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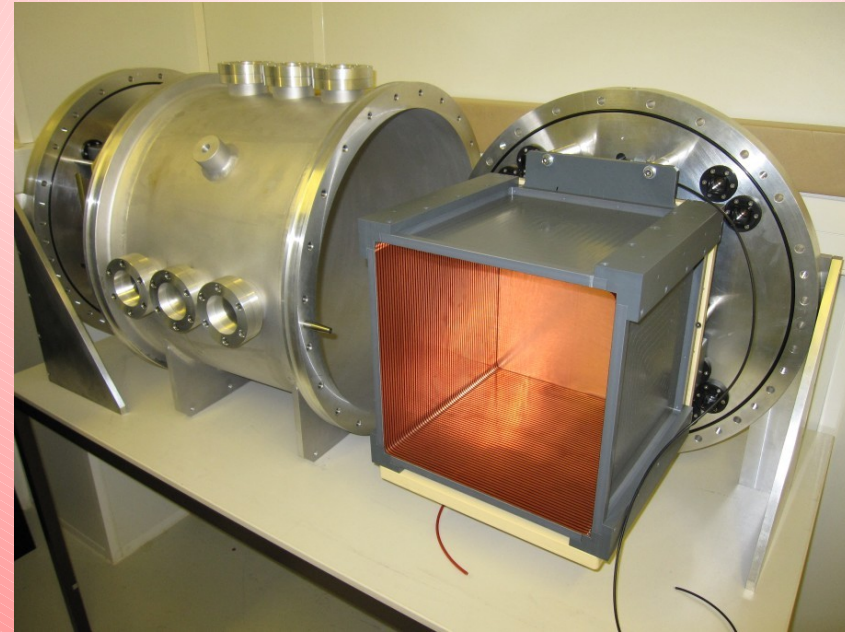
Measurement of gas stability  
using cosmic rays  
in the sealed HARPO TPC

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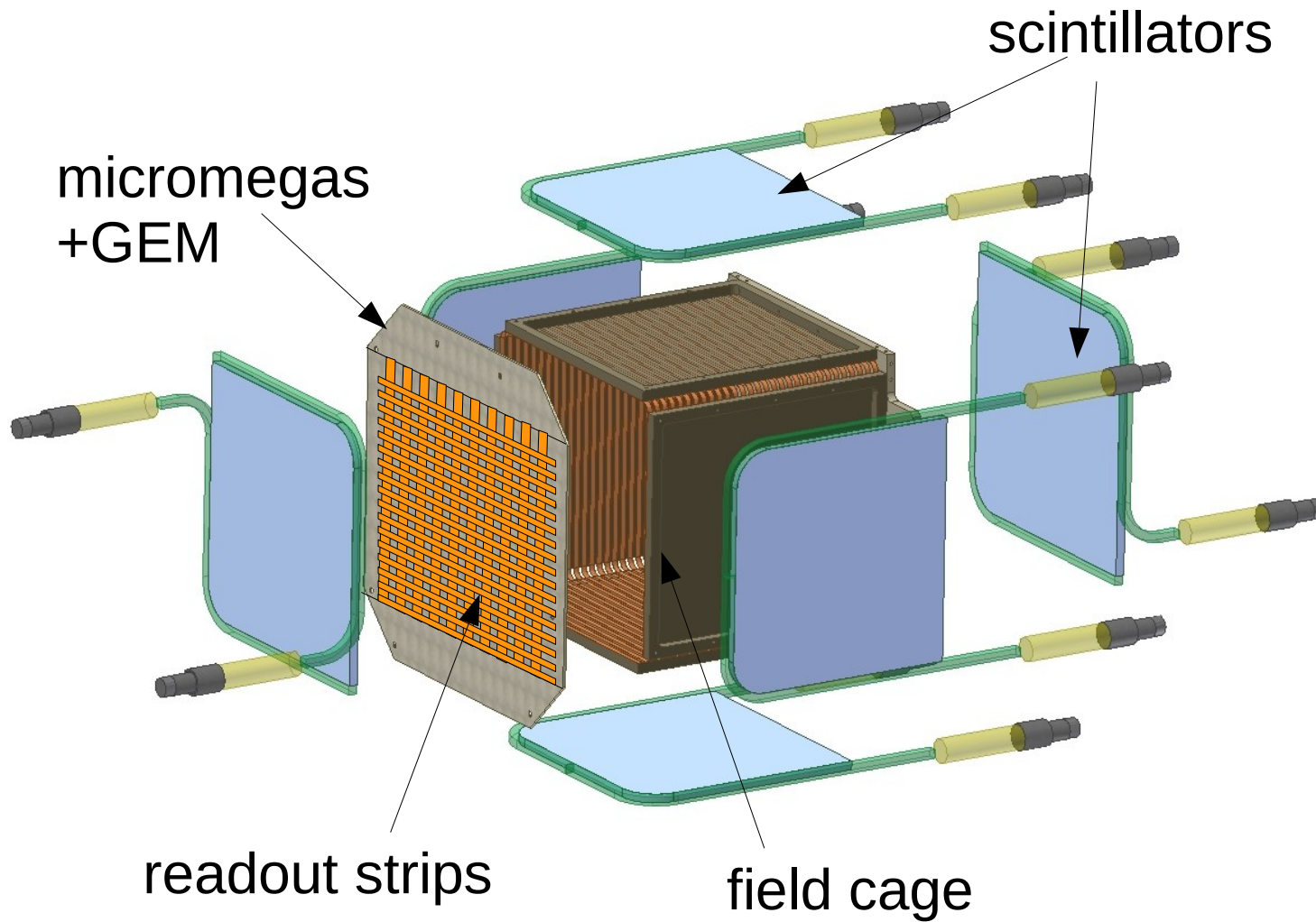
- The HARPO TPC
- Method
  - Cosmic ray data
  - Charge measurement
- Results
  - Evolution over 4 months

