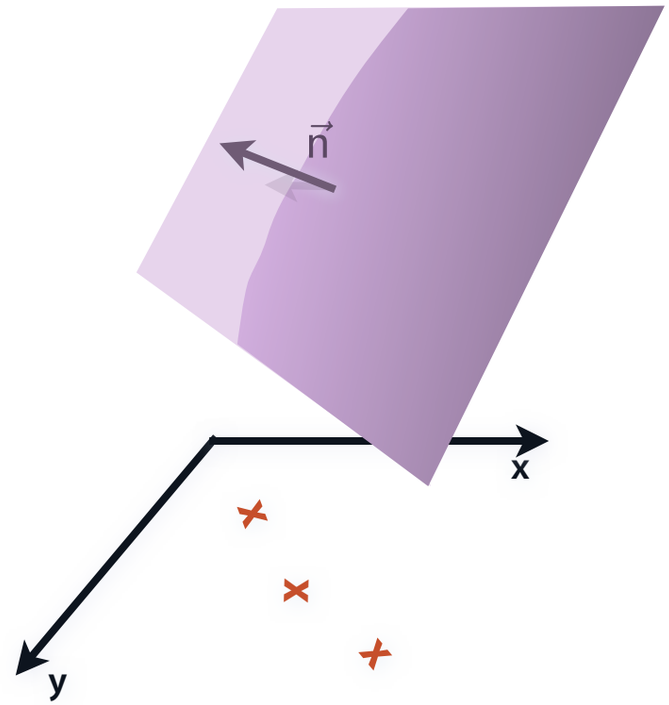


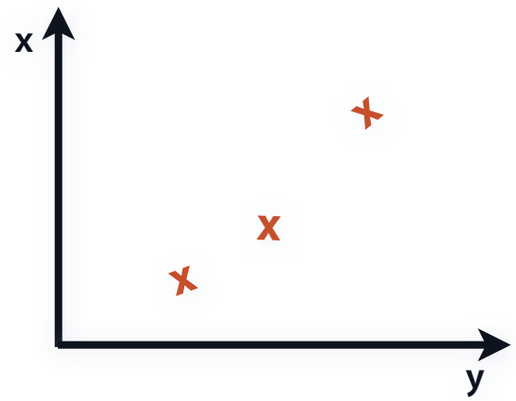
III

IV

Riemann Surface (paraboloid)

Map • Mark • Create plane • Normal vector

Riemann Fit: Method – (x,y)



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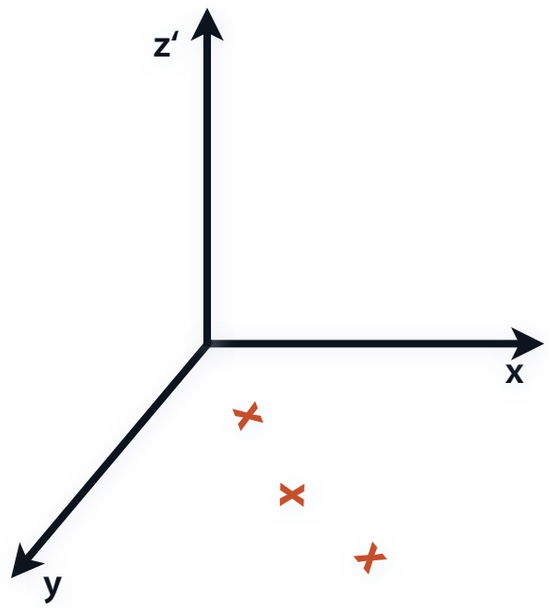
Hits in (x,y)



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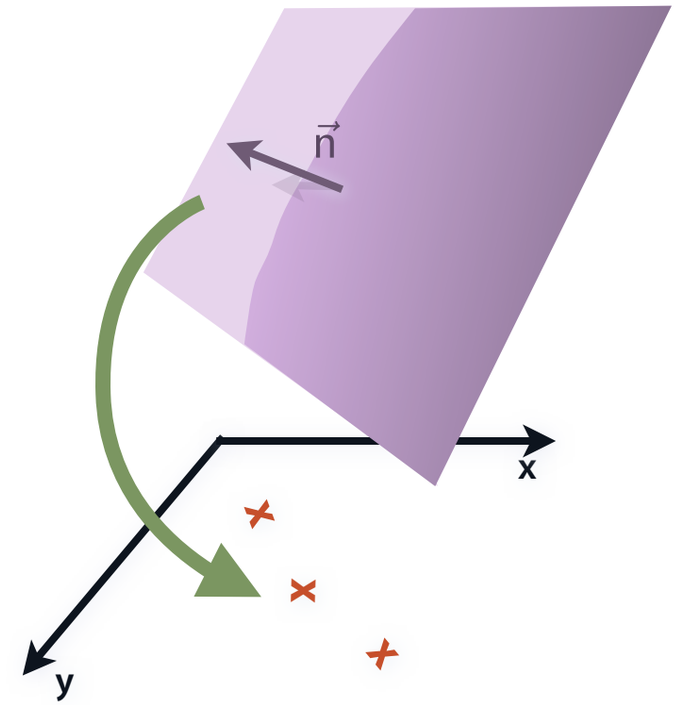


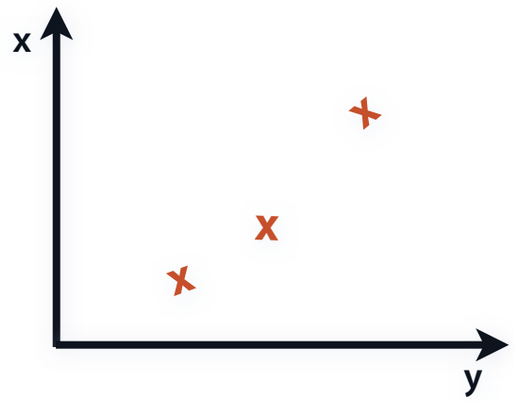
III

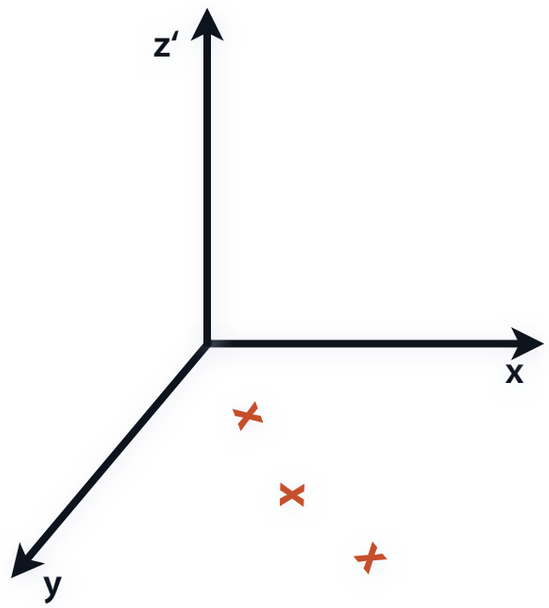
V

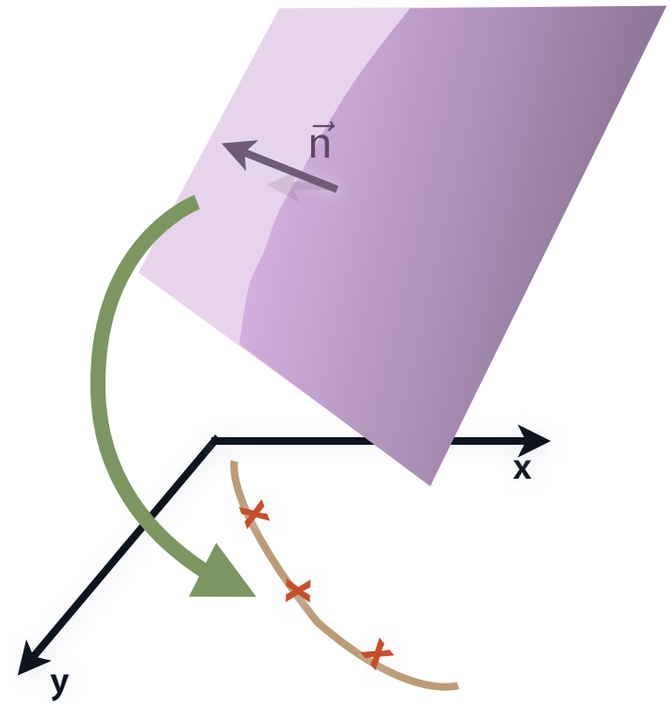
Riemann Surface (paraboloid)

Map • Mark • Create plane • Normal vector
Map back

Riemann Fit: Method – (x,y)







