



university of
groningen

faculty of science
and engineering

First estimate for noise inside the upgraded VELO for $B_c \rightarrow \tau \nu$

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Search for $B_c \rightarrow \tau \nu$

Not observed before

b/c quark production ~ 1 in 10^5

Predicted efficiency of measuring the decay $\sim 8.7E-5$

Branching fraction

Lepton flavour universality

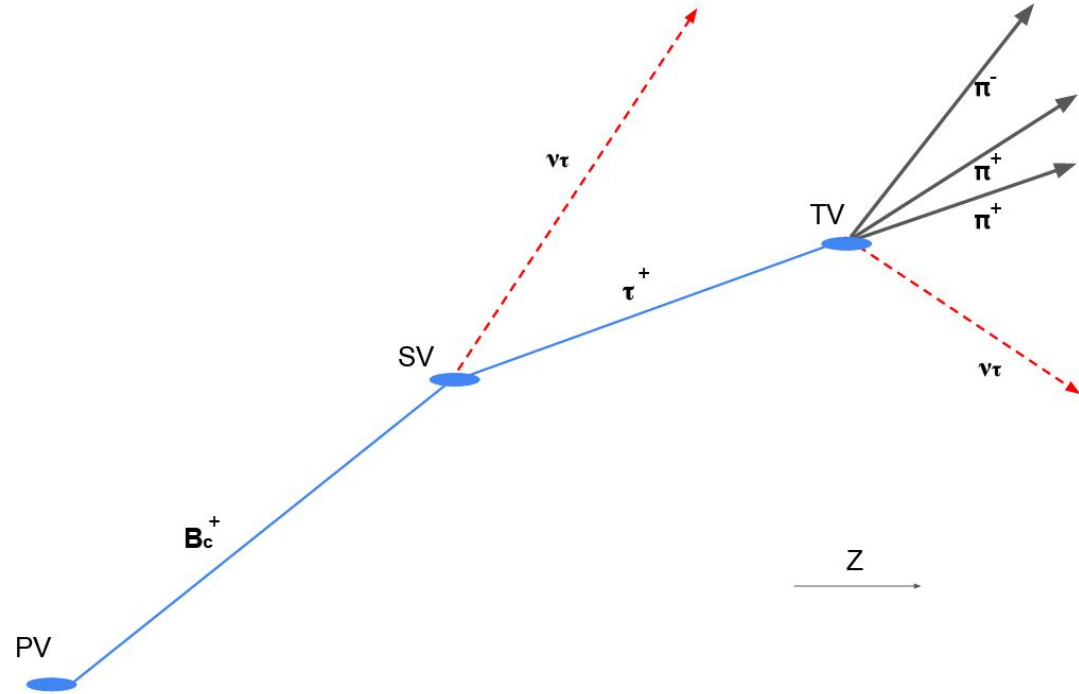


Event

Invisible neutrinos

Missing momentum

Unknown SV



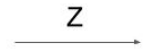
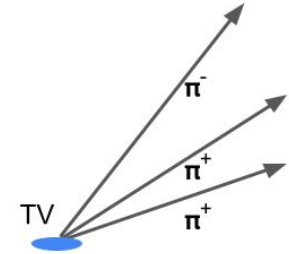


Event

Invisible neutrinos

Missing momentum

Unknown SV



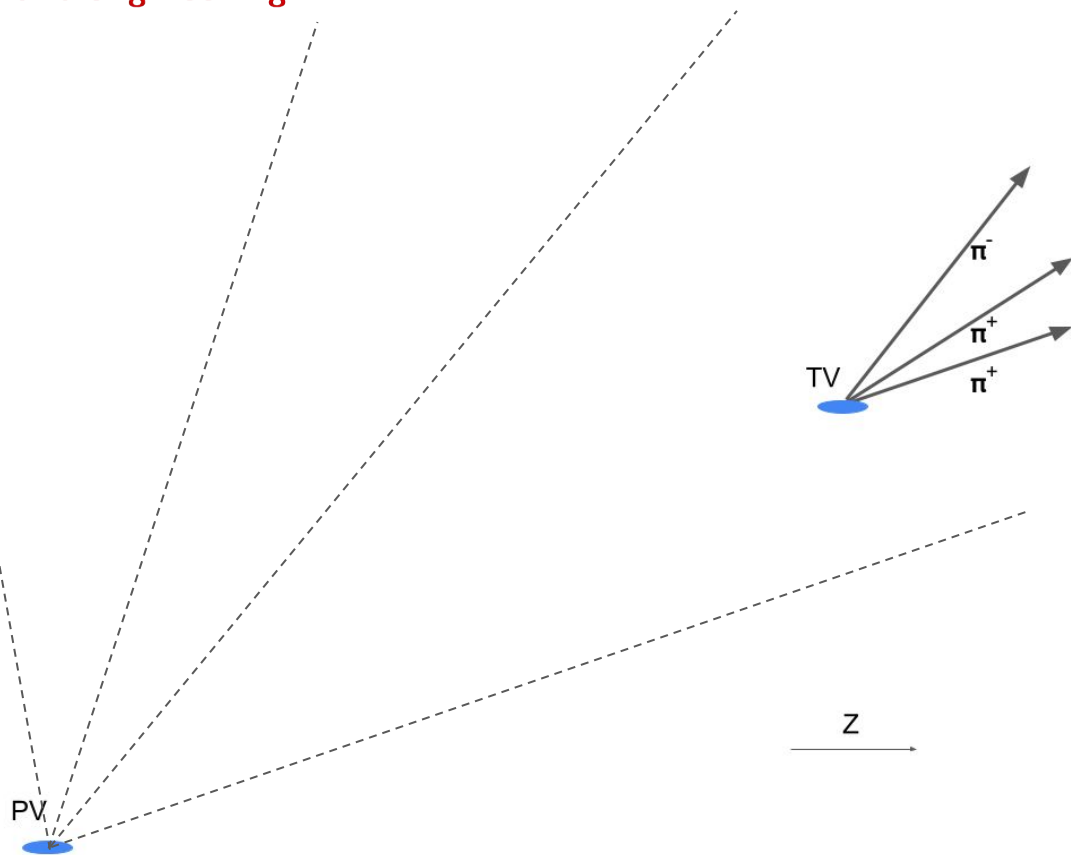


Event

Primary vertex (PV)

Reconstructed by other particles

Created during the pp collision



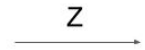
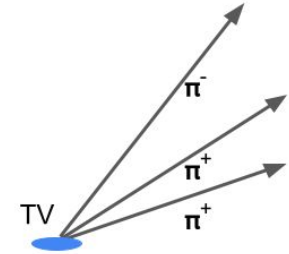


Event

Tertiary vertex (TV)

