# Performances evaluation for GP300

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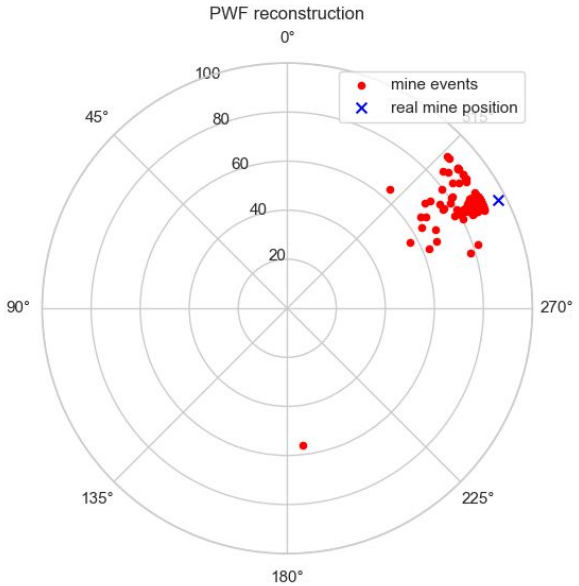
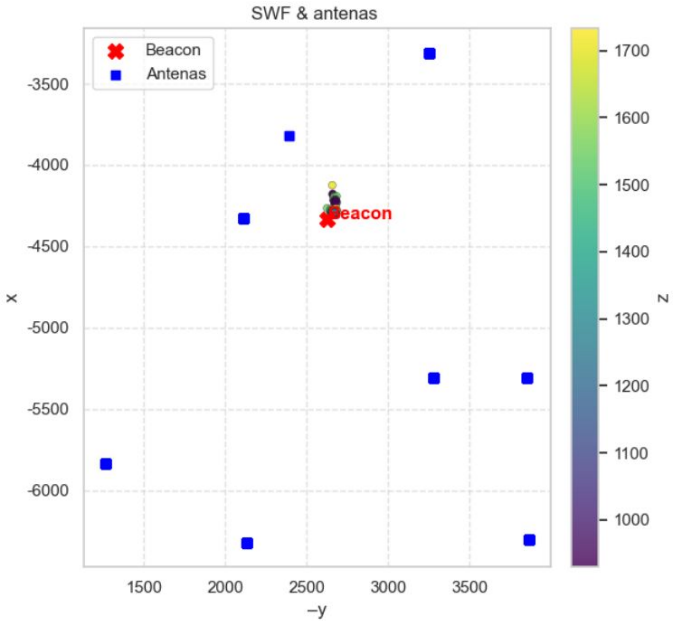
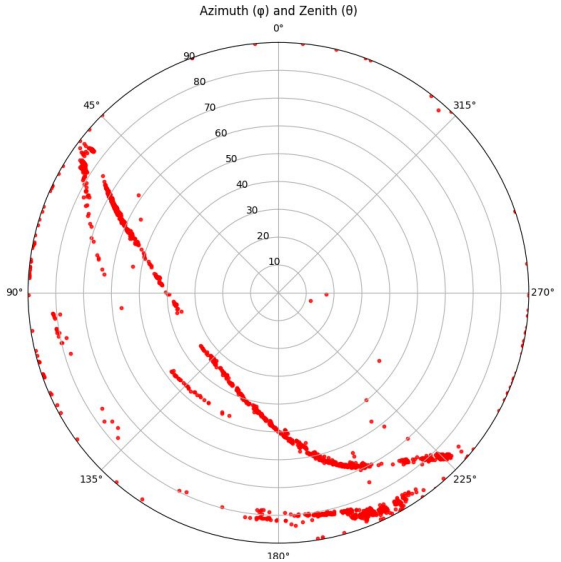
Supervised by Olivier Martineau

# Motivation

Use well known background sources, to characterise the detector (trigger efficiency, timing accuracy, livetime) and reconstruction methods (PWF, SWF)