- TPC for measurement of polarised gamma rays
  - $e^+e^-$  conversion (MeV~GeV)
  - Various astrophysics applications (in space)
  - Low multiple scattering => high angular resolution
  - Sensitive to linear polarisation
  - High pressure gas for higher conversion probability
- Project LLR+Irfu, funded by P2IO and ANR

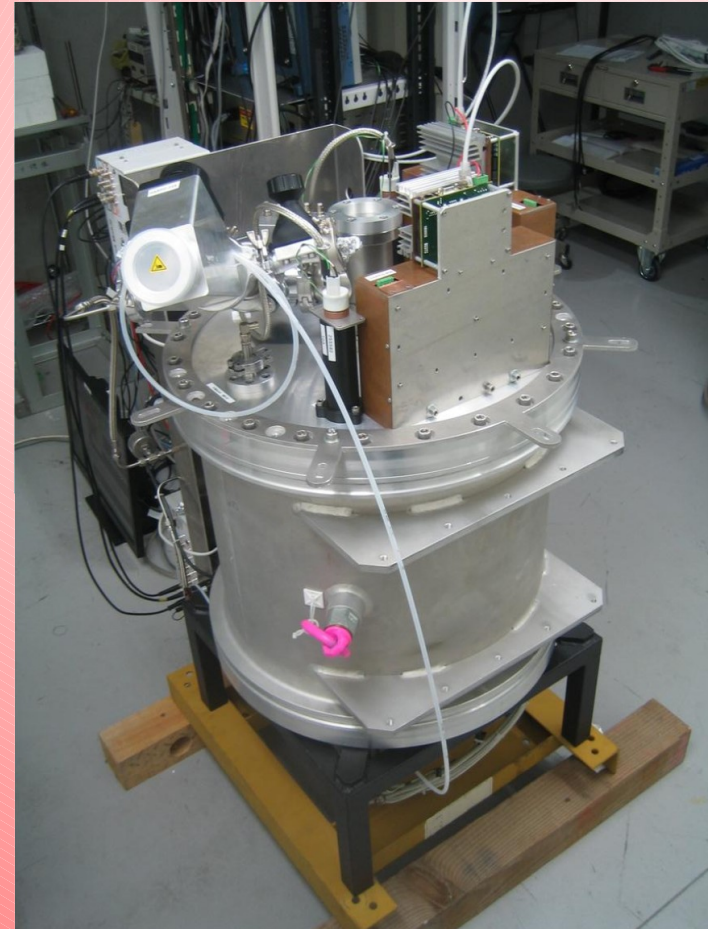
- Purpose
  - Assess challenges
  - Demonstrate performance in test beam
- Realisation
  - 30cm cubic TPC
  - Ar/iC<sub>4</sub>H<sub>10</sub> 95/5 up to 5bar
  - micromegas+2GEM amplification
  - 2x288 strips readout (x&y), 1mm pitch
  - AFTER readout electronics, 511 time bins, up to 50MHz (33 used)
  - trigger: 6 scintillators