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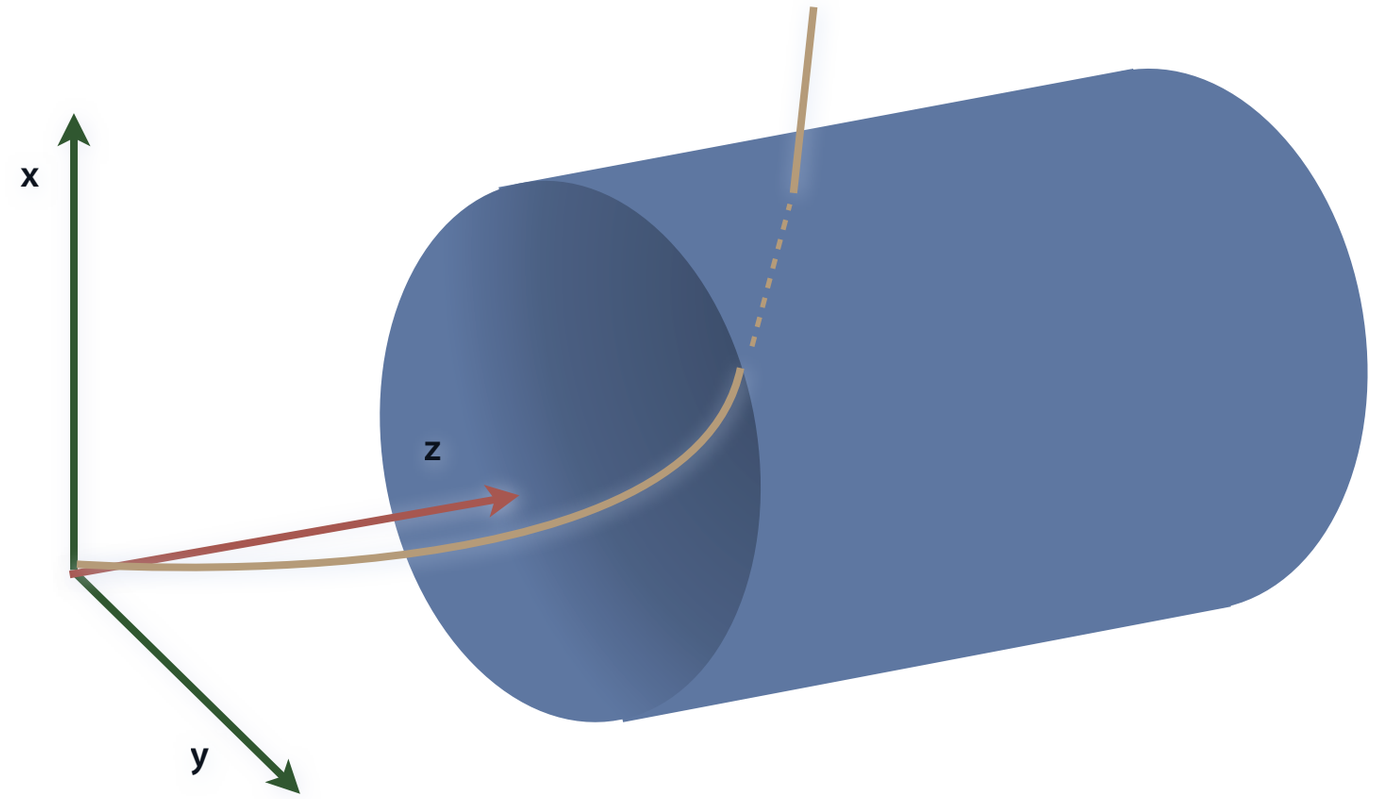
Riemann Fit: Method



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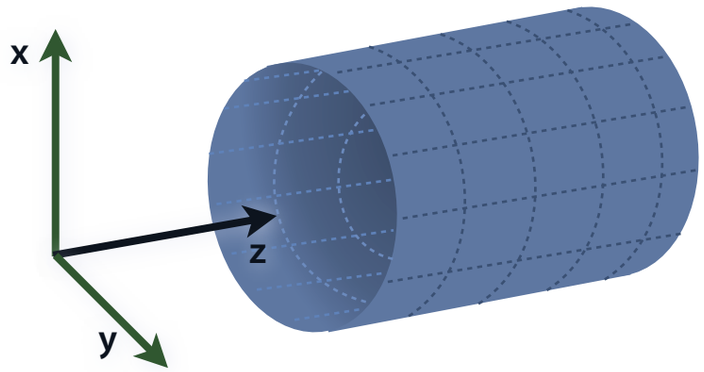
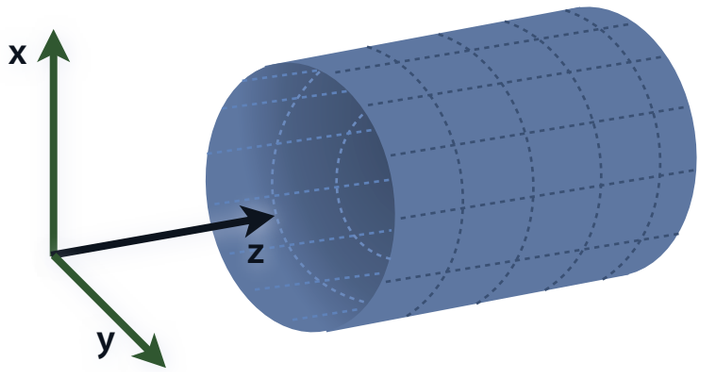
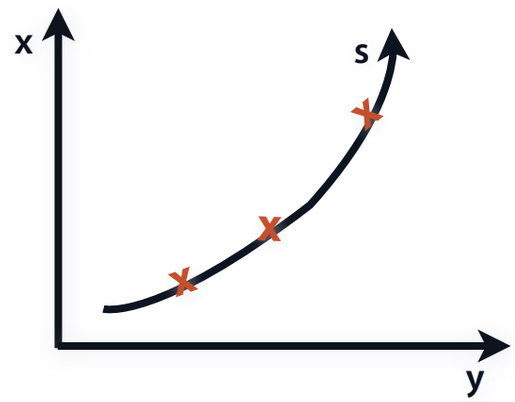


I

z position fixed

Riemann Fit: Method – z





I

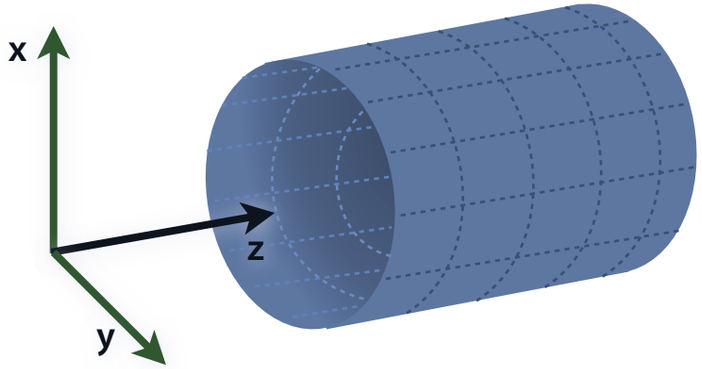
z position fixed

II

New value: **s**

Arc length on fitted circle
(from part 1)

Riemann Fit: Method – z



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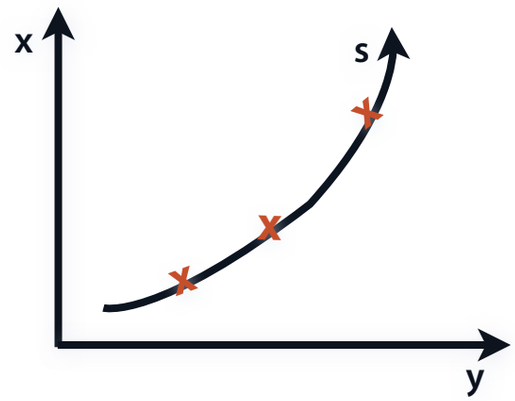

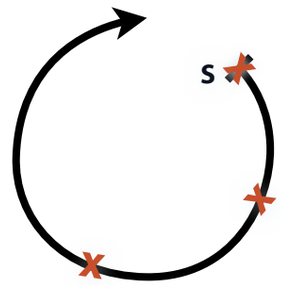

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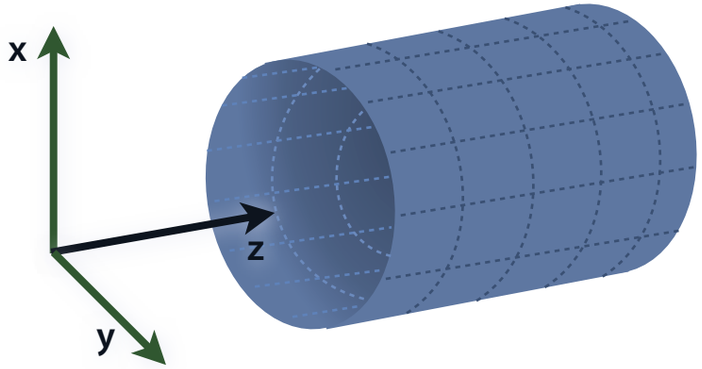

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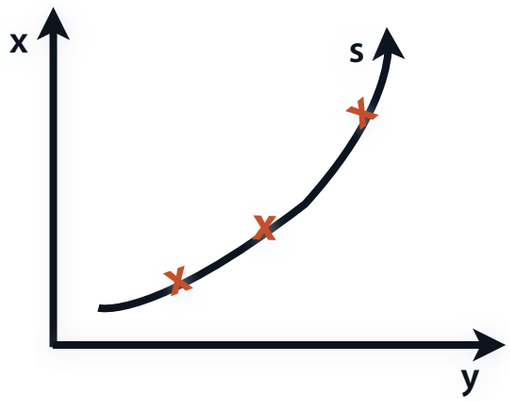

