The first miniTRASGO Cosmic Ray detector

XV CPAN days
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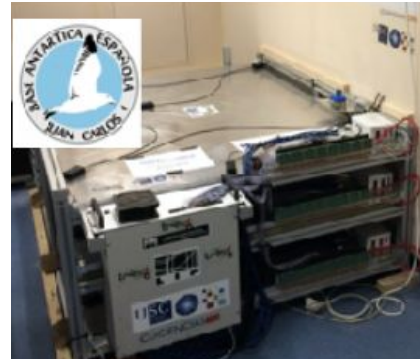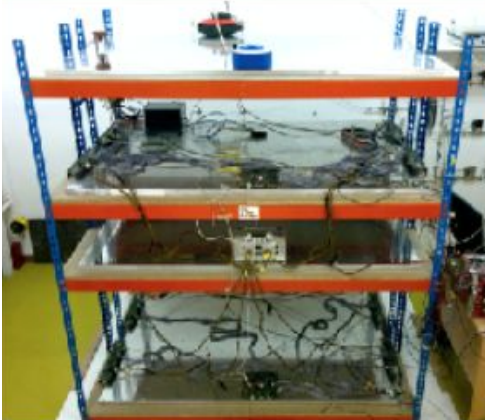
Summary

- **Introduction:** The TRASGO project and the miniTRASGO
- **Measuring with miniTRASGO**
- **Results**: Position maps, charge spectra and multiplicity
- **Conclusions**

Introduction

The TRASGO project and the miniTRASGO

The TRASGO project

- Measure **cosmic muons and electrons** with granularity
- TRASGO concept: **TRAck reconStructinG bOx**
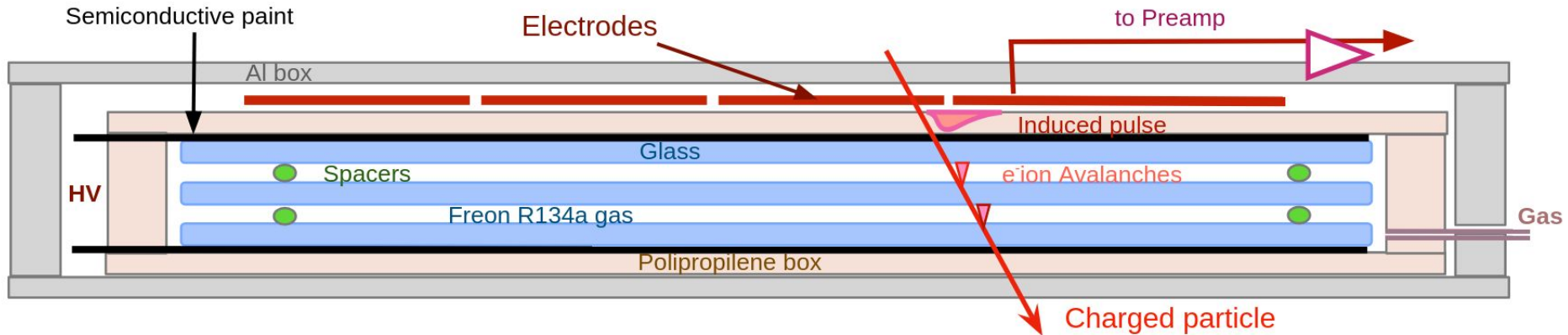- **Resistive Plate Chambers** (RPCs)
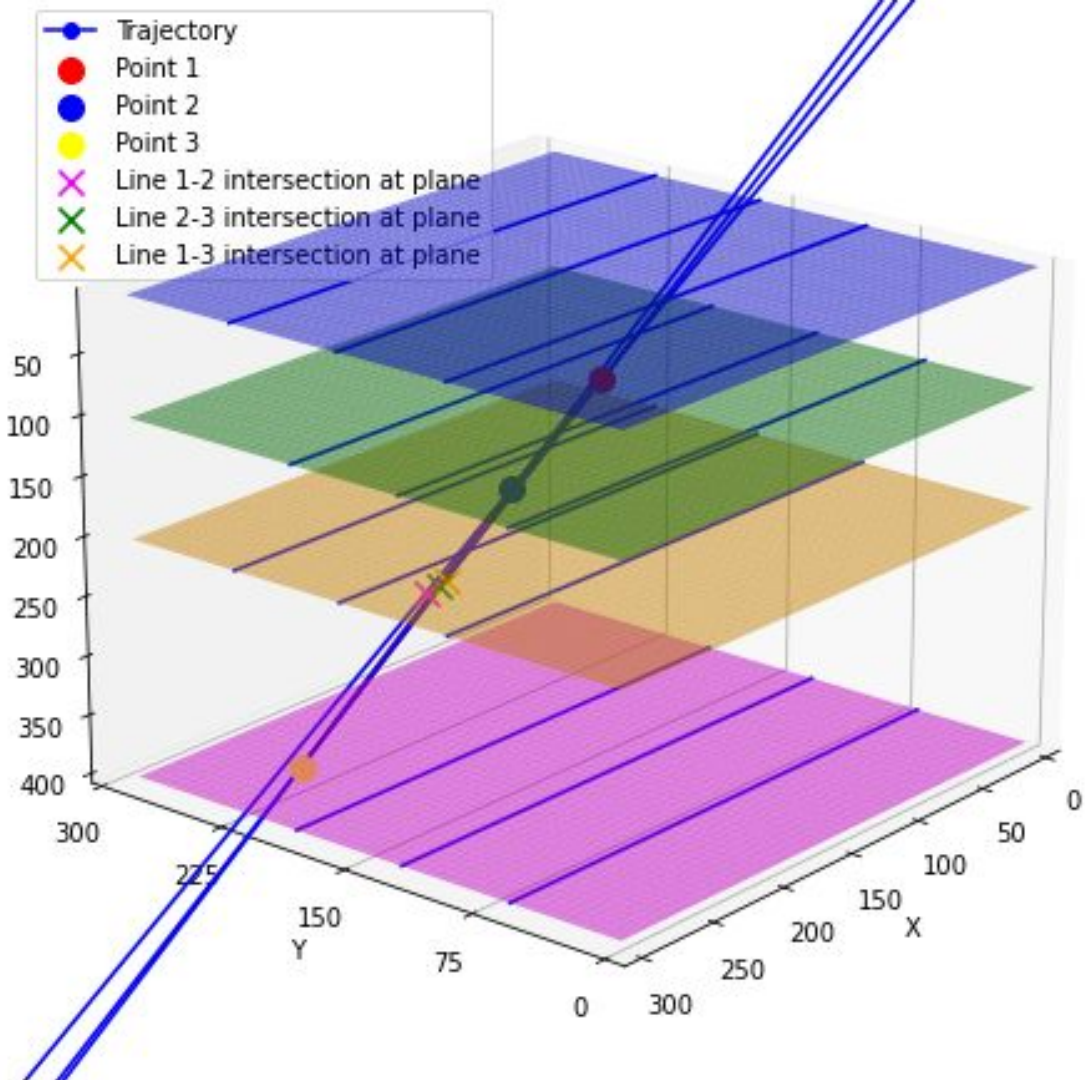
The miniature TRASGO