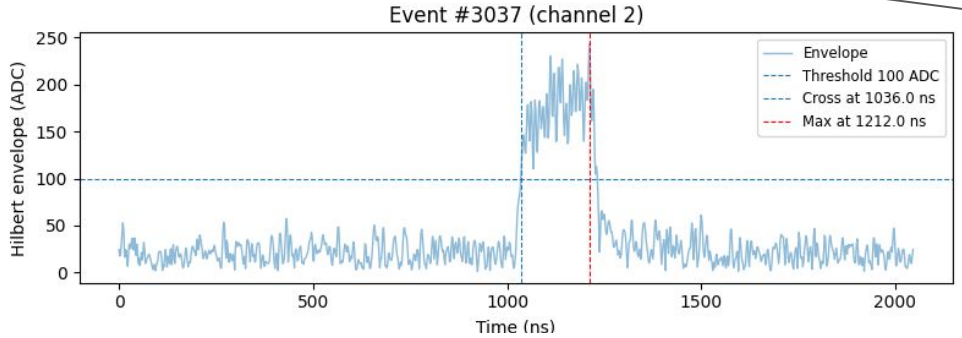

Transformer mine

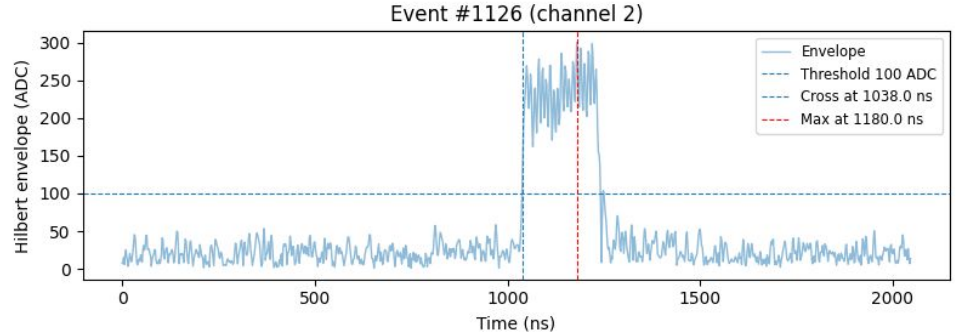
Beacon

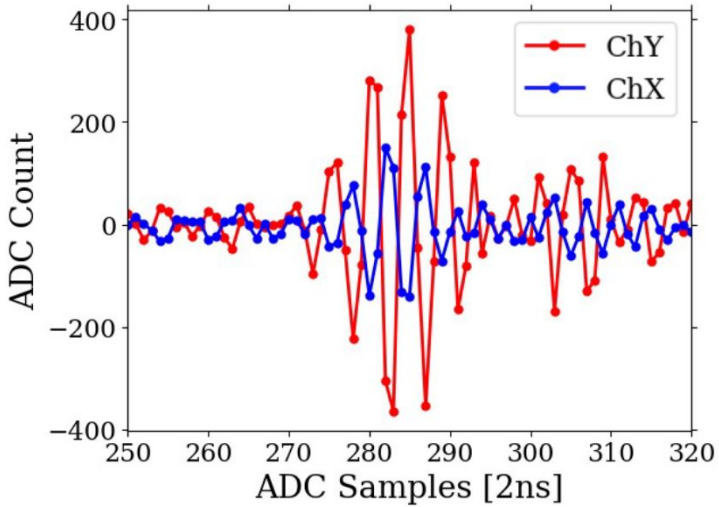
Planes

# 1- Beacon

GP80_20250424_102757_RUN173_CD




***Beacon characteristic :*** *Sine wave (A=1V, f=100MHz) with 20 periods and repetition rate between 1 and 100Hz.*

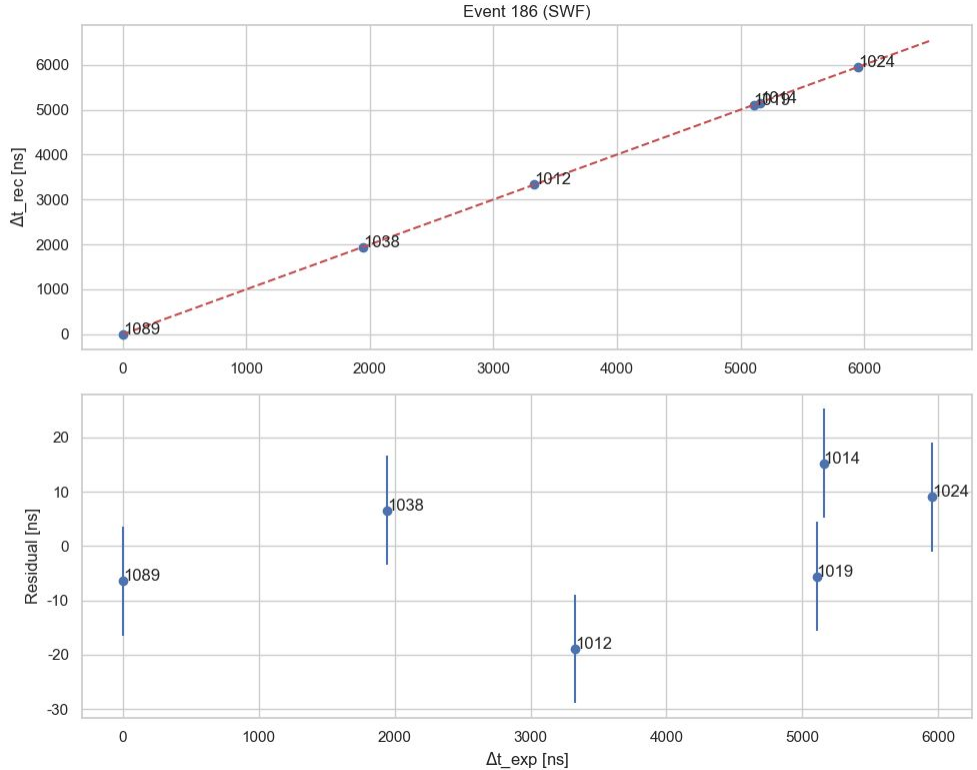
*from Xishui Tian*

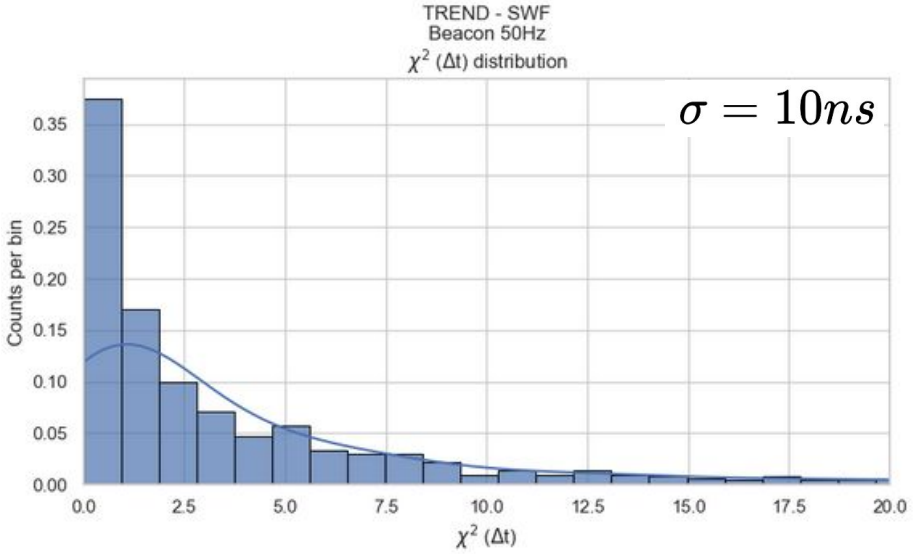
# 1- Beacon

How to assess quality of the reconstruction ?