Reconstructed by 3 pions

From the tau decay





Event

Extra information

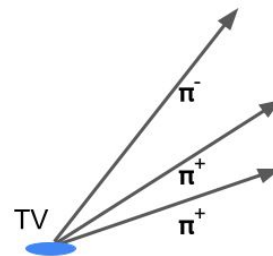
Vertex locator

3 types of hits

PV



VELO



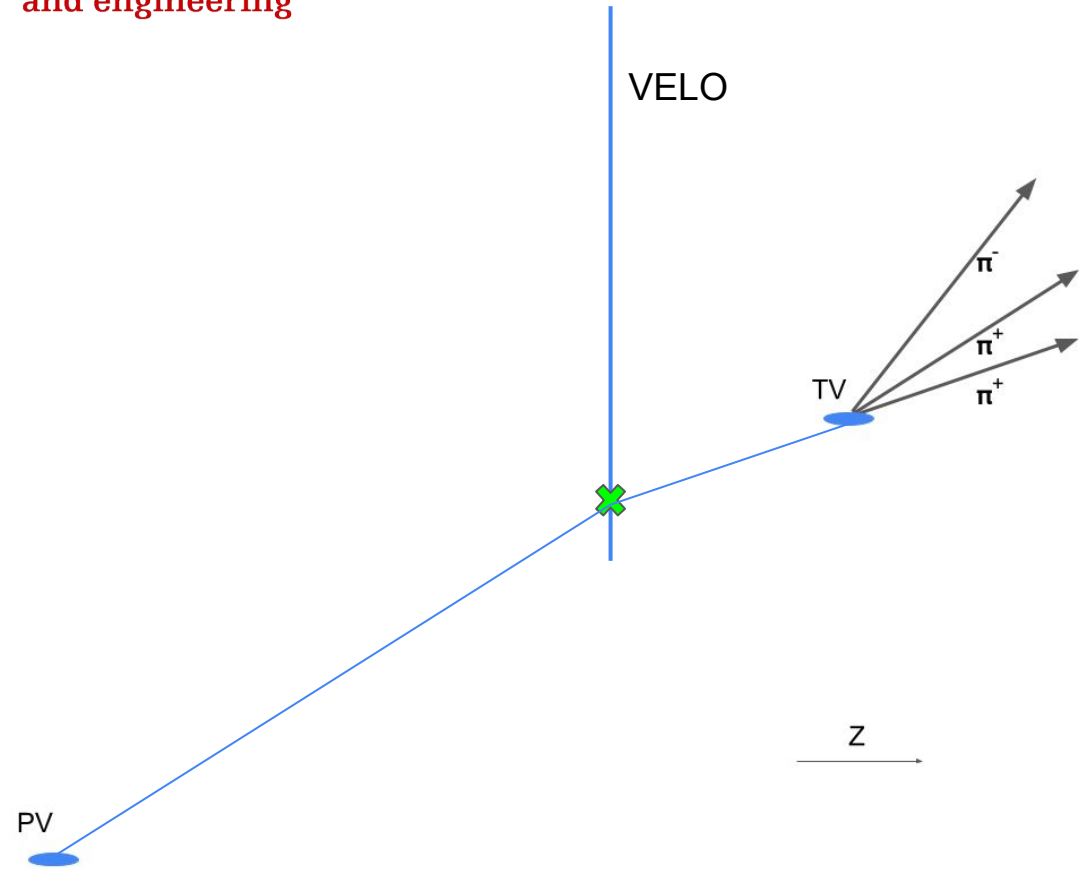
z





Event

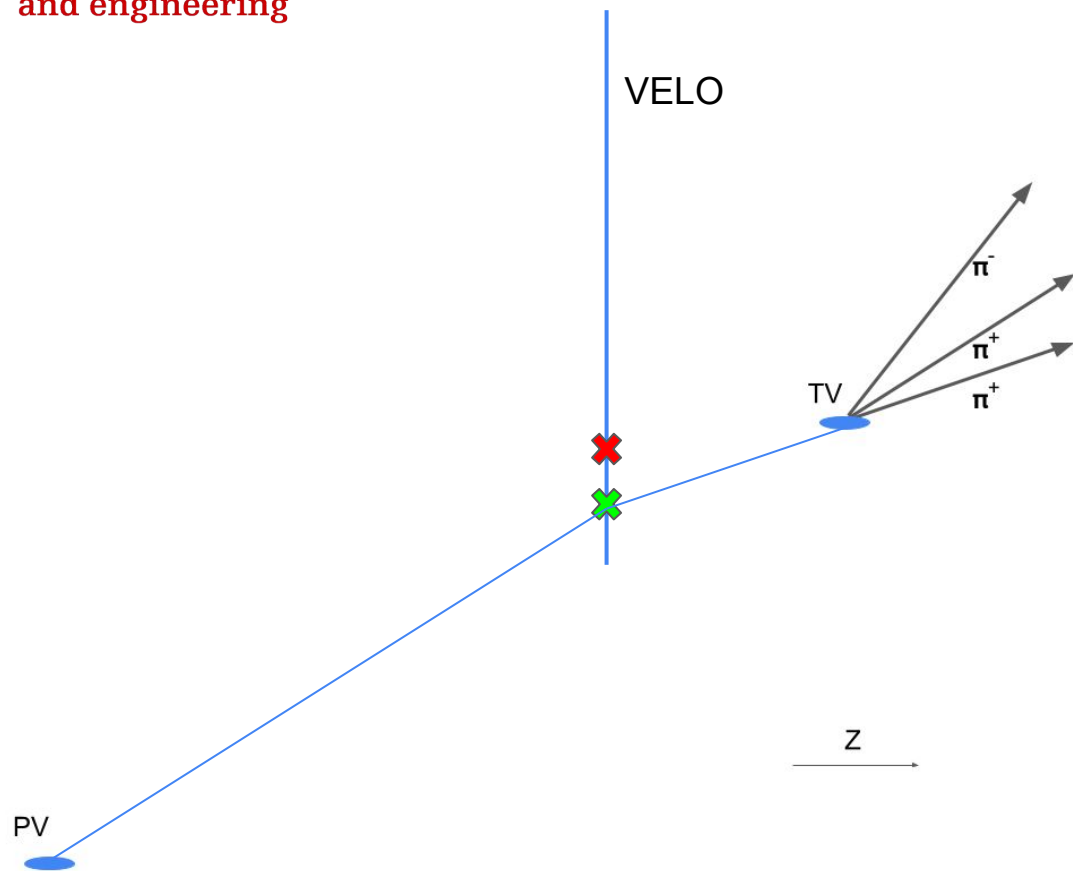
True hit





Noise

Extra hit