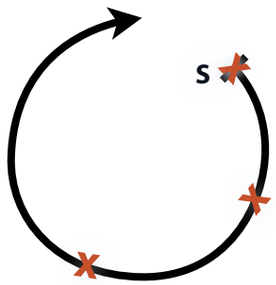

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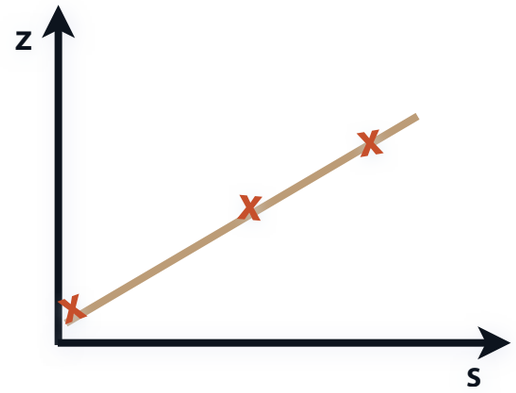
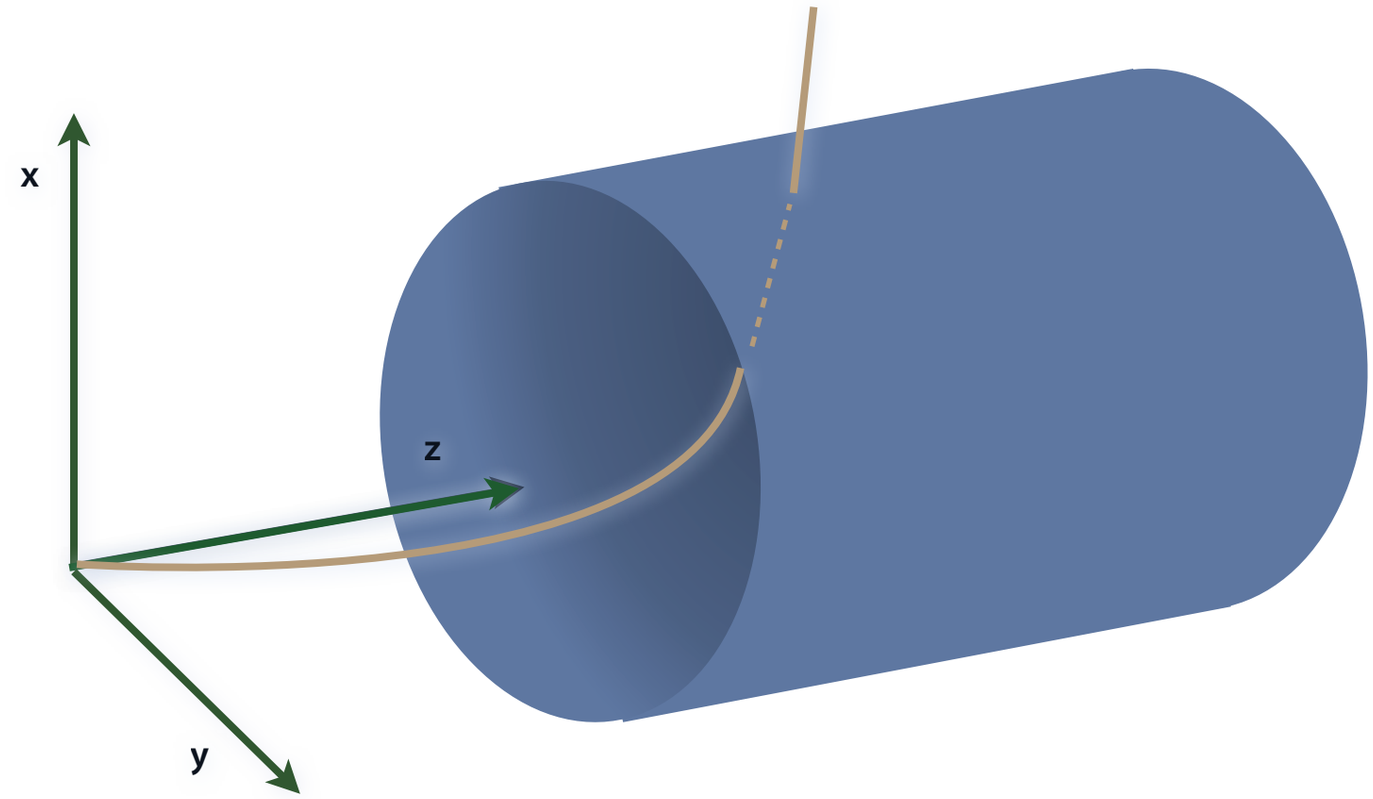


III

Points in **z** vs **s**

Regression
Ideal helix = Hits on straight line

Riemann Fit: Method



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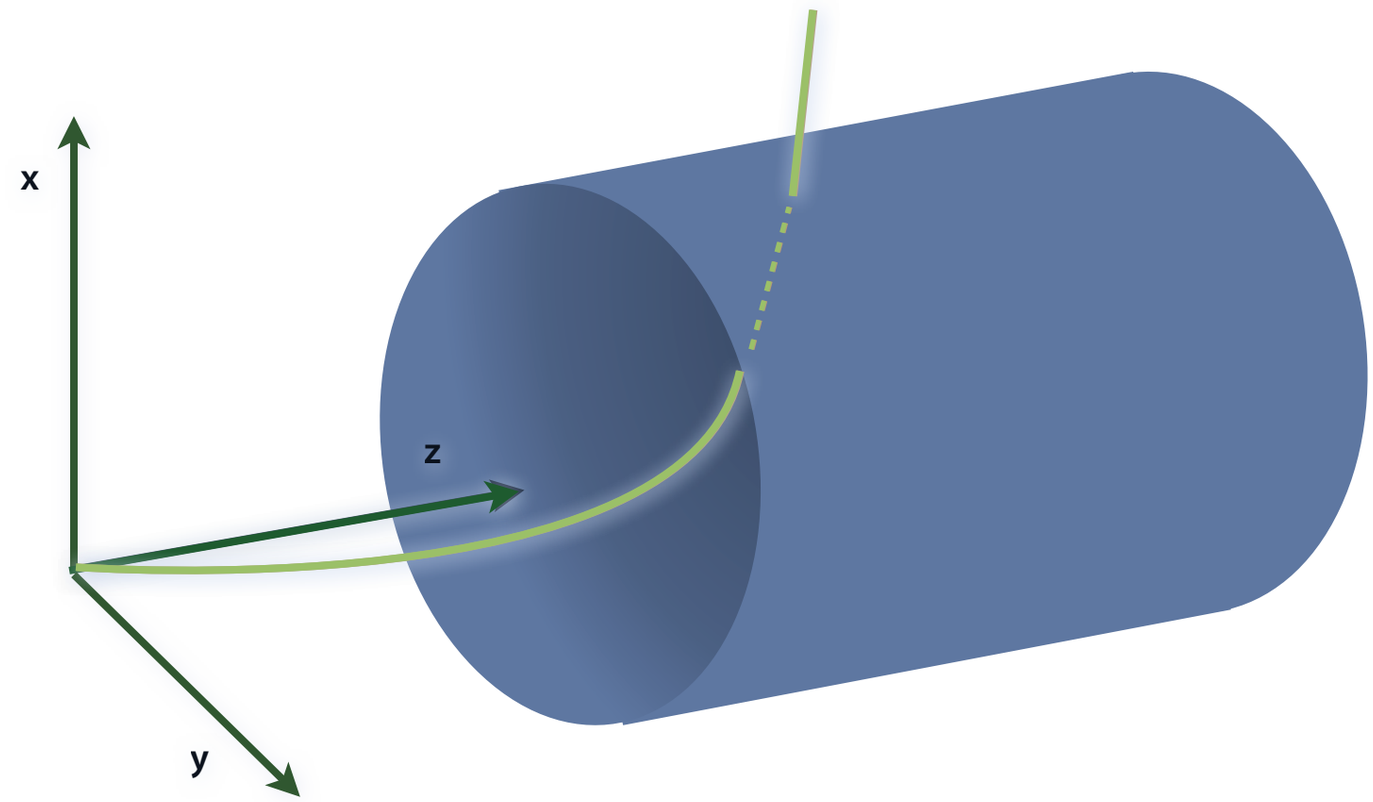

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Riemann Fit: Implementation

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  - Track finding & pre-fitting
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    - More precise

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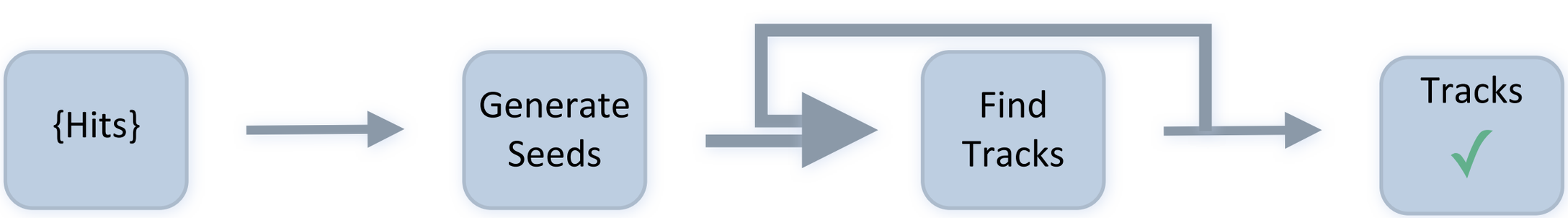

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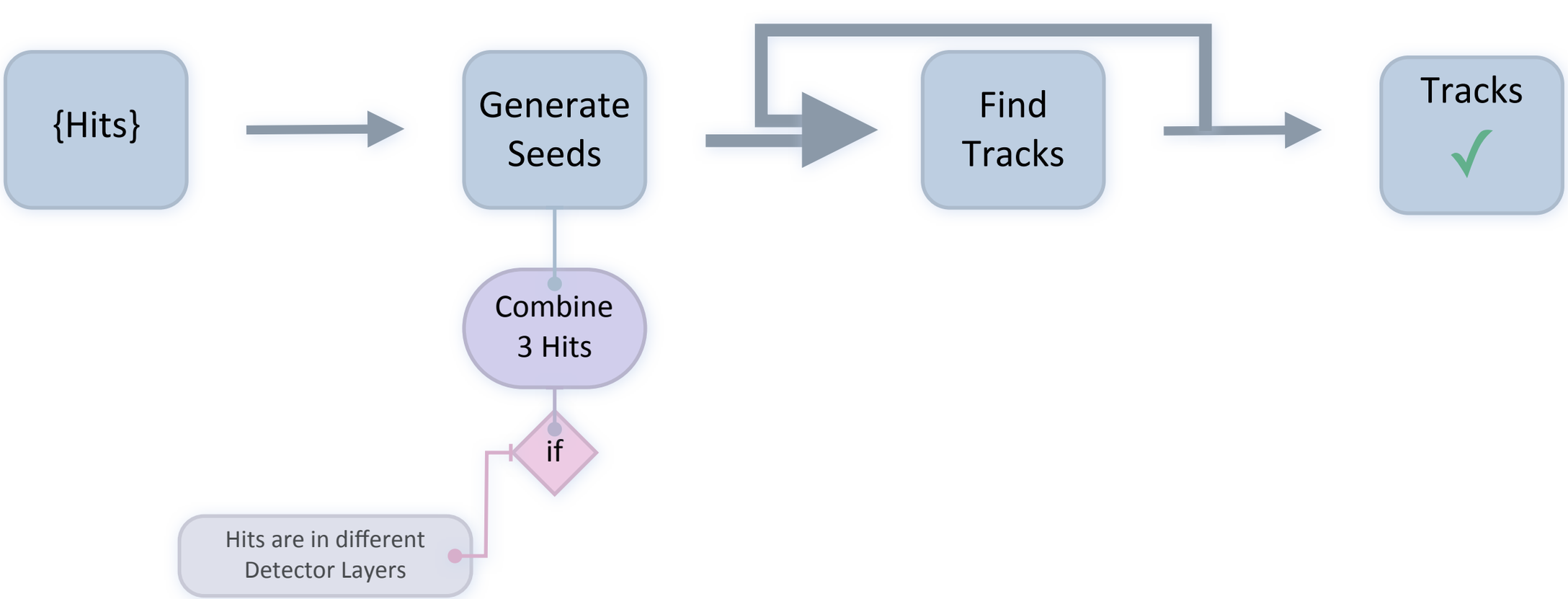

