CR search in data

Jolan Lavoisier -
PhD CNRS/U-Tokyo, IAP (ILANCE, ICRR)
Under the supervision of Kumiko Kotera and Takashi Sako

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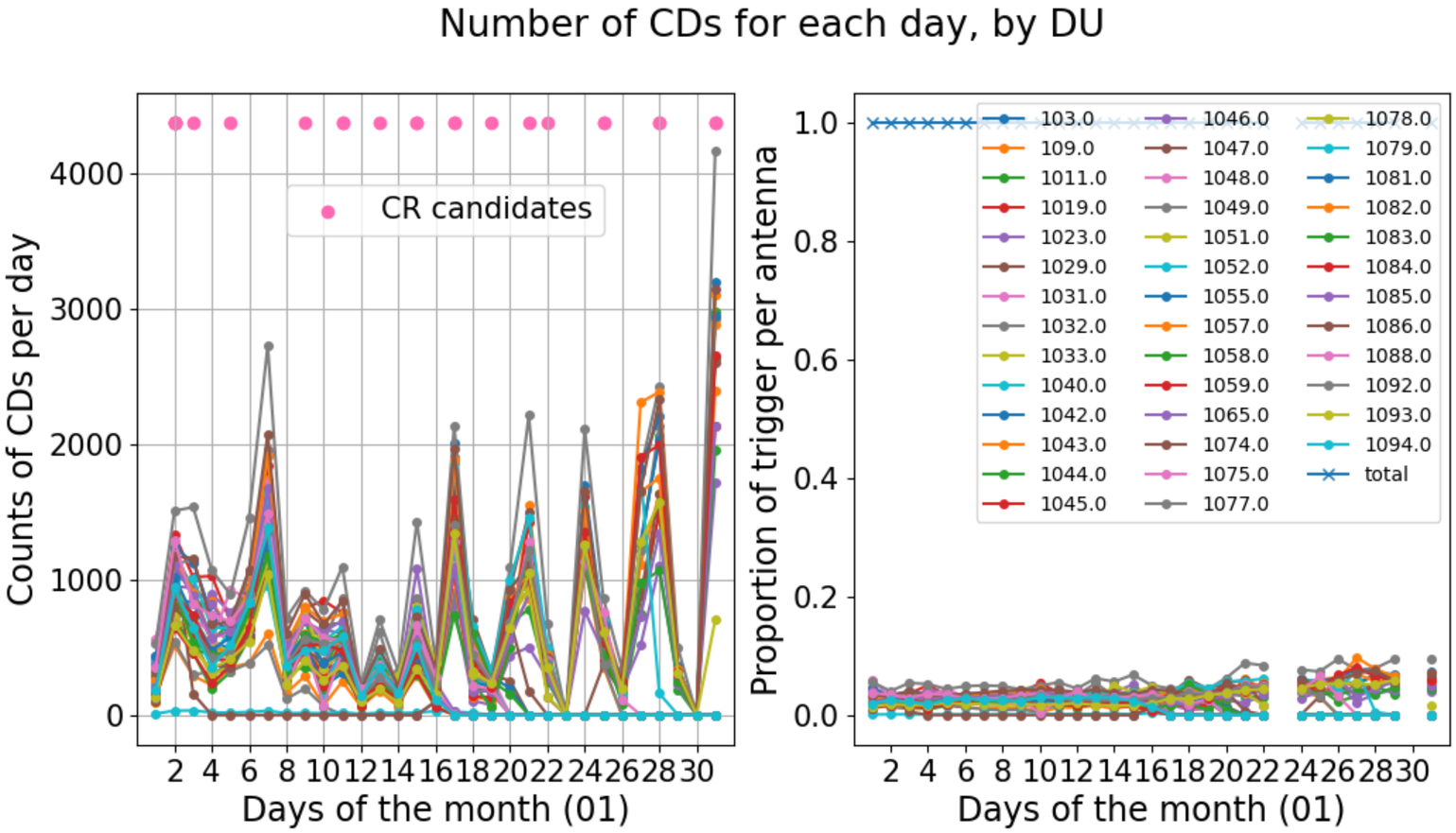
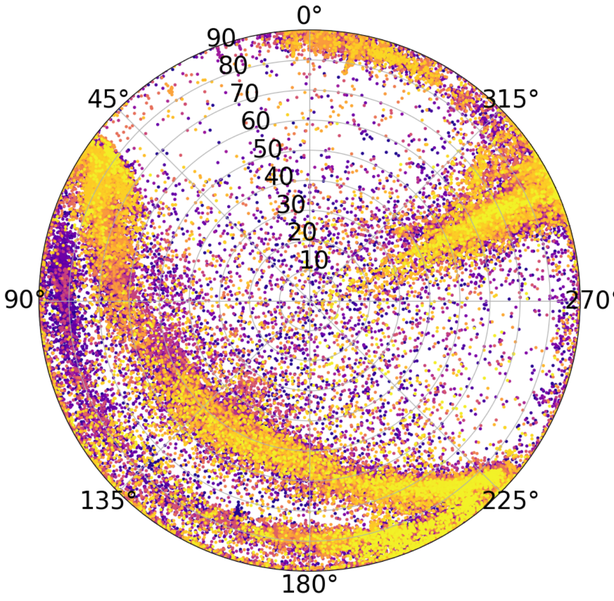
Data for CR search

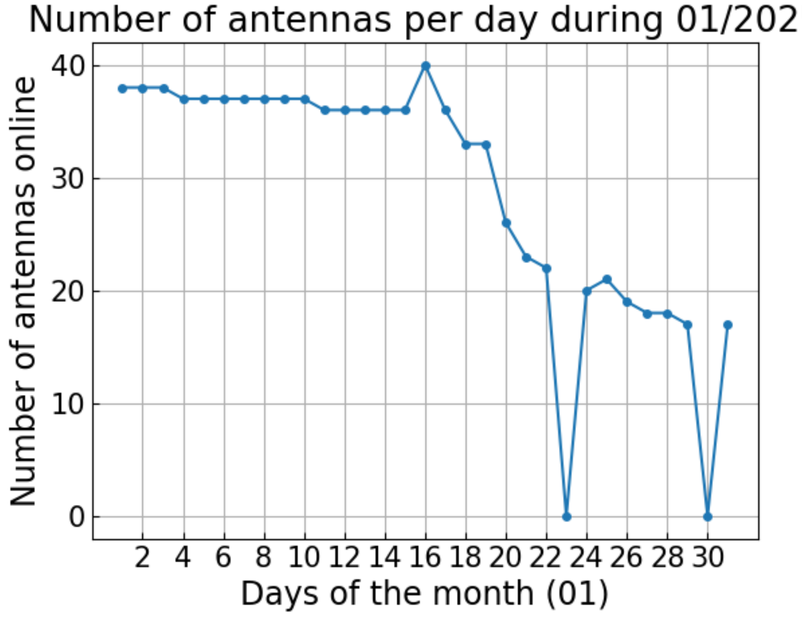
Data used: December to March (13449 runs), **CD runs**

Month	Number of runs	Longest stable period	Number of events (>=4 ant)	Number of CR candidates
Dec	4044	2 times 10 days	101k	10
Jan	4704	19 days	97k	24
Feb	1246	4 days	48k	5
Mar	3268	Inconclusive	Inconclusive	2

January set up stability





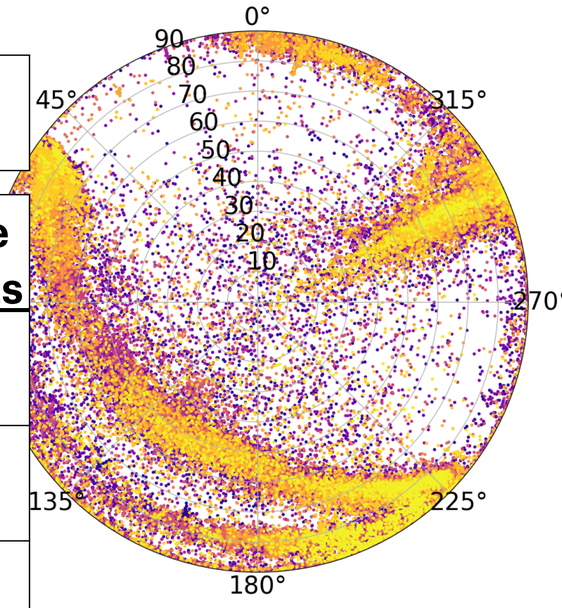


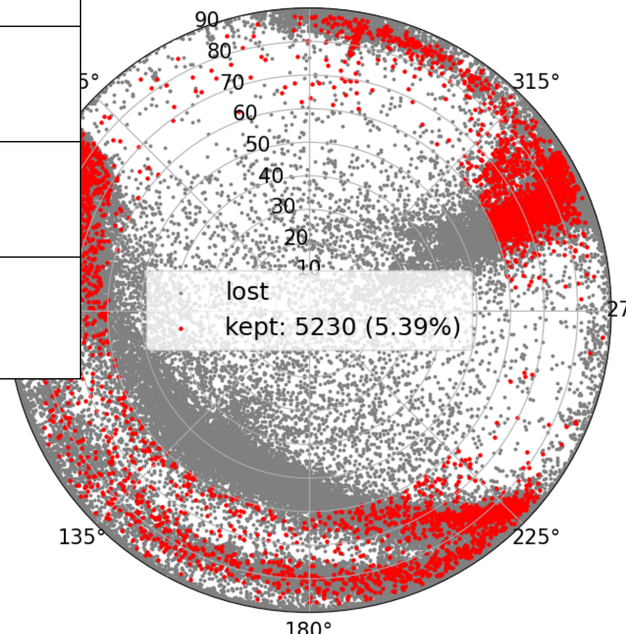
kumiko 10:05 AM

Hi all, @paul.minodier is proposing to run a set of sims in the cluster in Japan for the actual layout of January, which is stable.
He will do not core-contained sims with Coreas, with cores thrown around 200km2 around.
Then @katosei can compute the exposure for that specific month
and we can possibly make a comparison for the distribution in energy & zenith of events detected.

Applying cuts on January

			Stand alone		Cumulative	
Cut	**Parameters**	**Values**	**Events left after cut**	**Percentage of left events**	**Events left after cut**	**Percentage of left events**
Witness	-	-	98k	100 %	98k	100 %
Clustering	time_win angular_win	5 s 5 deg	37.4k	38 %	37.4k	38 %
Polarisation	max_pol	0.2	61.2k	63 %	22.8k	23 %
PWF error cut	max_error	0.5 deg	74.7k	77 %	15.7k	16 %
Nb of antenna	Min number of antennas	5	57.7k	59 %	7.9k	8 %
Zenith	θ_min θ_max	60 88	58.1k	60 %	5.2k	5 %





Clustering cut

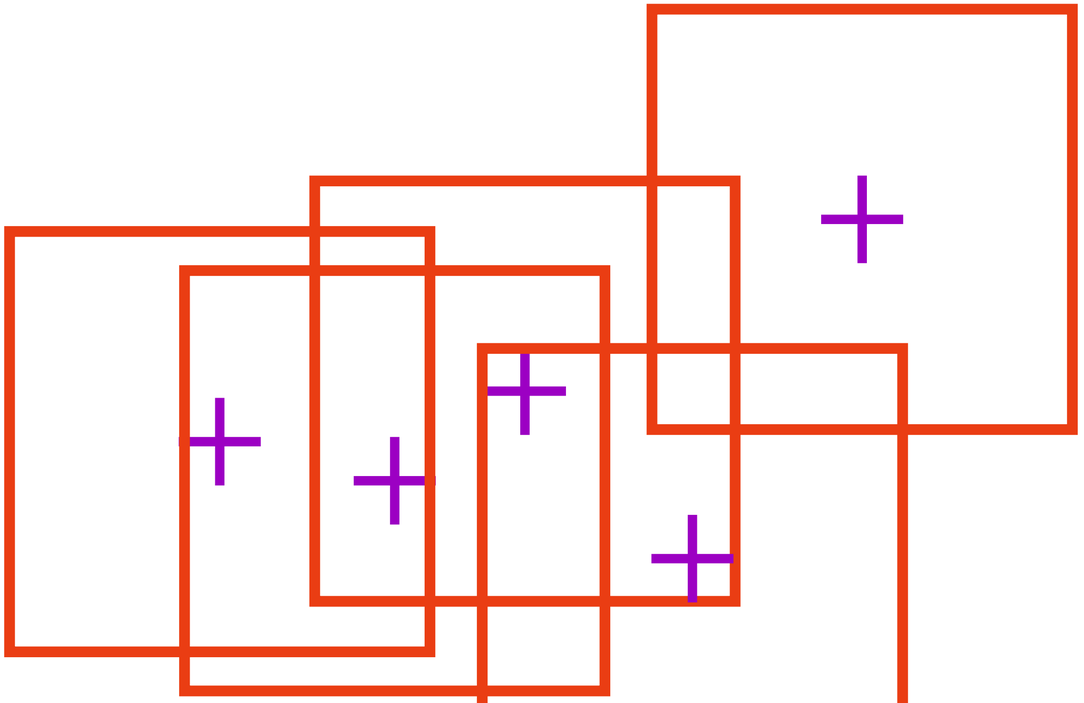
Objective: getting rid of events coming in waves

