



ELECTRONICS for HARPO

Design, development and validation of electronics for a high performance polarized γ -ray detector

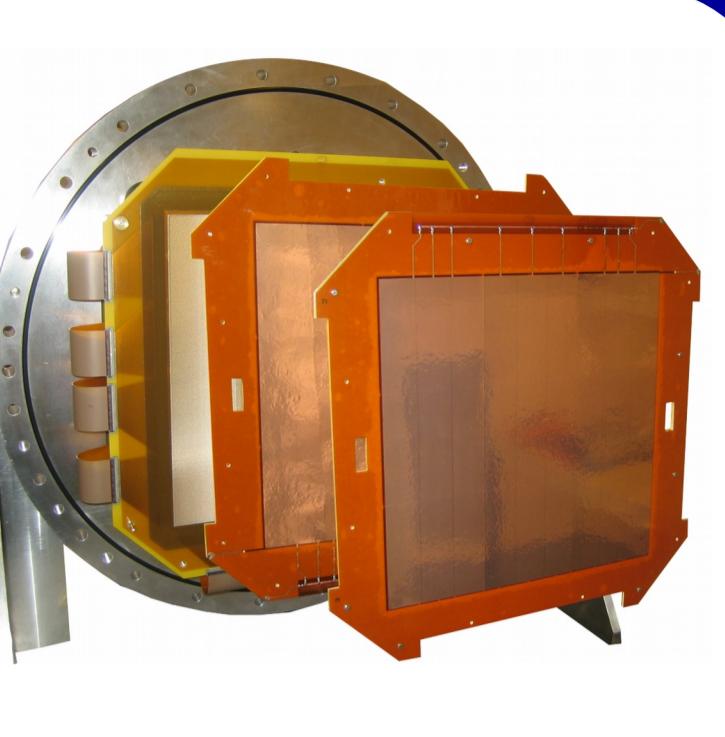
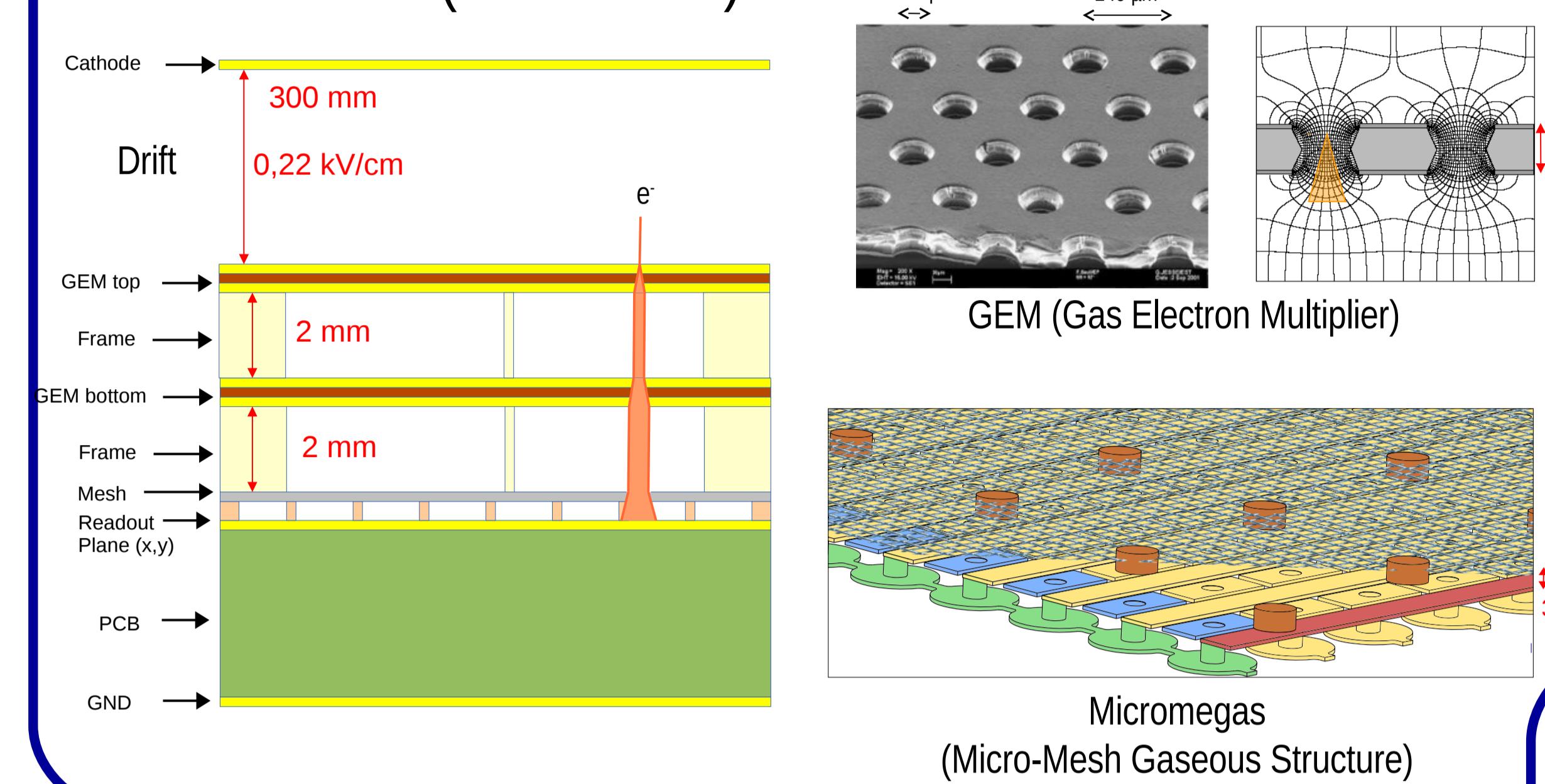