$$\Delta t_{rec} = t_{simu} + offset \dashrightarrow mean(t_{expe} - t_{simu})$$

$$residual = t_{expe} - t_{rec}$$

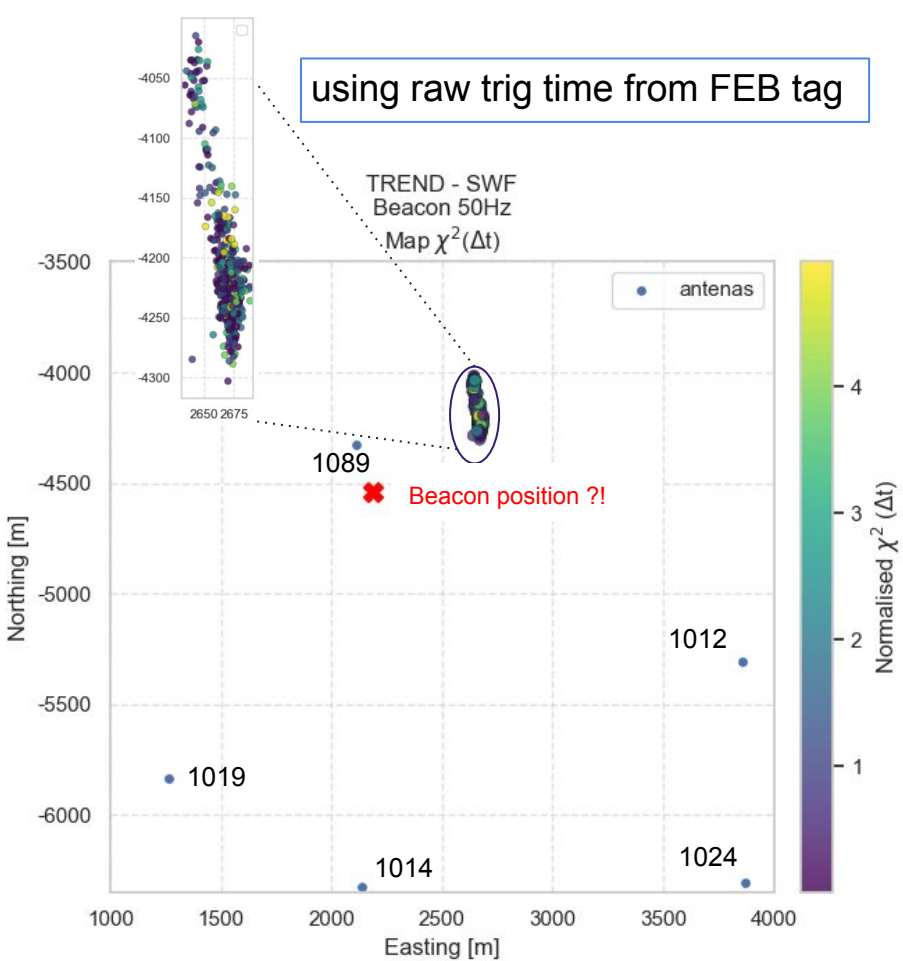


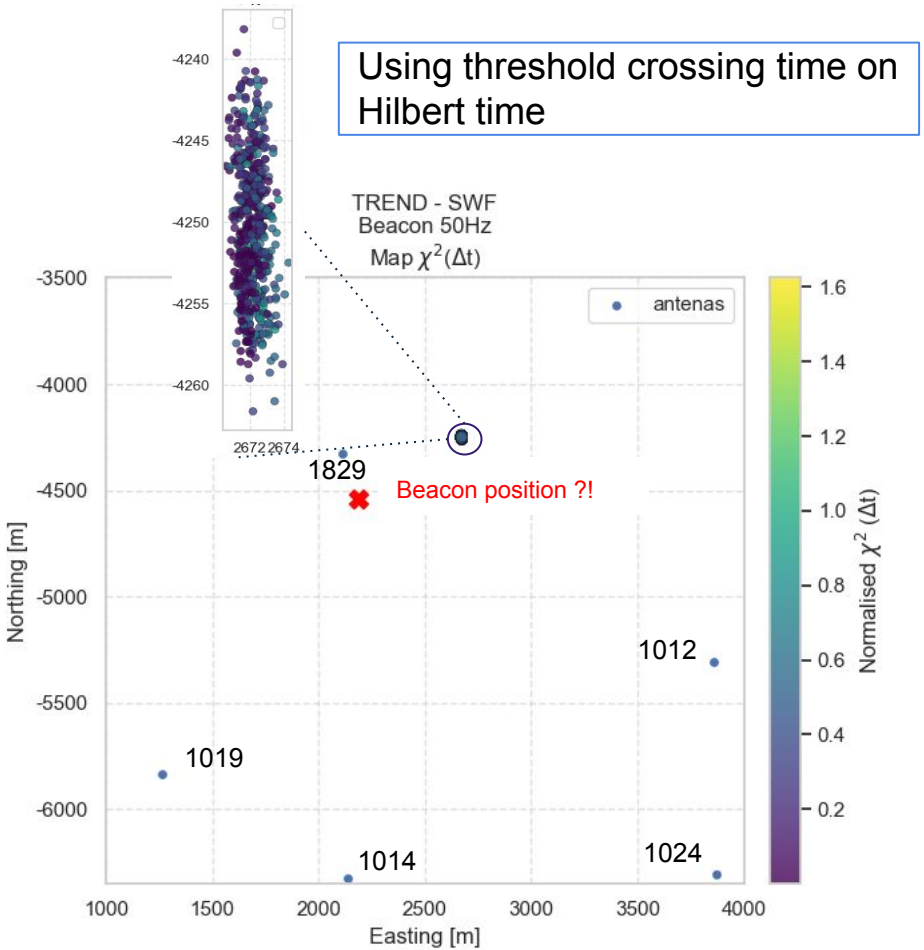




*so-called "TREND code", ie developed for TREND by V. Niess (2009!)*

# 1- Beacon

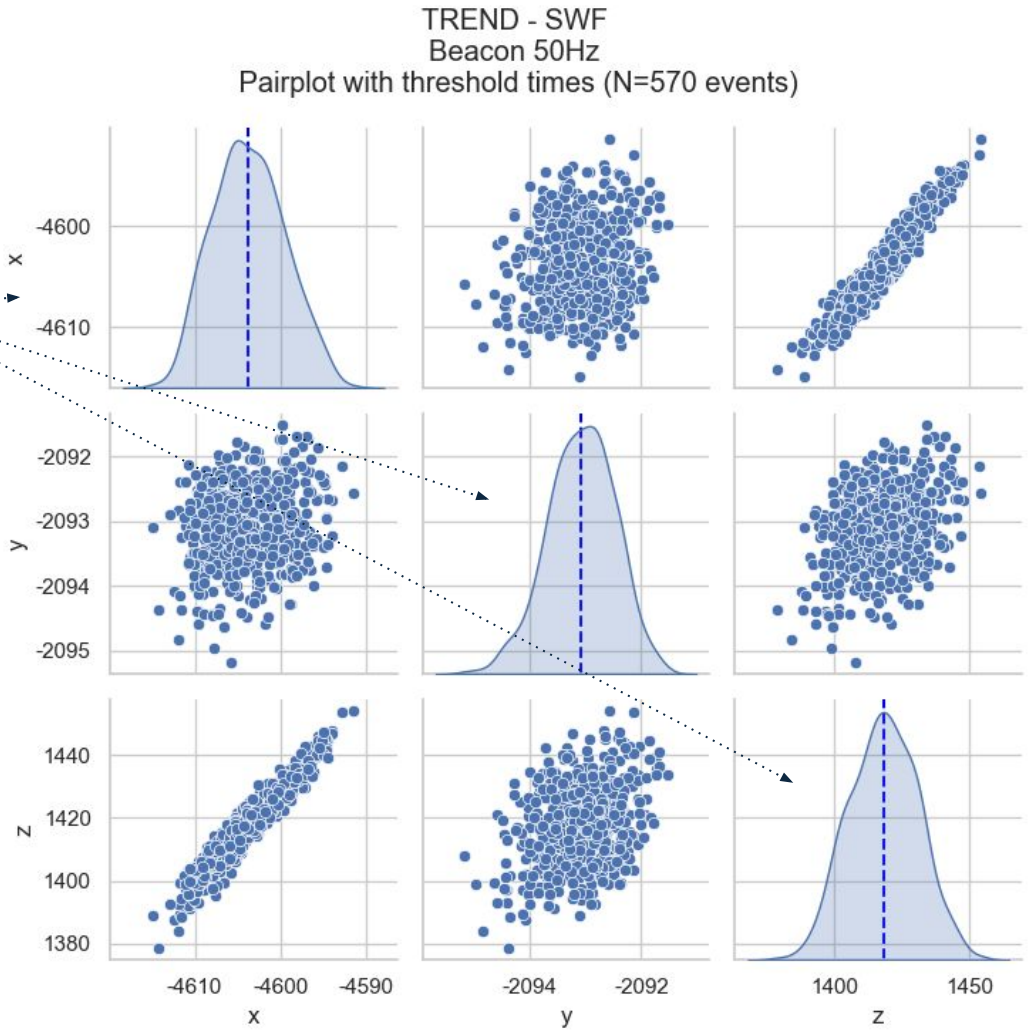
Difference between the different choices of reconstruction time