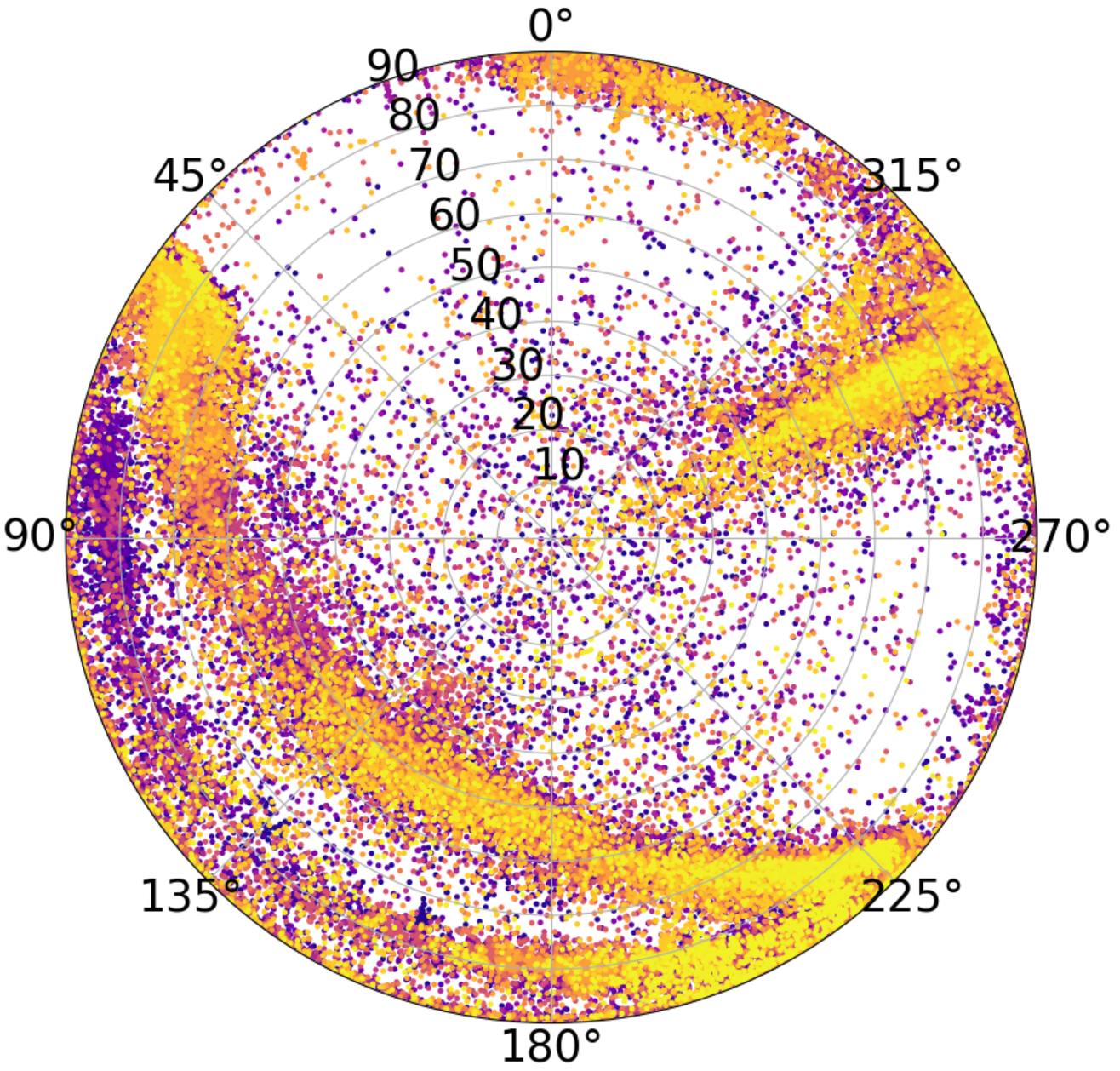
Algorithm:

$\geq$2 events $\in [\vartheta - 5\mathrm{deg}, \vartheta + 5\mathrm{deg}]$

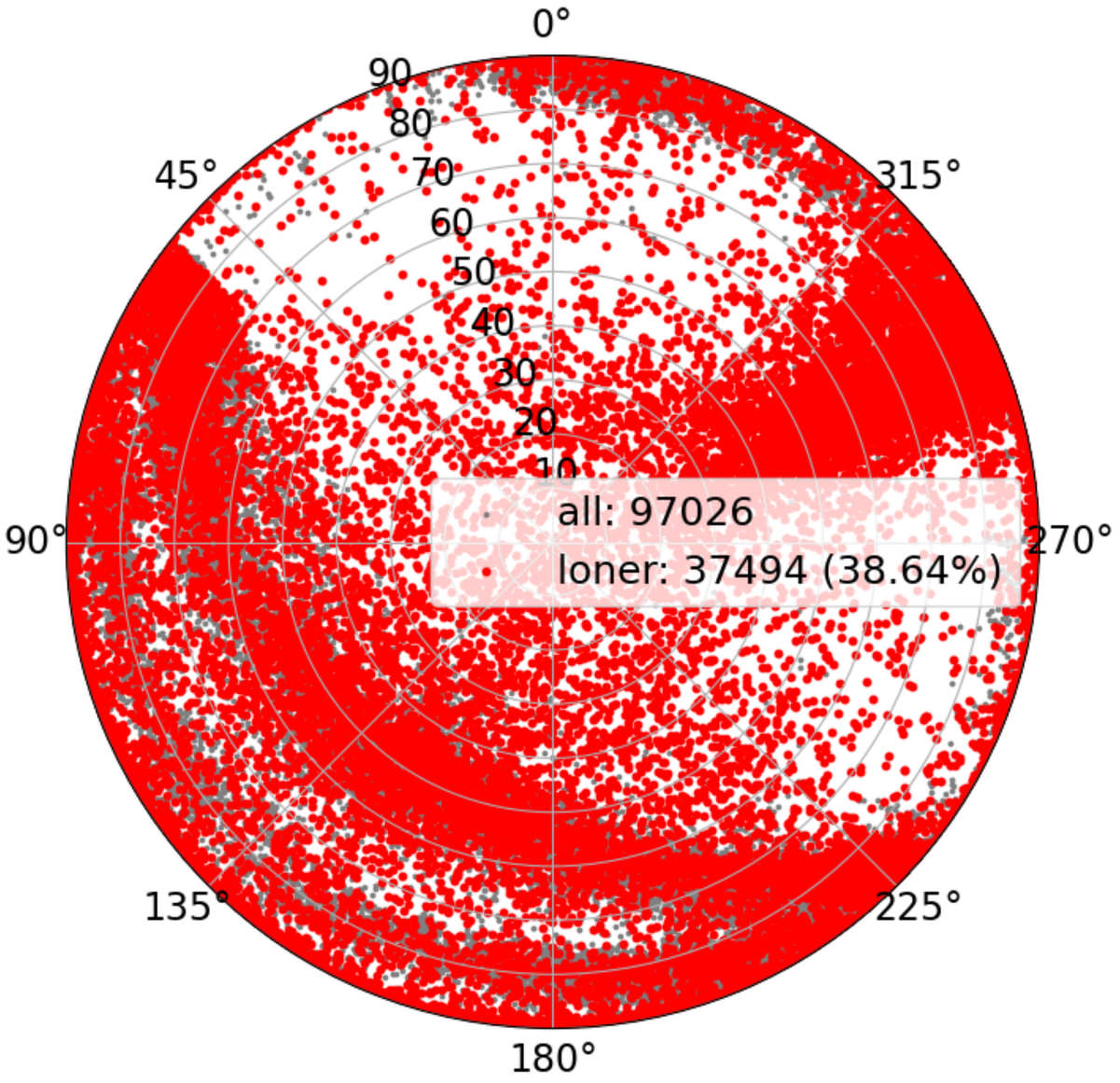
$\in [t - 5\mathrm{s}, \mathrm{t} + 5\mathrm{s}]$

