



Report on Catania Test Beam

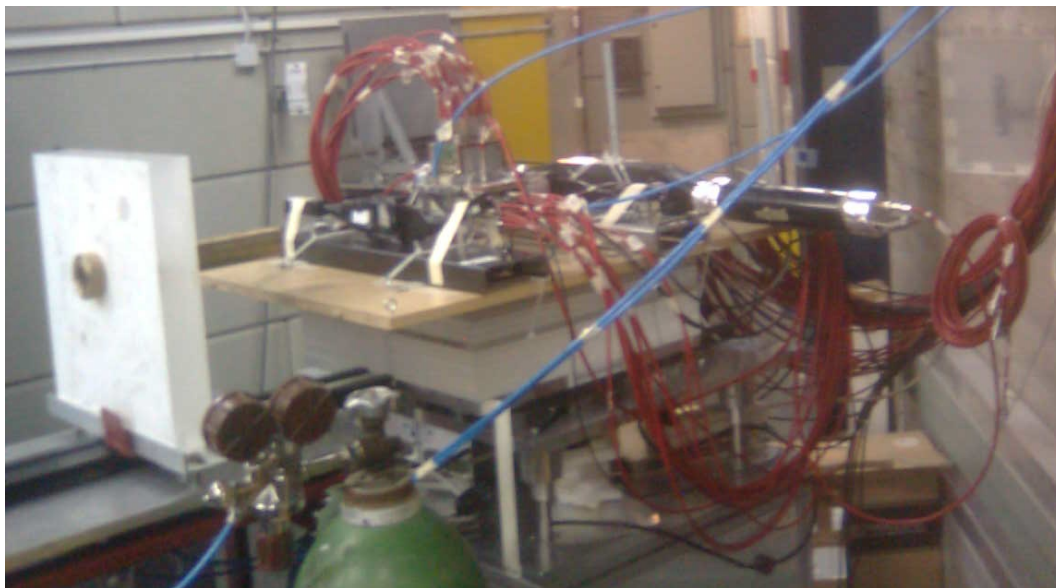


A. Paoloni, V. Patera, **A. Sarti**, A. Sciubba



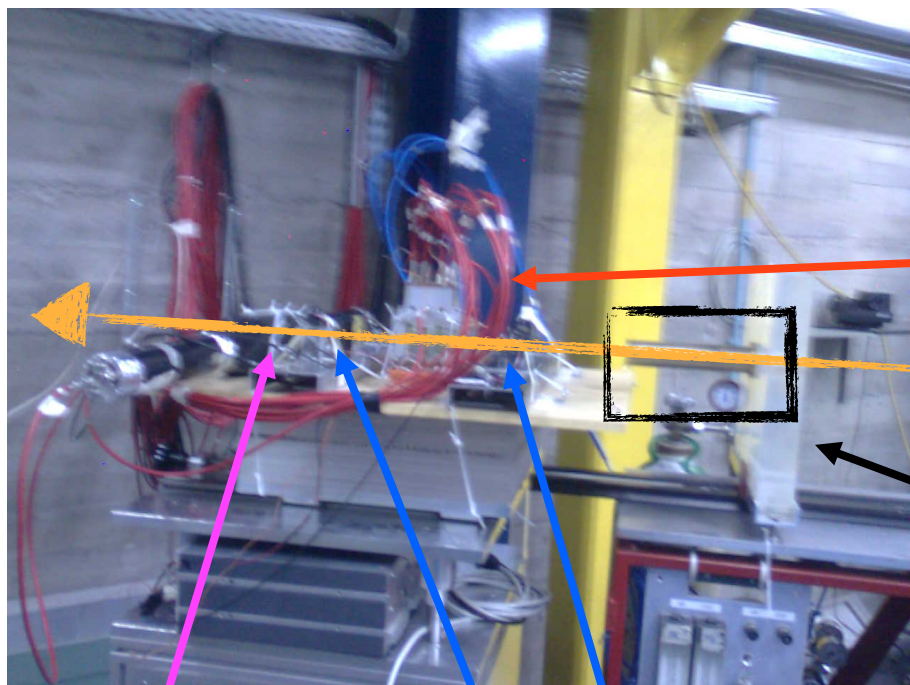
Data taking conditions

- After a fundamental test of the setup with cosmic rays we collected:
 - Four CO_2/Ar gas mixtures (80/20, 70/30, 60/40, 50/50) with 4-5 HV values (1.8 - 2.5 kV) runs (30 min each)
 - one high rate (5 kHz) run (10 min)
 - one long (several hours) Al target run



many thanks to all LNS researchers and services for their invaluable help in logistics and support