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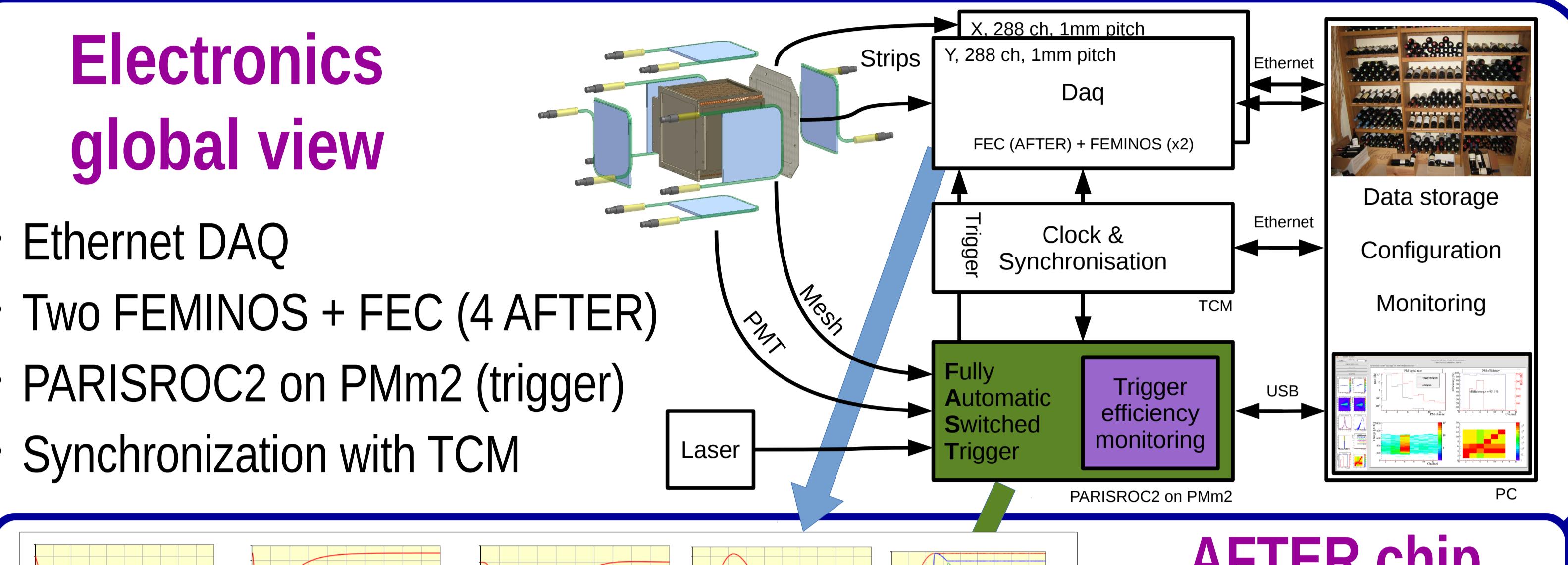
Electron amplification