- **LIP Coimbra**
- 4 RPCs not evenly spaced
- Compact
- Autonomous

The miniTRASGO layout

- Each RPC module:
    - 1 mm **gas gaps**
    - 2 mm thick **glass** of about 300 × 300 mm²
- **HV** electrodes to apply 2800 kV/gap
- **4 asymmetric copper strips**

Semiconductive paint

Electrodes

to Preamp

Al box

Induced pulse

Glass

Spacers

e⁻ion Avalanches

HV

Freon R134a gas

Gas

Polipropilene box

Charged particle

Detection...
readout of signal at the end of each strip (F or B)

and tracking...
providing angular distributions

Measuring with miniTRASGO

Types of detections and products of the measurement

Some definitions

- **RPC detection**: any strip on Front (F) or Back (B) sides receives signal.
- **Event** is **triggered** if
    → *detection in a time window of 200 ns in three of the four RPCs.*
- Time measure is **relative to trigger** time
    → *signal on both sides of the strip is required*

The product of the measurement: charge

- **Not proportional** to energy
- Strip of the detection chosen, *s*, based on the charge

$$Q = \frac{Q_{F,s} + Q_{B,s}}{2} + \varepsilon_{T,s}^{Q}$$

The product of the measurement: position

- *Y* position determined according to strip and RPC.
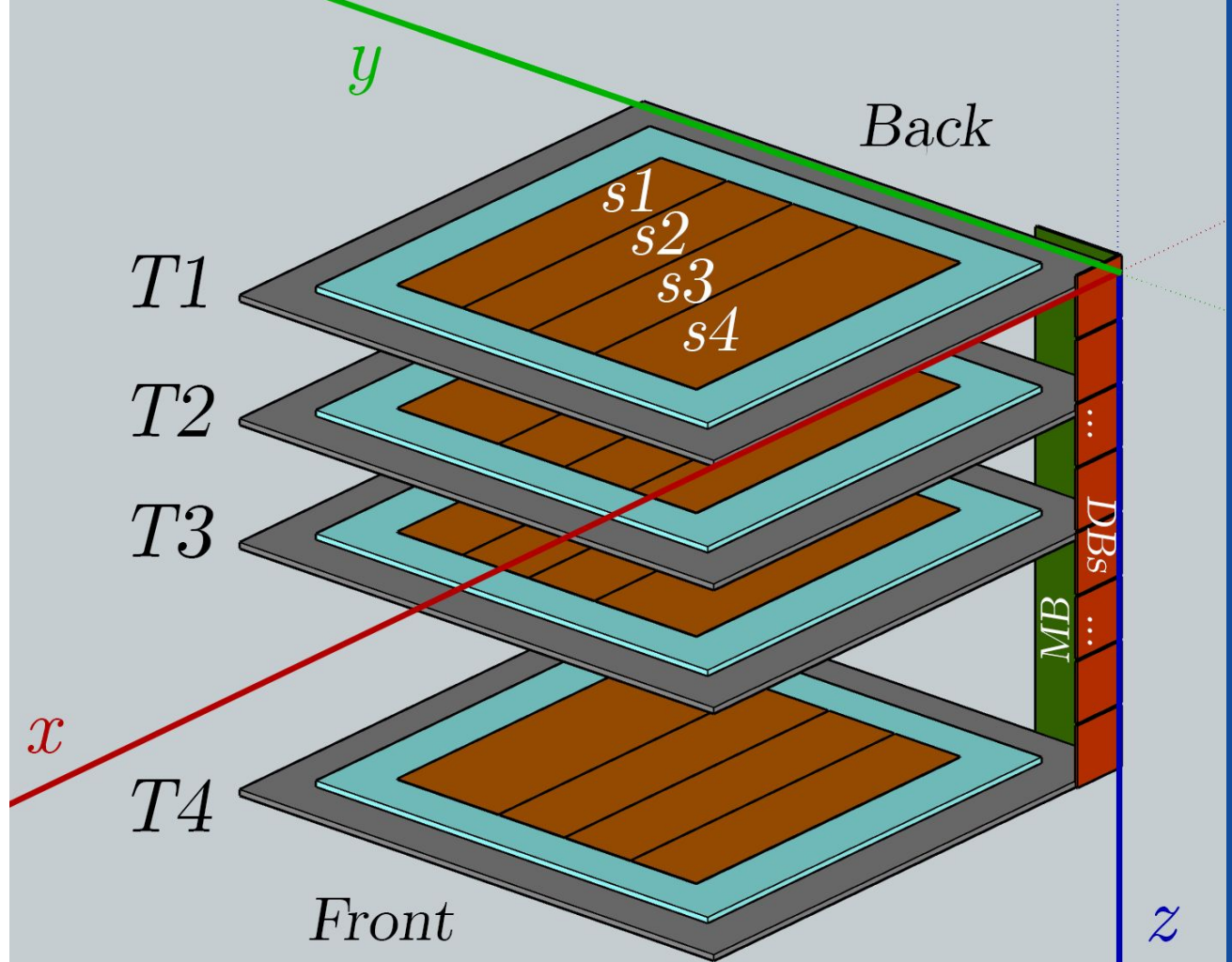- Position along the strip, *X*, is calculated as:

$$X = \frac{T_{F,s} - T_{B,s}}{2} \cdot V_{\text{strip}} + \varepsilon_{T,s}^{T}$$