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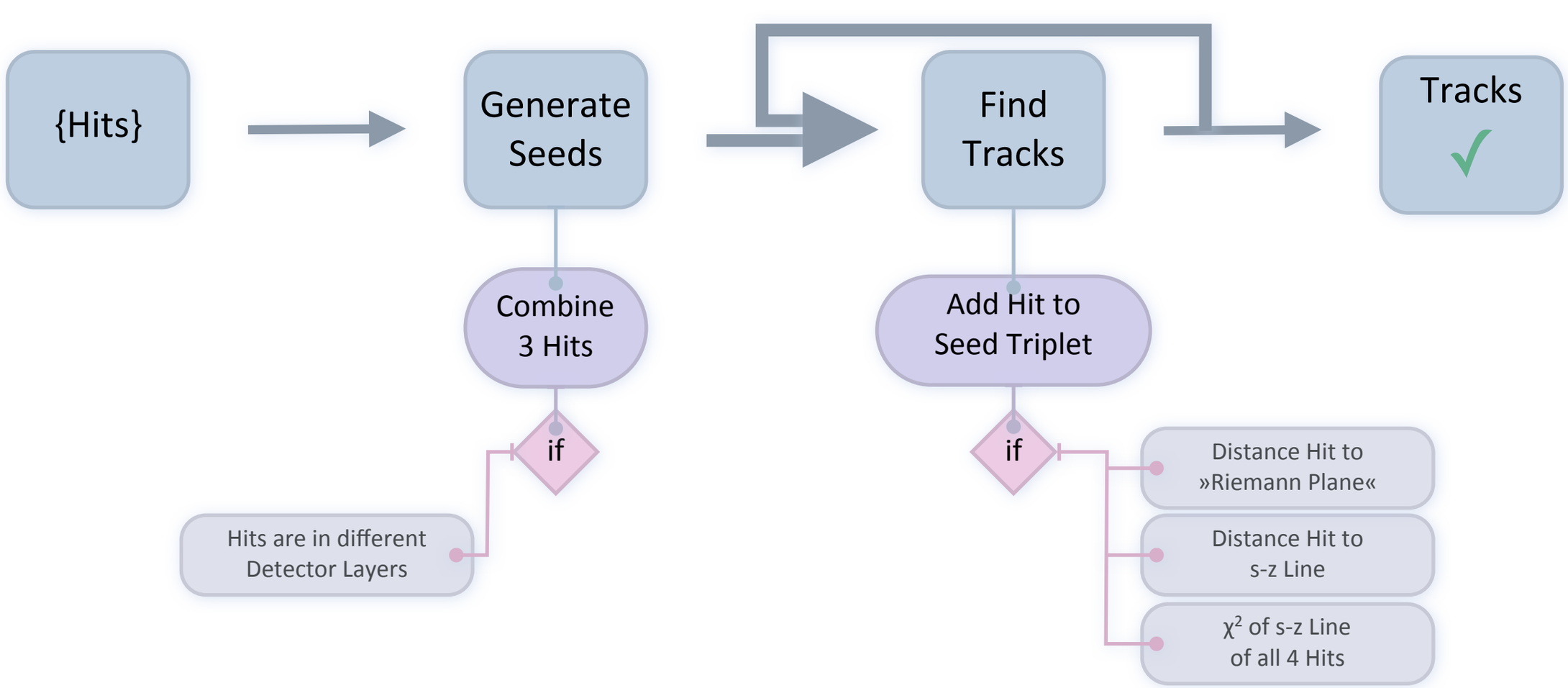

Riemann Fit: Implementation

- Riemann Fit
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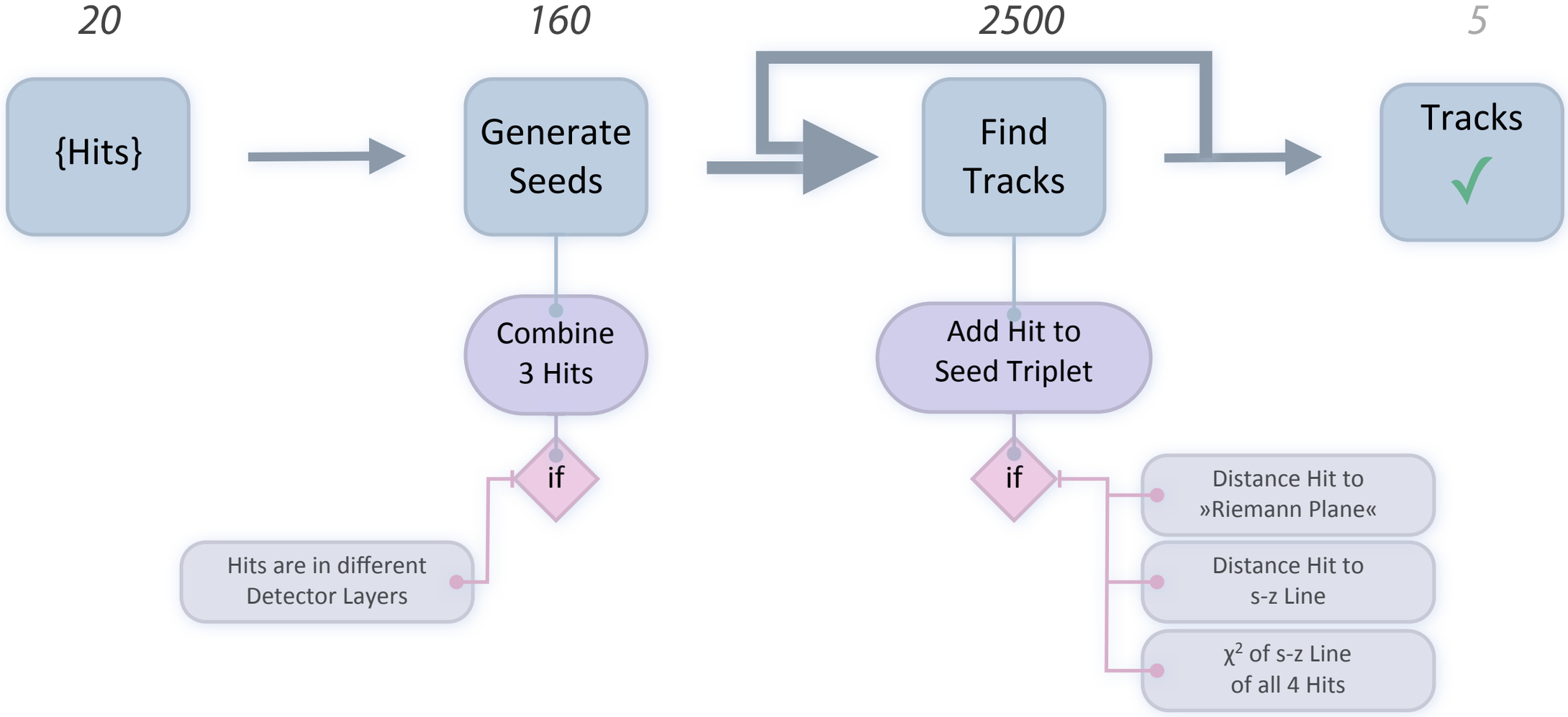
Problem:

Many unrealistic combinations →
Many unnecessary computations



Riemann Fit: Implementation

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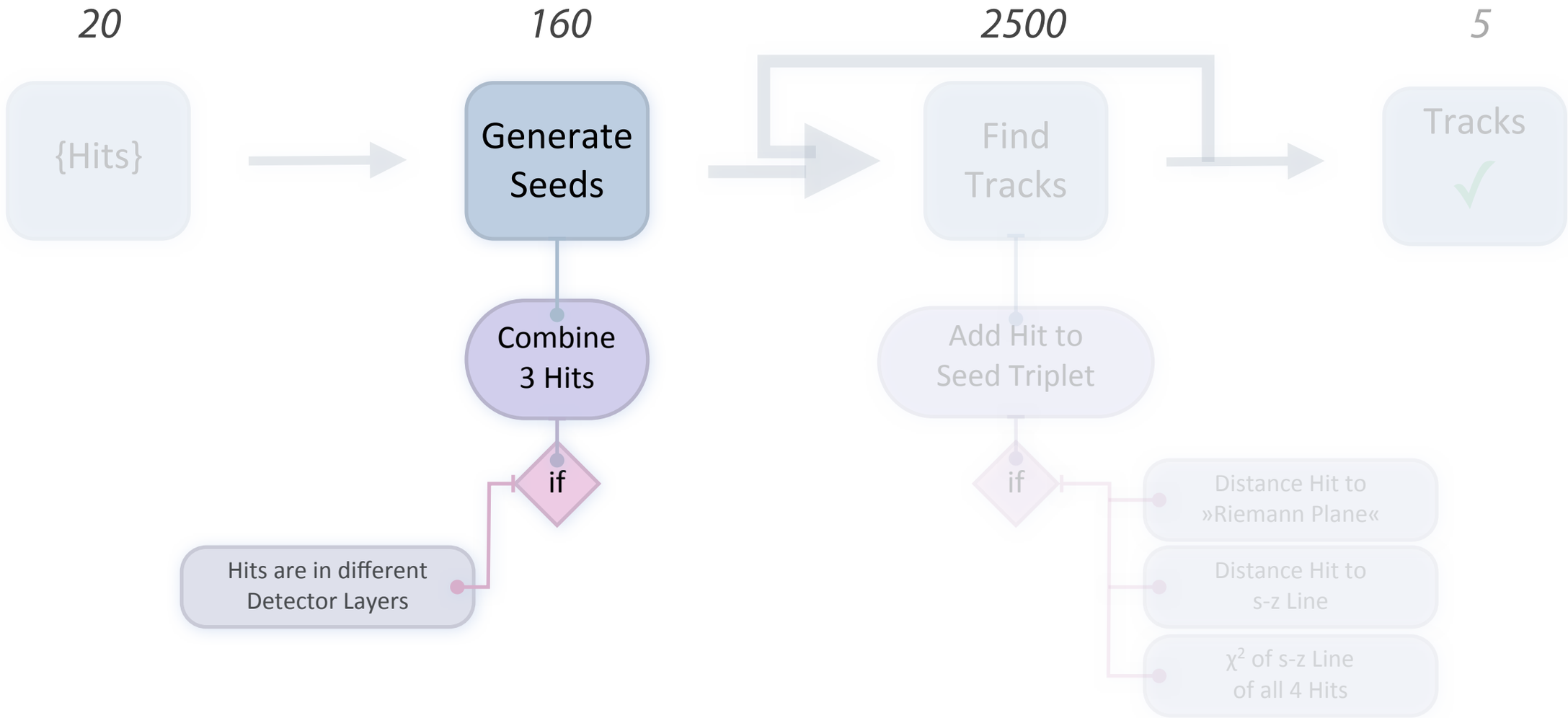
Solution:
Add an *early* quality criterion