# 1- Beacon

```
std x : 4.17 m
std y : 0.60 m
std z : 12.61 m
```




**x :** has a lower resolution
because, for all DUs : $x_{beacon} < x_{DUs}$

*limited constraints on the distance to source*

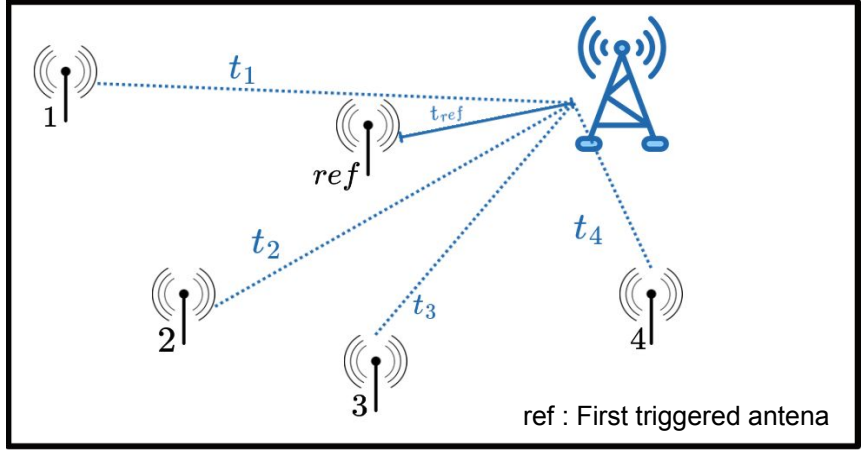
**z :** limited constraints because source & DUs are nearly in same plane + limited resolution GPS position