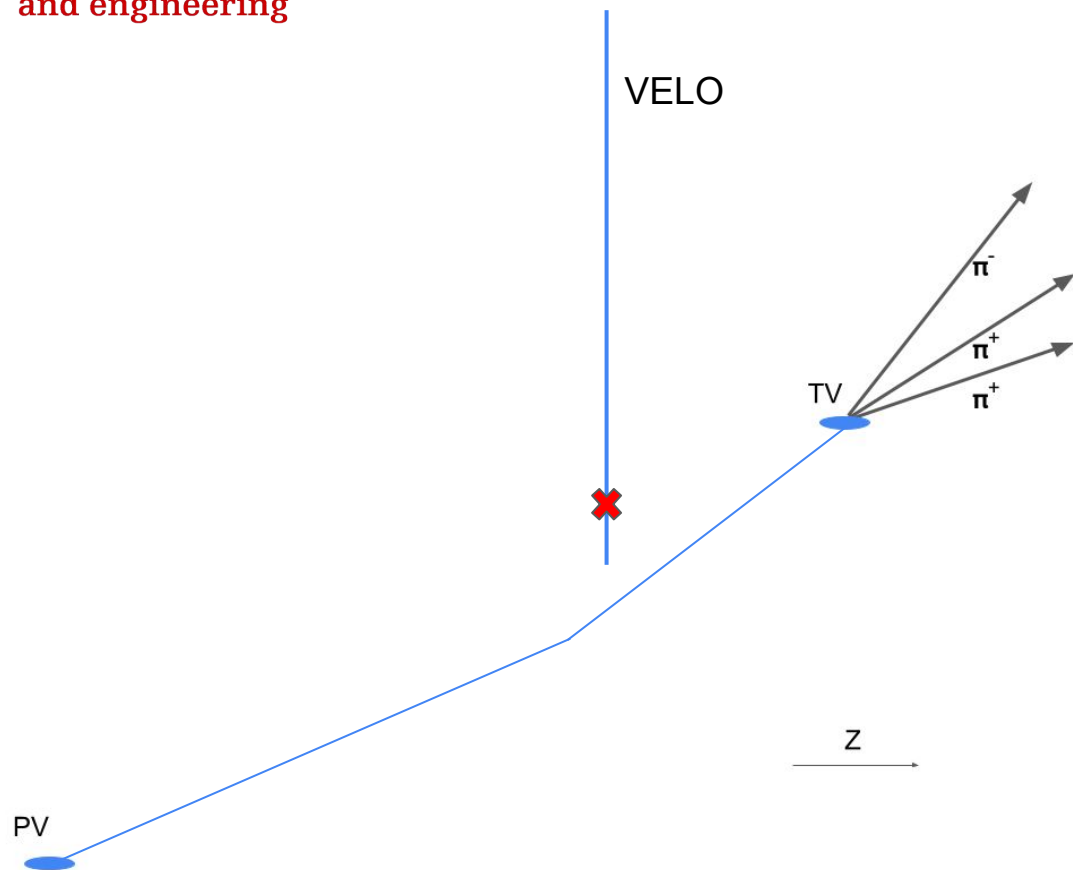




Noise

Particle leaves no hit in the VELO

False hit



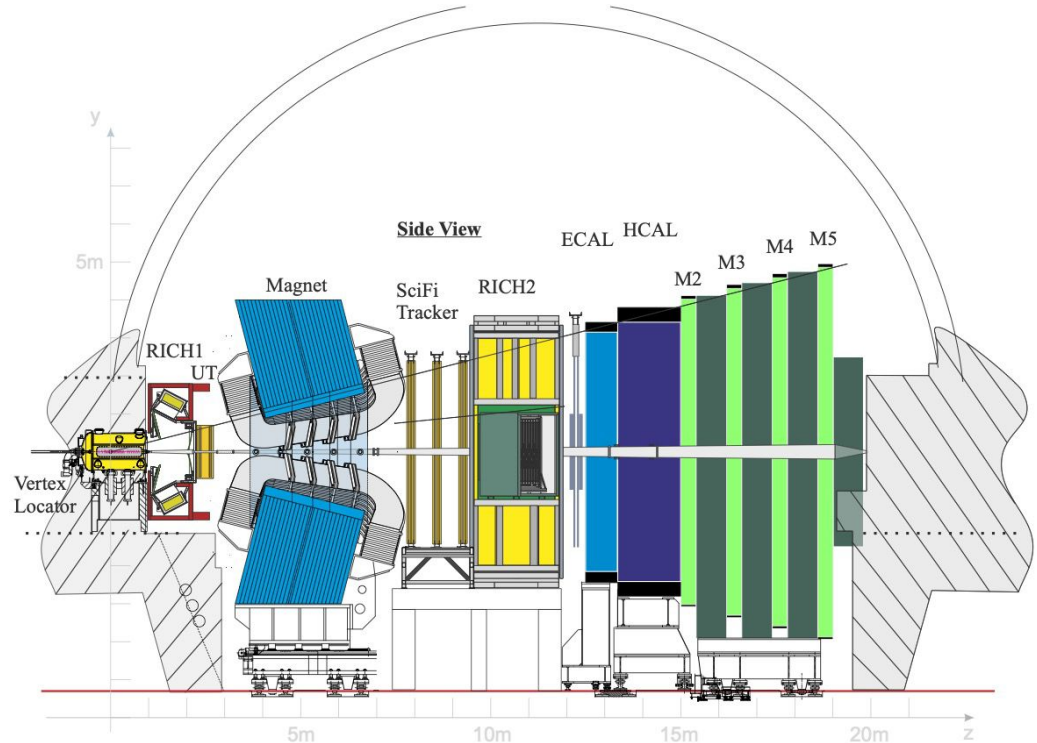


Lhcb

Single-arm forward spectrometer

Multiple detectors for

- Velocity
- Charge
- Momentum





VELO

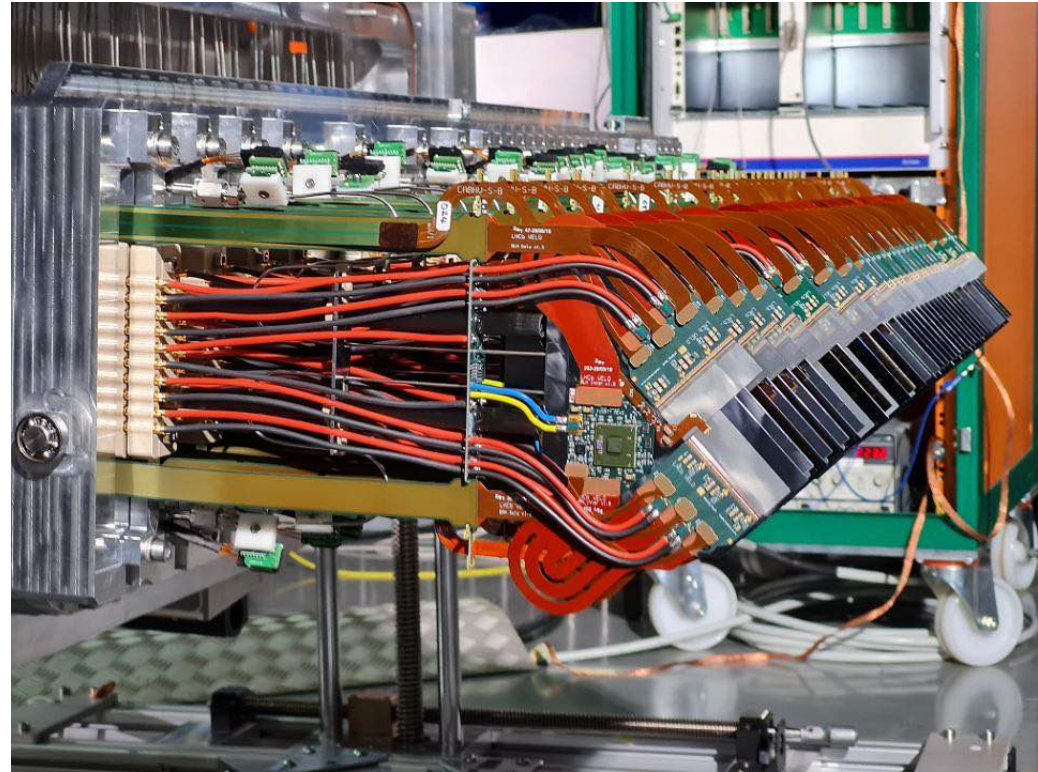
Inside beam pipe

5.1mm (3mm closer)