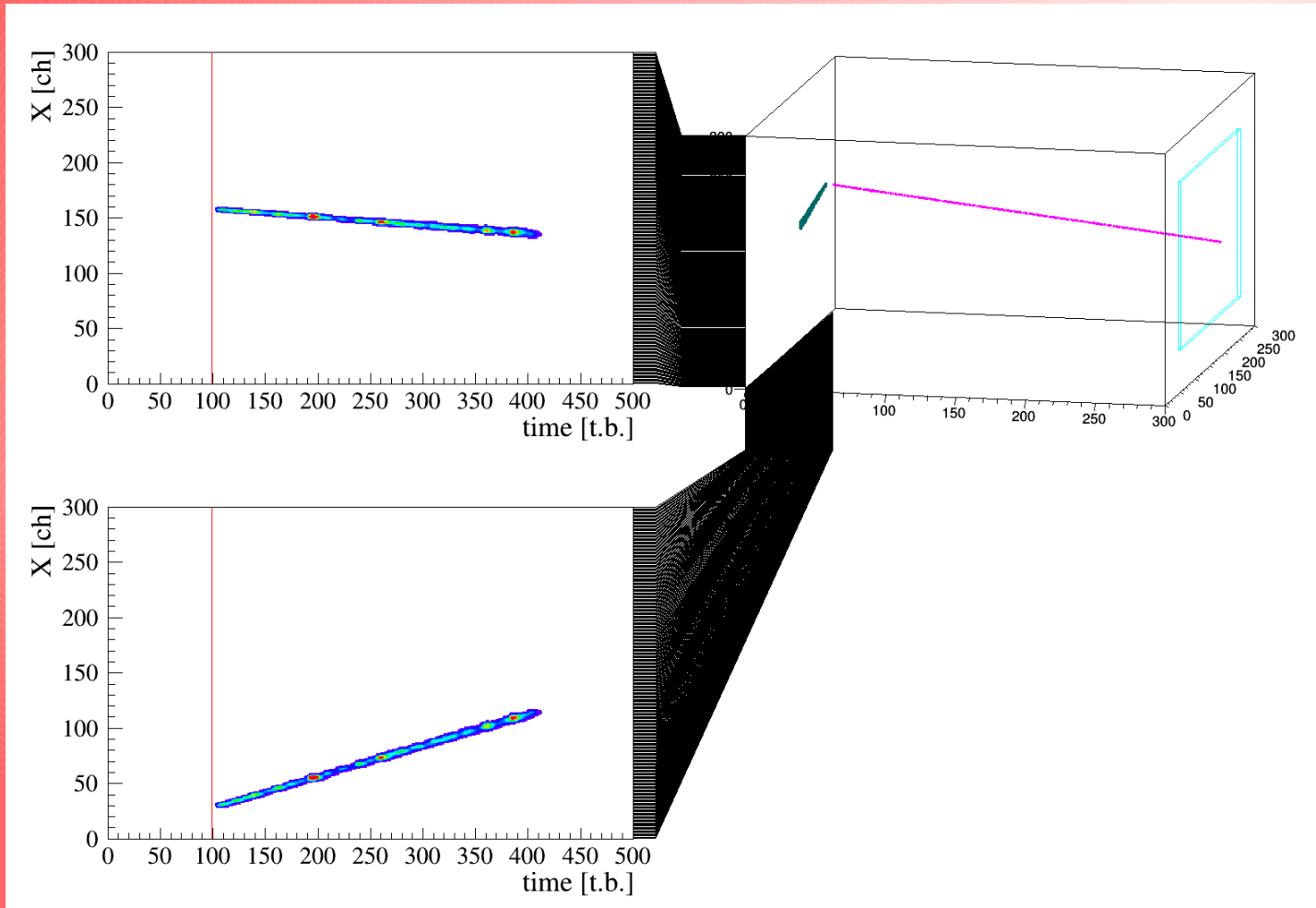






- “vertical” position
  - muons arrive through the readout plane
- Simple trigger
  - coincidence of 2 scintillators