Exp. setup



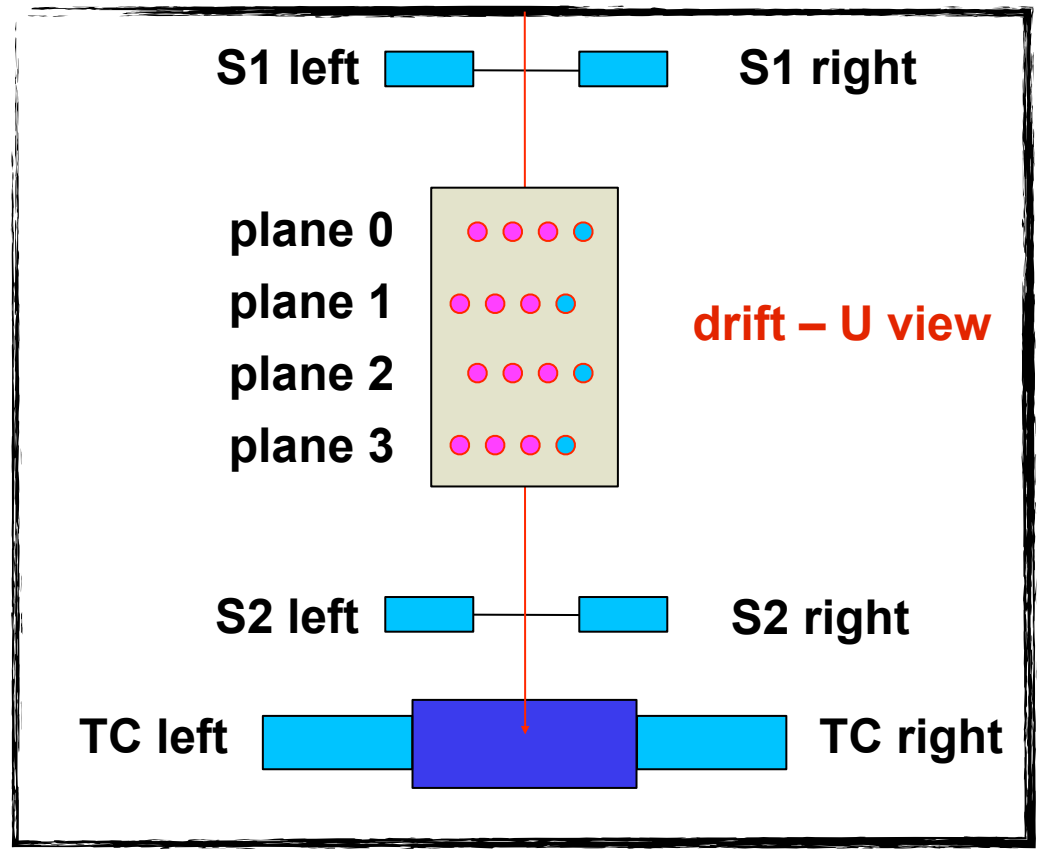
Beam Monitor (Drift Chamber)

C^{12} 62 MeV/A beam line

30 mm dia. collimator

TC trigger counter
 (6 cm scintillator)