Silicon tracker

Charged particles

Frequency 40 MHz



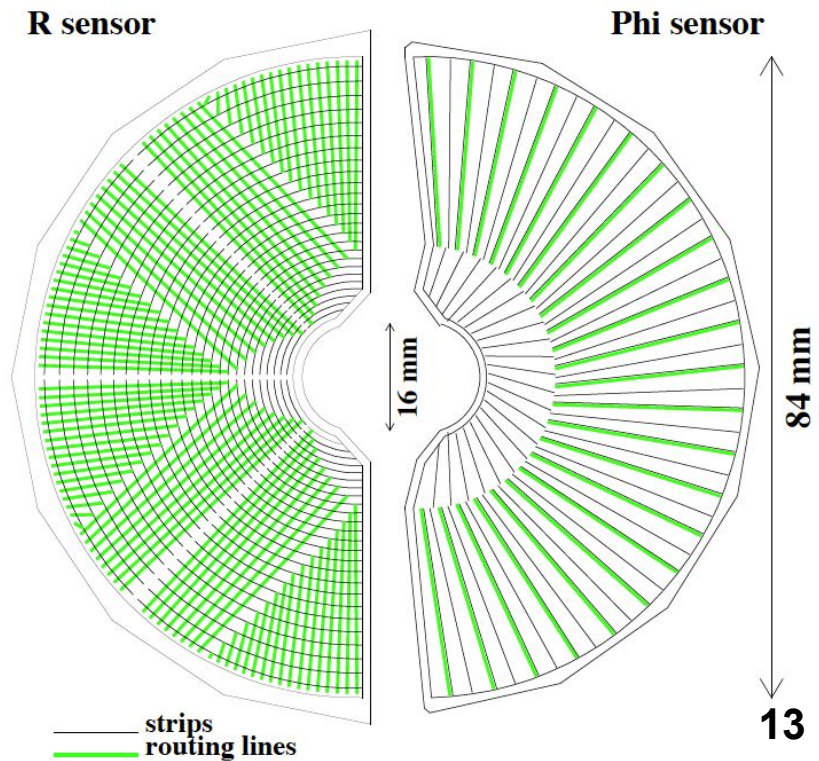


VELO

Old model

Cylindrical

Strips





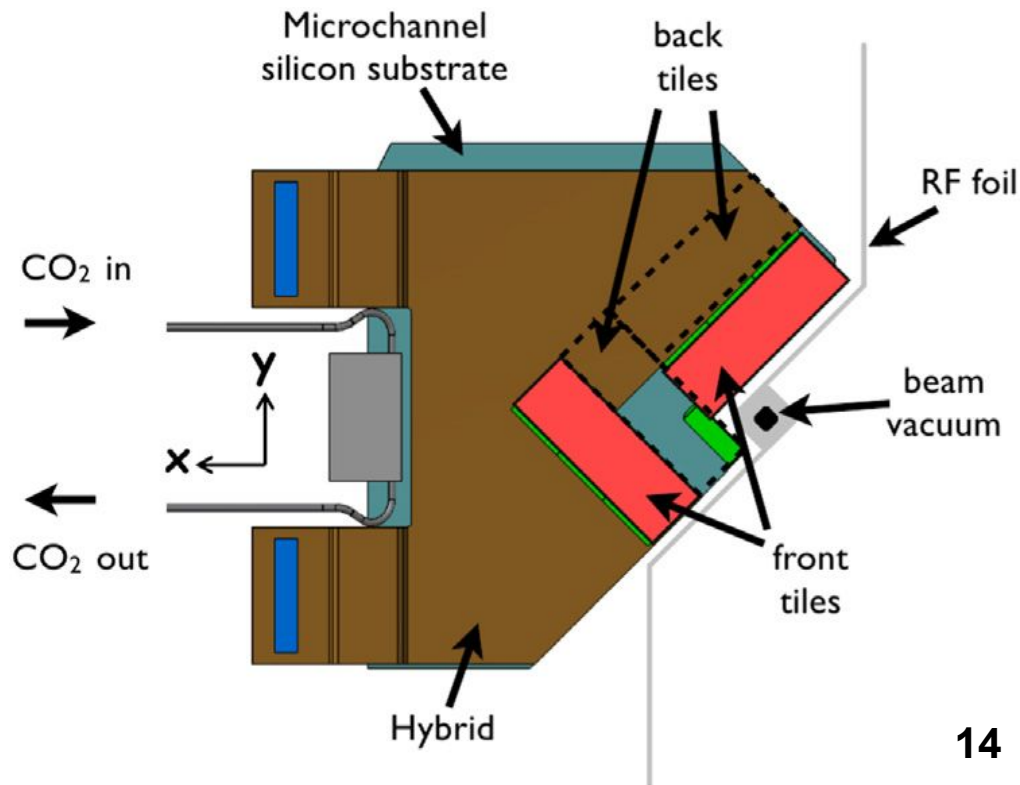
VELO

5.1mm to beam

Diamond shape

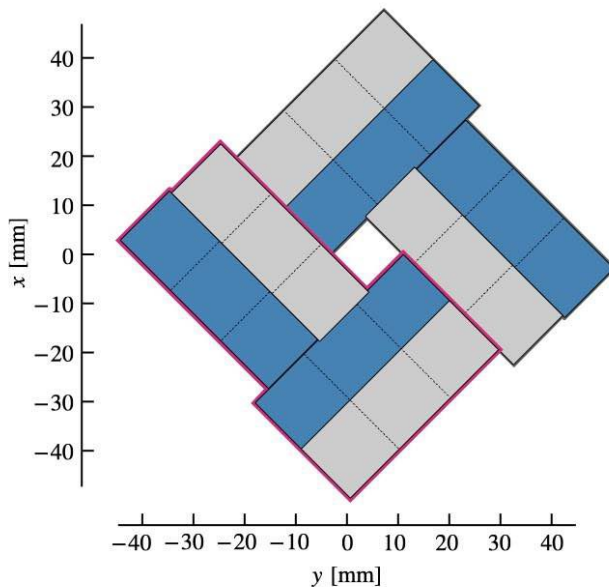
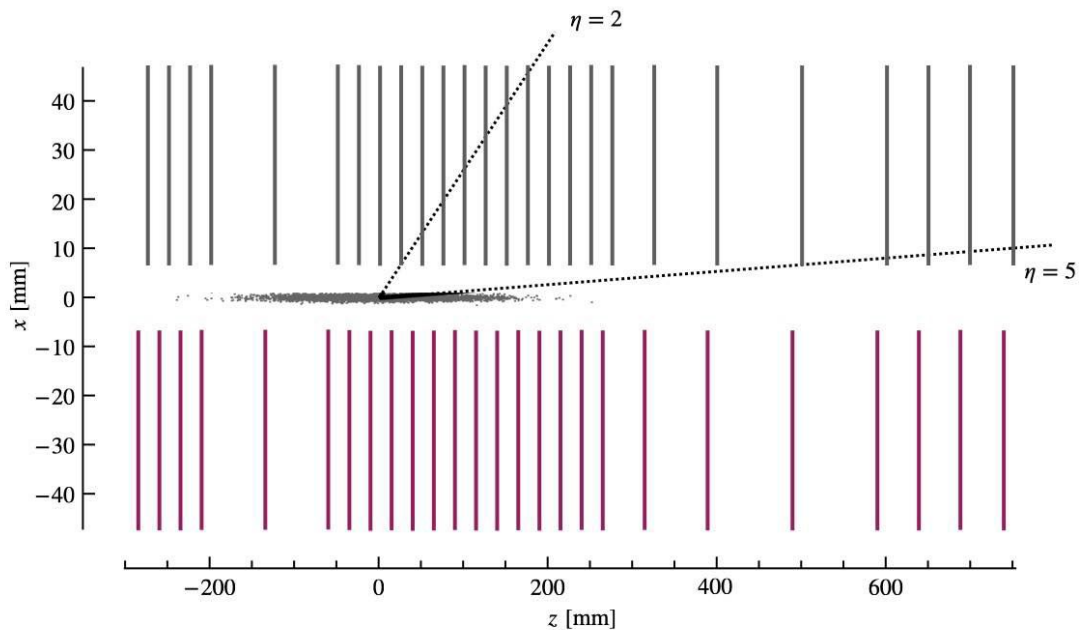
41 million pixels total