Riemann Fit: Implementation

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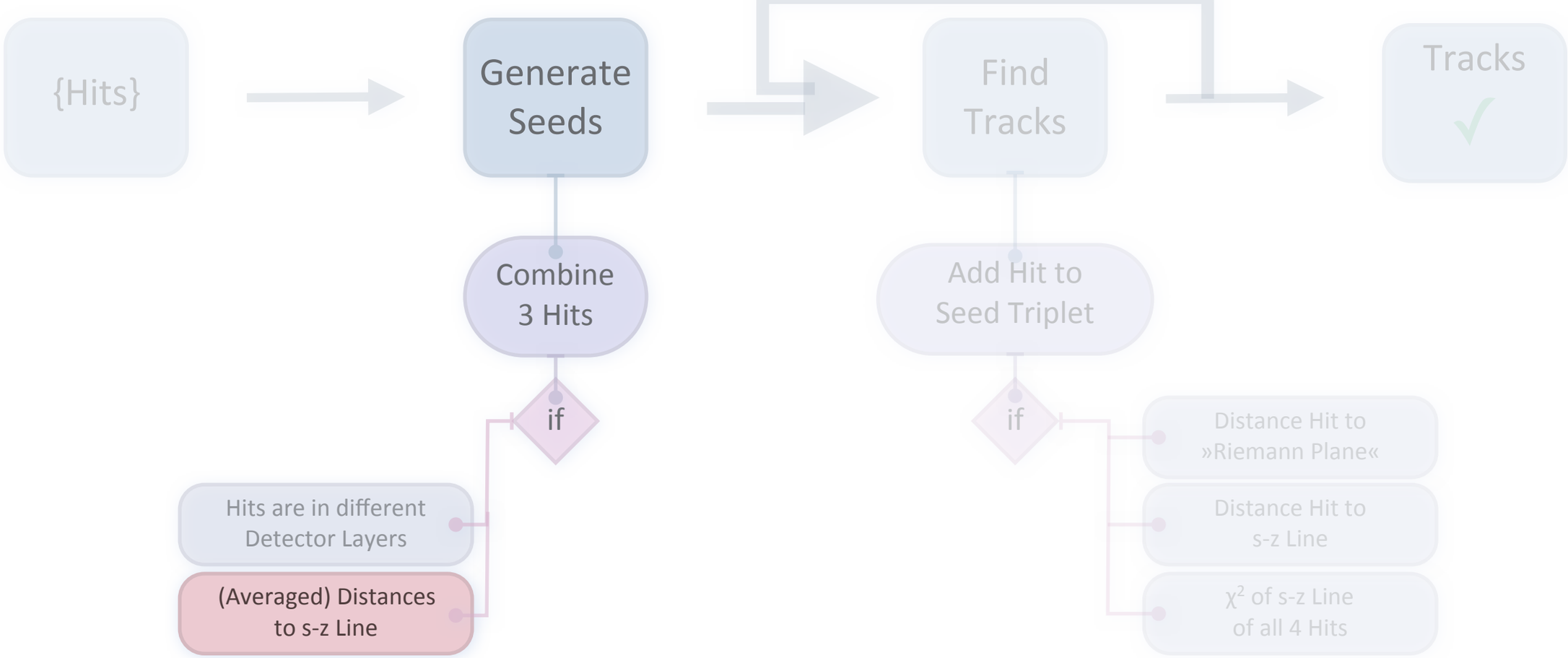
20 *~~160~~ 40* *~~2500~~ 680* *5*



Improvement: Quality Criterion

- s-z Diagram
  - At triplet generation three points are used to create a circle
  - Helix information of s-z fit is *at this point* not really used for anything
  - Change that! Use s-z helix propagation as quality criterion!

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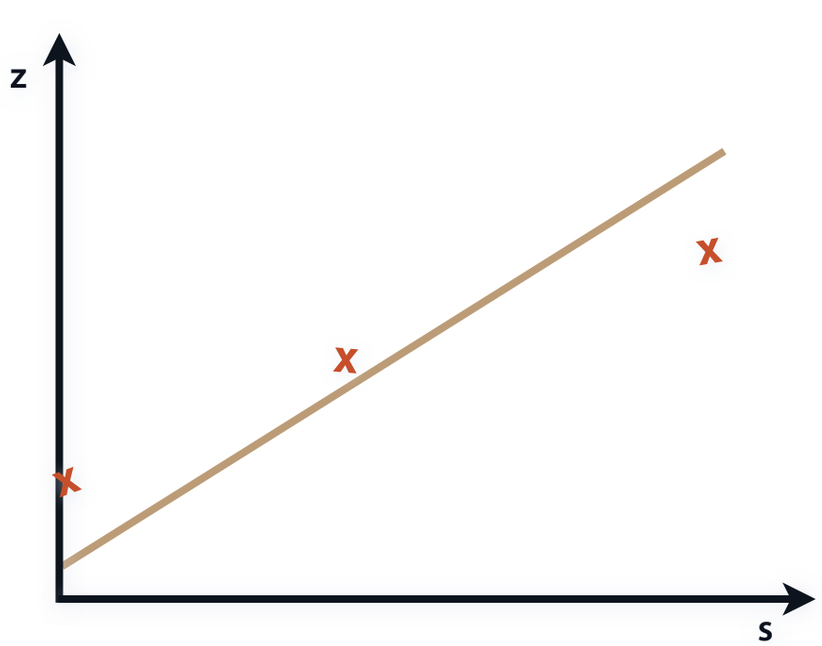

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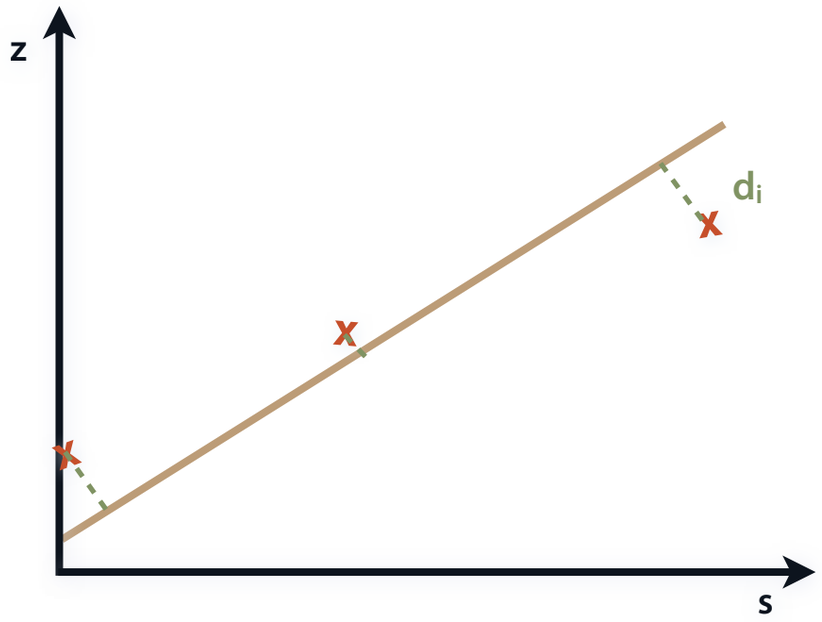

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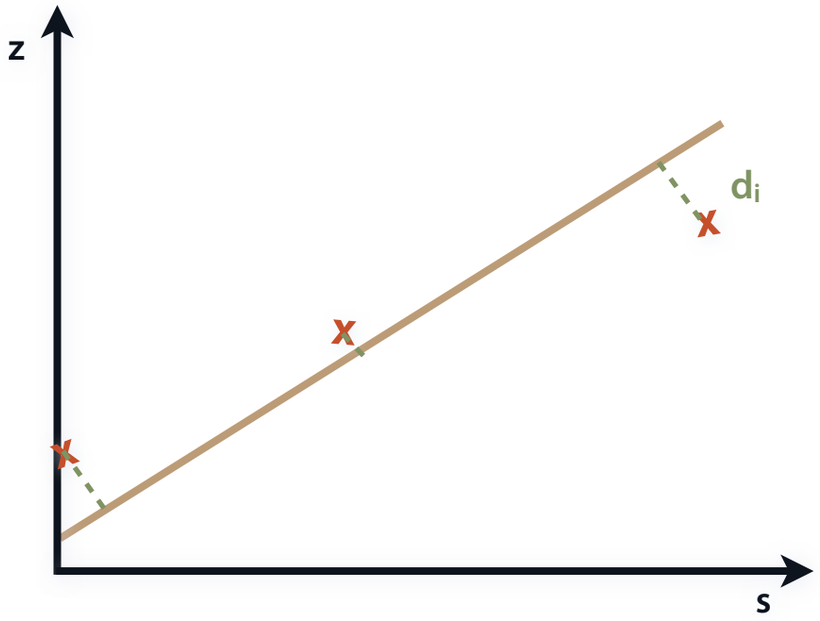