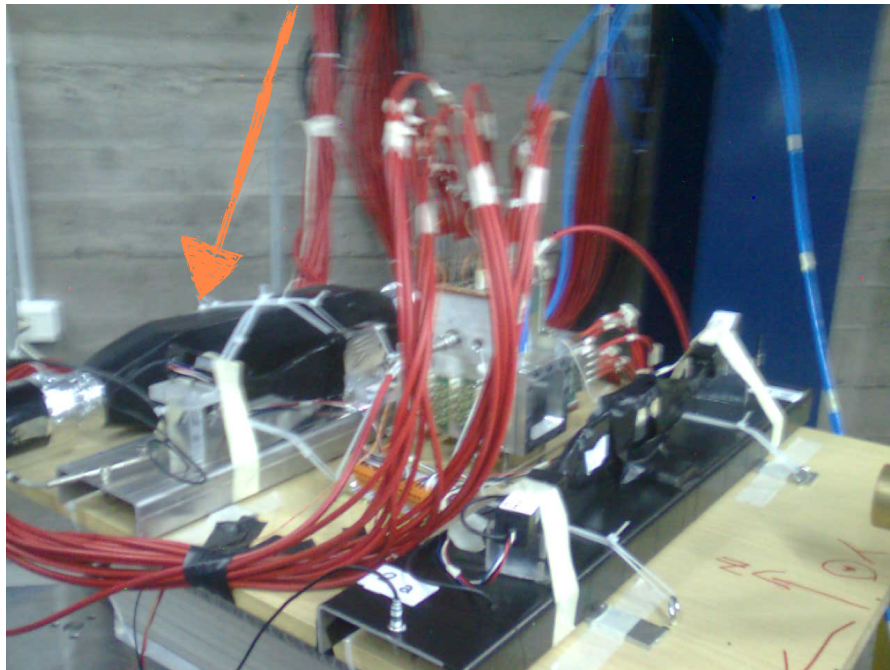
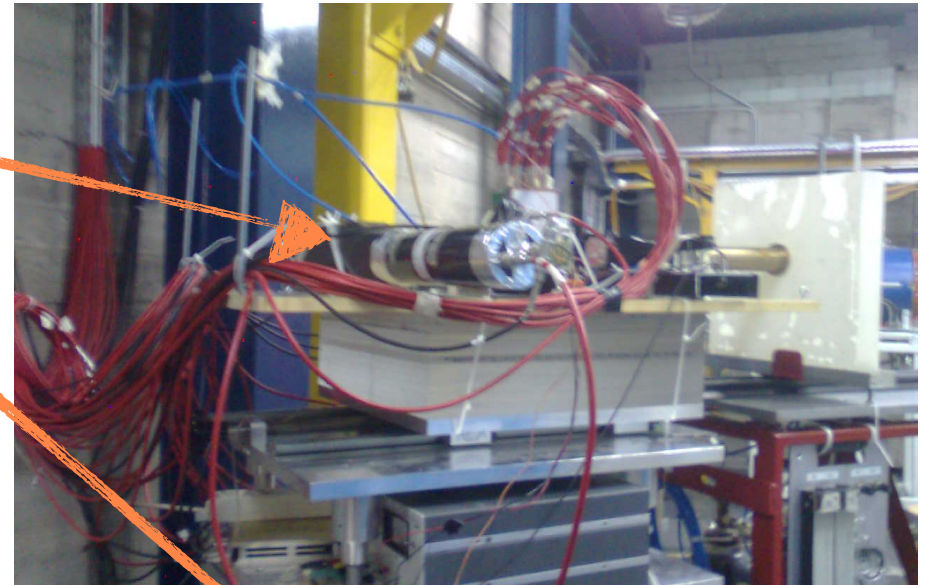
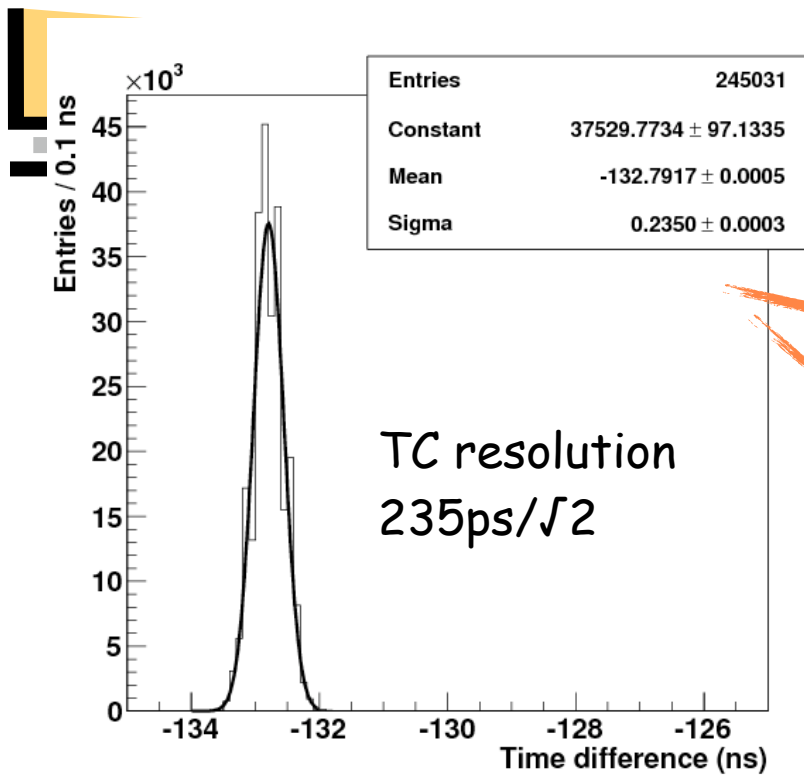
start counters S1 & S2