Detections in each RPC:

- None strip
- Only one
- Two
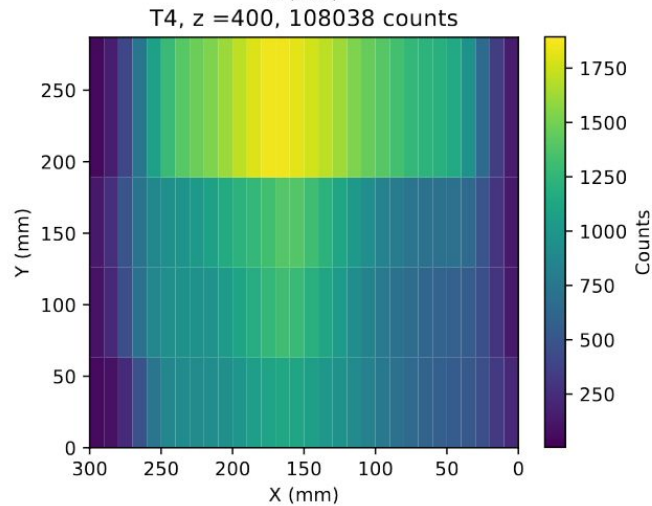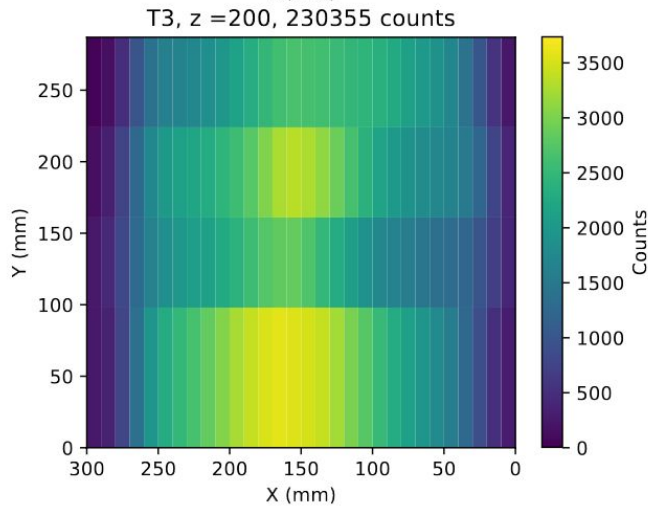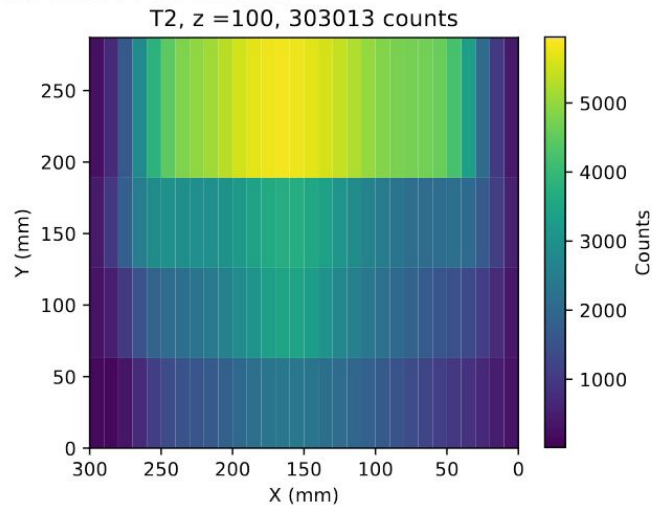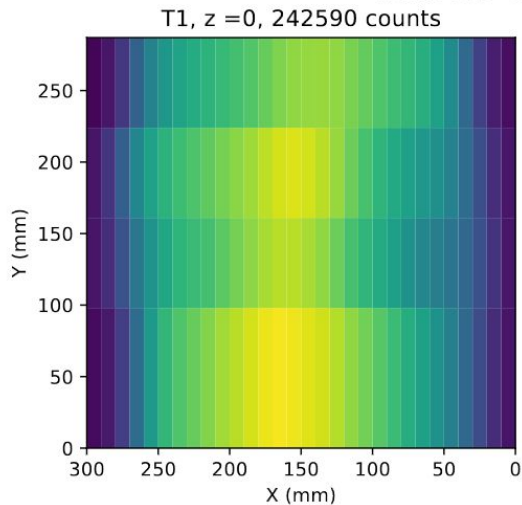- Three
- Four

To consider:
- Crosstalk
- Interstrip

Results

Position maps, charge spectra and multiplicity

Position maps

- Strip width and geometry have a crucial role on the number of counts

Corrected by efficiency hit position distribution
from 2023-08-07 00:05:01 to 2023-08-08 00:00:02