*bad constraint on orthogonal position*

# 1- Beacon

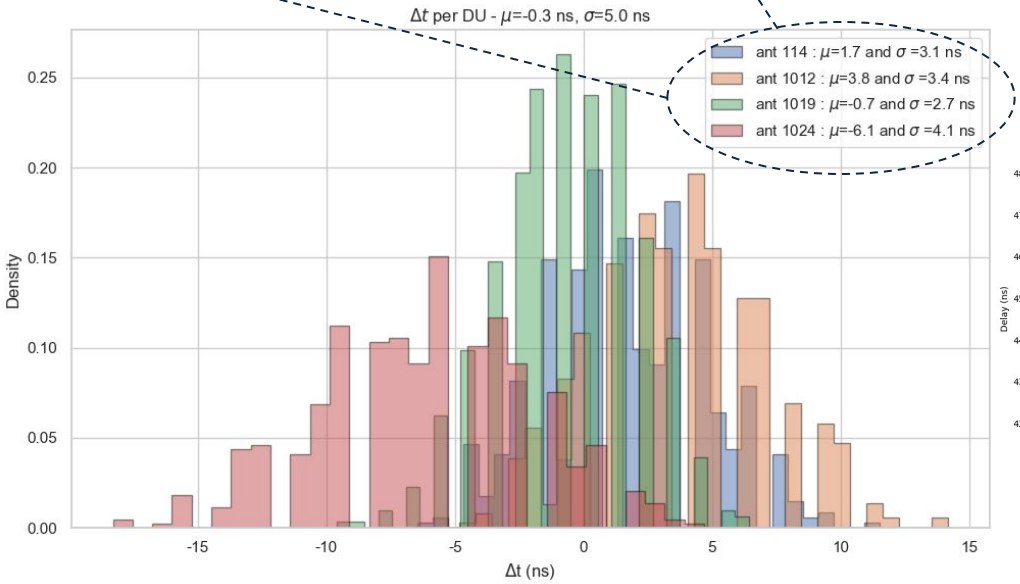
## Delay analysis

$$\Delta t_i = (t_i^{sim} - t_{ref}^{sim}) - (t_i^{expe} - t_{ref}^{expe})$$



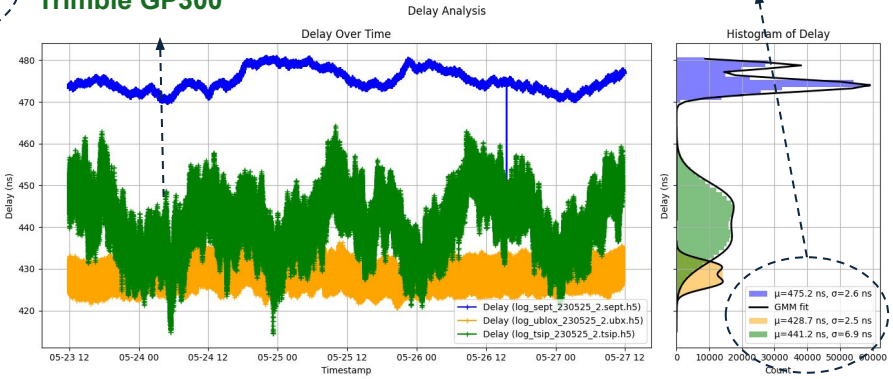

μ ≠ 0 understood as error on DU position (μ<4ns ≡ ε ~1m)