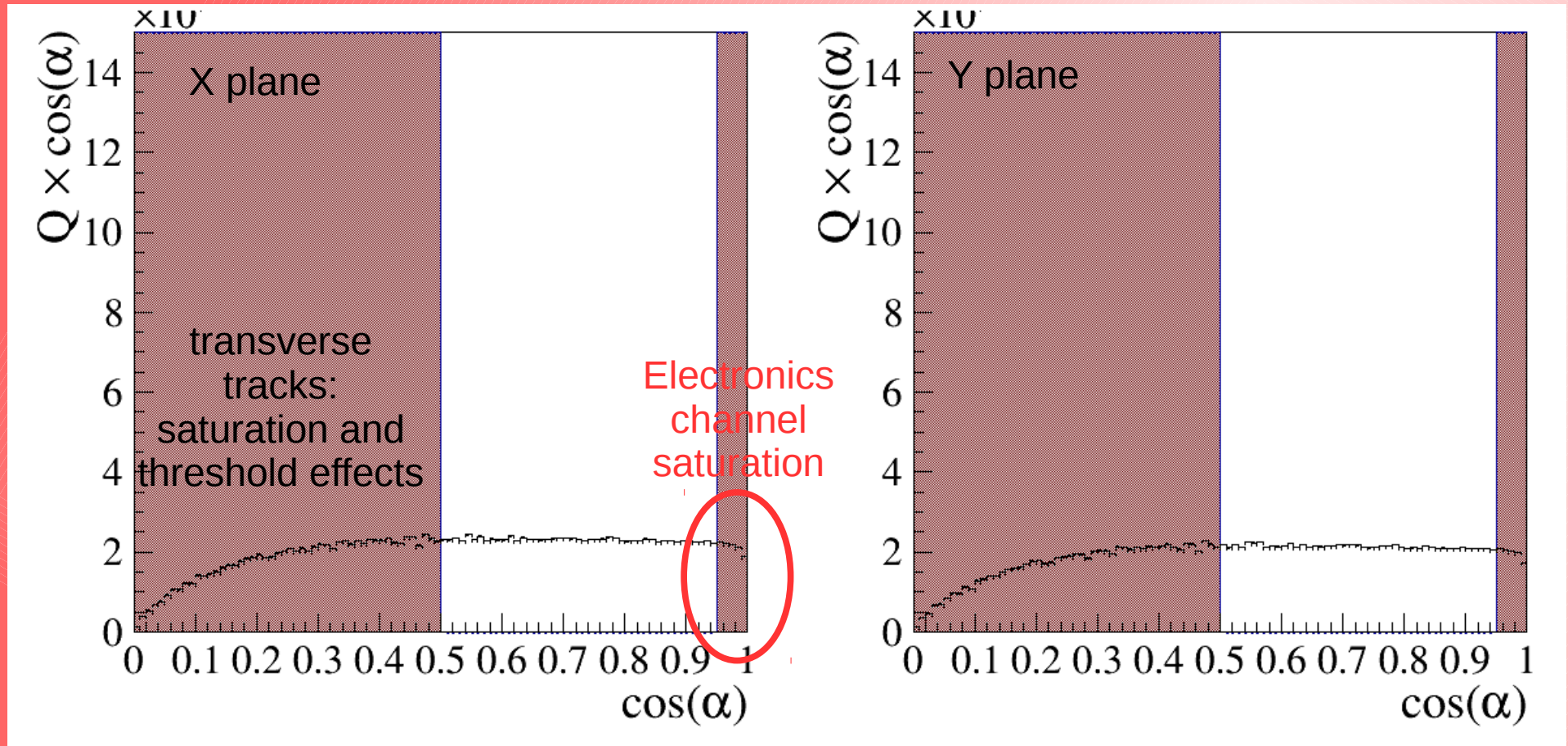




- Use high momentum tracks (muons)
  - $\langle dE/dx \rangle$  independent of event
  - Single track events for simplicity
- Use  $Q_{cl}$  vs  $Z_{drift}$ 
  - Angular corrections (length of track sample)
- Get MPV for all drift distances
  - Landau fit