Trigger: TC thresholds @150 mV/(signal \approx 9 V)

DAQ: time and amplitude of scintillators
 time of $\frac{3}{4}$ of chamber wires
 amplitude of 1 wire

Trigger (TC)



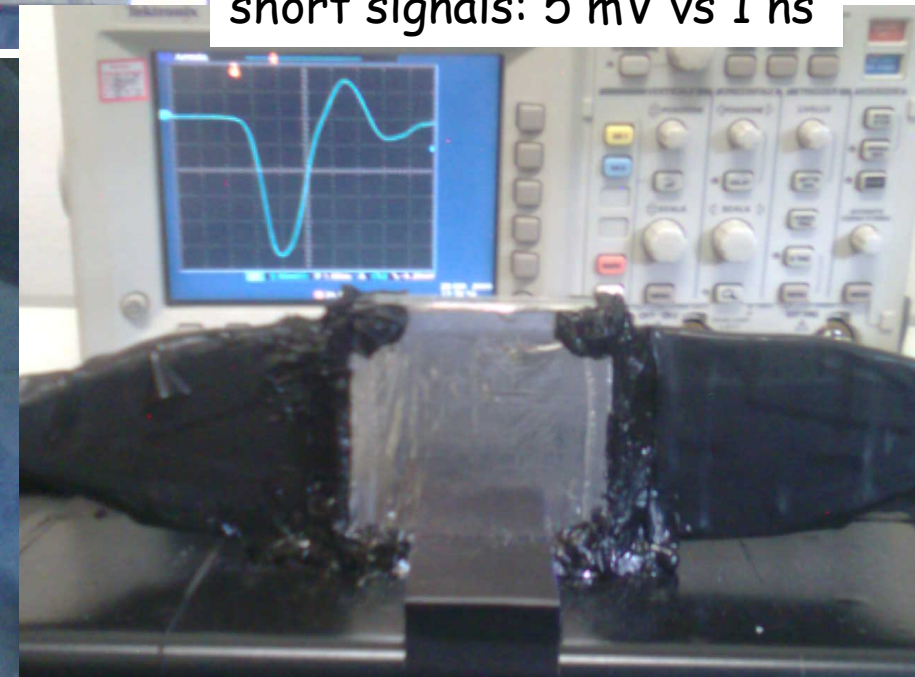
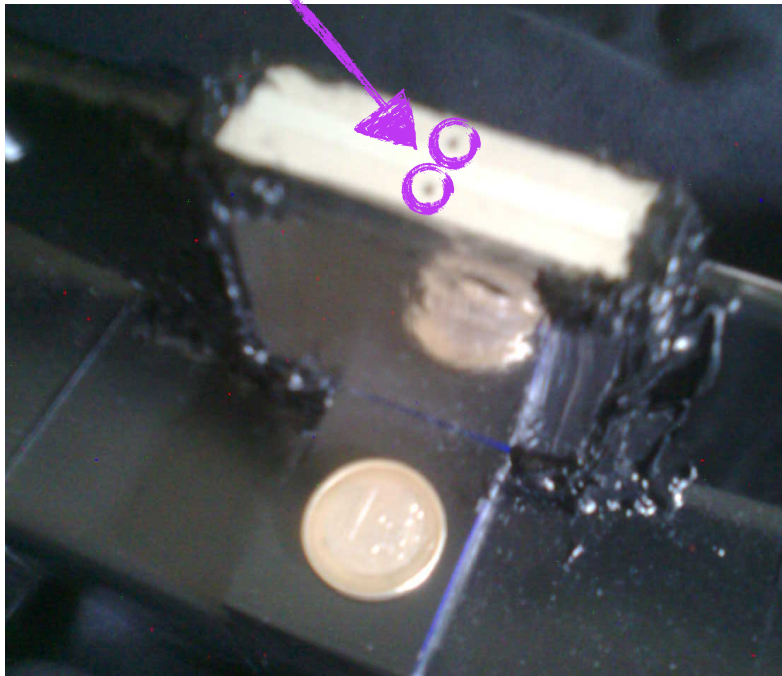
Start Counter