sigma interpreted as uncertainty on mean value




**Absolute time GPS**
**Trimble GP300**

6.9ns over 3 days but 3ns at given moment

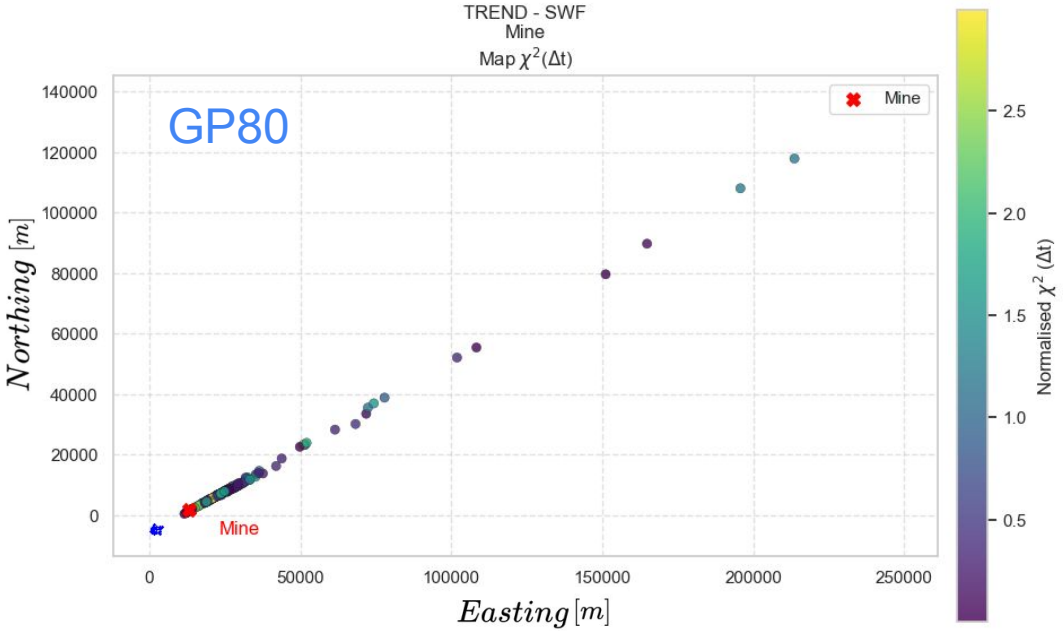


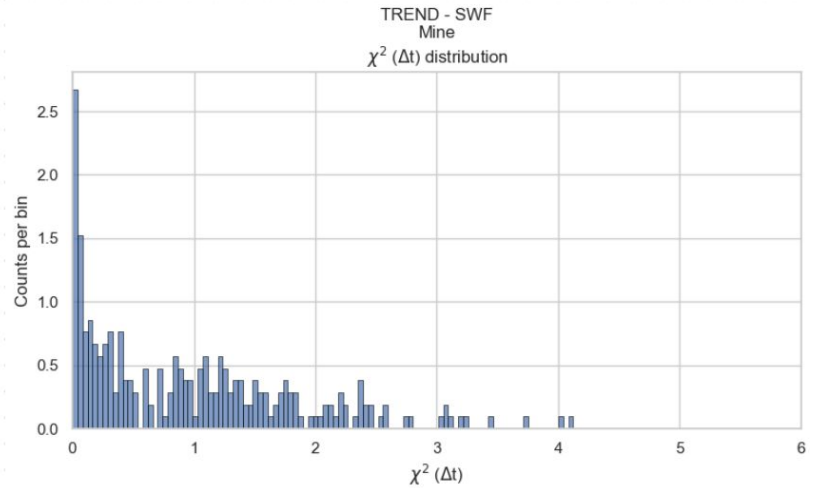

*See Vincent Voisin's talk on thursday*

# 2- Transformer mine

*Using : 20250309_235256_RUN10070*

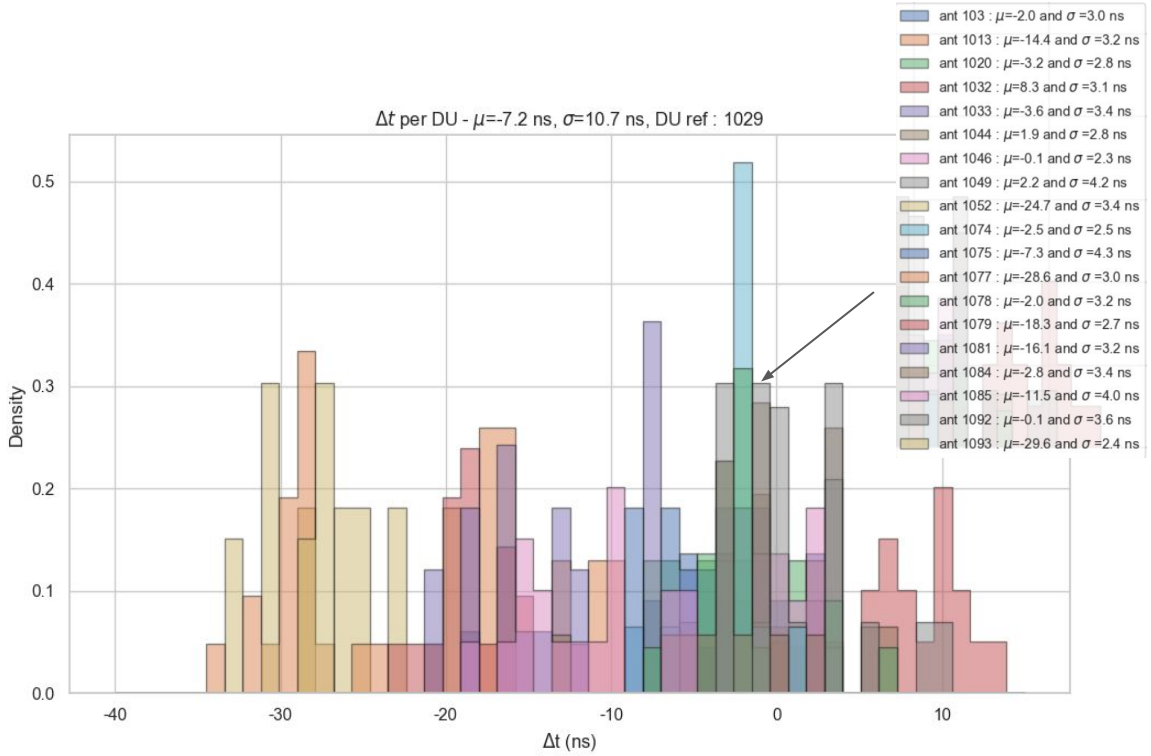
- Few events are reconstructed very far the transformer mine **but in the right direction**

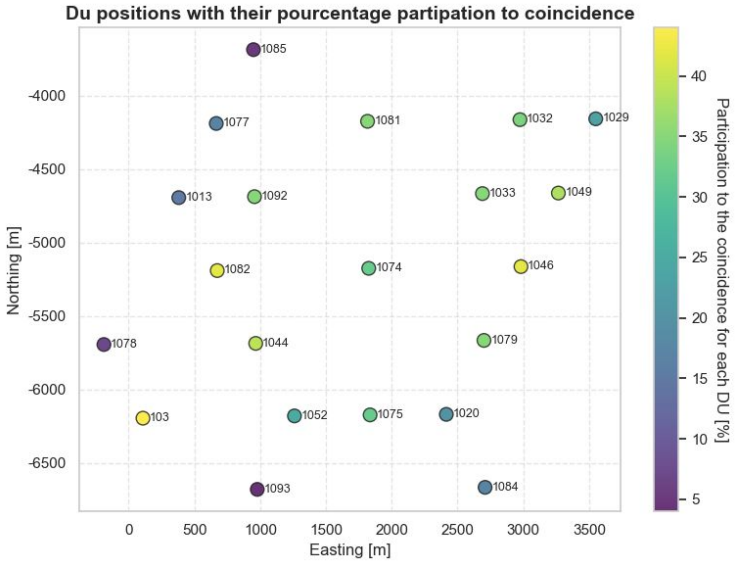


# 2- Transformer mine

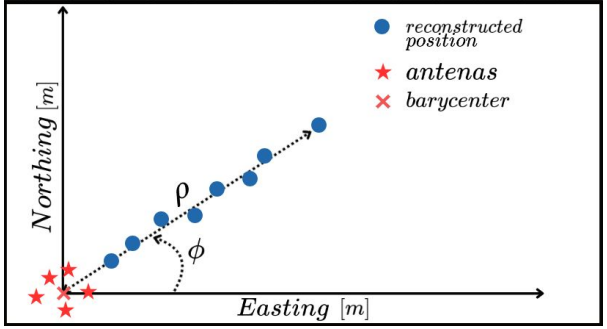
- Coherent sigmas
- Some interrogation about the mean offset (true propagation speed ?)