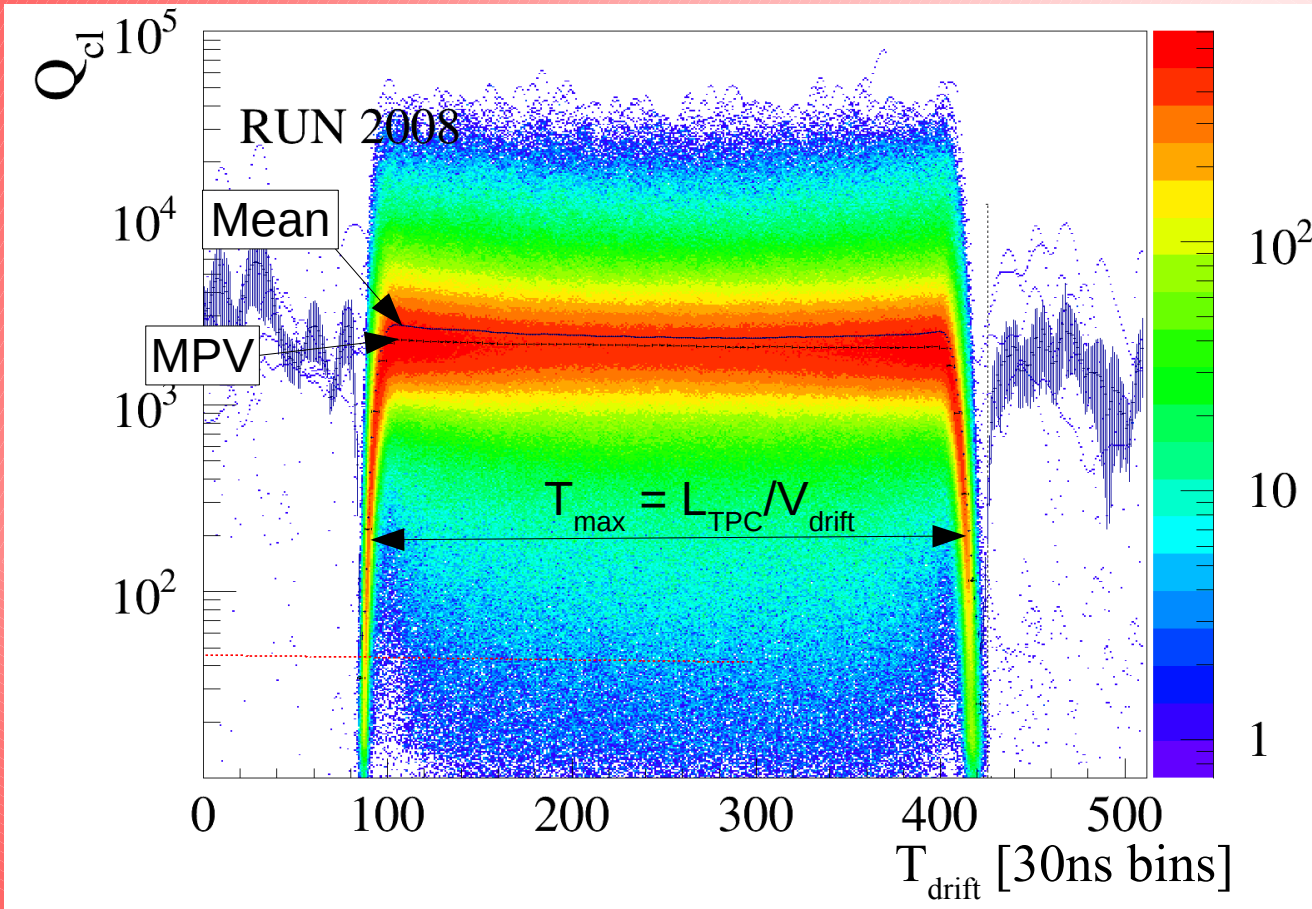


# Angular cut

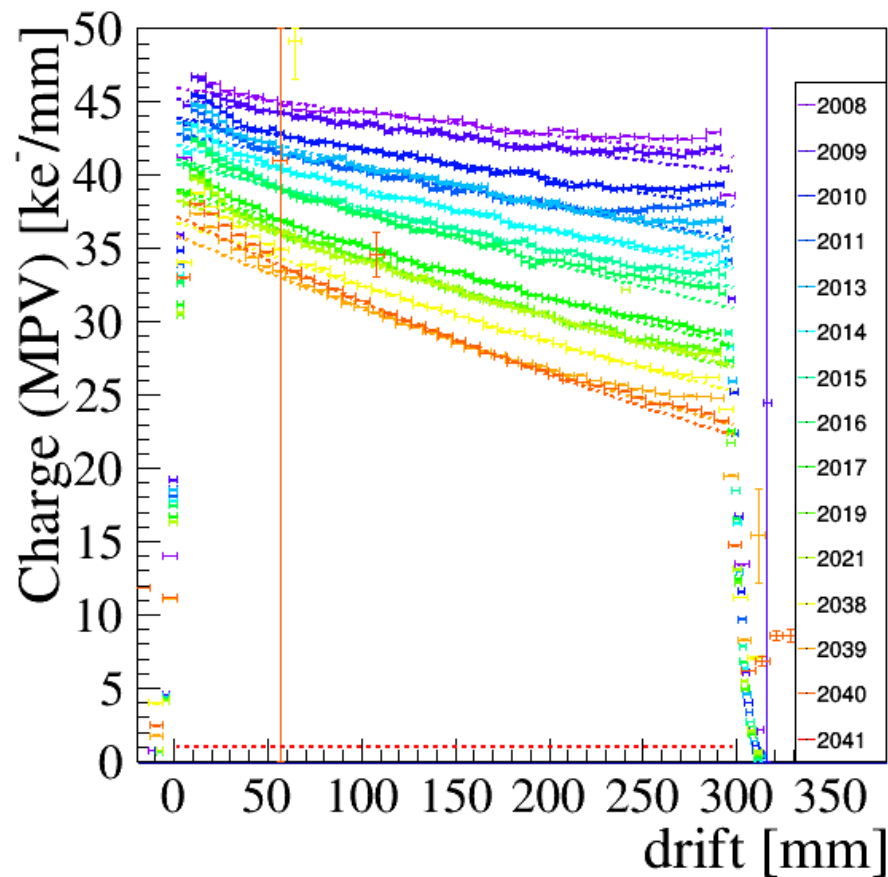
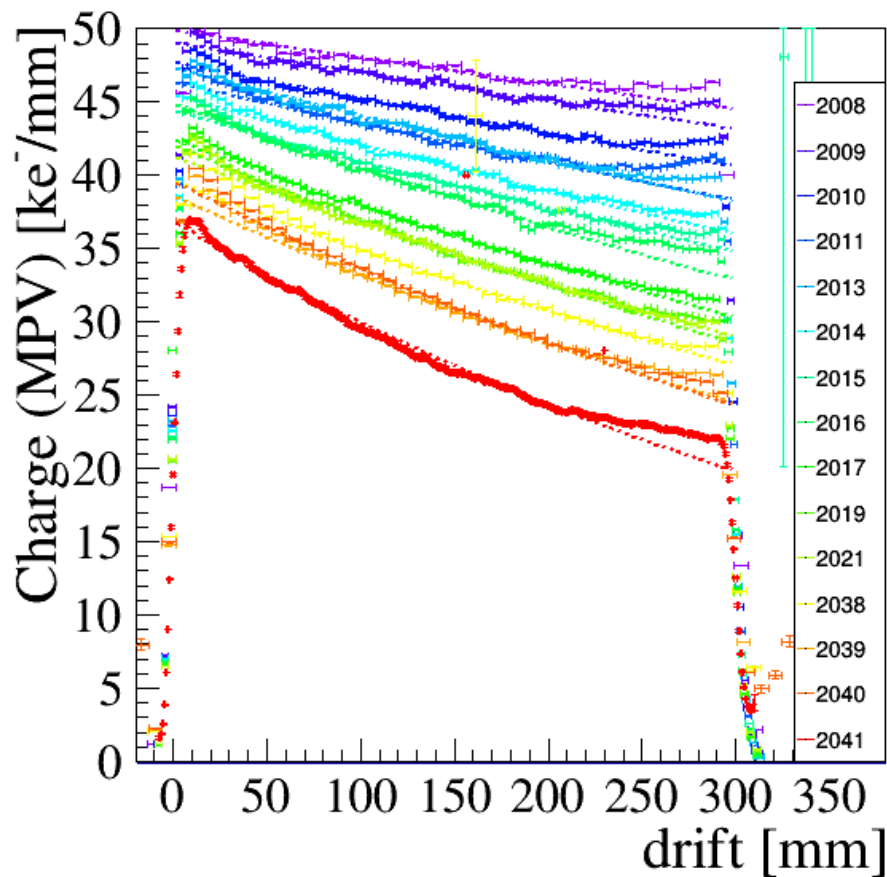


- The charge is normalised with regard to the track angle => independent of angle
- We select mostly longitudinal tracks
- there is a saturation for tracks aligned with 1 channel