Charge spectra

- For different number of strips triggered

- Overall smooth distribution in single and double strip detections

Charge/event in multistrip
from 2023-08-06 00:05:01 to 2023-08-07 00:18:35

Legend:
- All hits, 958467 events
- Single hits, 629698 events
- Double hits, 177264
- Triple hits, 92790 events
- Quadruple hits, 58711 events
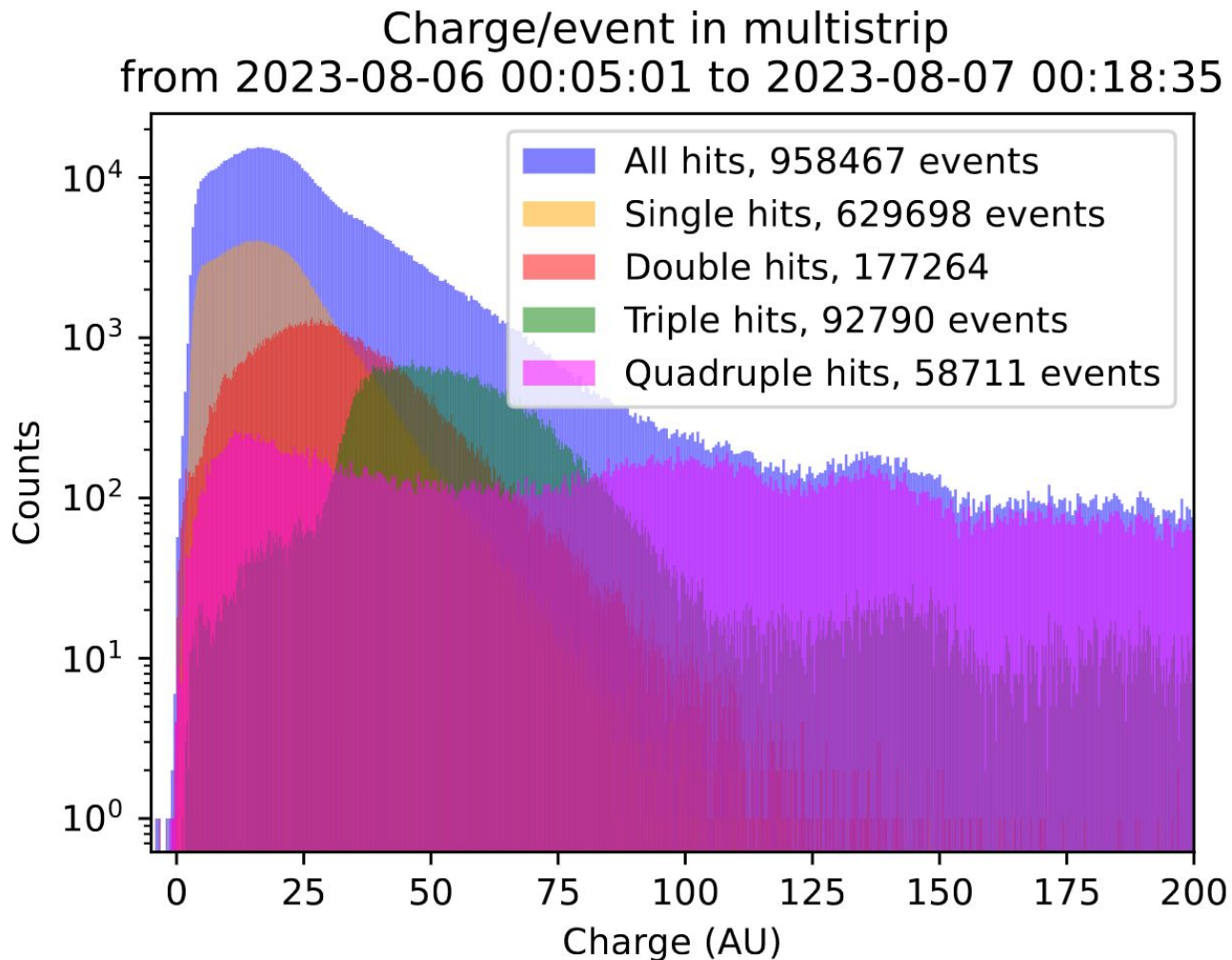
Multistrip spectra