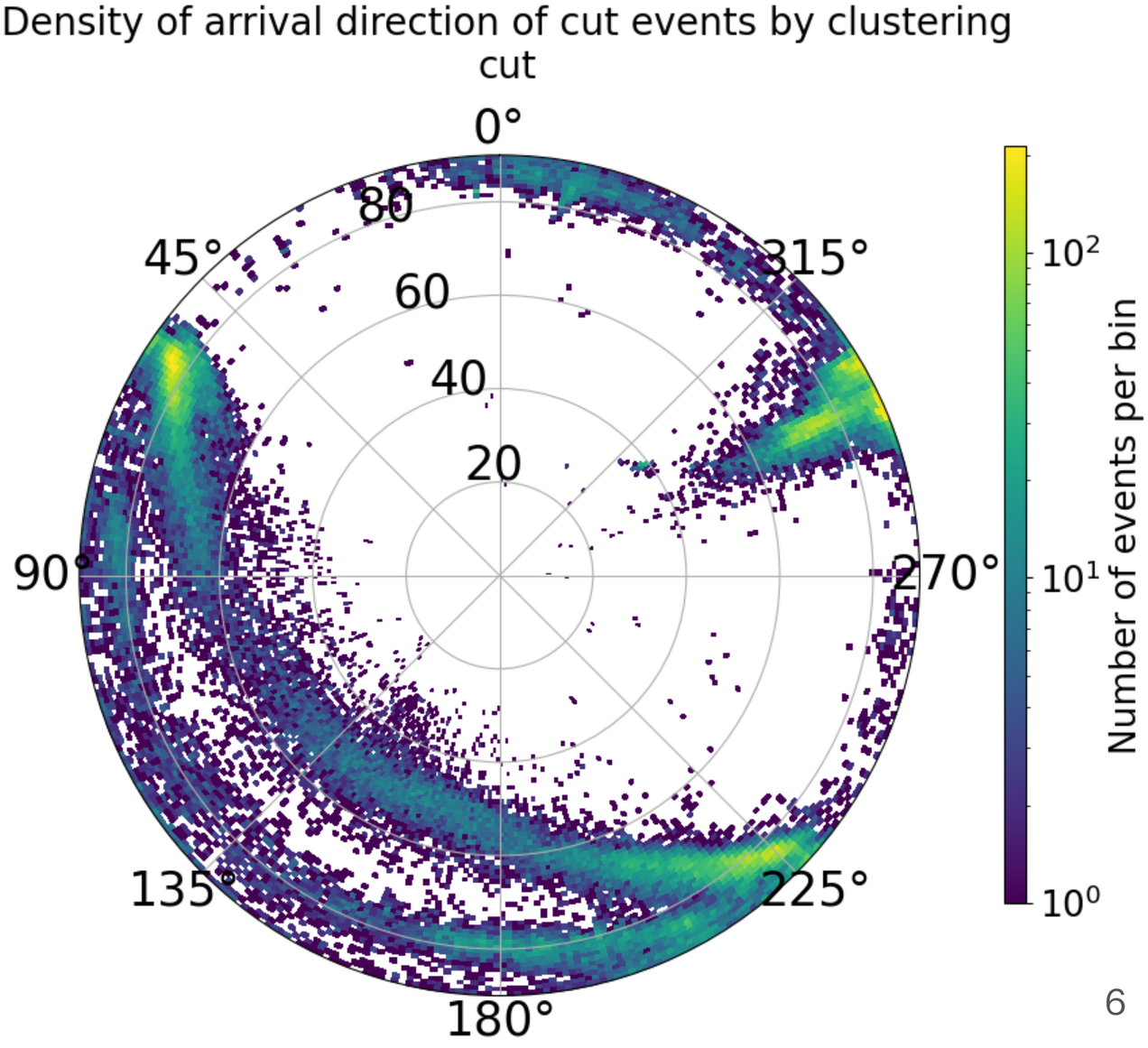
=> part of a cluster





Clustering cut on January data

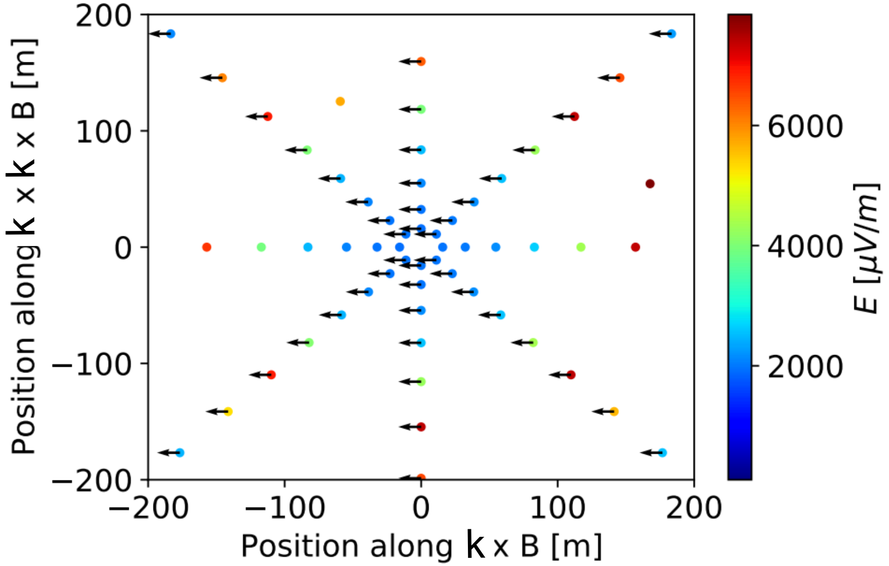




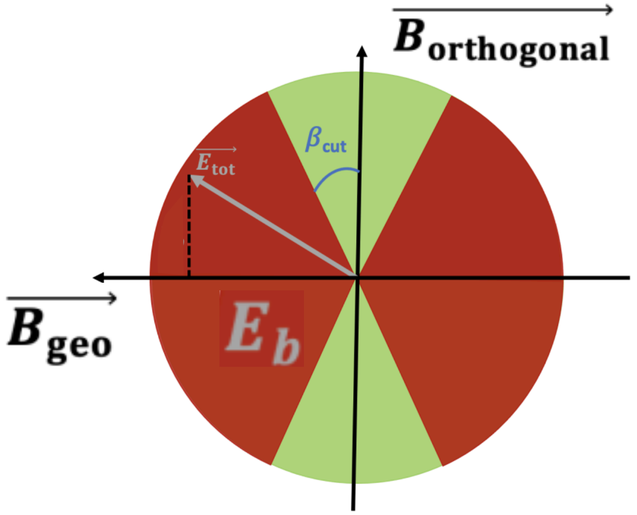
Polarisation cut

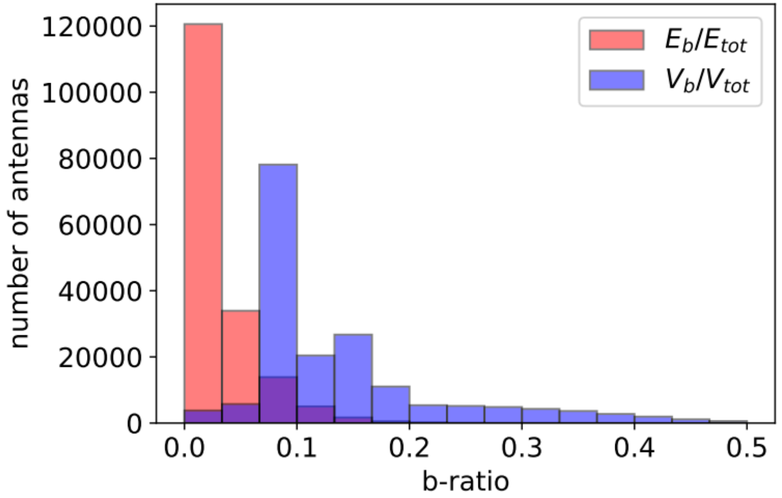
E-field amplitude and direction of the geomagnetic emission