# Q vs $T_{\text{drift}}$

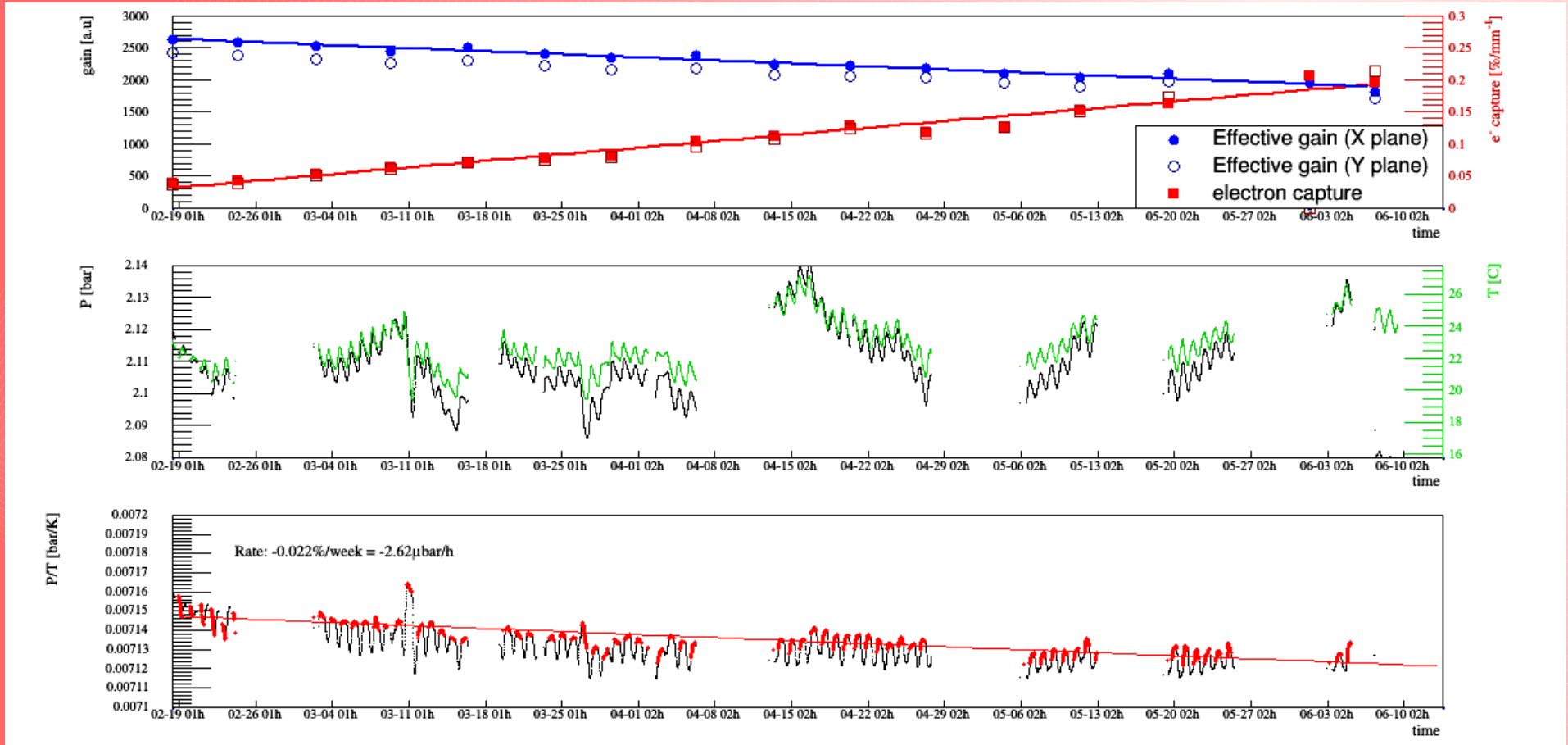


- The charge is normalised with regard to the track angle
- The MPV is obtained from a Landau fit (of slices) (mean value affected by threshold/saturation effects)
- $v_{\text{drift}}$  is also easily extracted from this plot



- Weekly data taking of  $\sim 1.5$ h, for 4 months
- Clear degradation of gain and e<sup>-</sup> capture
- A saturation of the effect of capture appears on the last runs

# Time evolution over 4 months





- Ongoing analysis of the gas
  - mass spectrometry and specific O<sub>2</sub>, H<sub>2</sub>O
  - requires gas samples => pressure change
  - contamination risks in the procedure
- Installation of circulation and purification system
  - simple loop with O<sub>2</sub> and H<sub>2</sub>O filters
  - small turbine for flow