$$\sqrt{\sum_{i=1}^{3} d_i^2} =$$

Improvement: Quality Criterion

- s-z Diagram
  - At triplet generation three points are used to create a circle
  - Helix information of s-z fit is *at this point* not really used for anything
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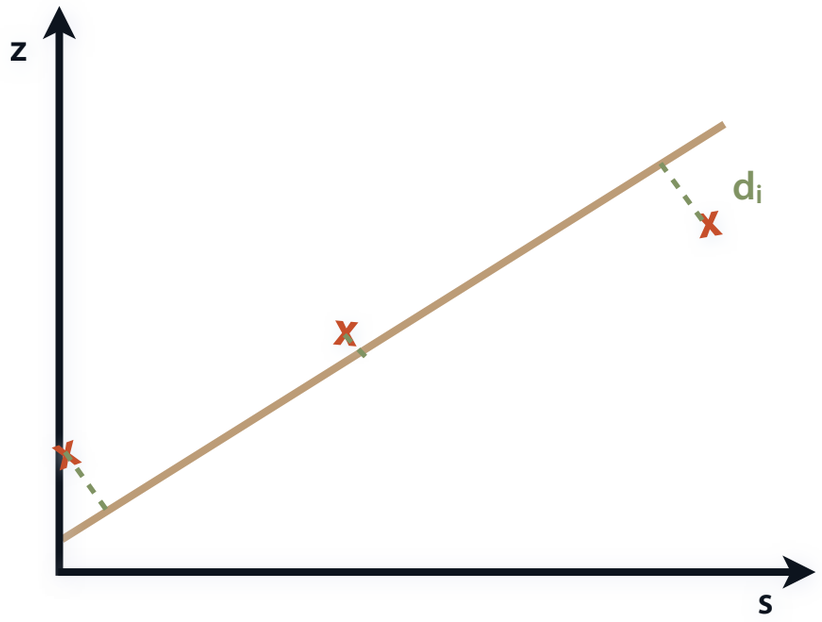
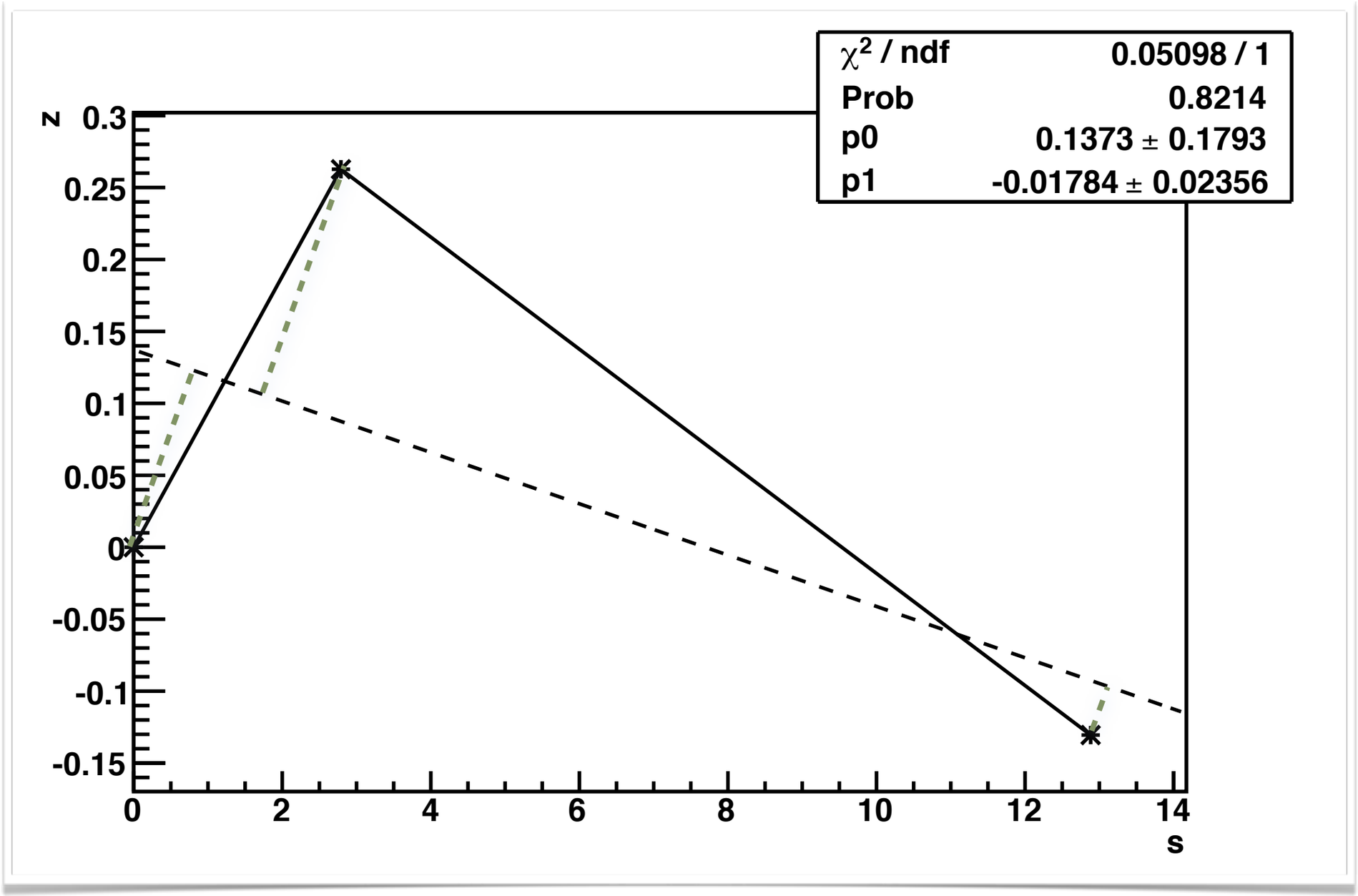
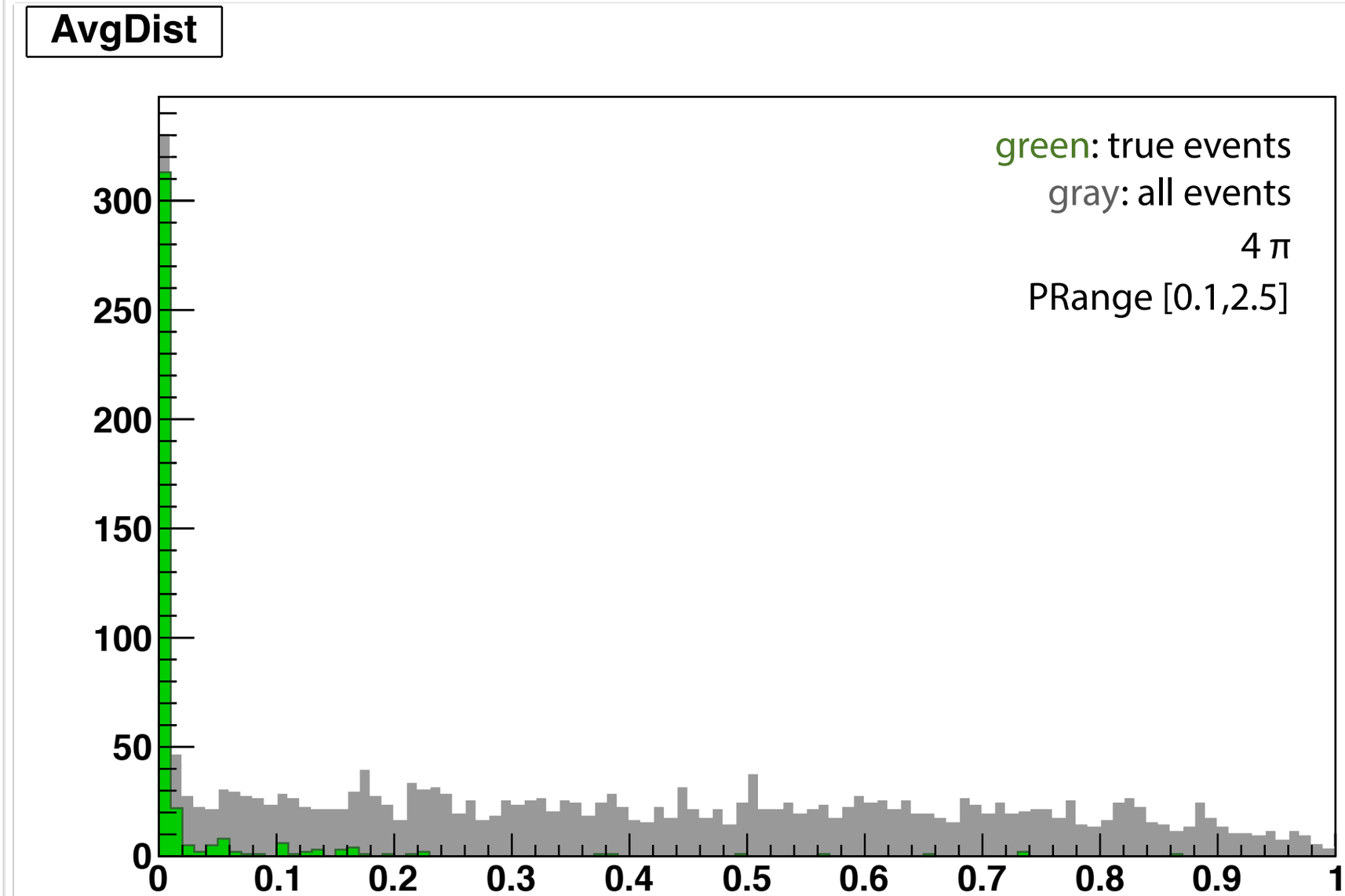