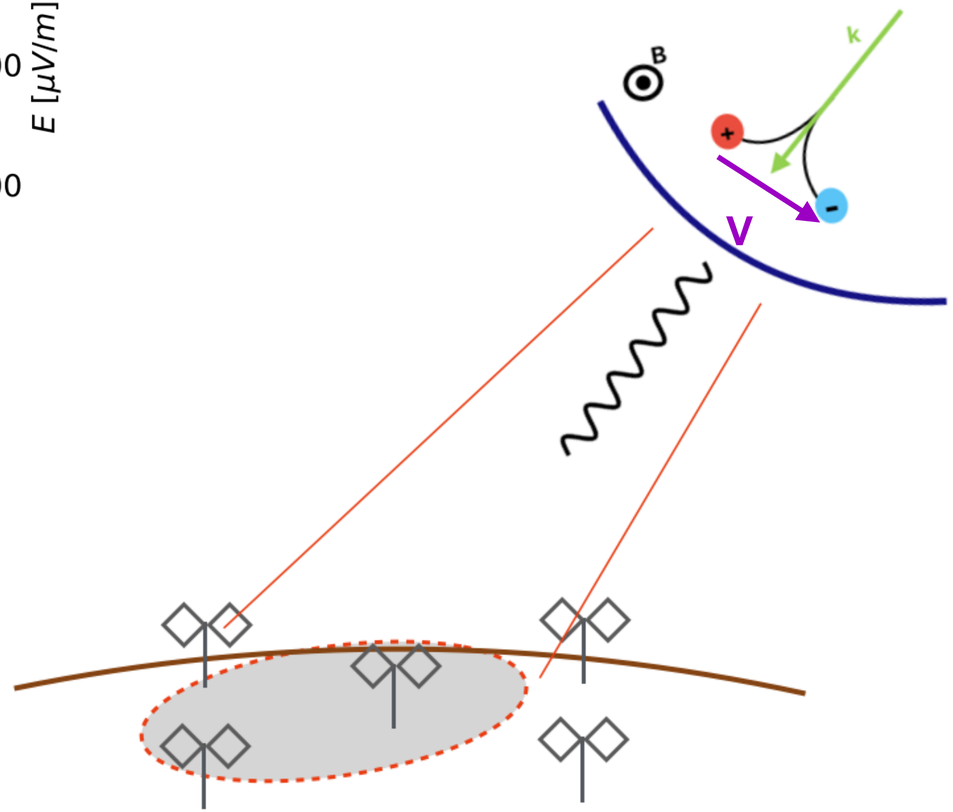
Geomagnetic effect



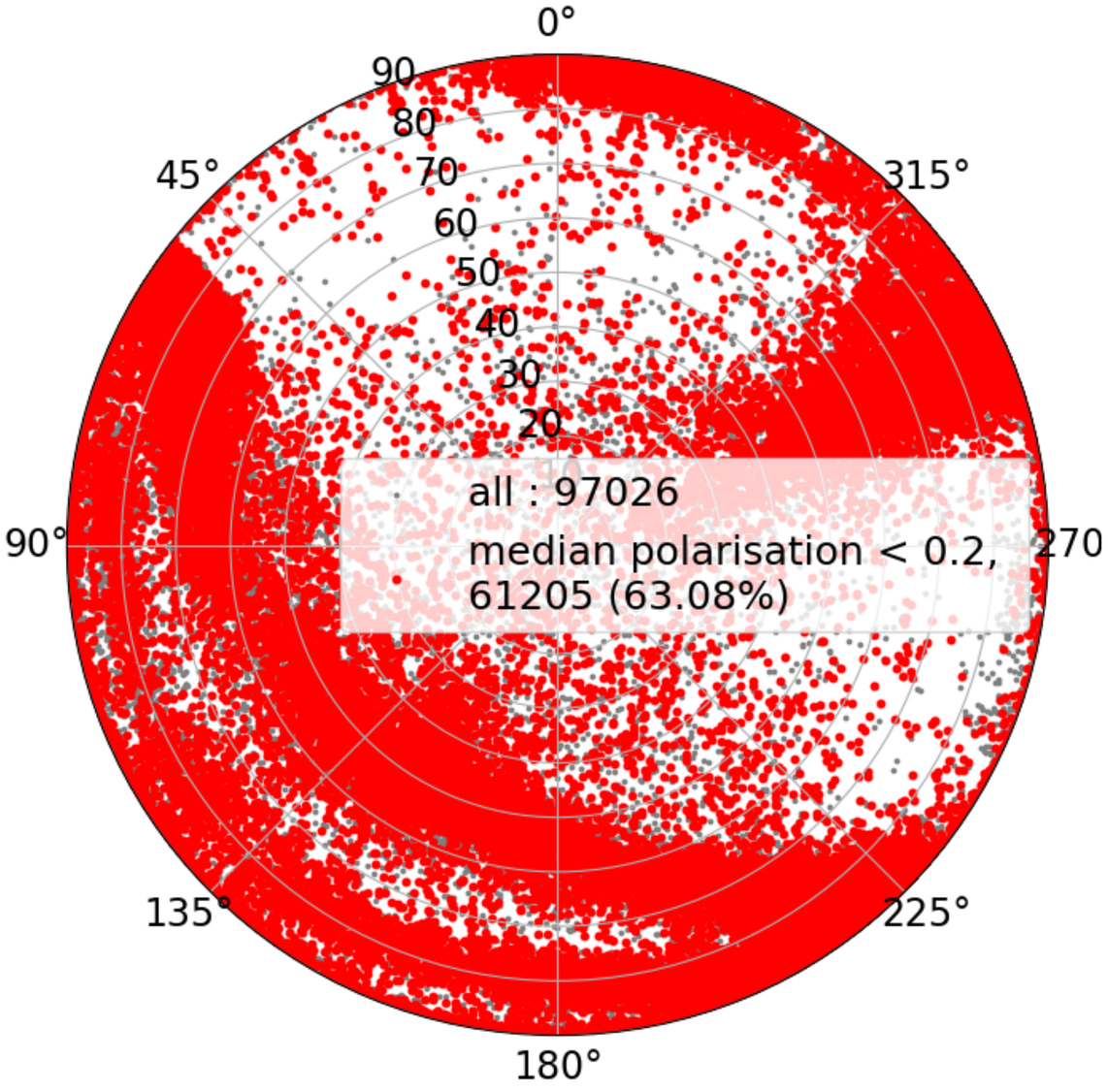
Chiche et al., 2022

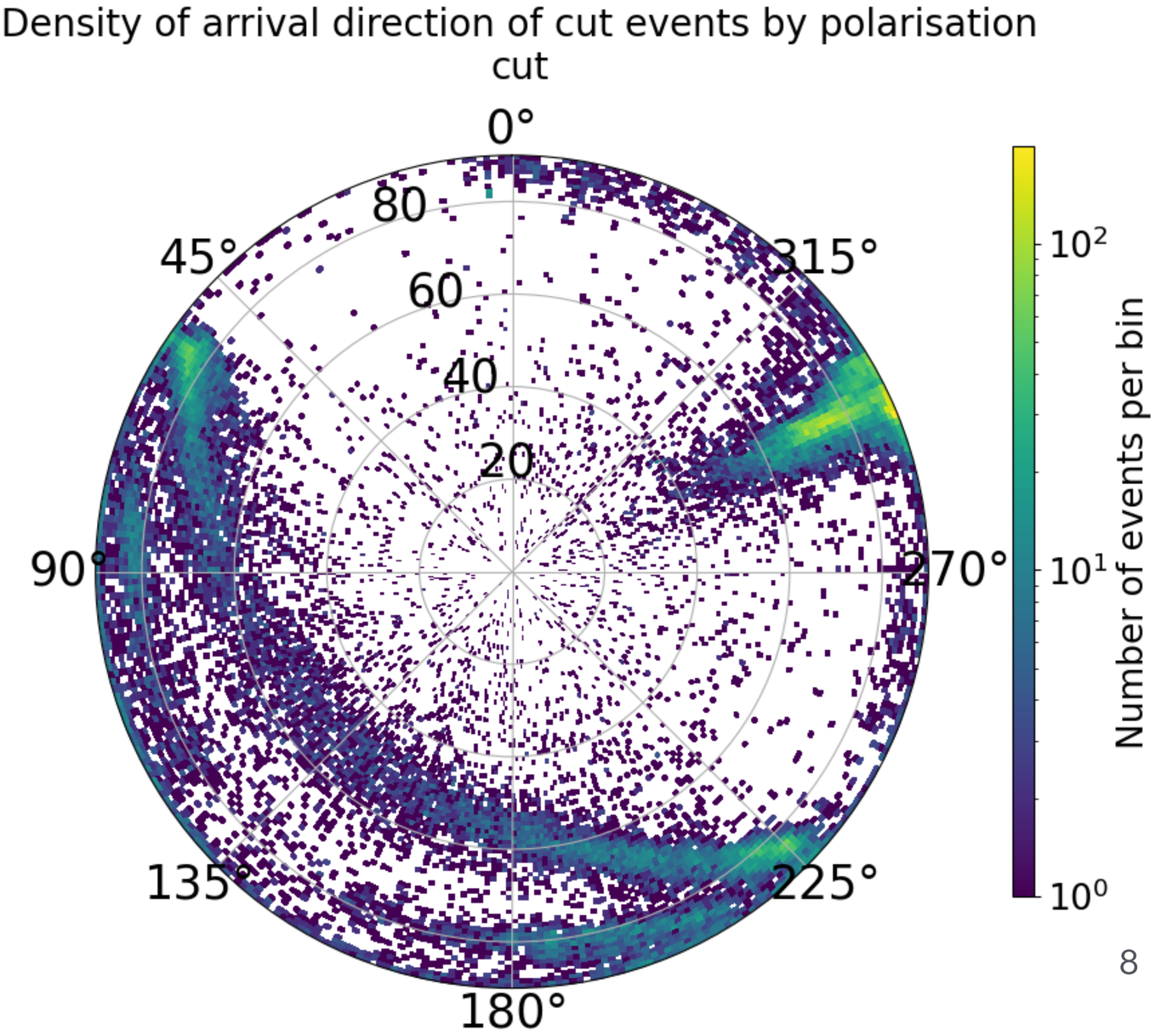




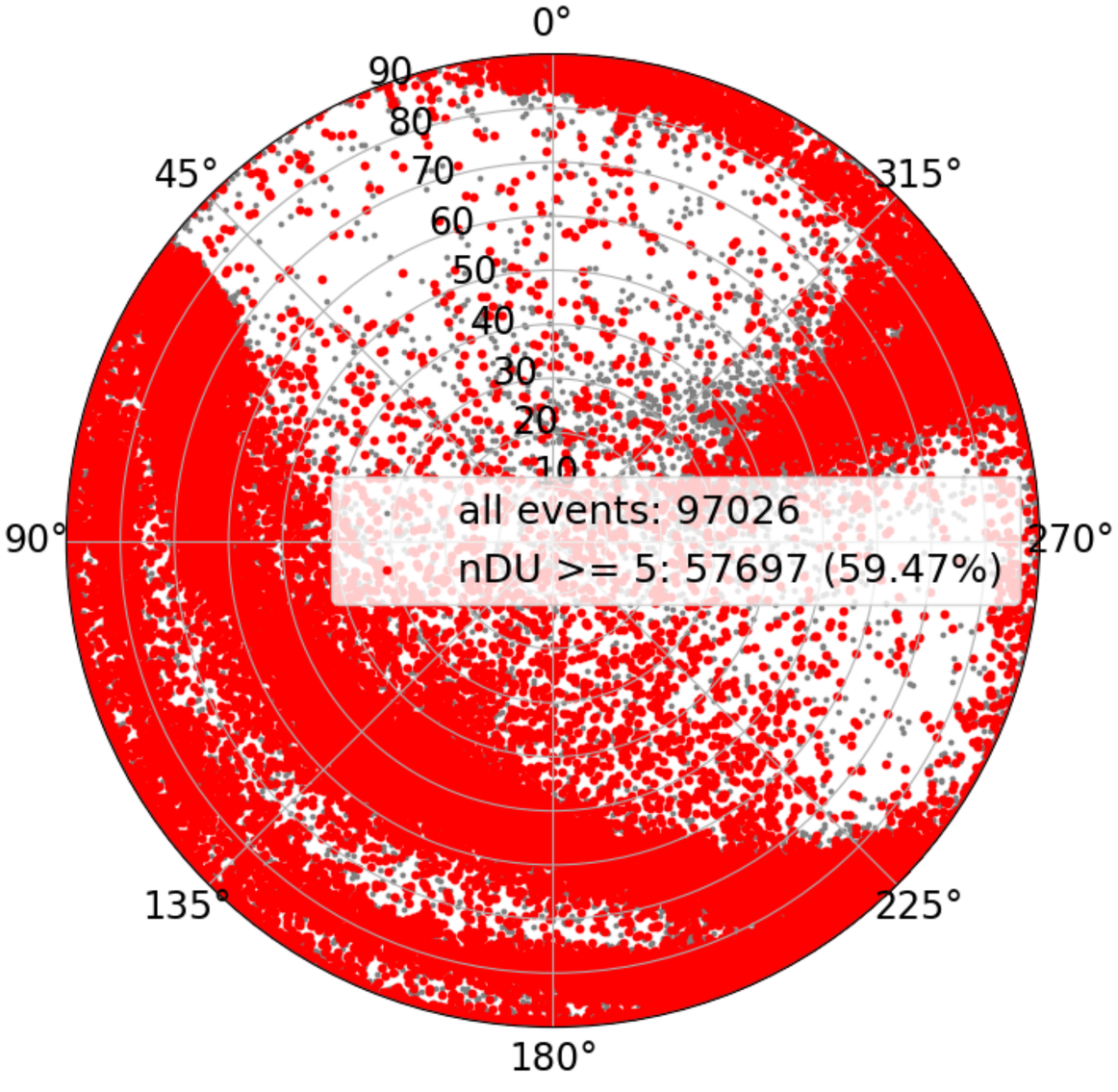


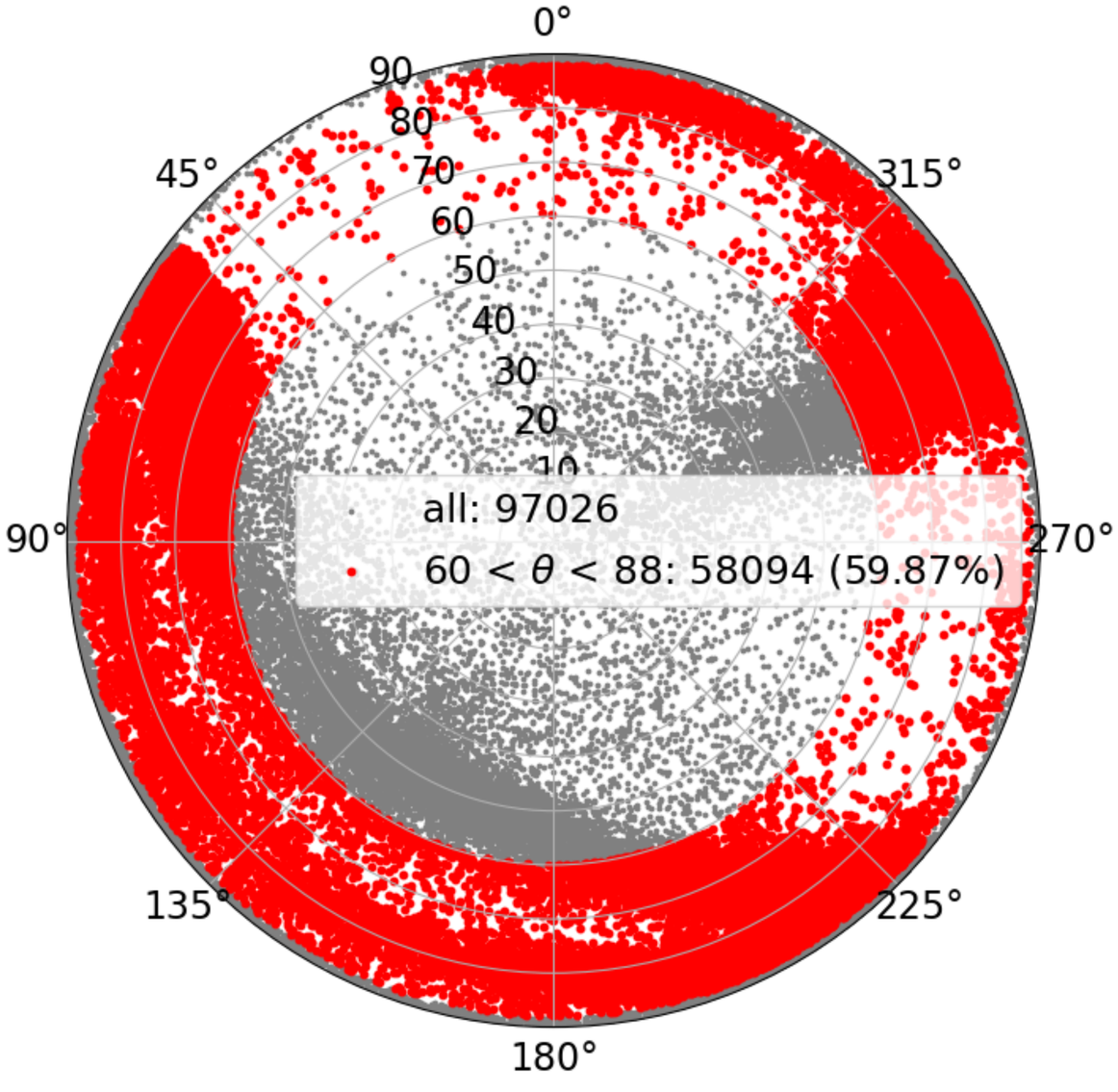
Polarisation cut on January data





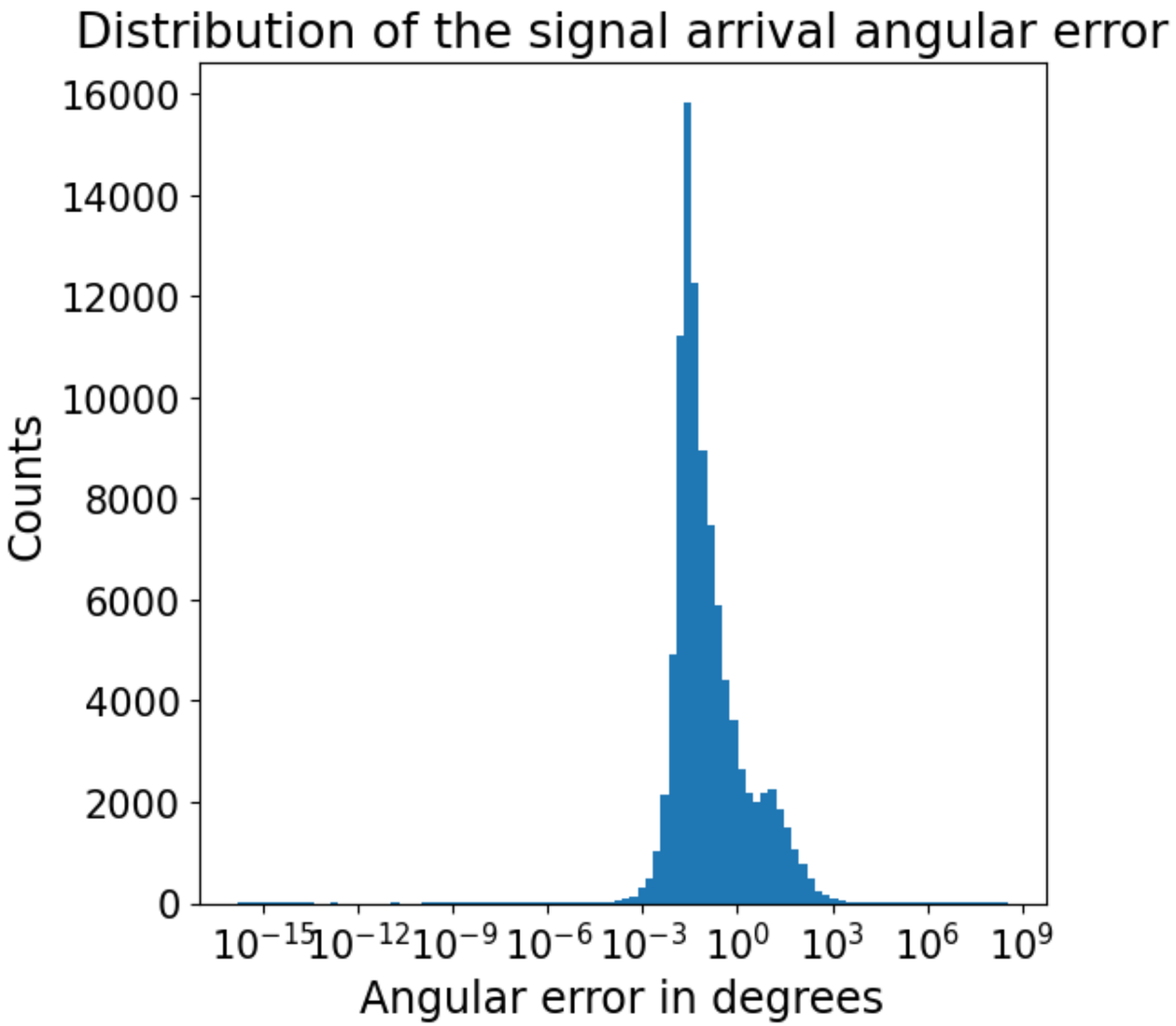
Number of antennas and zenith cuts





PWF error cut (?)