short signals: 5 mV vs 1 ns

100 μm EJ228 (Pilot U) 390 nm

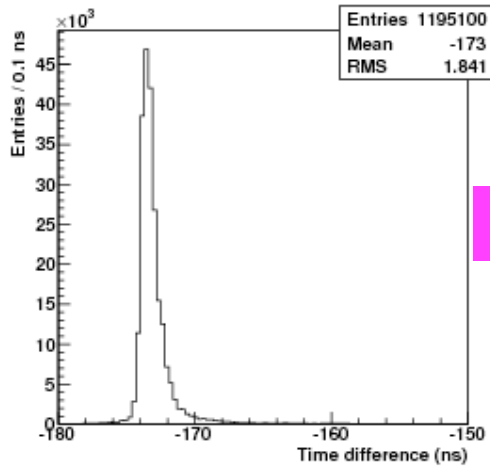
Ready for vacuum operation
(not necessary)



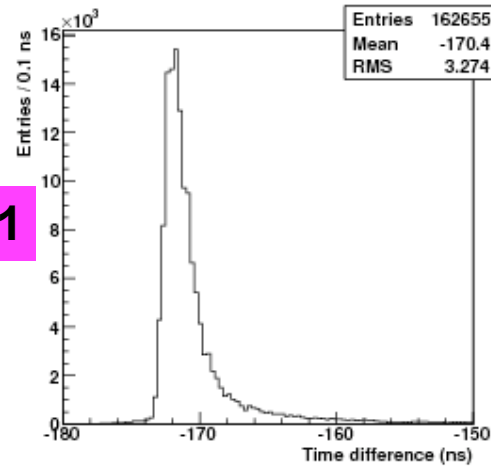
H10721-210 40% q.e.
250ps/ $\sqrt{\text{p.e.}}$

2 x 2,1 μm aluminized mylar windows

Timing performances

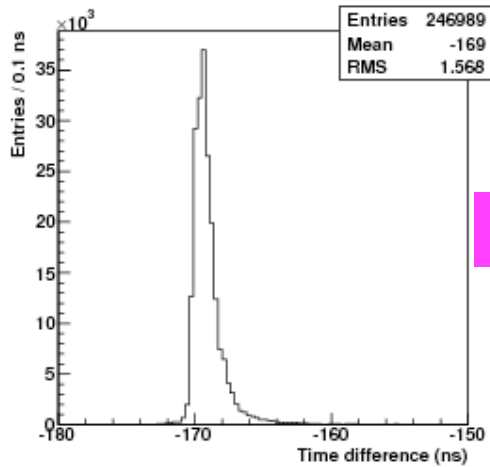
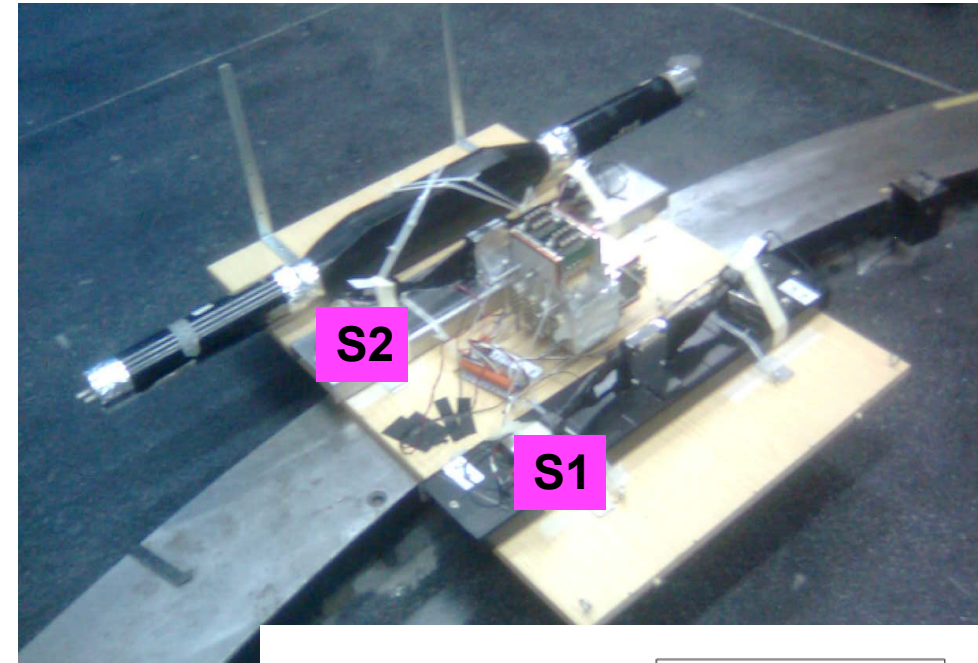