- Number of events in which a minimum number of strips where triggered

- **Note that double strip hits are a 20% of the total**

Normalized number of strips triggered in each RPC from 2023-08-09 00:05:02 to 2023-08-10 00:00:01
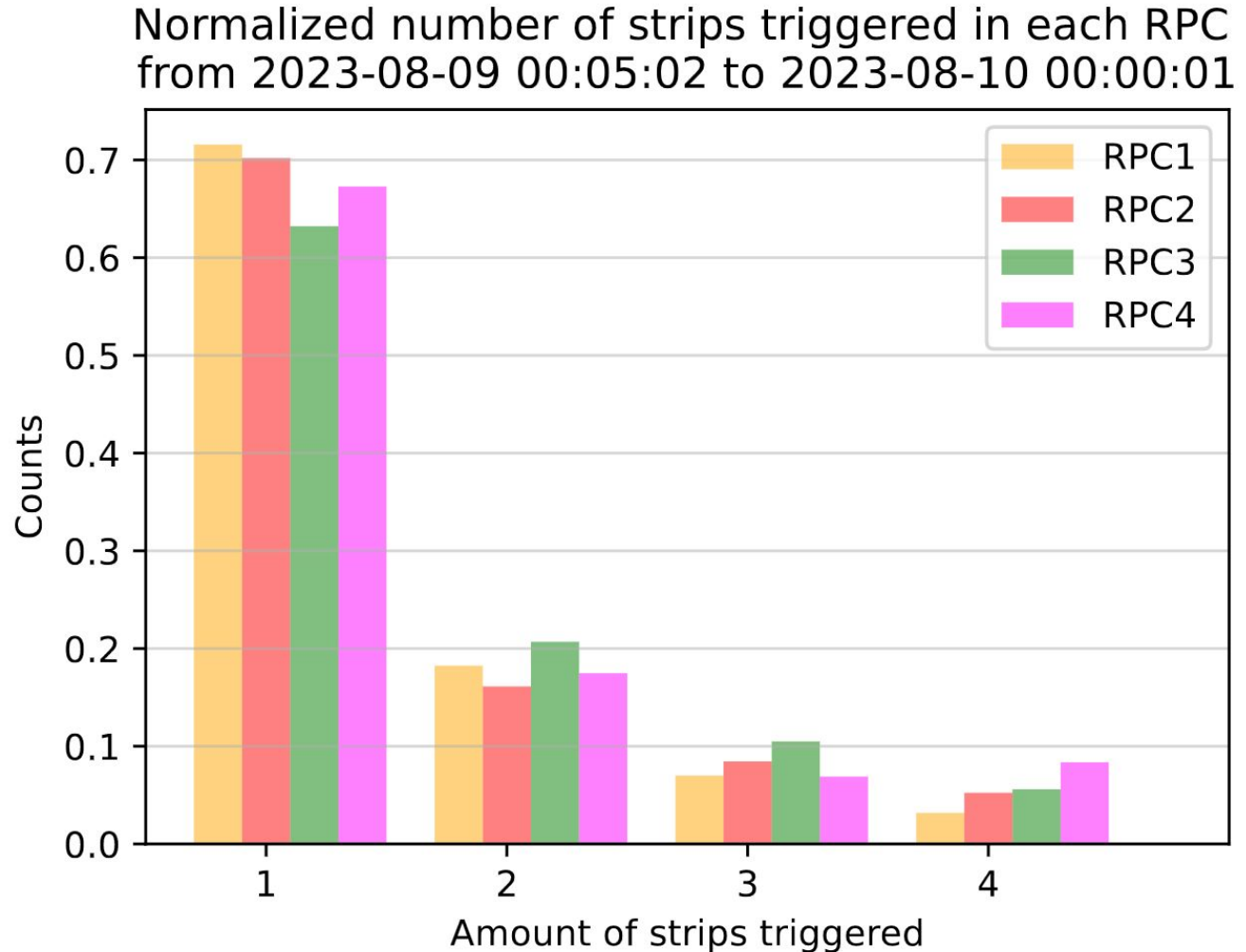
Charge spectra

- In events where only one strip is triggered

- Plot for all RPCs

Charge in single hits
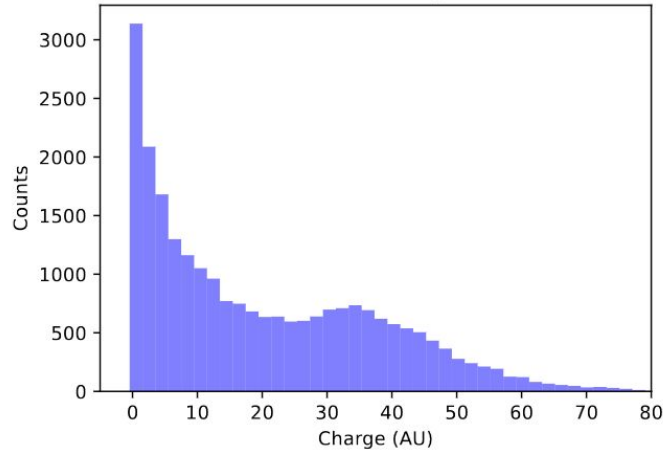from 2023-08-09 00:05:02 to 2023-08-10 00:00:01