For January data:



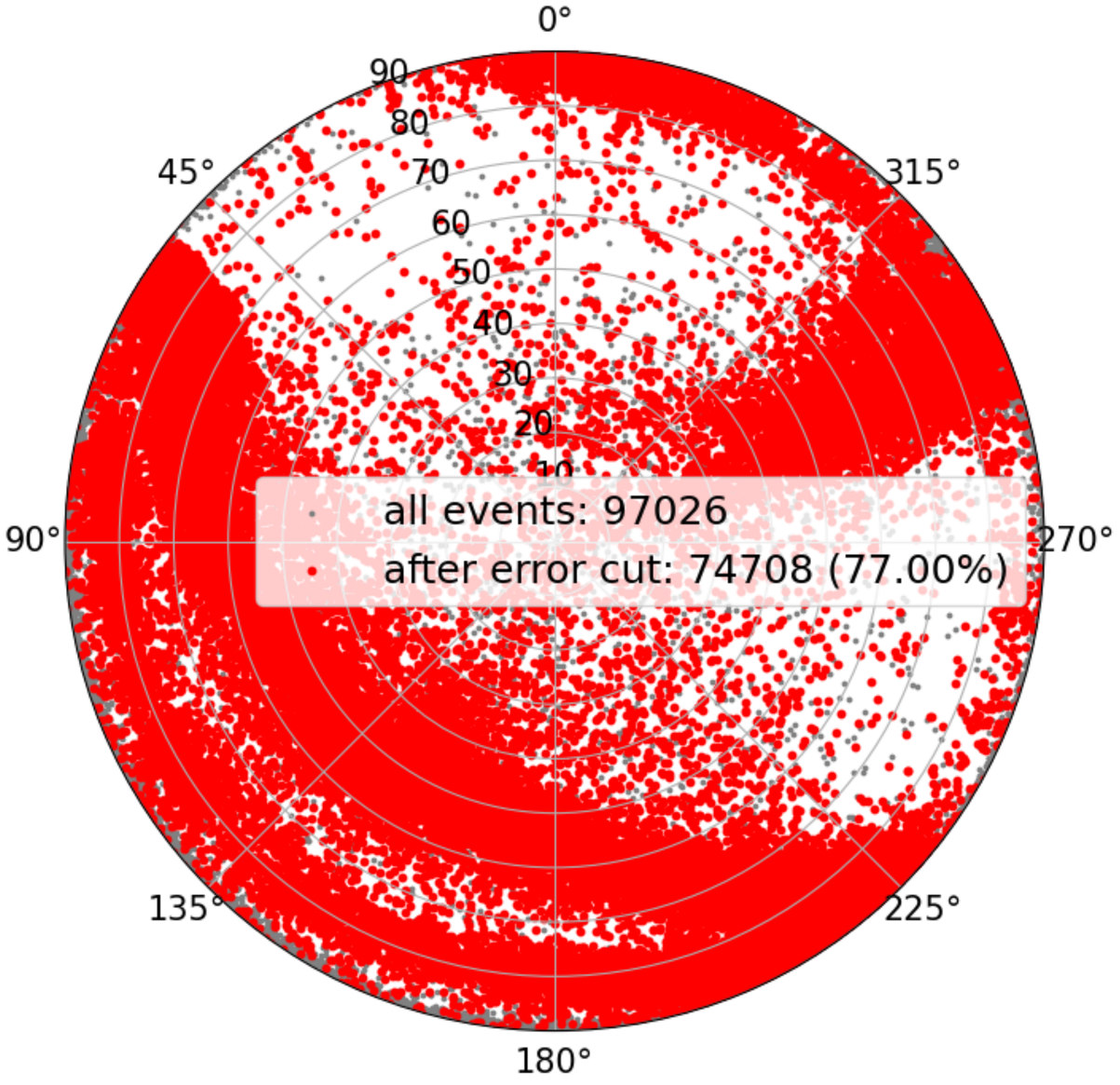
Get rid of all events under 0.5

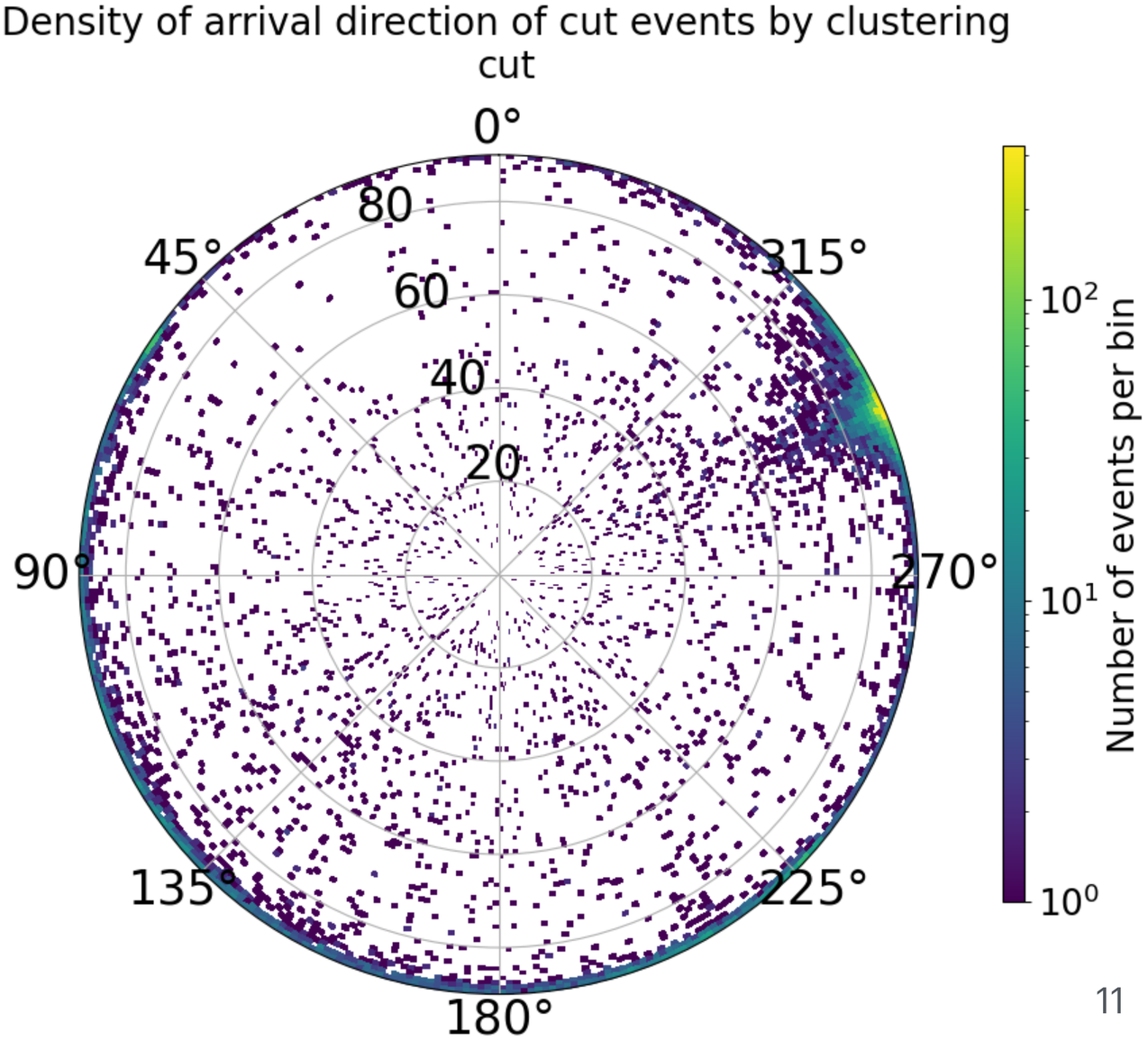
Objective of the cut: getting rid of events triggered by multiple sources

But: measures the error IF THE EVENT WERE TO BE IN PLANAR WAVE FRONT

Relevance?