4 tiles per module





VELO





Visualisation

For clarity and debugging

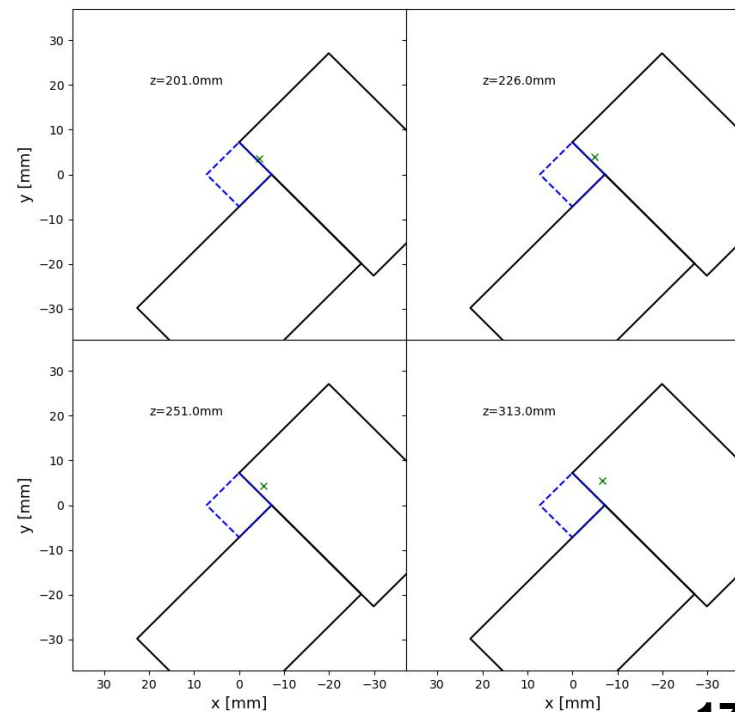
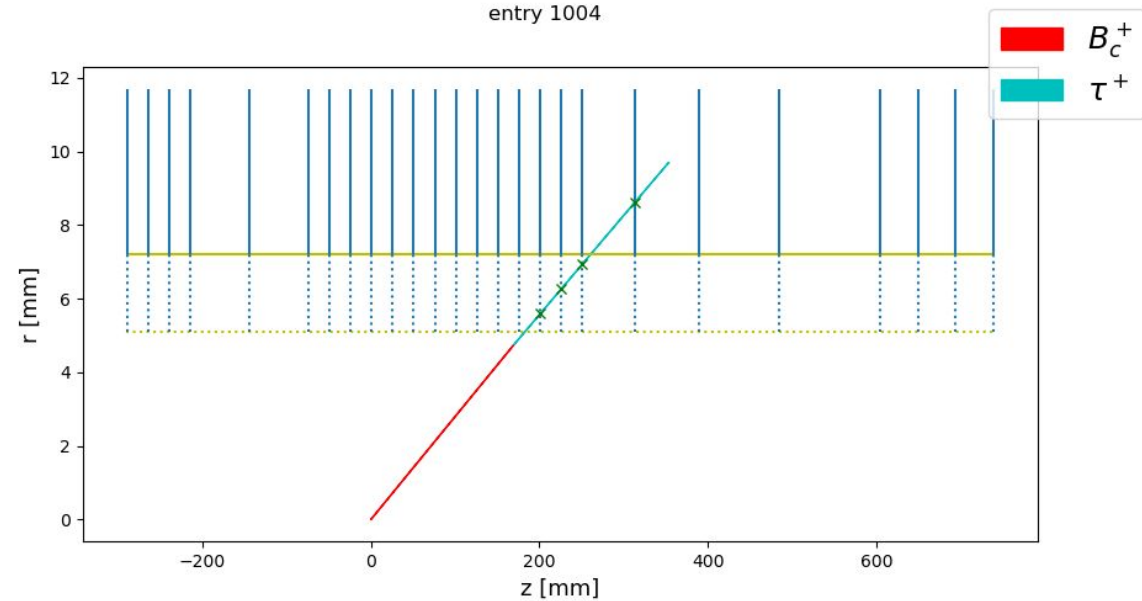
Used for simulated data



Visualisation

Example:

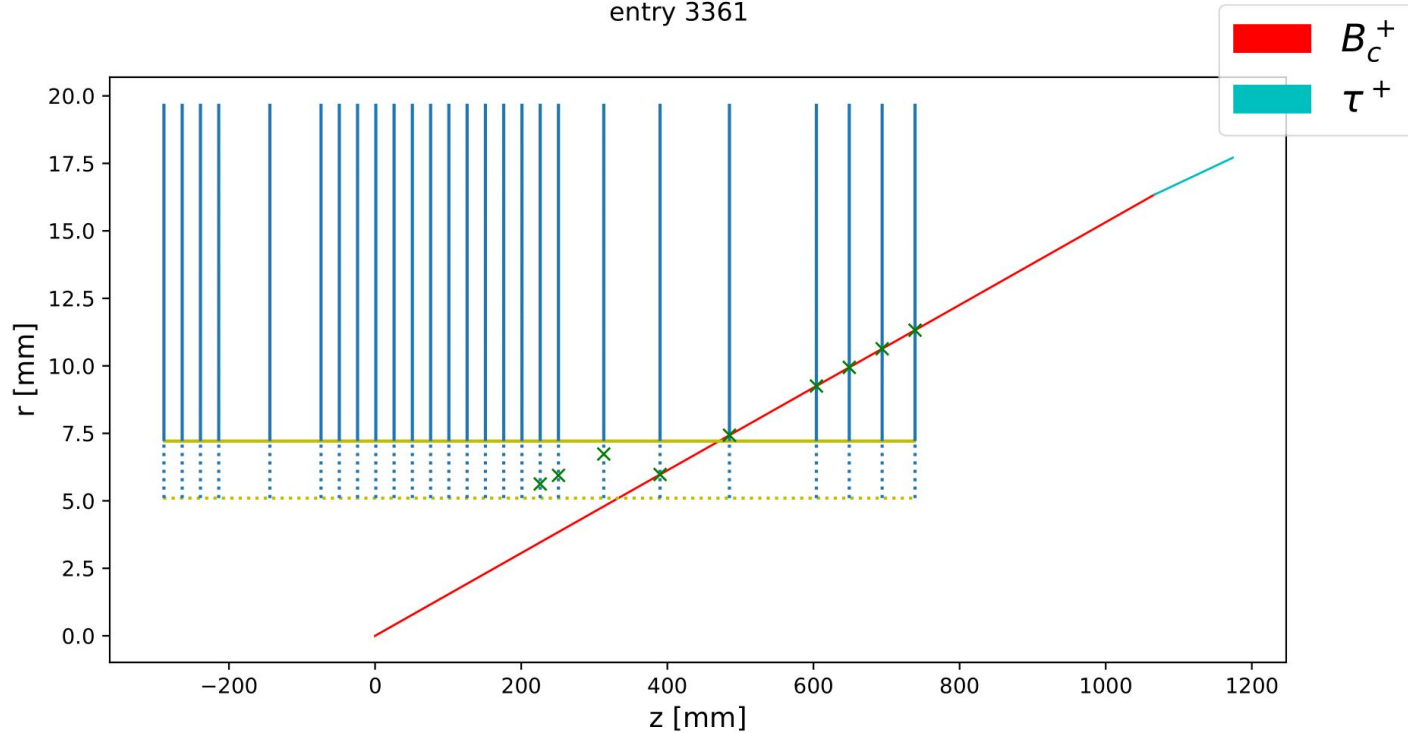
entry 1004





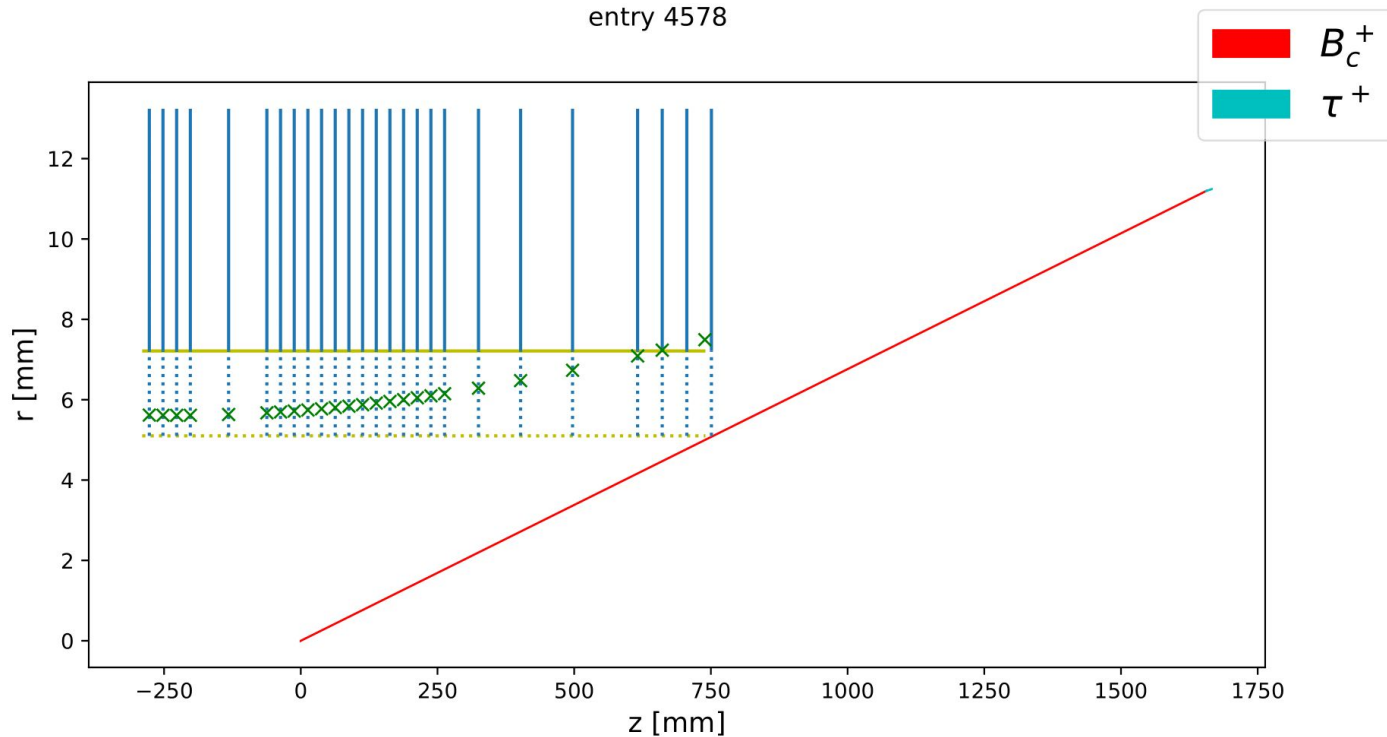
Best failures

entry 3361



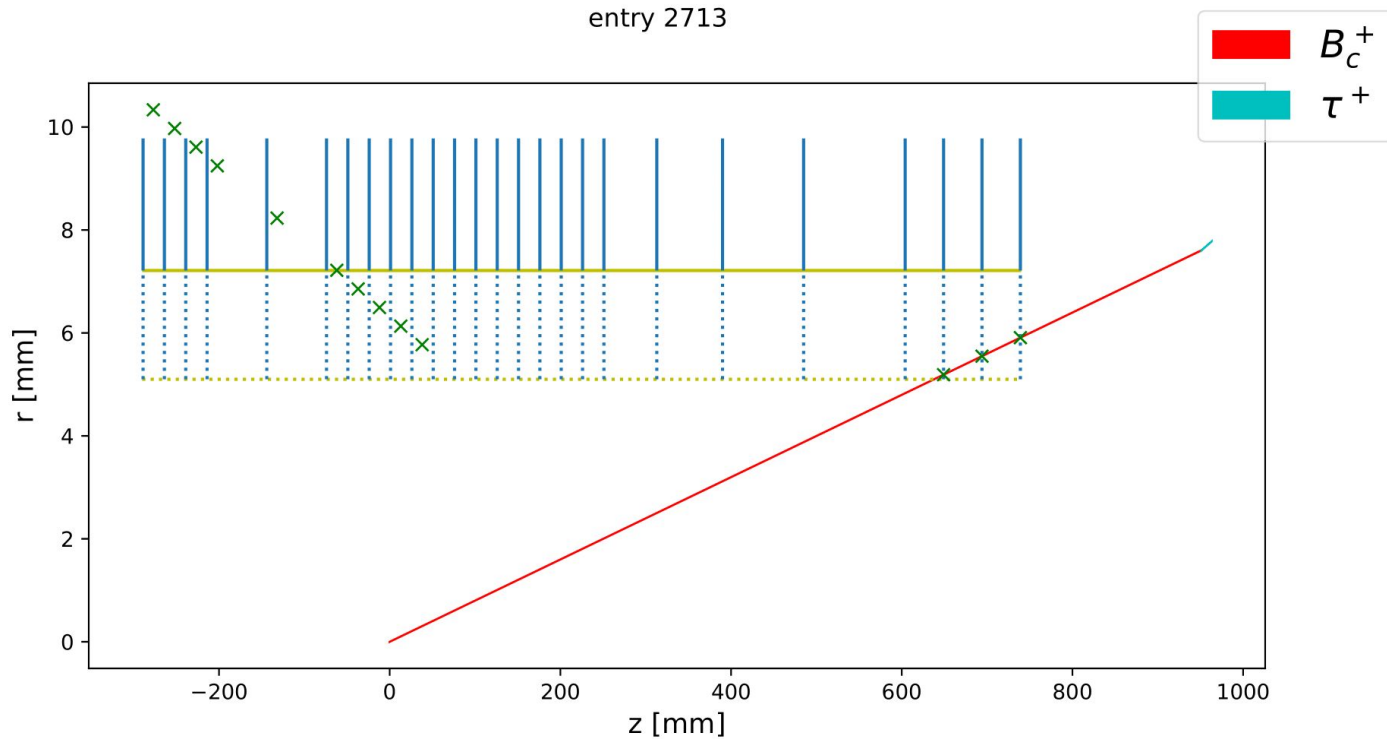


Best failures





Best failures





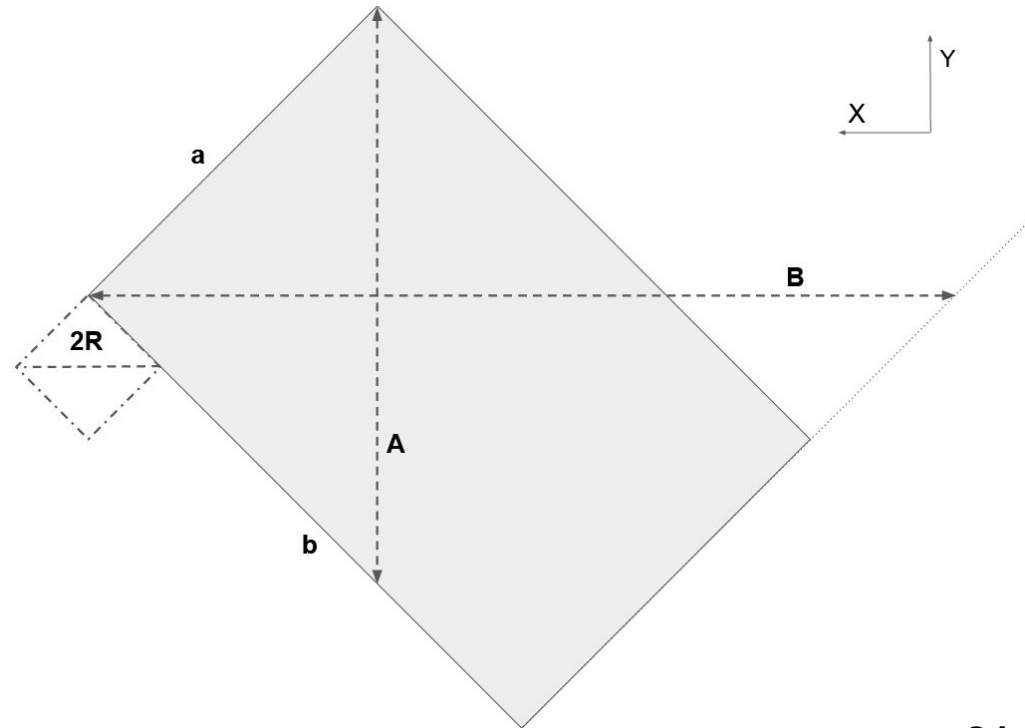
New model/algorithm

New geometry

45 degree tilt

2 parts is one module

12.5 mm shift between modules