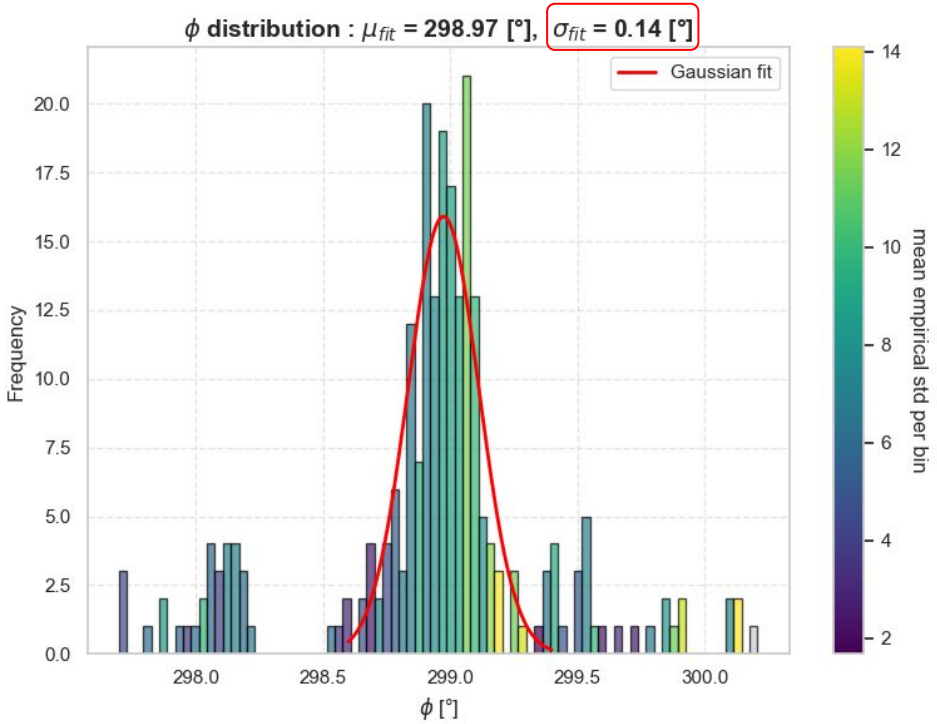


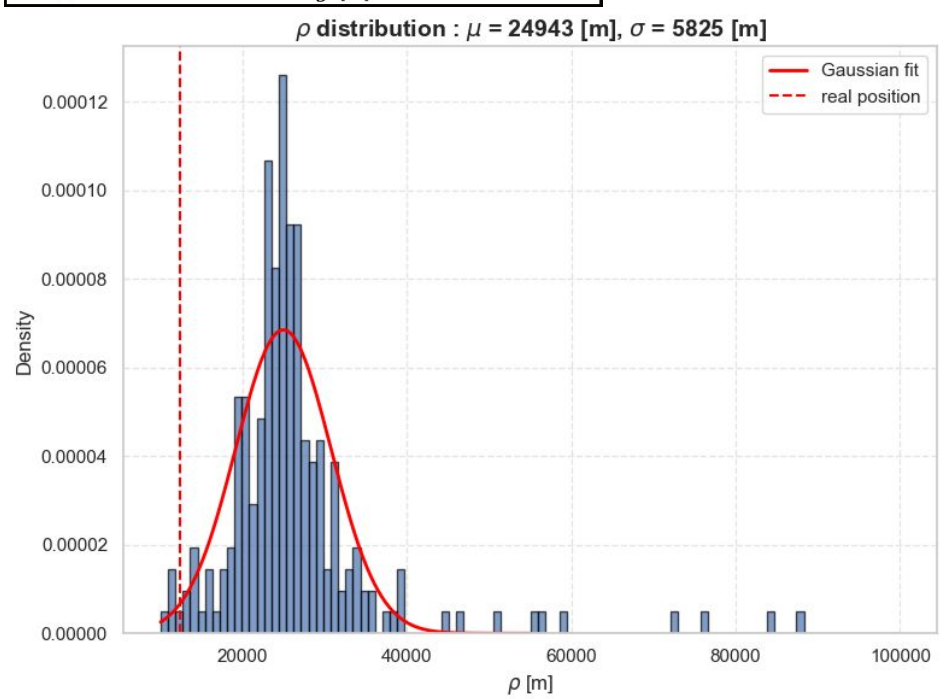



# 2- Transformer mine

Characterize the detector accuracy



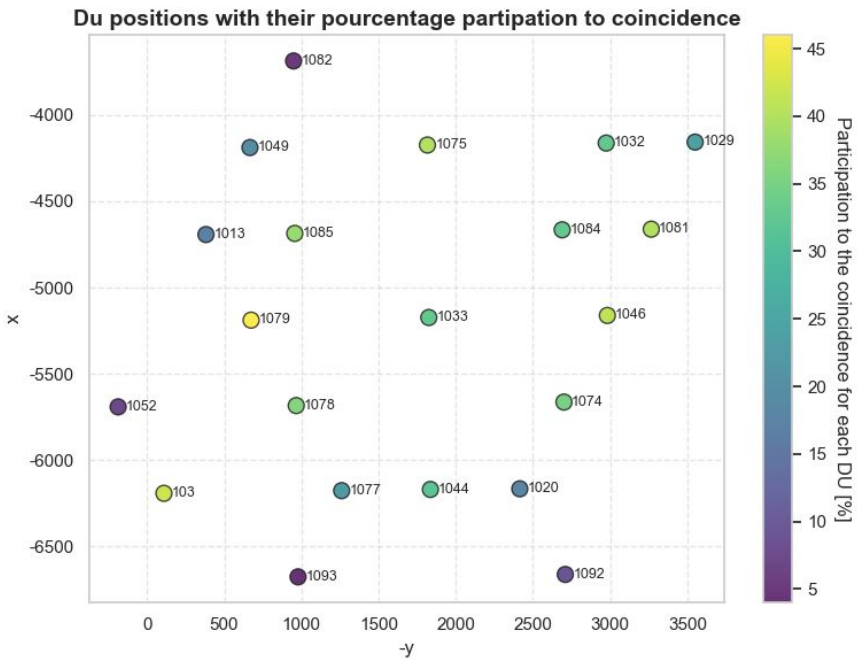
# Summary

- Measurement of the experimental (relative) timing precision using beacon + mine trigger times. It results a mean standard deviation of < 4 ns.
- Determine the experimental angular resolution by reconstructing known source positions (e.g., transformer-mine runs) and comparing the mean reconstructed direction to the given source, yielding an angular spread < 0.2°.

- To compare with the work of PengFei et al." https://forge.in2p3.fr/projects/data-commissioning-of-gp13-and-grand-auger/wiki/GP13_beacon_delay_correction" and Aurelien "https://forge.in2p3.fr/projects/data-commissioning-of-gp13-and-grand-auger/wiki/AnalysisBeacon_nov1st2nd"