- Multi-stage amplification: Two GEM + Micromegas
- Gas: Ar/iC₄H₁₀ 95/5% up to 5 bar
- High dynamic range, low spark rate
- Gain : ~ 2500 (5 x 5 x 100)



Electronics global view

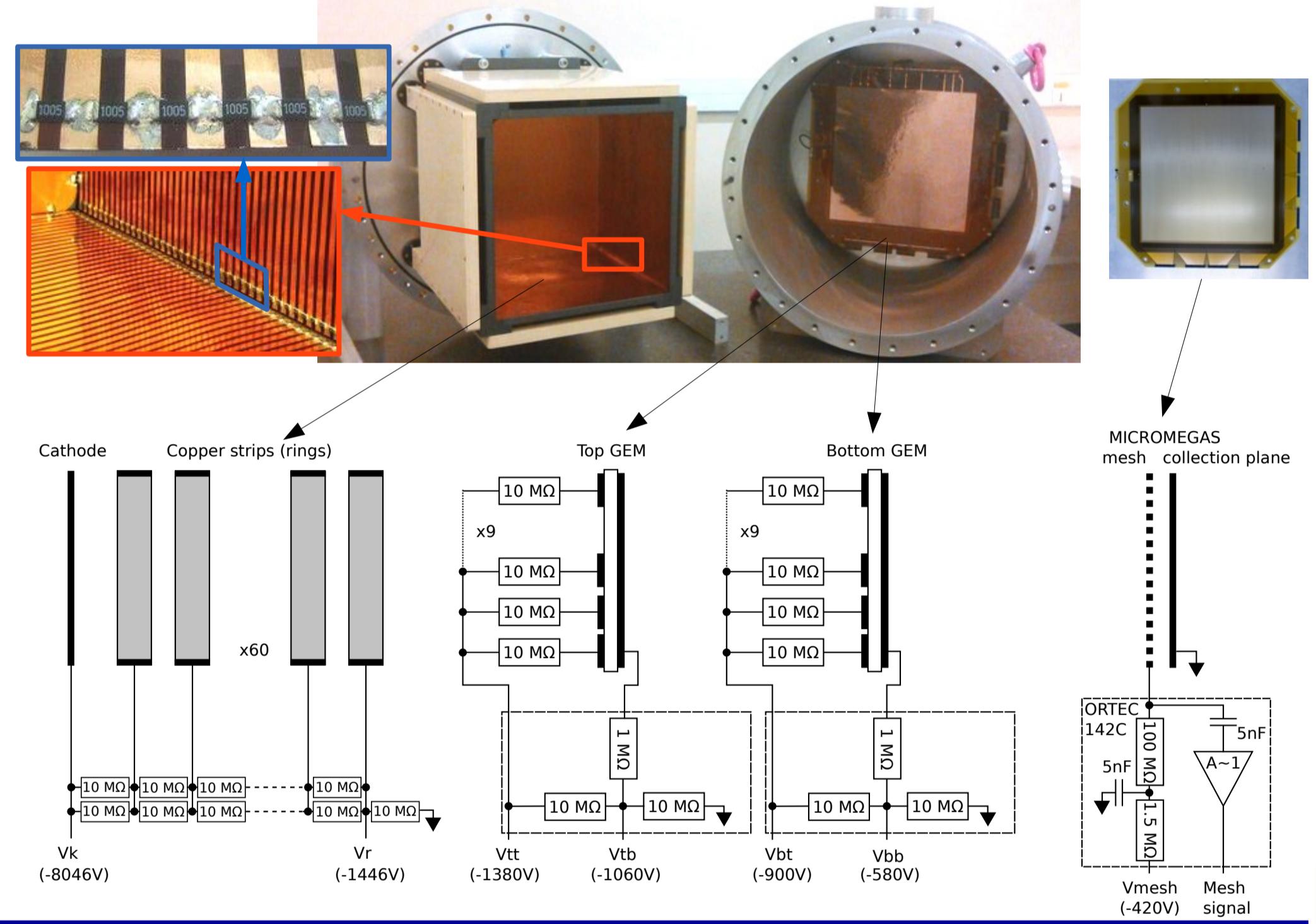
- Ethernet DAQ
- Two FEMINOS + FEC (4 AFTER)
- PARISROC2 on PMm2 (trigger)
- Synchronization with TCM