$$\sqrt{\sum_{i=1}^{3} d_i^2} = \text{AvgDist}$$

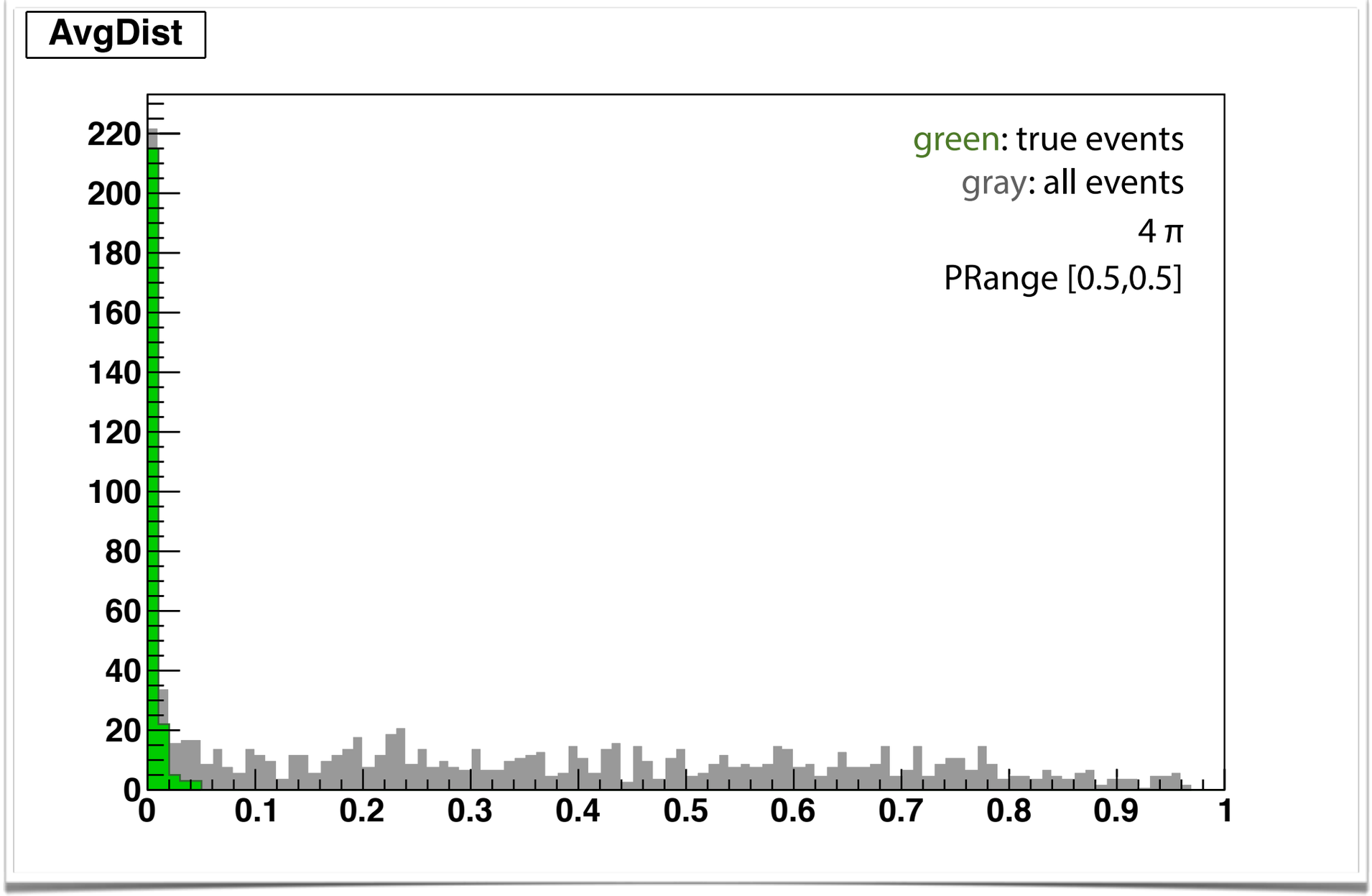
Improvement: AvgDist – Calculation



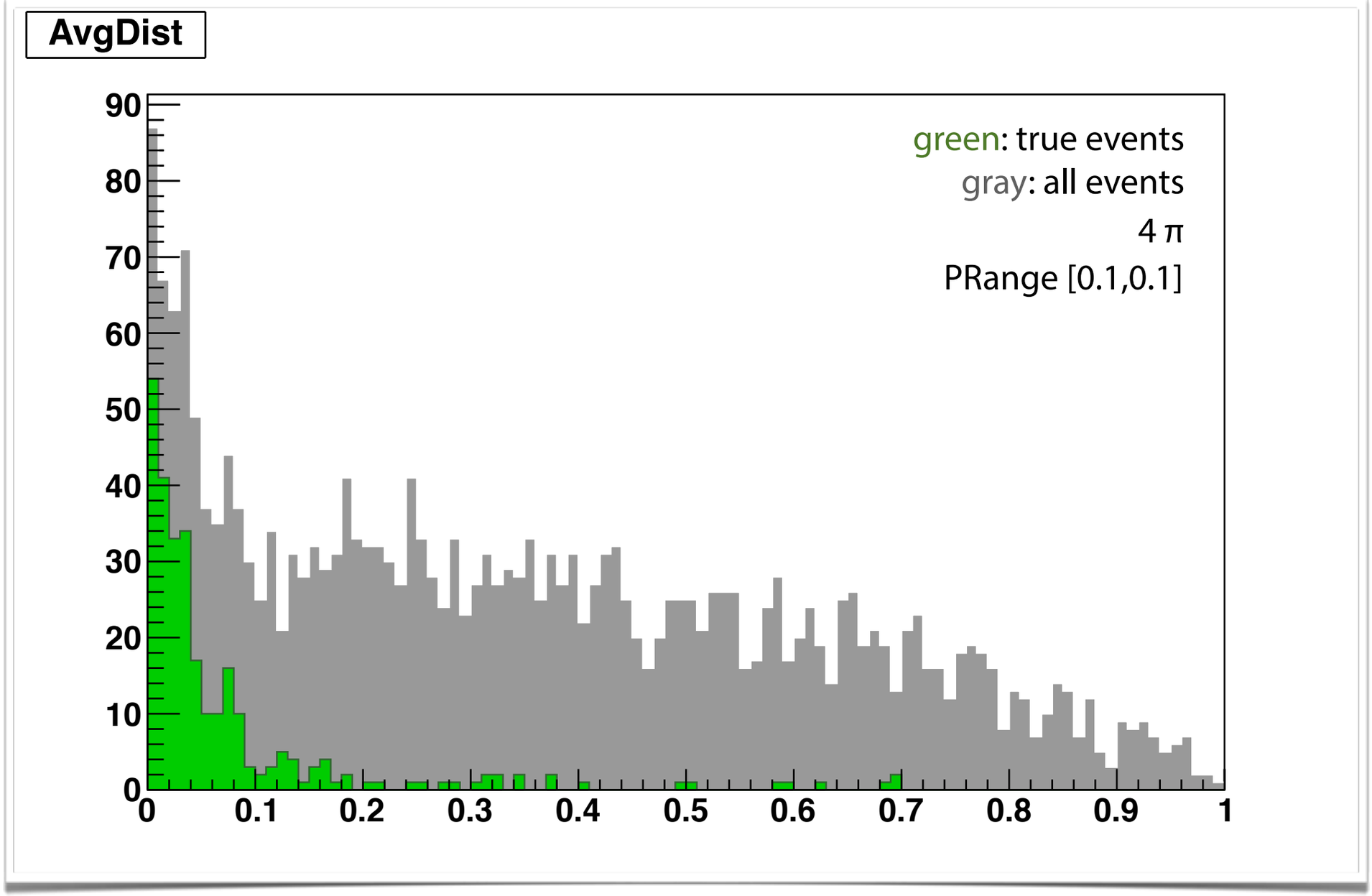
Improvement: AvgDist – Distribution



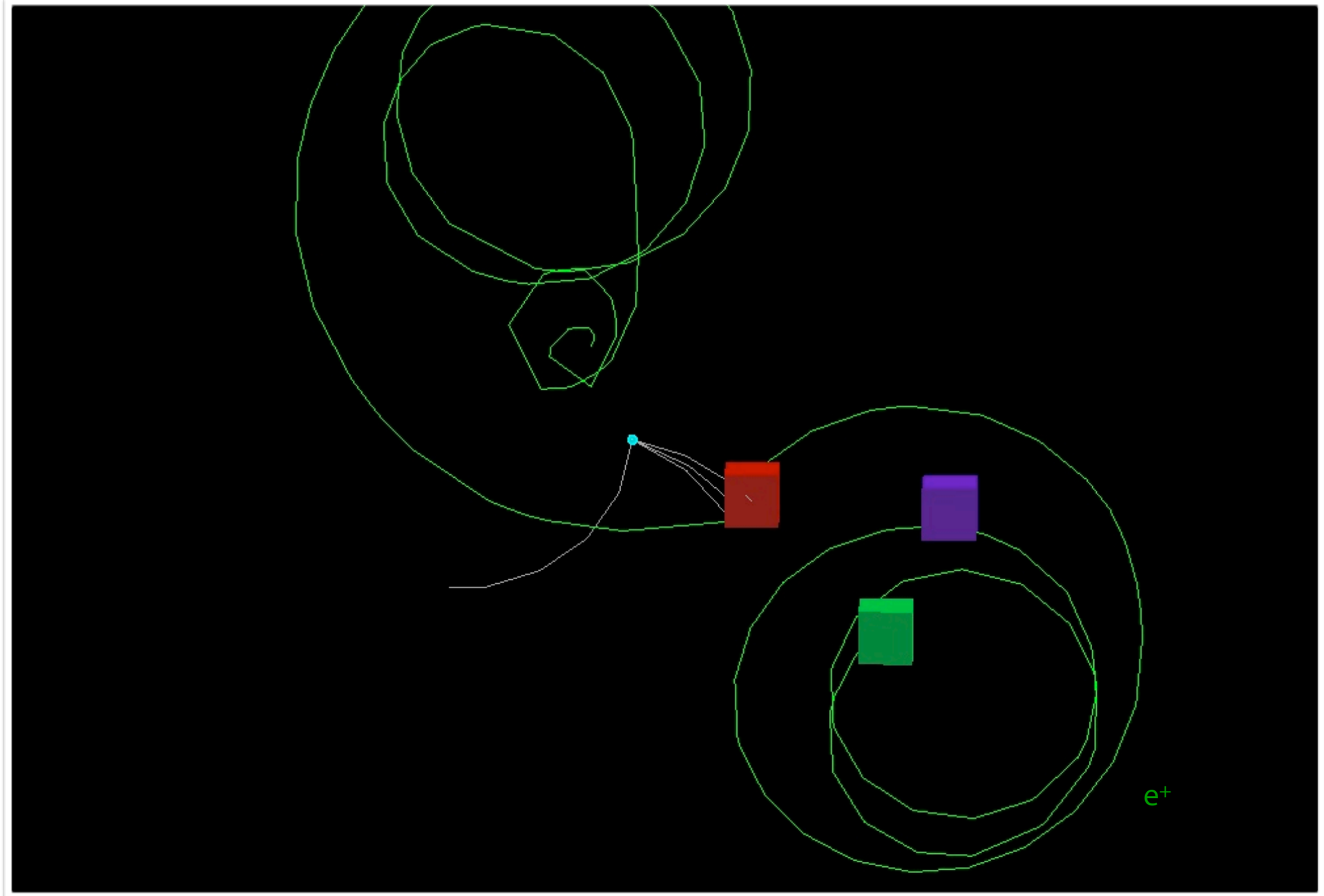
Improvement: AvgDist – Distribution



Improvement: AvgDist – Distribution



Improvement: AvgDist – Event Display



Done & To Be Done

- Done:
  - Look at AvgDist of particles with broad distributions of momenta
  - Investigate noticeable events at high AvgDist being *true*
    - Explanation: Low-momentum, curling particles
- Currently Doing:
  - Analyse low-momentum (p_t) particles
  - Gather information for cut parameter
- To Be Done:
  - Efficiency / Purity
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    - Find