S1

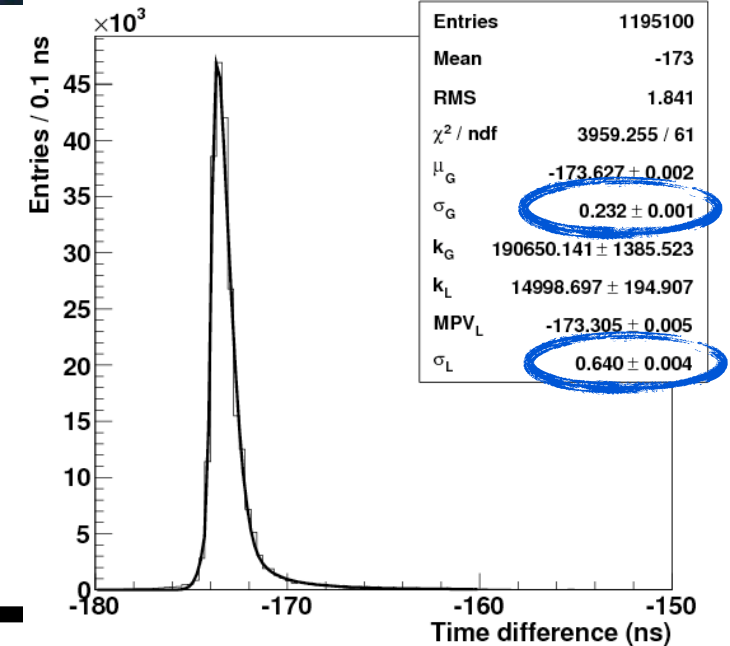
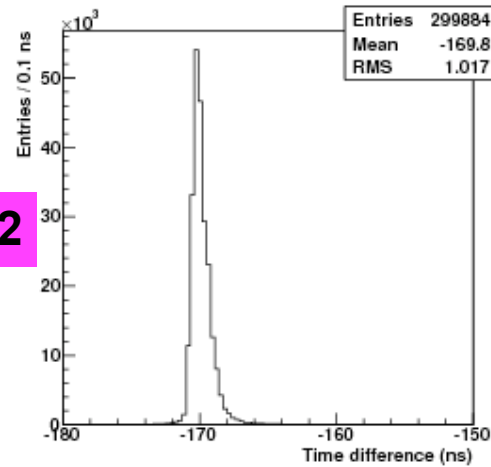


S2

S1



S2



**~300 ps resolution
 compatible with bad S/N (10 mV/5 mV r.m.s)
 due to grounding and small amplitude**



→ Working on the light recovery:

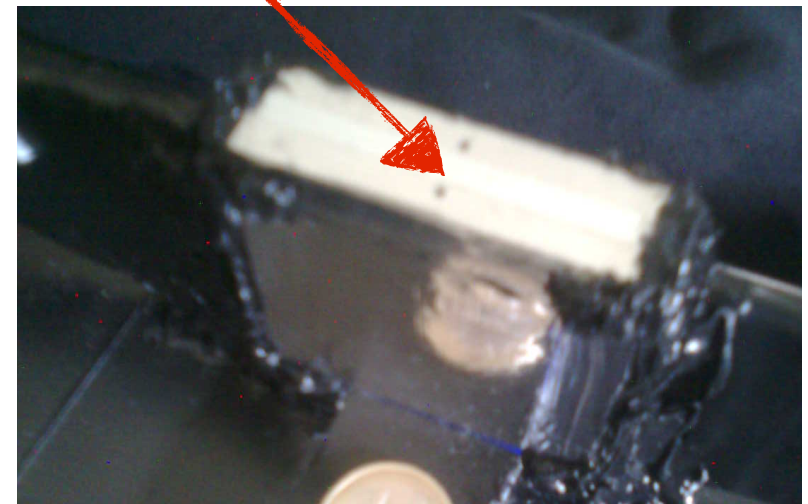
- Twist scintillator layers to work as a readout, bringing the light directly inside photomultiplier
- Change the fiber readout layout in order to recover light at large angle from center