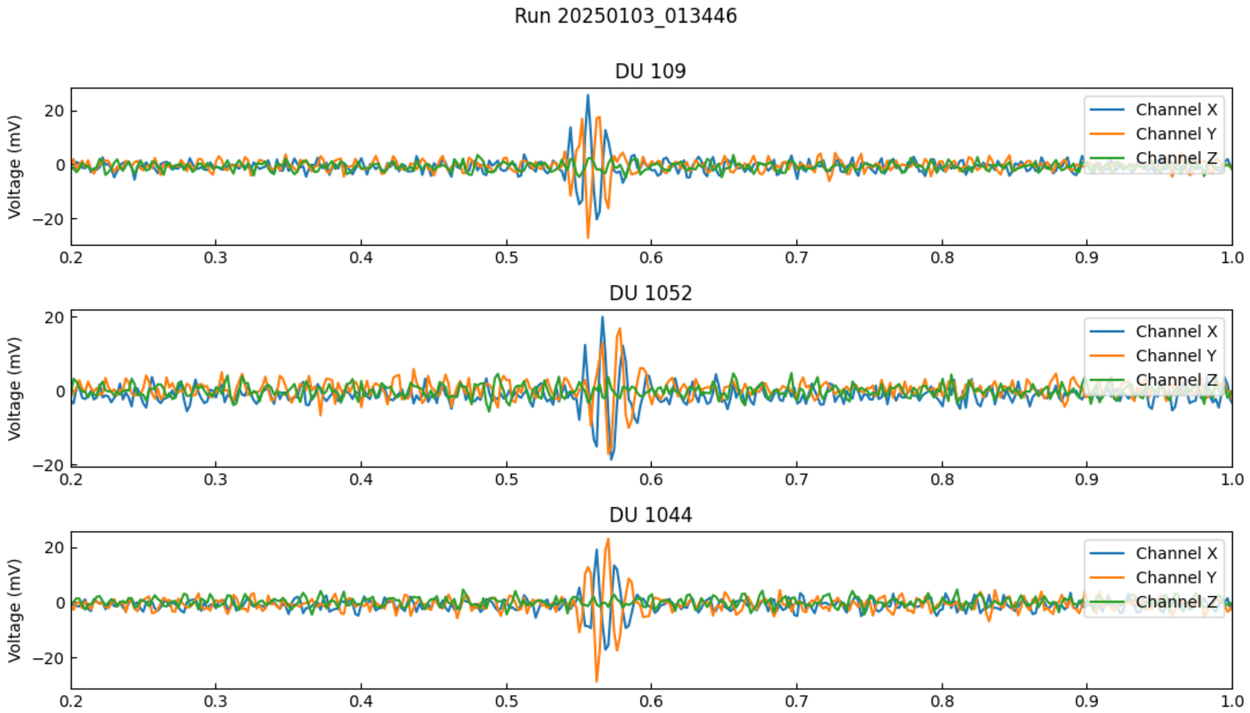
PWF error cut

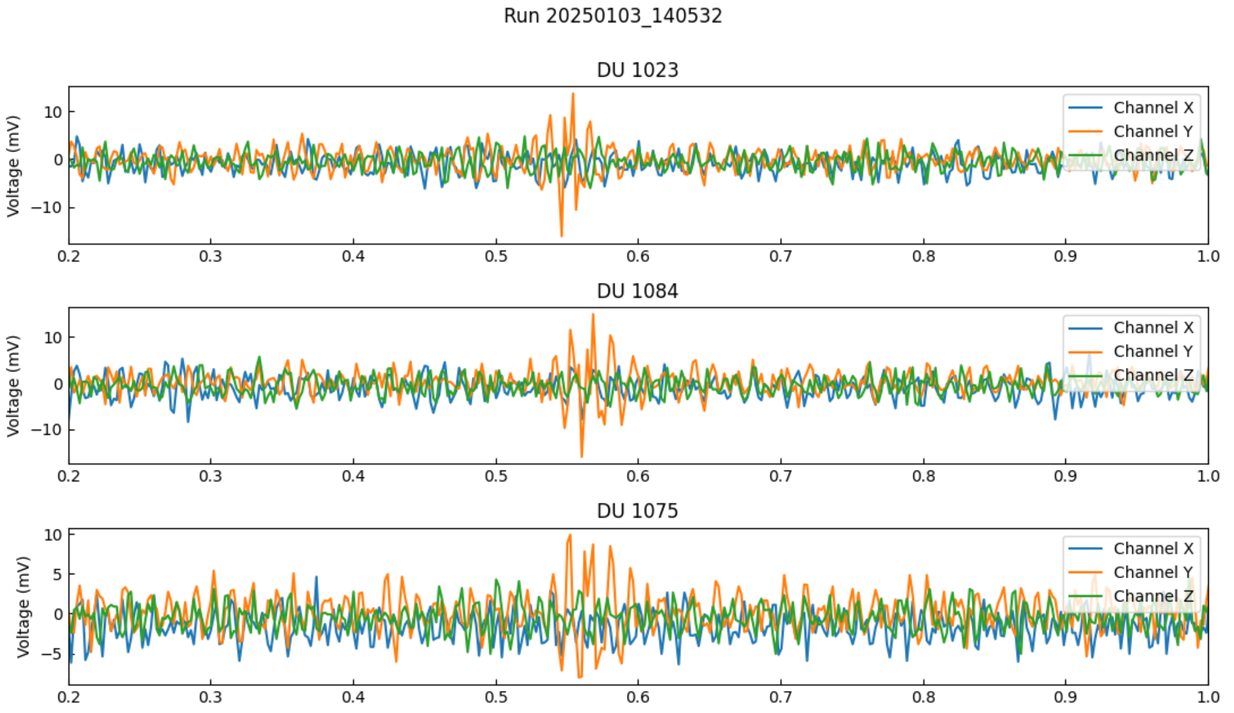




Visual cuts: traces

Visual cuts describe my looking into events passing all previous cuts

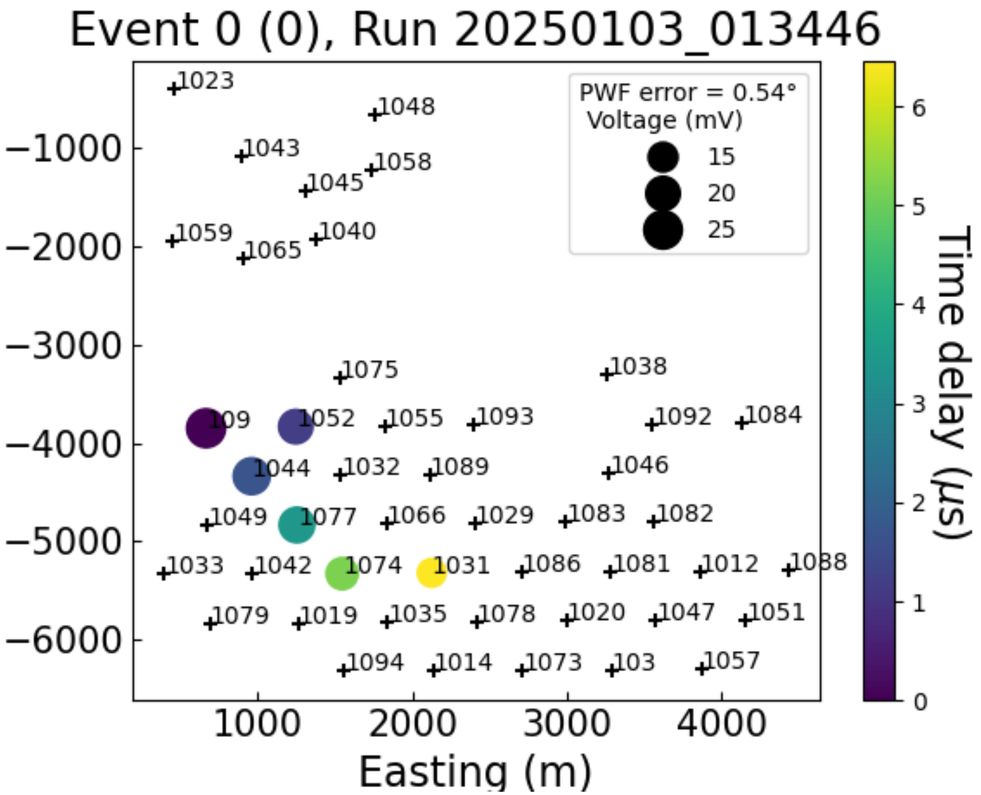


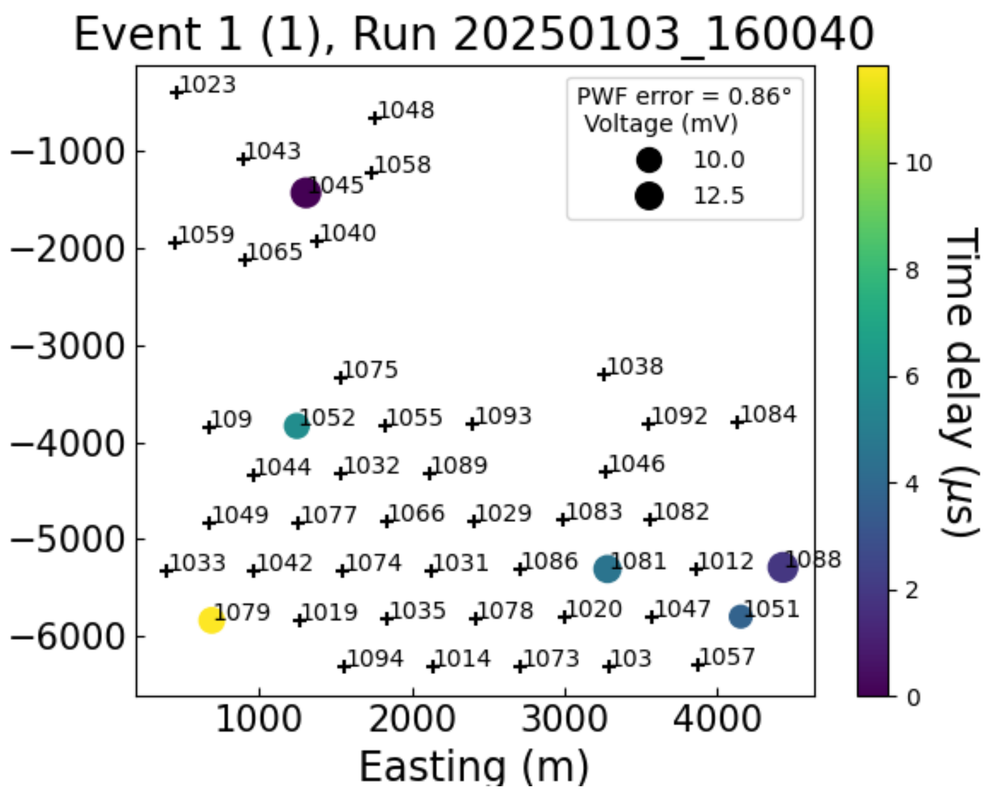


Good traces: short time pulse, not too “spiky”

Transforming it into a cut: measure the time pulse

Visual cuts: footprints

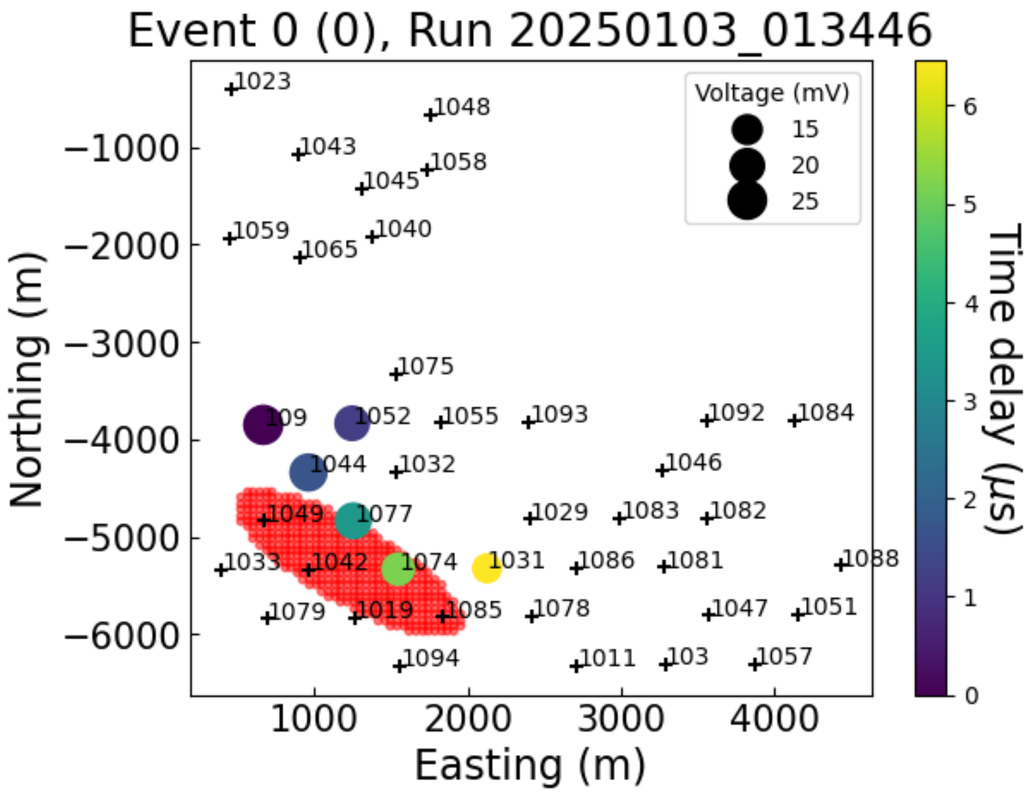


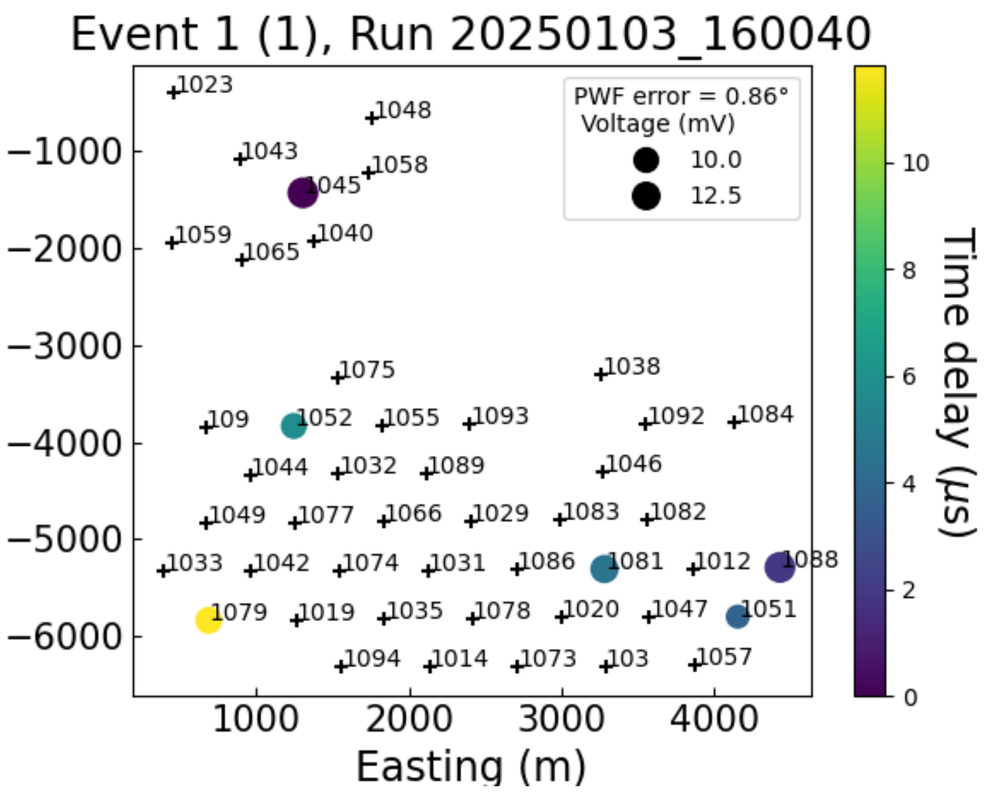


Good footprint: no dispersion, close

Transforming it into a cut: measure the area of triggered antennas and compare it to theoretical footprint