AFTER chip

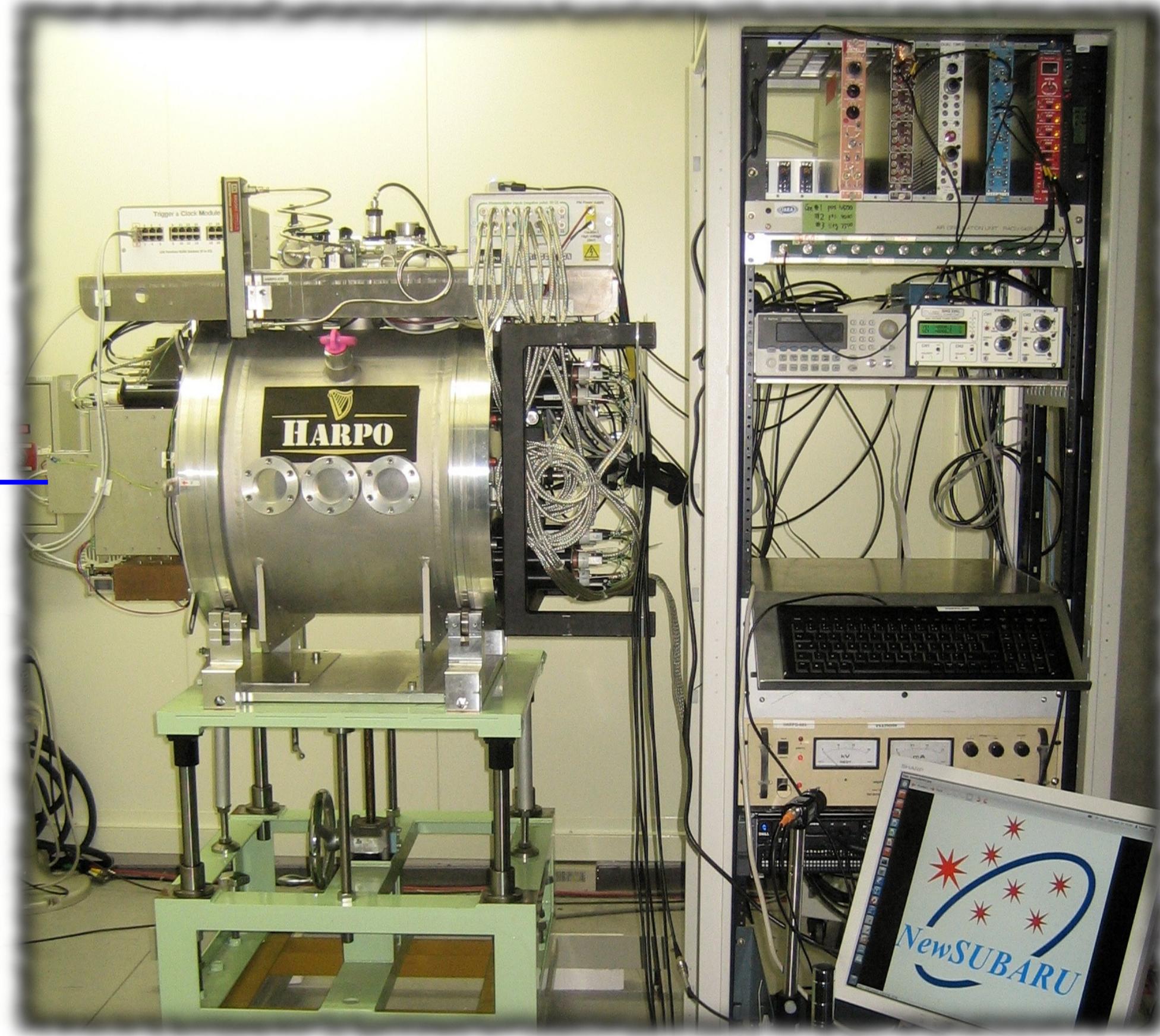
- 72 channels
- 511 time bins
- Input: 120fC to 600fC
- Up to 100MHz sampling