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→ Speed up Riemann fit

JÜLICH
FORSCHUNGSZENTRUM

panda

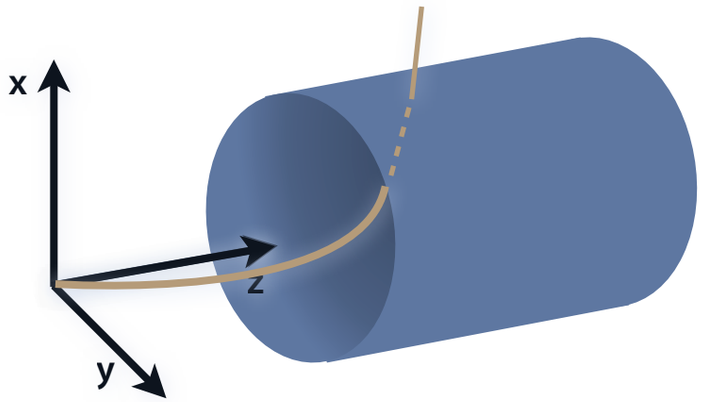
Thank you for your attention!

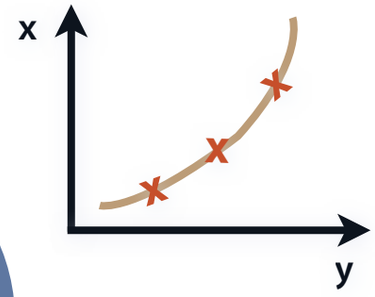
Panda taken from the Open Clip Art Library

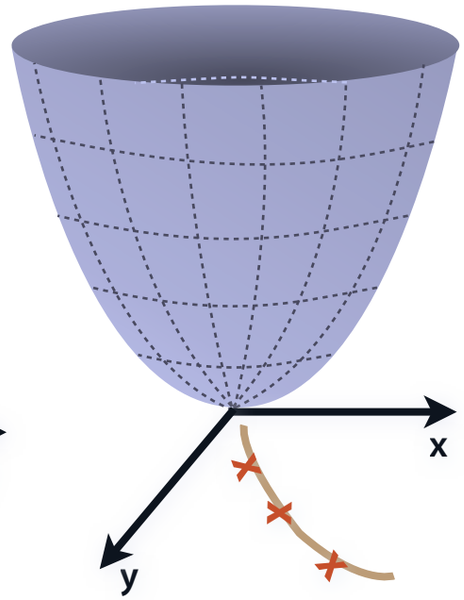
Backup

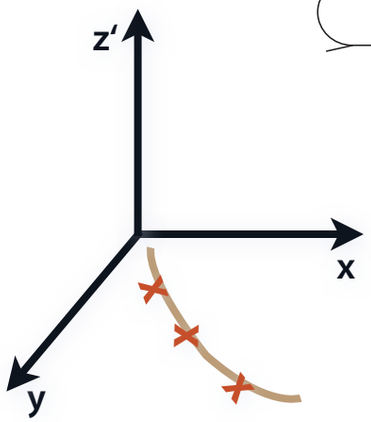
More is more.

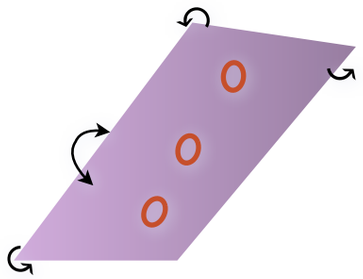
Riemann Fit: Method

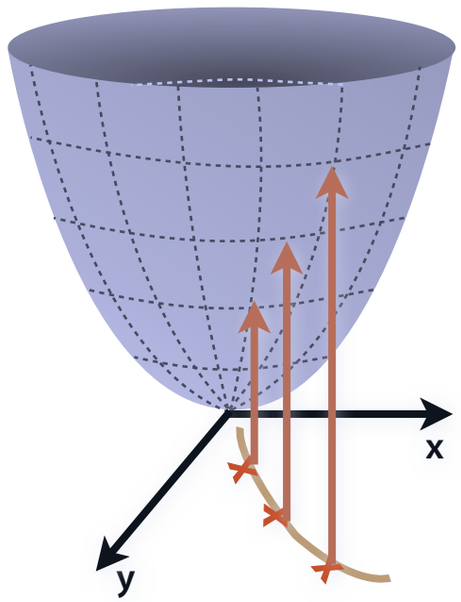


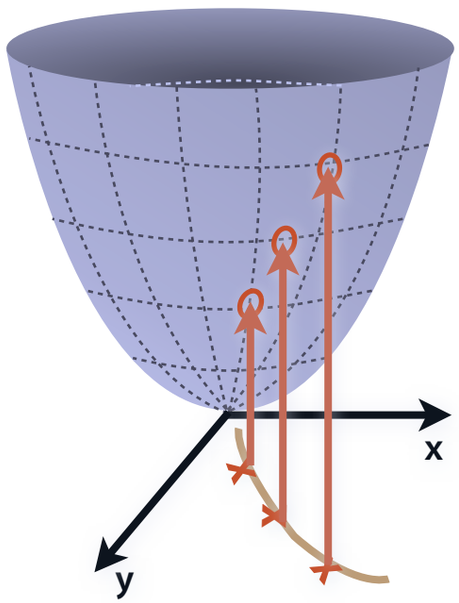


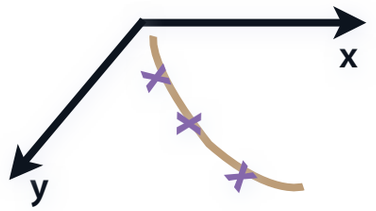


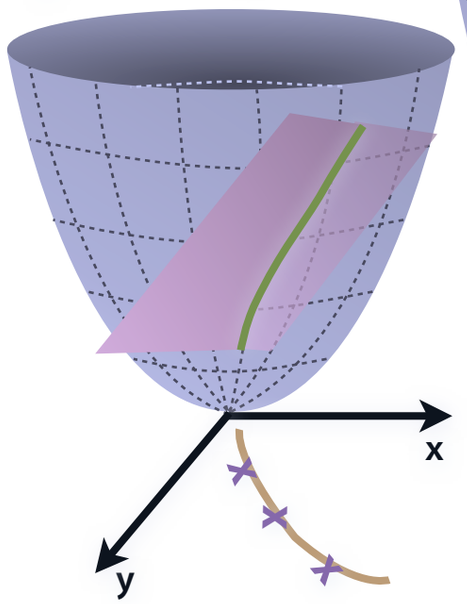


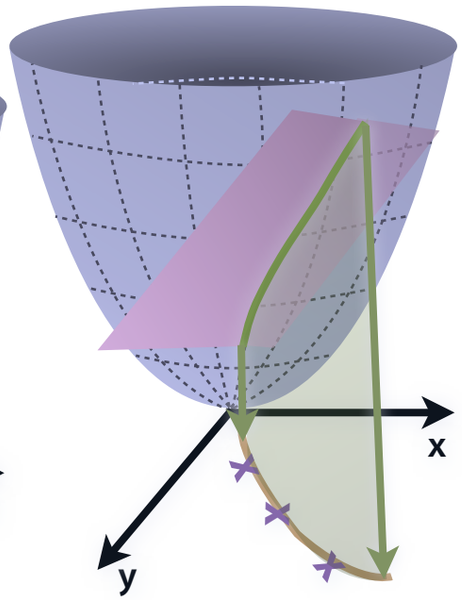


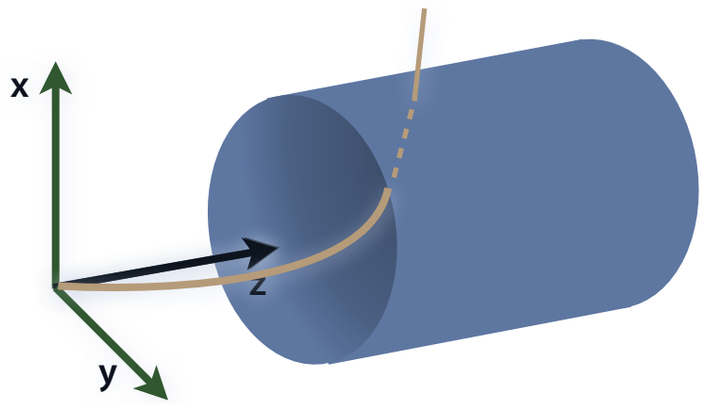












Riemann Fit: Method