Charge spectra

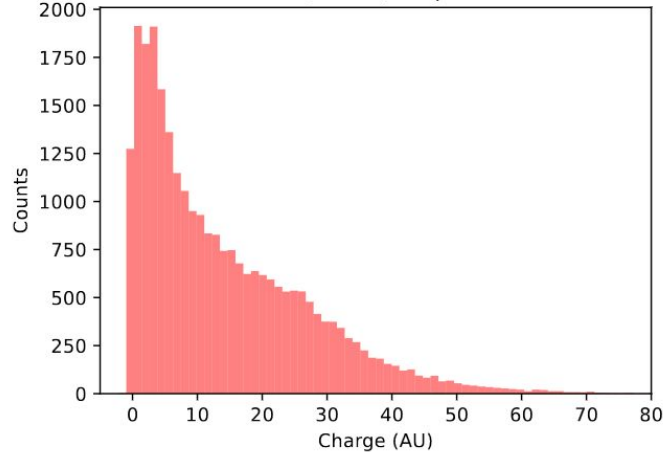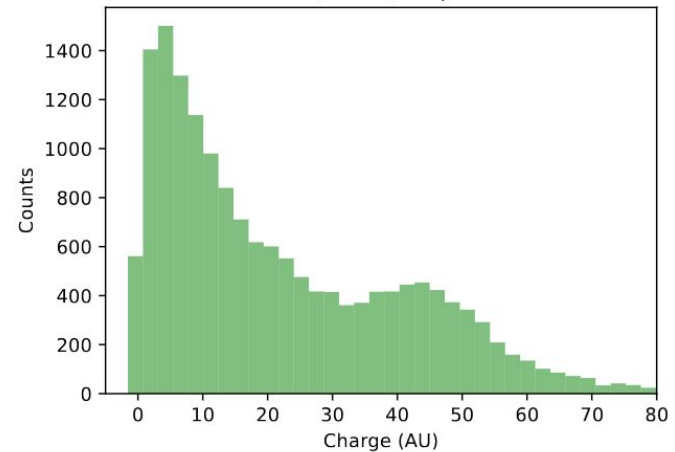- In events where only two strip are triggered
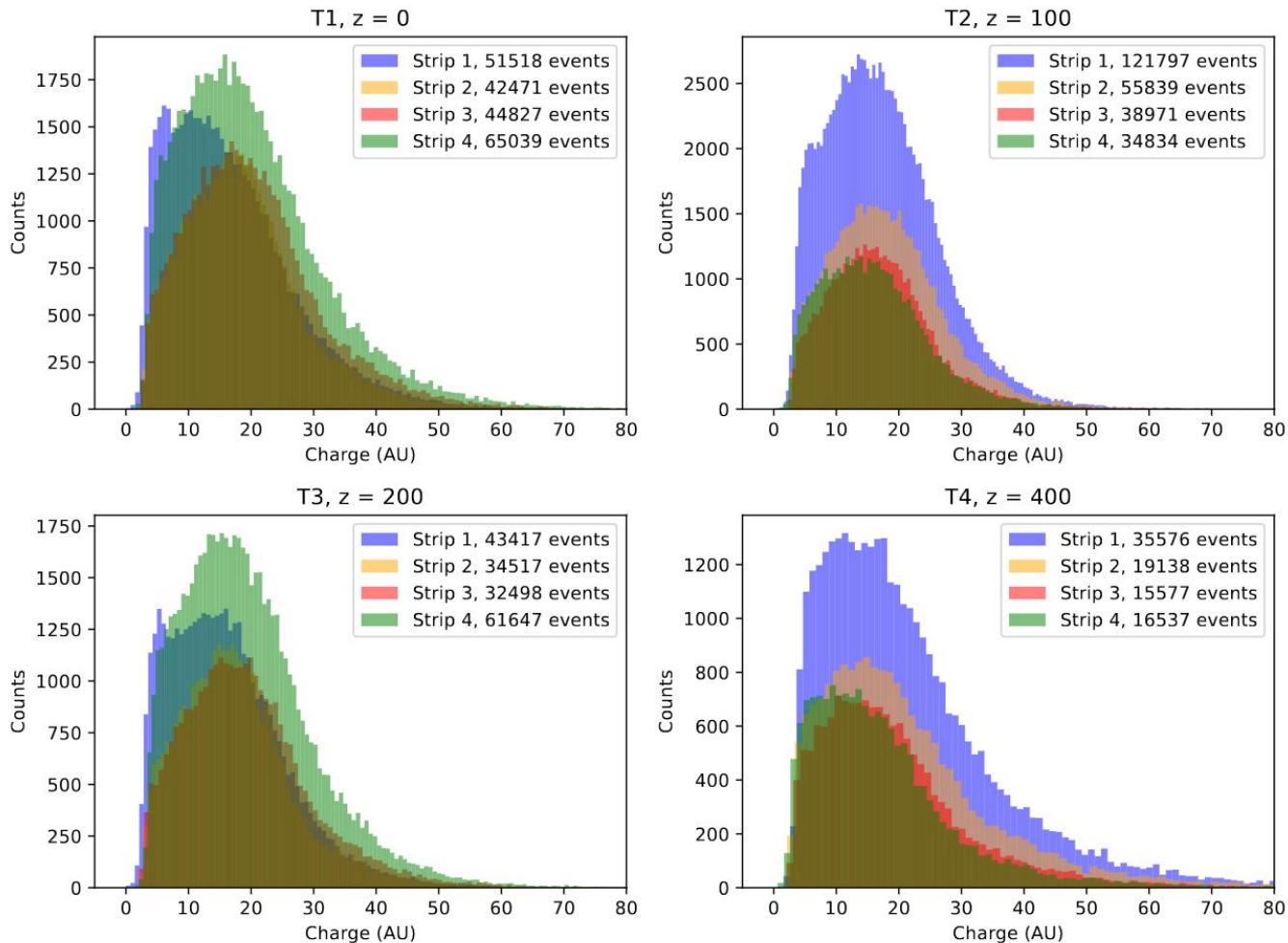
- Stripwise plot:

Stripwise charge spectra in double hits
from 2023-08-06 00:05:01 to 2023-08-07 00:00:01
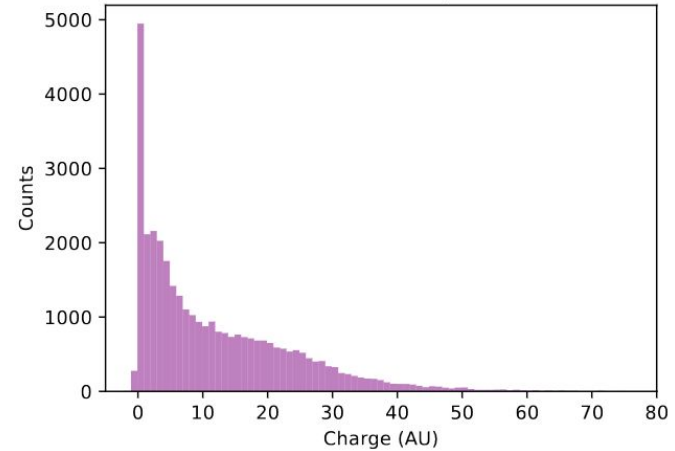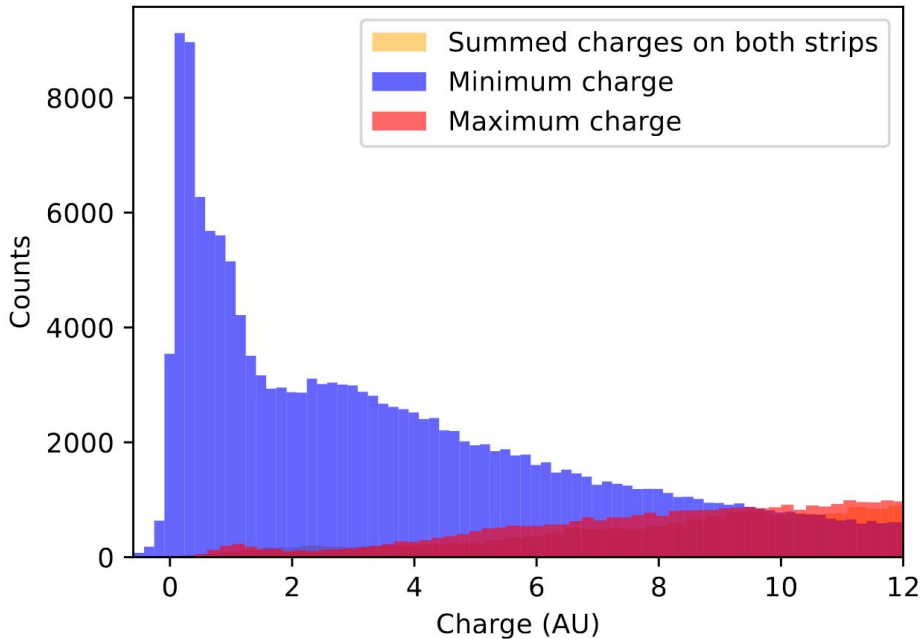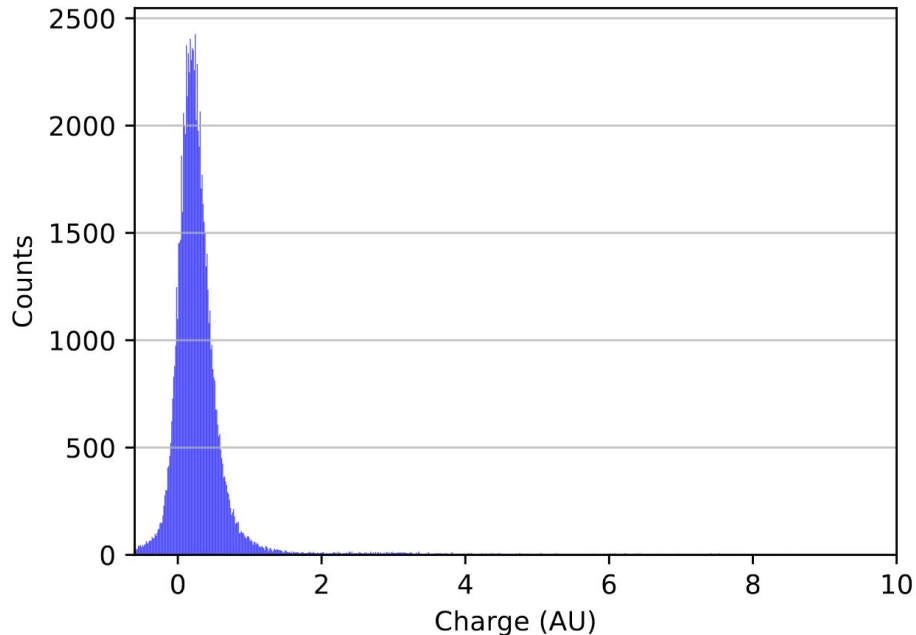
Crosstalk characterization

Values of charge in a strip in double hits
from 2023-08-06 00:05:01 to 2023-08-07 00:18:35

- Summed charges on both strips
- Minimum charge
- Maximum charge

Minimum value of charge in a strip in triple hits
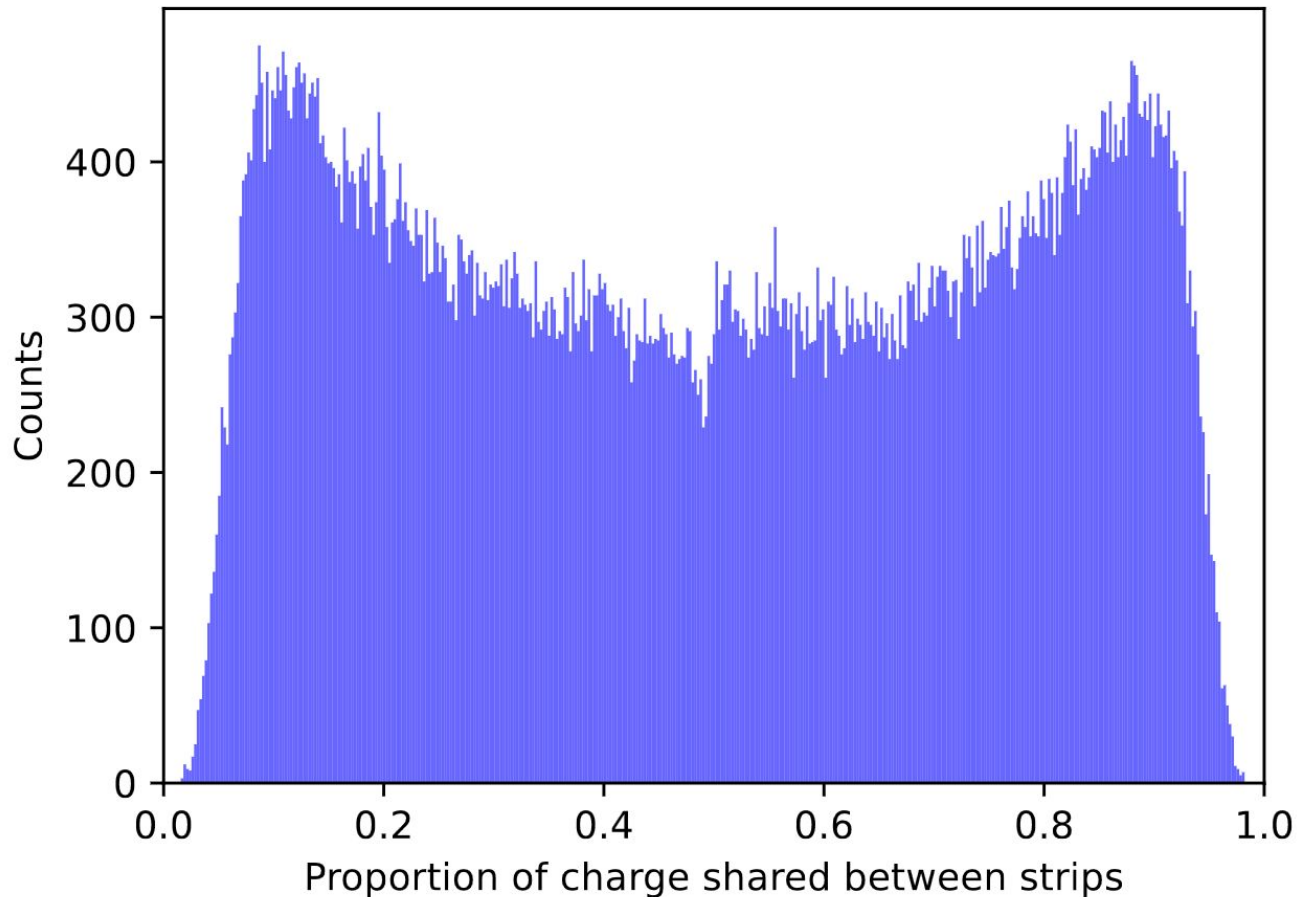from 2023-08-06 00:05:01 to 2023-08-07 00:18:35