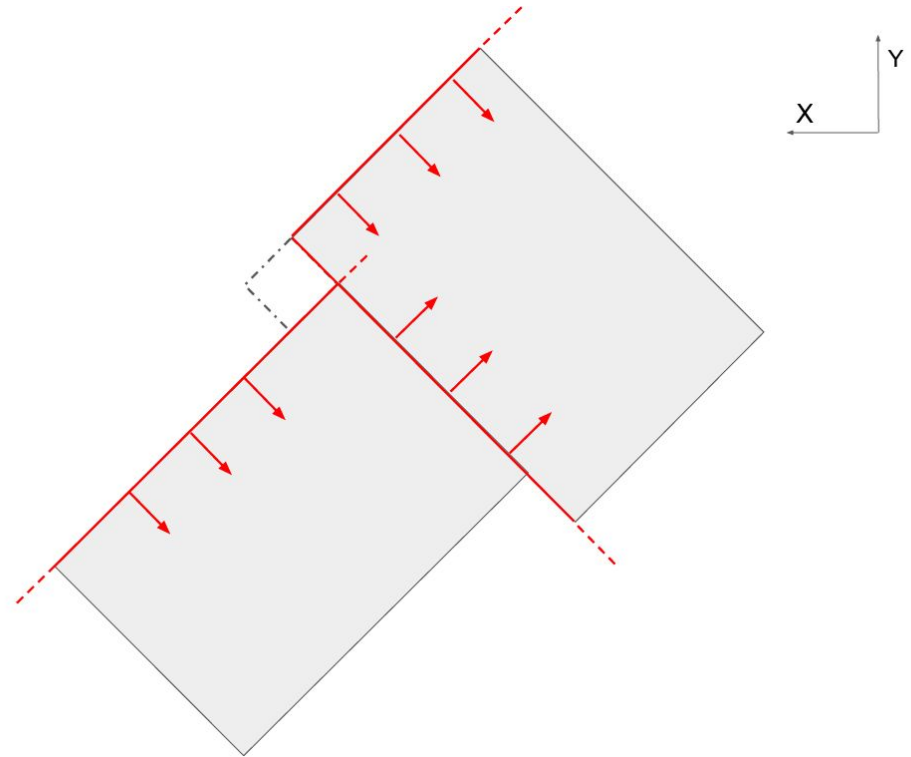


New model/algorithm

Check if inside

Full module, 8 lines

Optimised, 3 lines



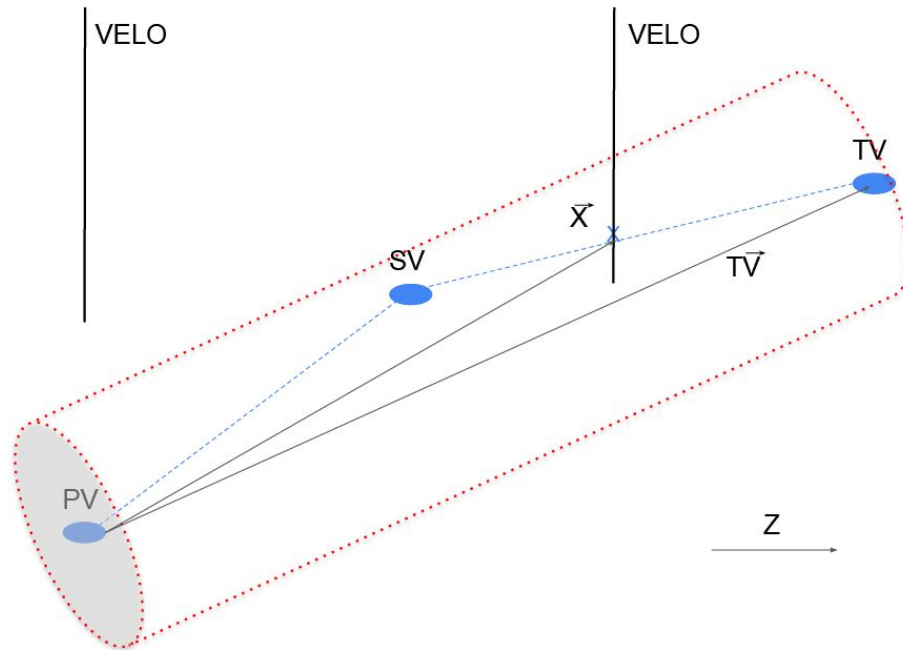


Adding noise

No data on the noise yet

Occupancy 0.125%

Cylinder



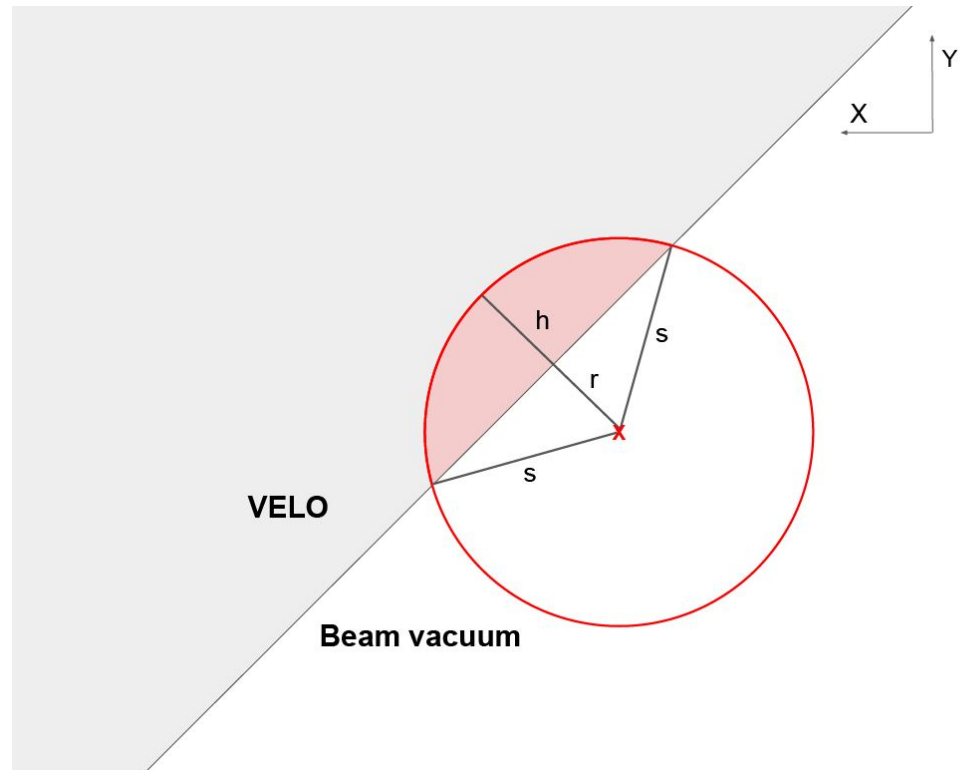


Adding noise

Area on a module where noise is possible.