Visual cuts: footprints

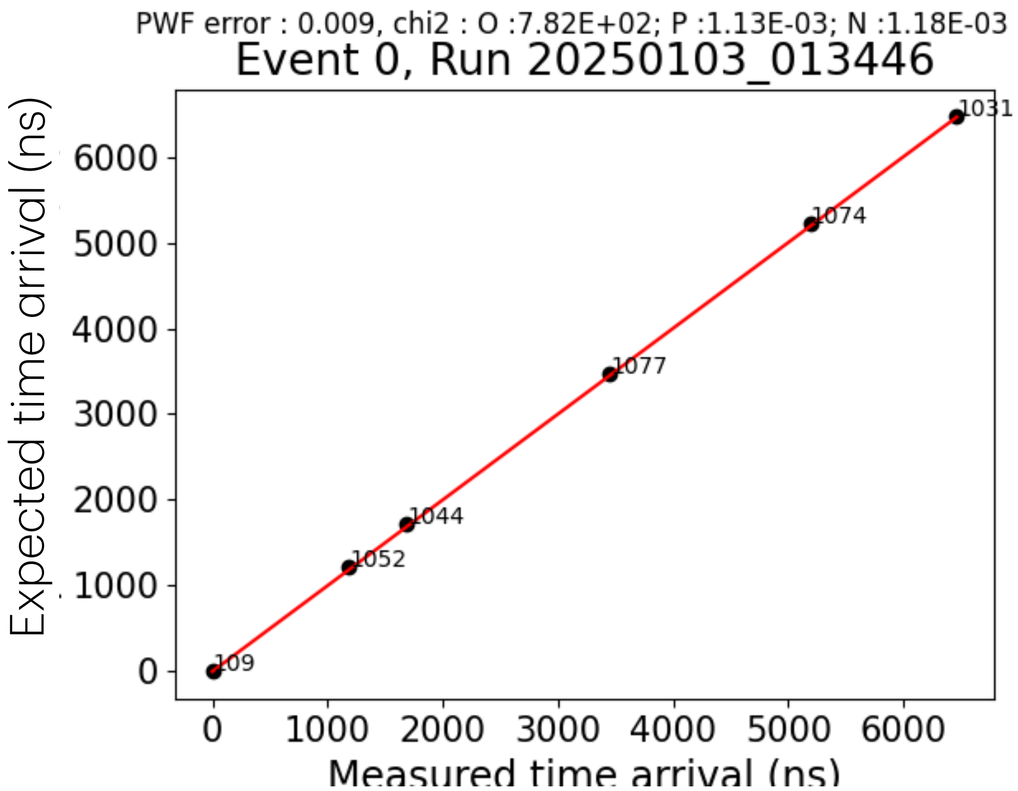


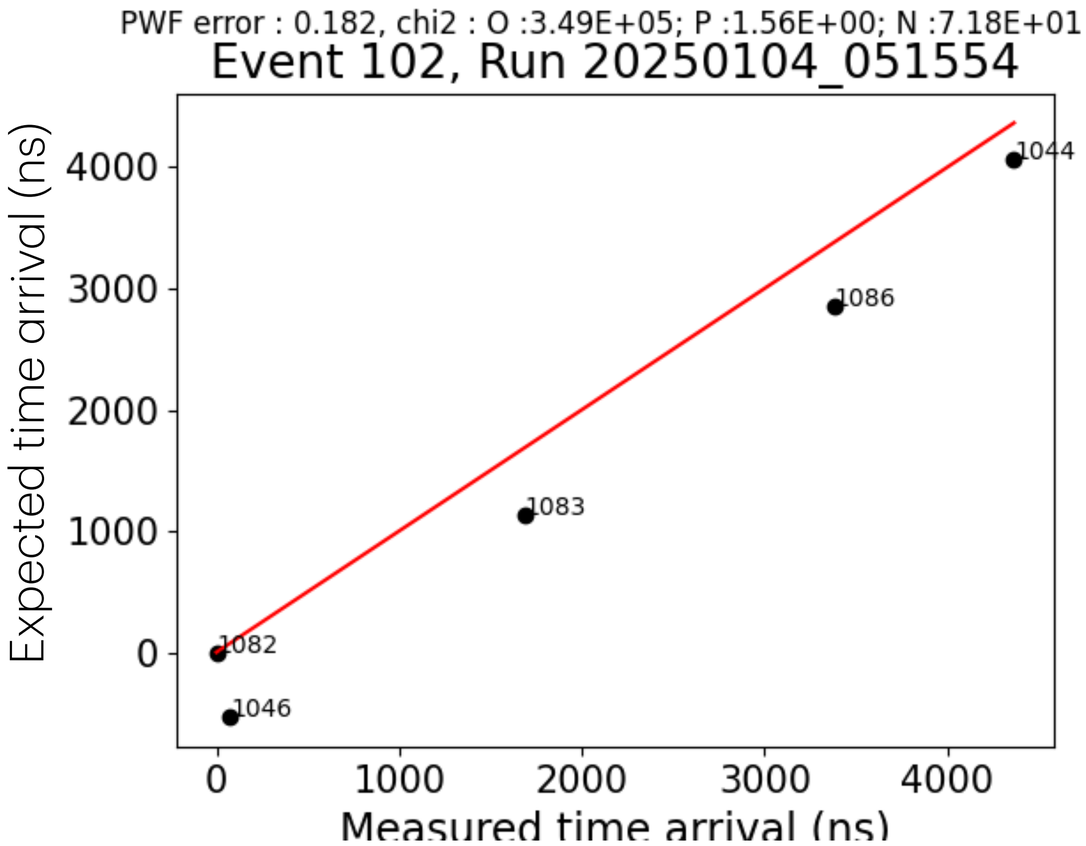


Good footprint: no dispersion, close

Transforming it into a cut: measure the area of triggered antennas and compare it to theoretical footprint

Visual cuts: delay timing

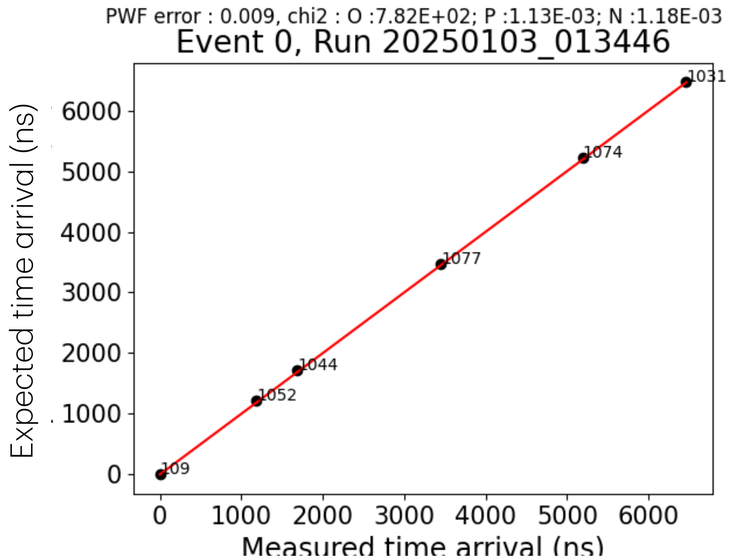


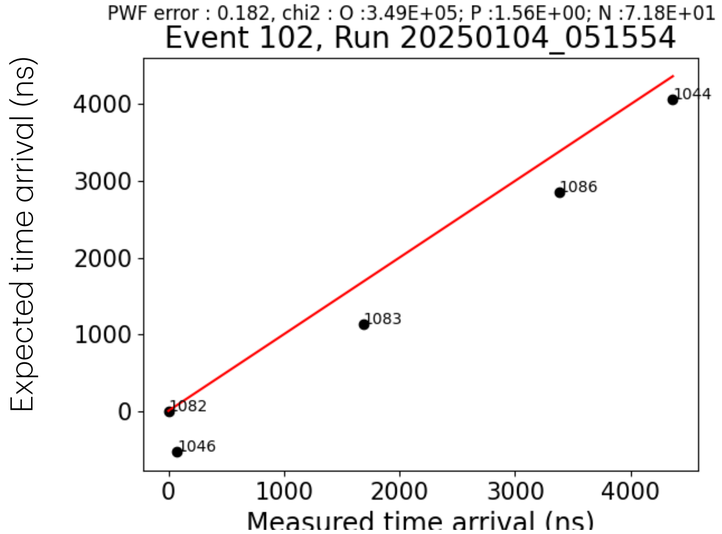


Good footprint: all points on line

Transforming it into a cut: select one χ^2 and apply a cut

Visual cuts: delay timing

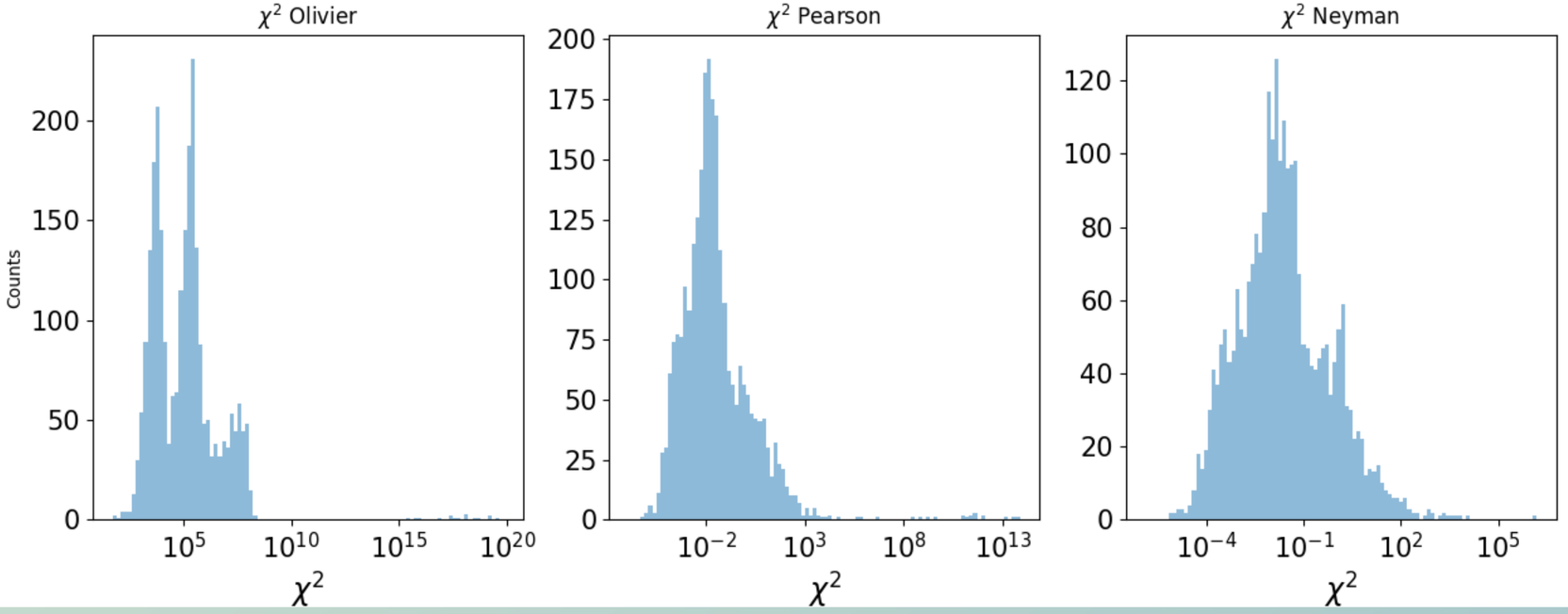




$$\chi^2_{\text{Olivier}} = \sum_i \frac{(t_{\text{meas}} - t_{\text{exp}})^2}{N-2}$$

$$\chi^2_{\text{Pearson}} = \sum_i \frac{(t_{\text{meas}} - t_{\text{exp}})^2}{t^2_{\text{exp}}}$$