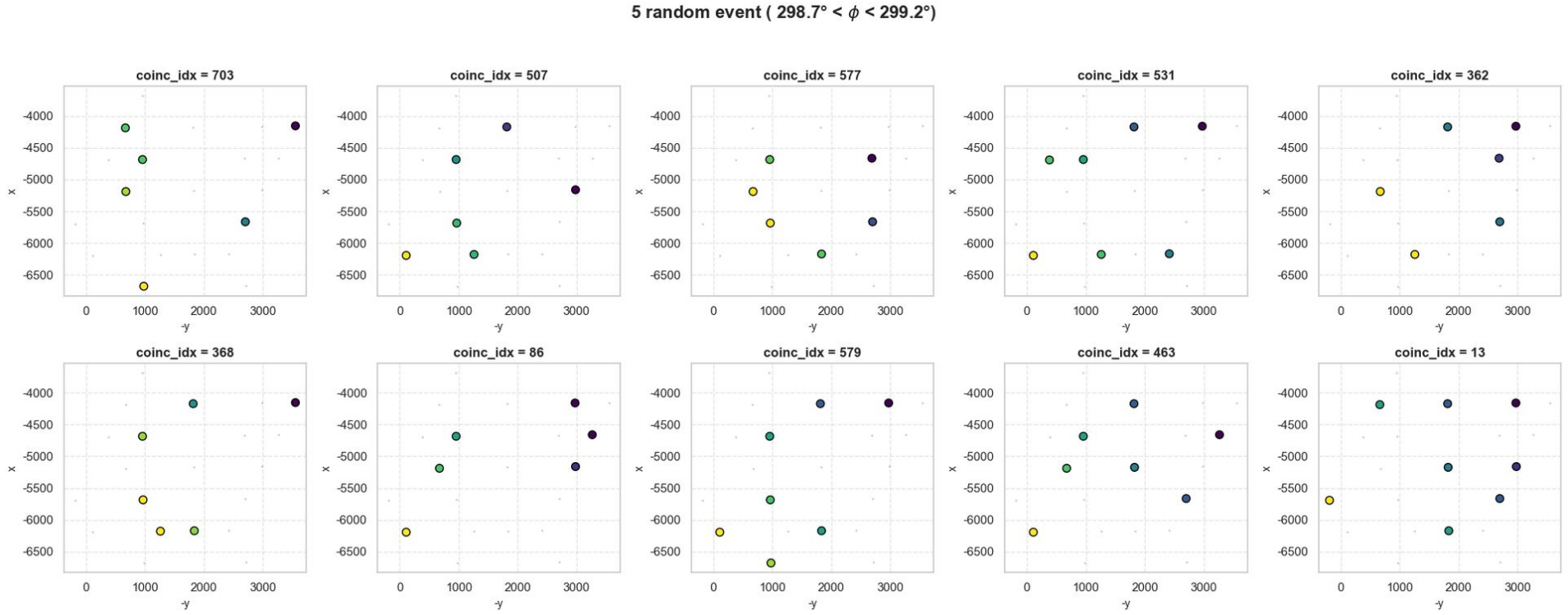
# Outlook

- The next step is to pursue this work by studying plane sources. Access to high-precision ADS-B system of their locations will allow us to better characterize the detector.
- Study the temporal evolution of these sources in order to evaluate the detector's stability over time.
- Continue the analysis to gain a deeper understanding of the trigger pattern and its footprint.



Thanks for your
attention !

# Backup


5 random event ( 298.7° < $\phi$ < 299.2°)
coinc_idx = 703
coinc_idx = 507
coinc_idx = 577
coinc_idx = 531
coinc_idx = 362
coinc_idx = 368
coinc_idx = 86
coinc_idx = 579
coinc_idx = 463
coinc_idx = 13
x
-y
-4000
-4500
-5000
-5500
-6000
-6500
0
1000
2000
3000