Scale with the occupancy.

Radius of the cylinder is an important parameter!



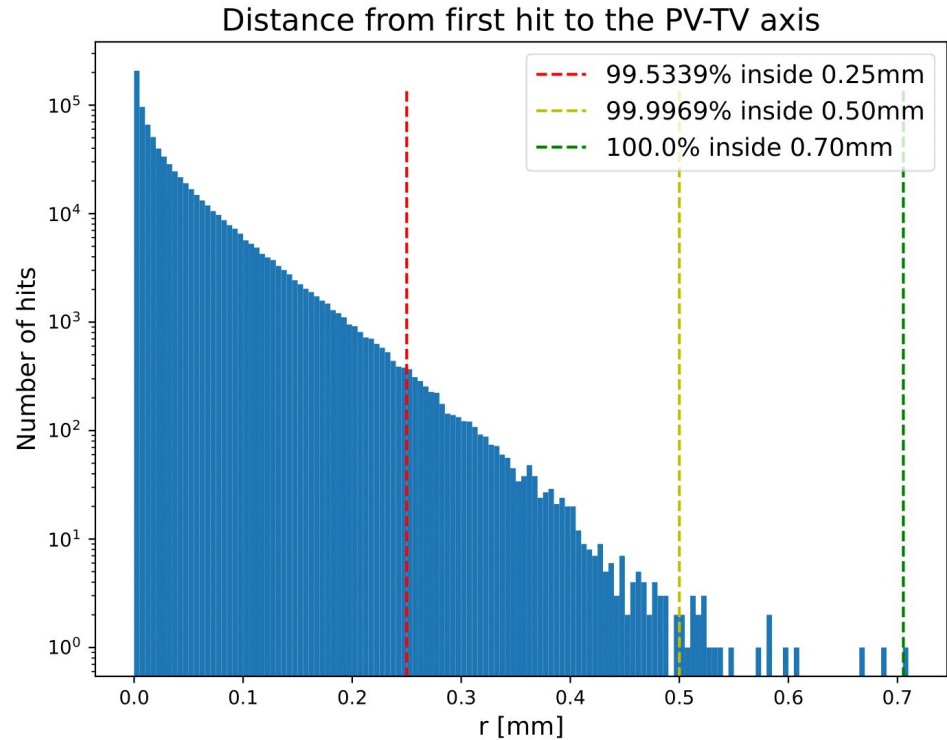


Results

Hit Distance

On filtered events 76% hits

0.50mm optimal search range

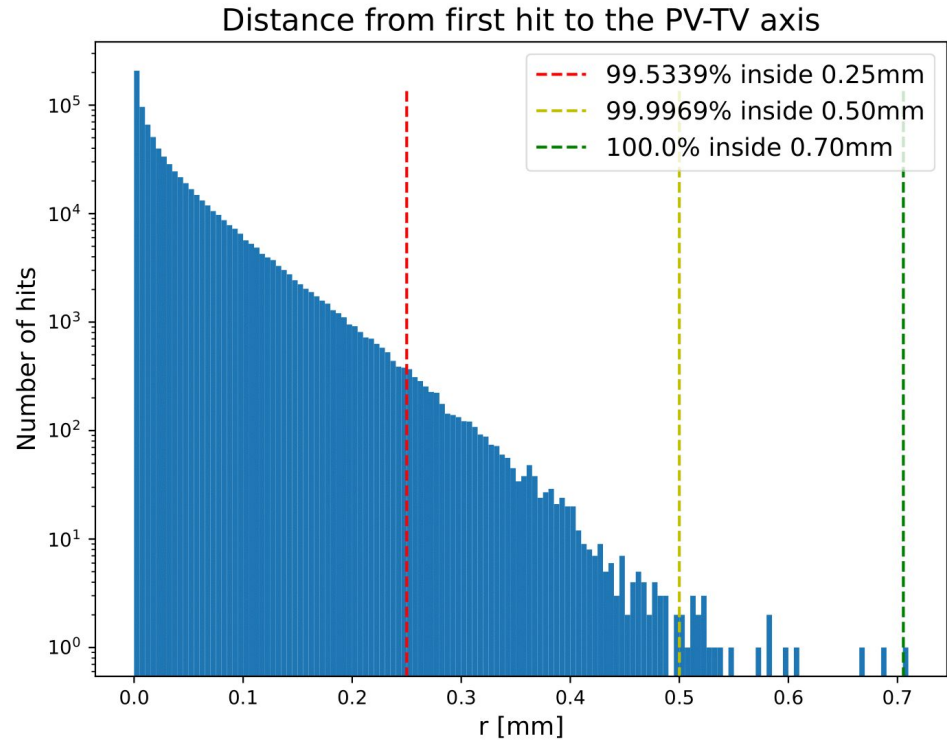




Results

True hit efficiency 96.4%

Extra hit probability 19.6%

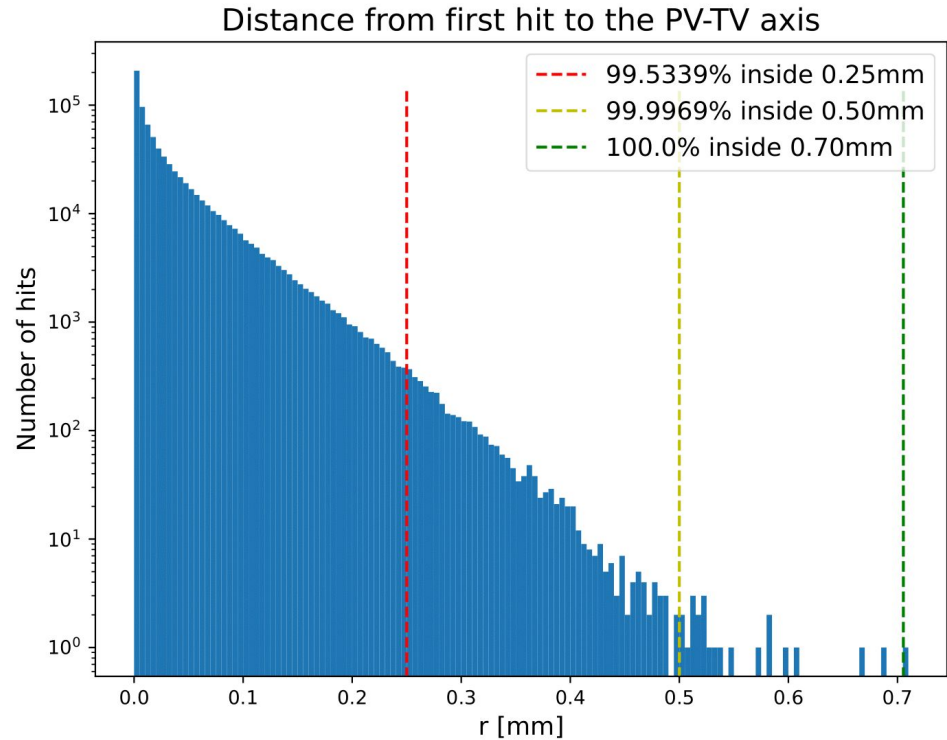




Results

0.25mm range cuts to much data.

0.70mm range has an
extra hit prob. 29.7%





discussion

The value for the noise is **very** conservative

Hitfinding algorithm can be optimised

The search window can be optimised



Conclusions

Most hits are close to the PV-TV axis

Extra hits are the biggest threat.

The tools created for this project can be used in further research.