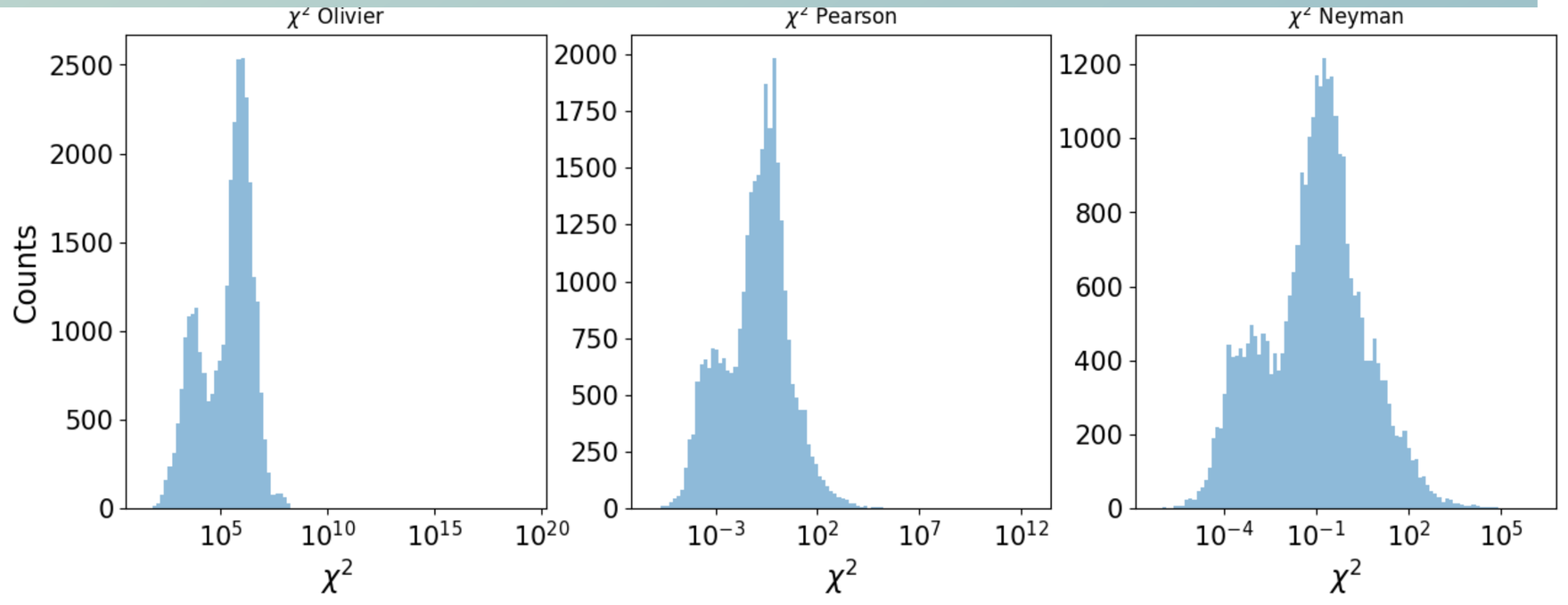
$$\chi^2_{\text{Neyman}} = \sum_i \frac{(t_{\text{meas}} - t_{\text{exp}})^2}{t^2_{\text{meas}}}$$



North

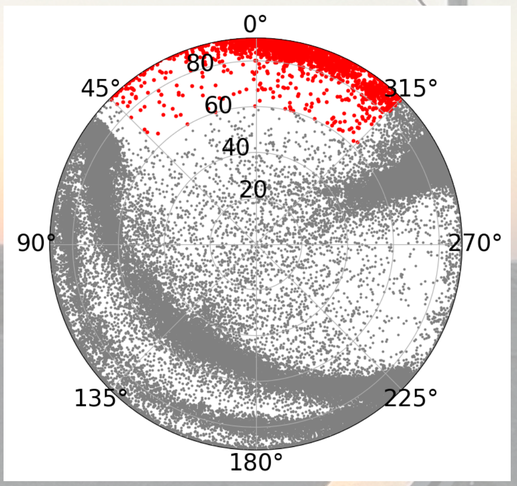
χ^2 distributions

Mine

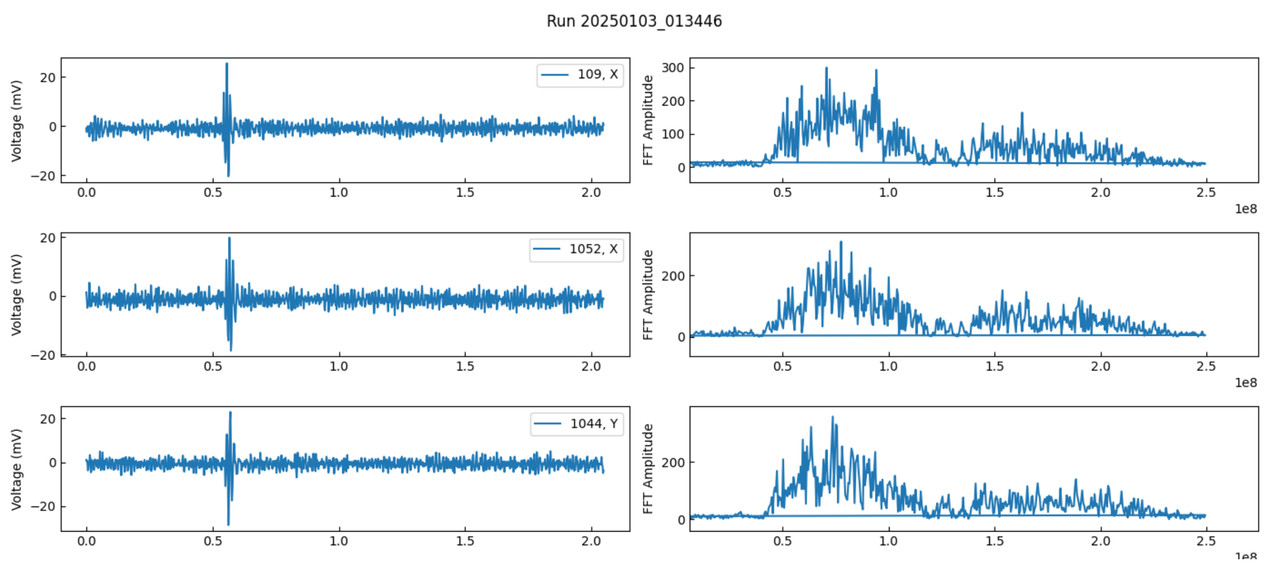


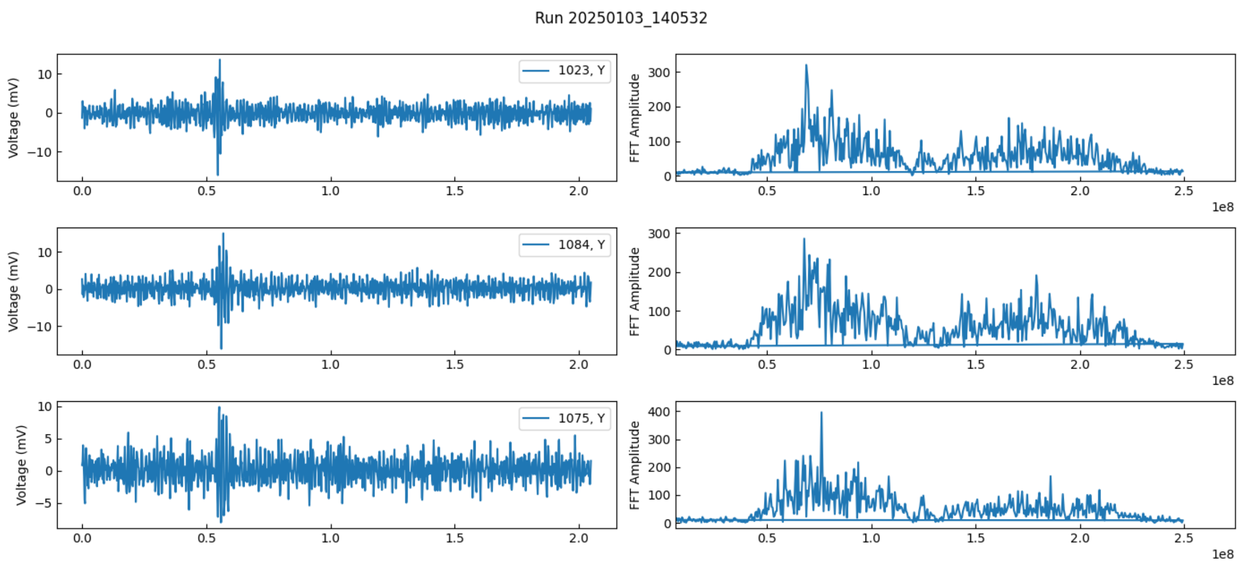
Summary

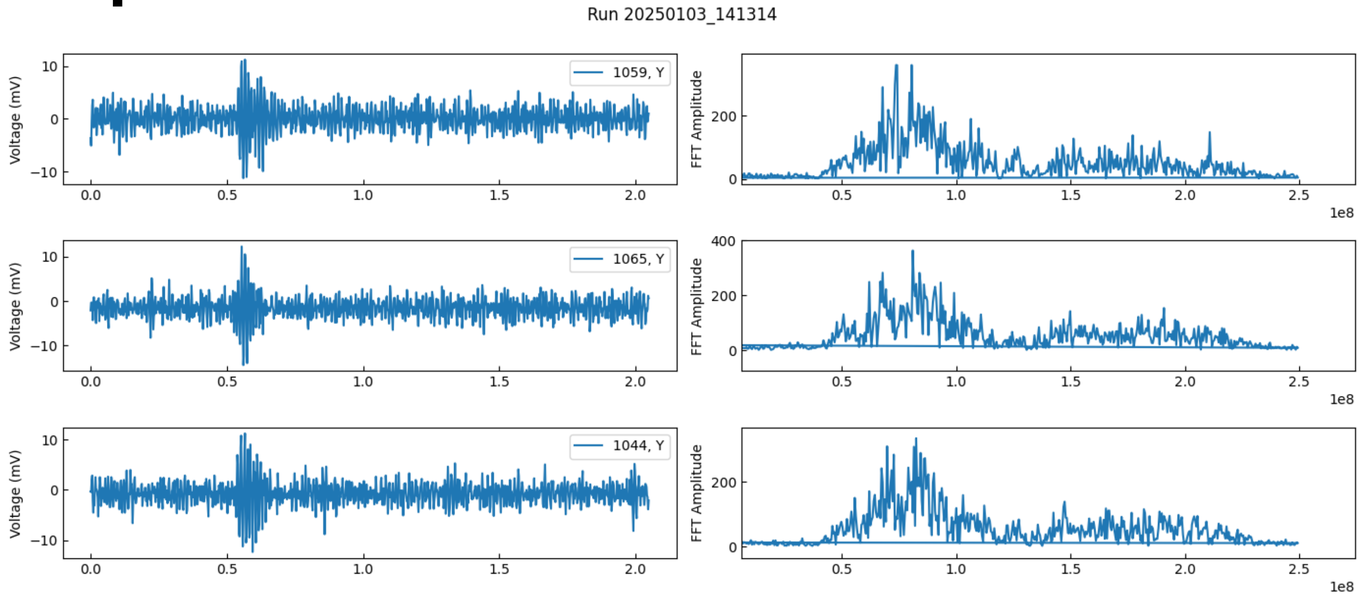
- Methods give me a lot of events left
  - Cannot look at all left events (5700 in January)
  - Must choose the region I apply my visual cut to (North region)
- Visual cuts need to be implemented as actual cuts



Visual cuts: frequencies







Harder to put a cut on frequencies

I am not 100% sure, but I think my approach makes sense. Basically every CD file comes from UD files going through the 3rd trigger. When a planes passes by or the mine cries out, we end up with a lot of signals, and of coincidences -> if there is a CR among those signals, its associated index in the CD file would be random. When the background is quiet and a CR comes by, there is a high chance that, inside the UD file, only this coincidence occurs, and thus the CD file would have few events, and CRs would be in them. This is why, when looking for CRs, I like to see how many events there are in a candidate's root file. If all CRs are not of index 0, there is a chance that some event 0 (in pretty empty files) are CRs.