Set a reasonable upper bound of **1.75 AU**

Interstrip study

- All double strip events with no crosstalk and how they share the charge

  → **Resolution** can be **improved** with this study

Ratio of shared charge in double hits (no crosstalk) from 2023-08-09 00:05:02 to 2023-08-10 00:00:01

Multiplicity study

- Applied this **crosstalk** filtering to multistrip events with an algorithm

- Note that some double strip events are actually *n=1* events

Normalized multiplicity distribution in each RPC from 2023-08-09 00:05:02 to 2023-08-10 00:00:01

Legend:
- RPC1 283584 events
- RPC2 355935 events
- RPC3 270145 events
- RPC4 126632 events

(y-axis: Counts, x-axis: Multiplicity)
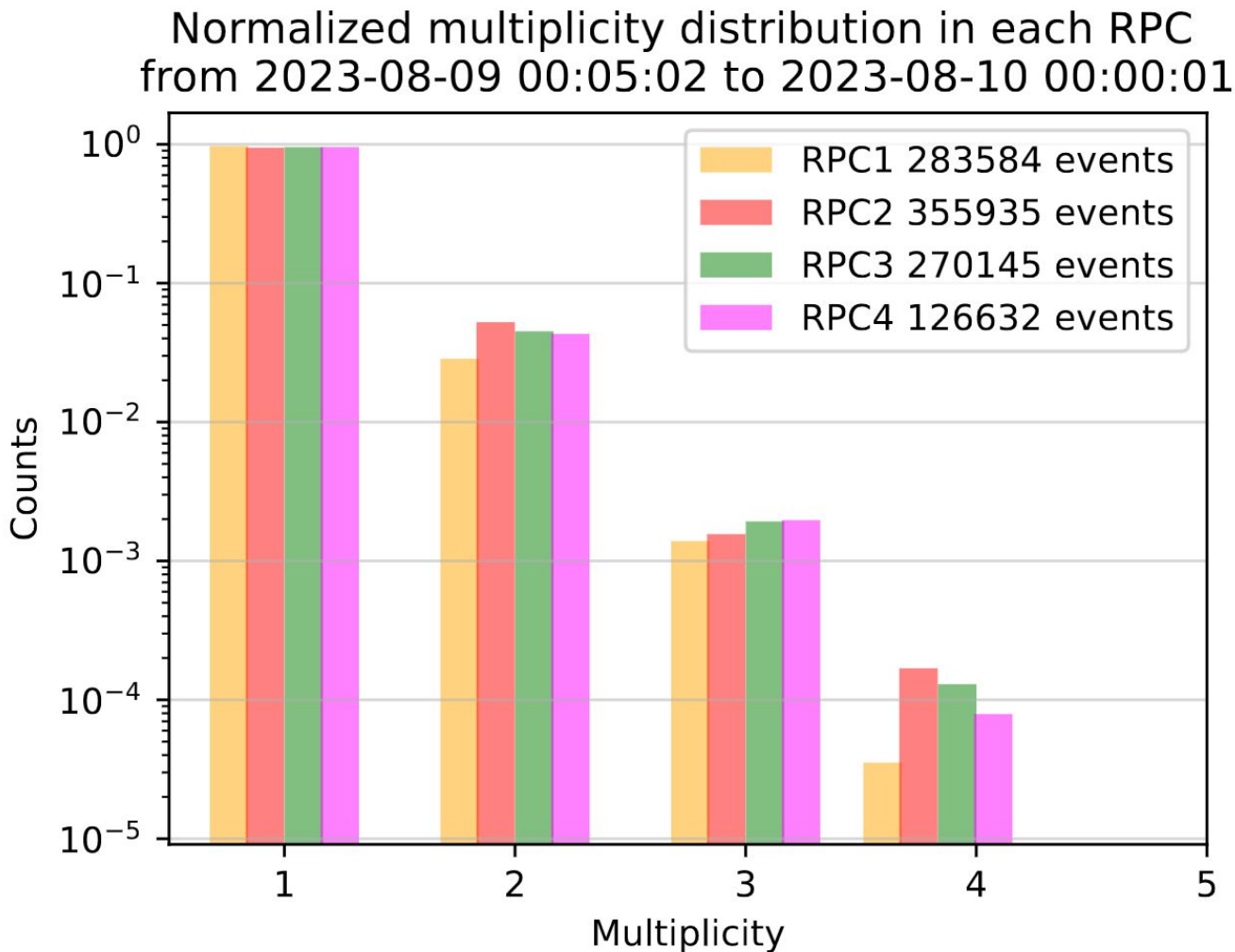
Conclusions

Conclusions

- The new **miniTRASGO detector** has been introduced.
- **Time and charge measurements** are simple but powerful tools.
- Some derivations, such as **multiplicity**, were presented.

This telescope is just born... **A lot of work is yet to be done!**

Thanks for your time!
Questions?

You may contact me at:
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