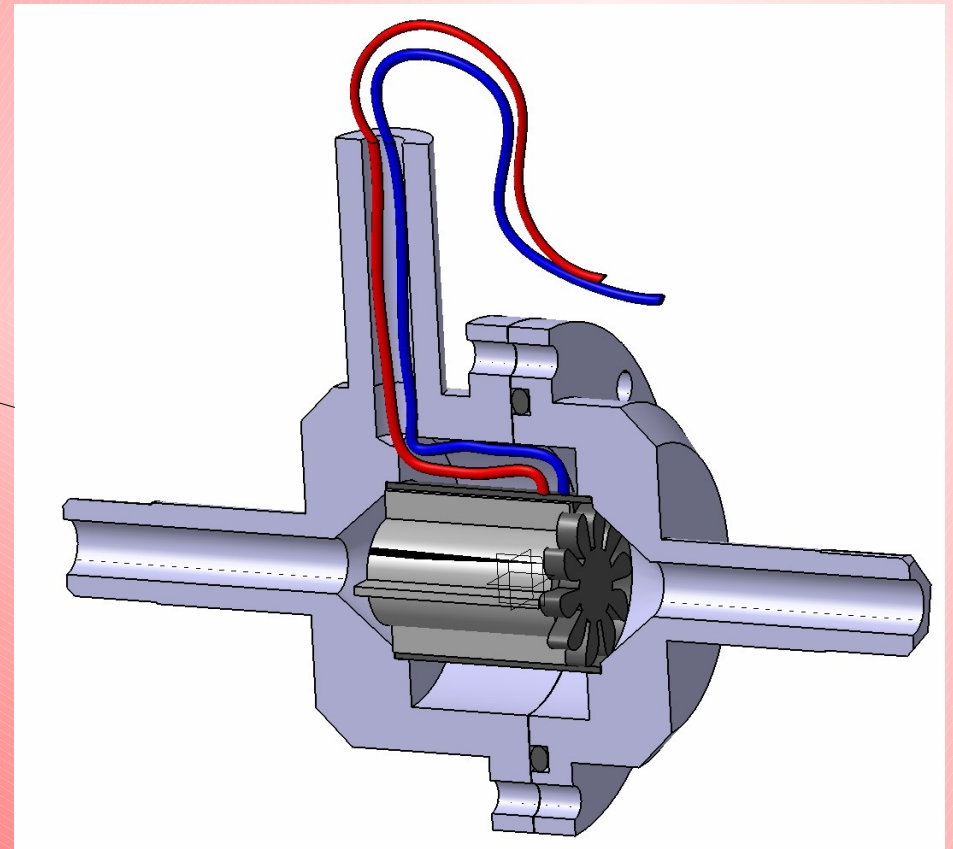
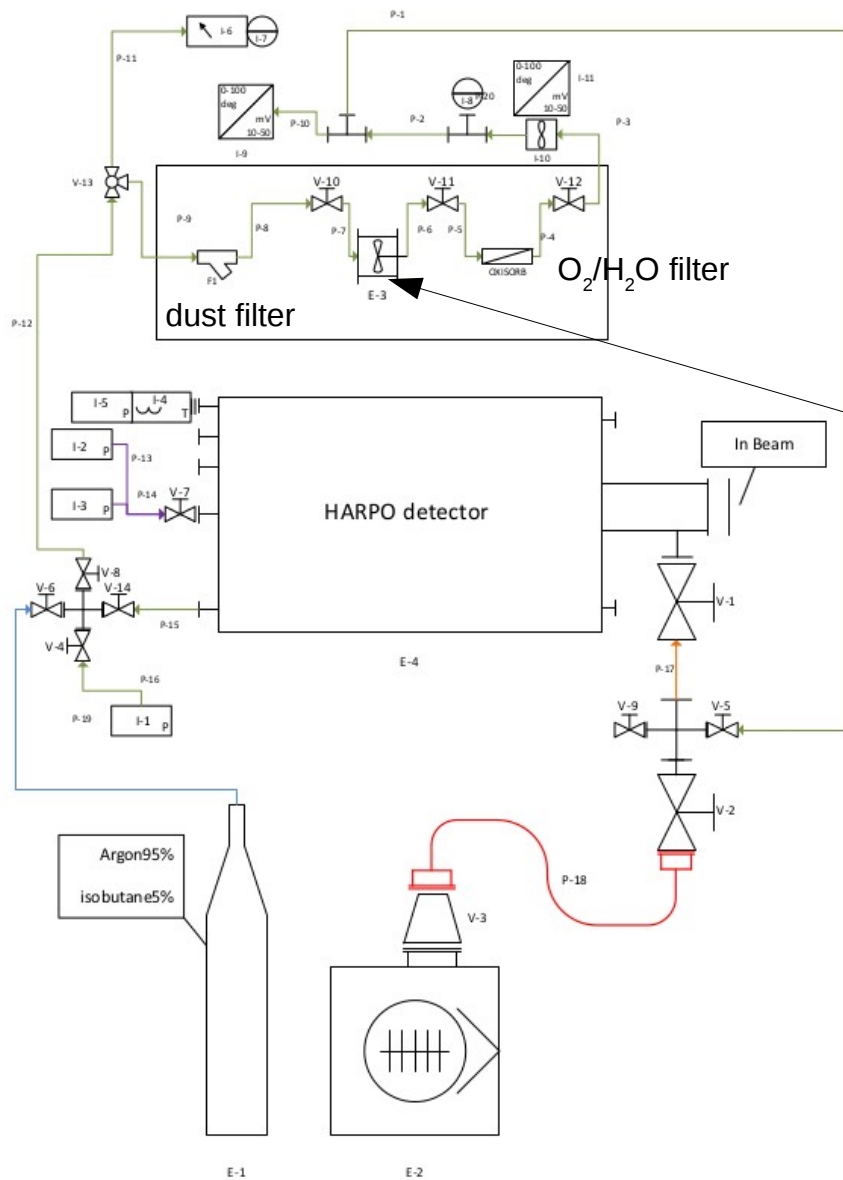
- HARPO offers a simple way to monitor the gas quality using cosmic rays
  - 4 months with same gas in sealed mode
    - degradation, from leaks or outgassing
    - gas analysis ongoing
  - Upcoming recirculation tests for recovery
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backup

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- Conversion ADC to electrons
  - 1ADC  $\sim$  20 electrons
- Full calculation not possible
  - theory:  $\langle dE/dx \rangle$ , reality: MPV (depends on correlations  $\Rightarrow$  simulation?)