Drift & amplification E fields



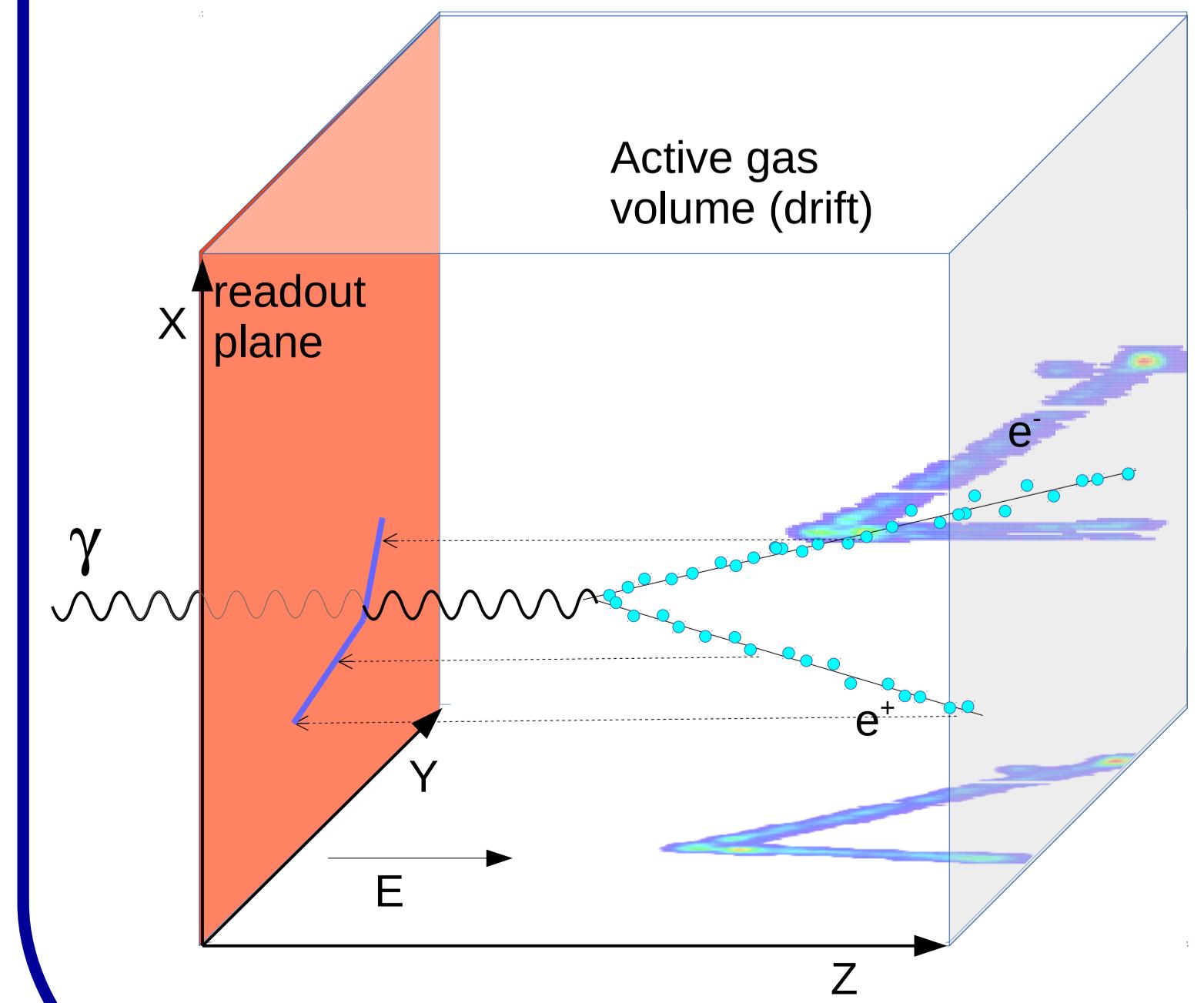
Data Taking at NewSUBARU LASTI, University of Hyôgo, Japan

- e⁻ beam → Scattering → Collimator → γ beam
- Pulser → Laser → Laser pulse (L)
- November 2014
 - 1.7 - 74MeV photons from inverse Compton scattering of IR/visible laser pulse on 0.6 to 1.5GeV e⁻ bunches
 - photon beam pseudo-monochromatic and high polarization by on-axis collimation
 - 60Mevts on disk, 13 energy points, P=0 or 100%, 4 TPC angles



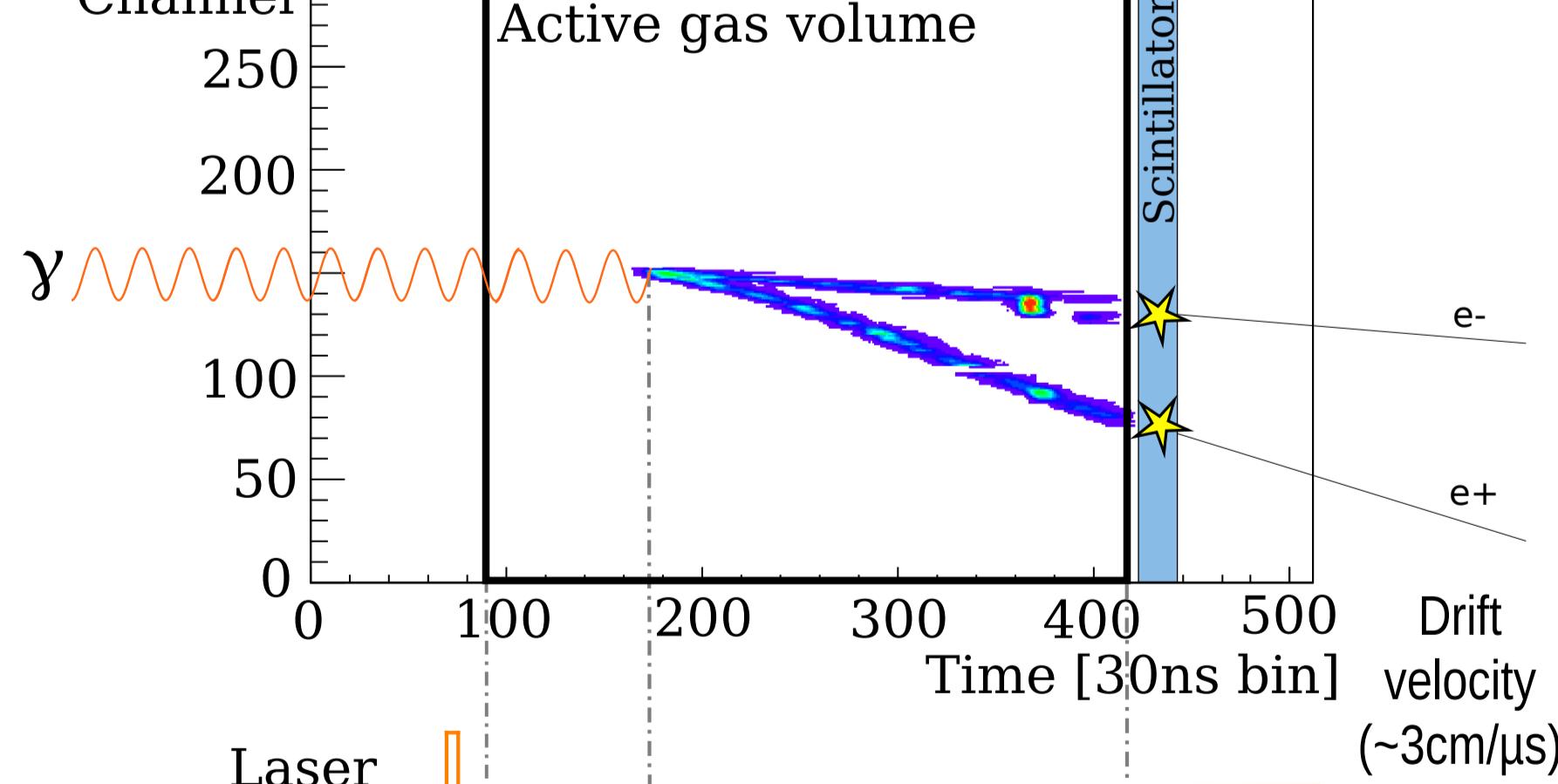
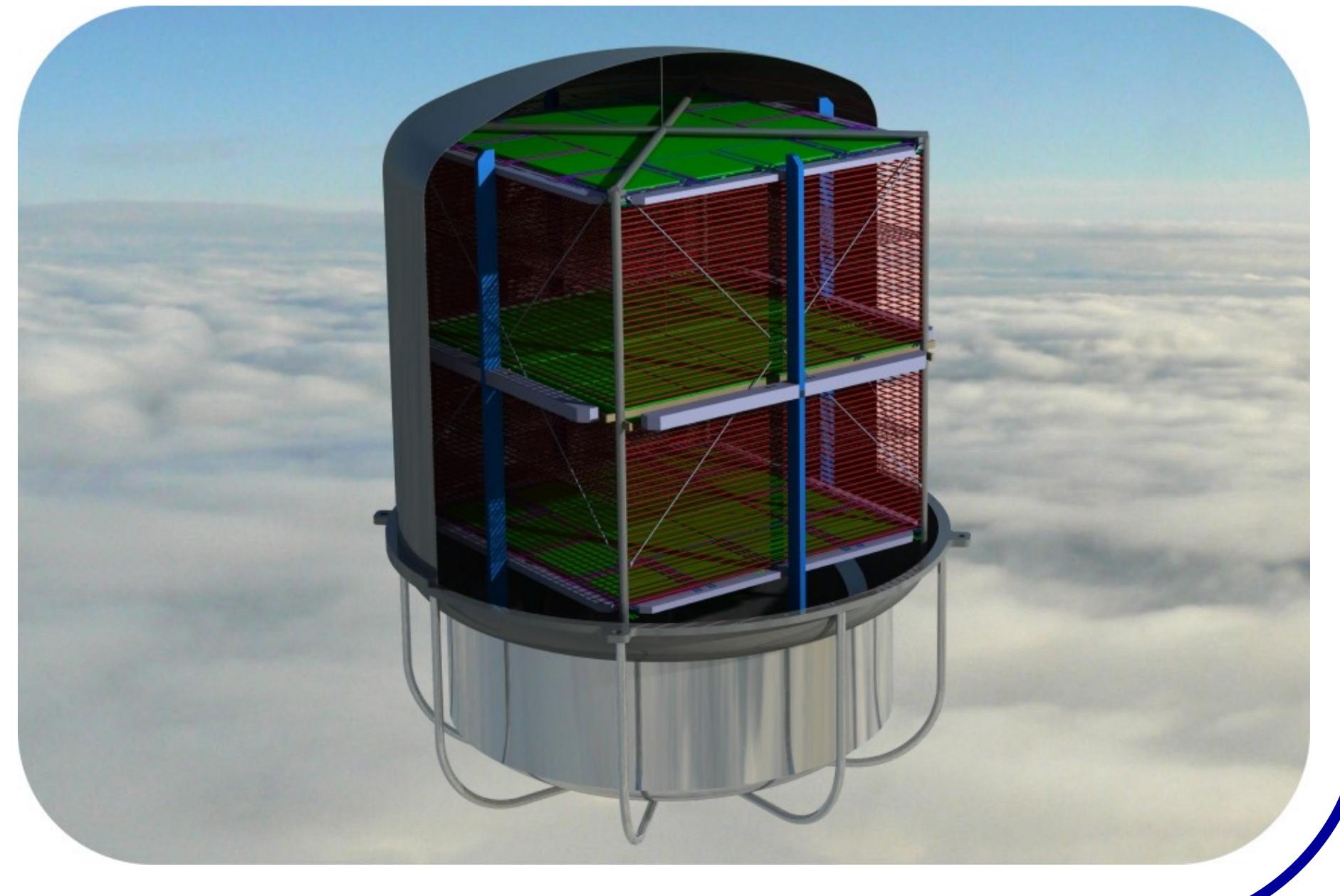
Time Projection Chamber (TPC)

- Pair conversion of γ in the gas $\gamma A \rightarrow e^+e^-A$
- e⁺e⁻ ionize gas along their trajectory
- e⁻ from ionization drift along the E field and are amplified and measured on the x-y readout plane
- Drift time gives a measure of the z coordinate
- Excellent tracking allows good background suppression



Outlook: Balloon flight

- ~1m³ active gas, 2bar
- Scintillator-free trigger (weight)
 => Multiples modules "à la HARPO"
- => AGET chips (real time multiplicity signal)
- Embedded low power electronics



Trigger timing

- Laser pulse,
- Veto upstream scintillator
- Signal in, at least, one downstream scintillator
- Veto early (<1μs) signal on Mesh
- Late (>1μs) signal on Mesh

Performance:
 ~99% noise rejection
 • Good events:
 >50% of triggered events
 ~50Hz Acq. rate