→ Other optimizations

- A fast preamplifier is under construction
- Constant fraction discrimination will help as well



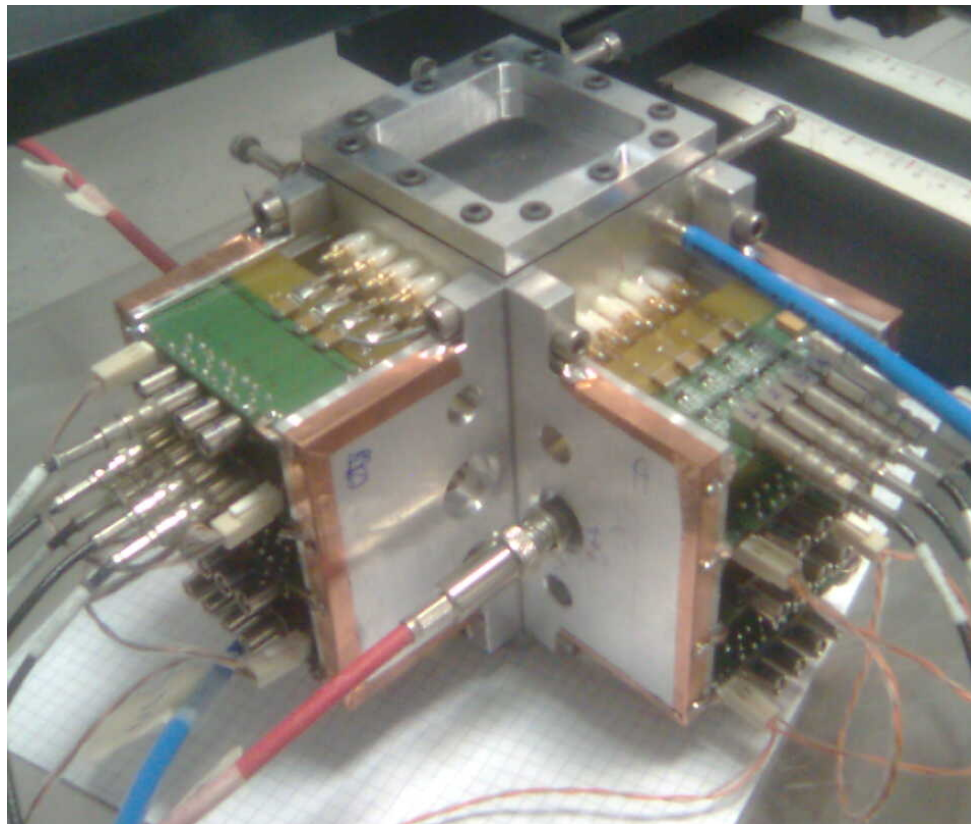
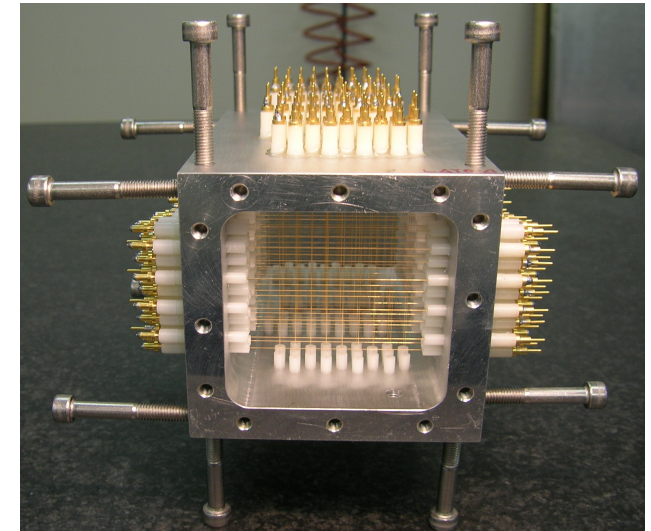
Doubling the scintillator thickness can also help doubling the collected charge



The Beam Monitor

→ Drift chamber

- X-Y view : 4 planes per view, only 3 instrumented (lack of discriminators)
- Exagonal cell: 0.5 cm radius
- Ar-CO₂ operation

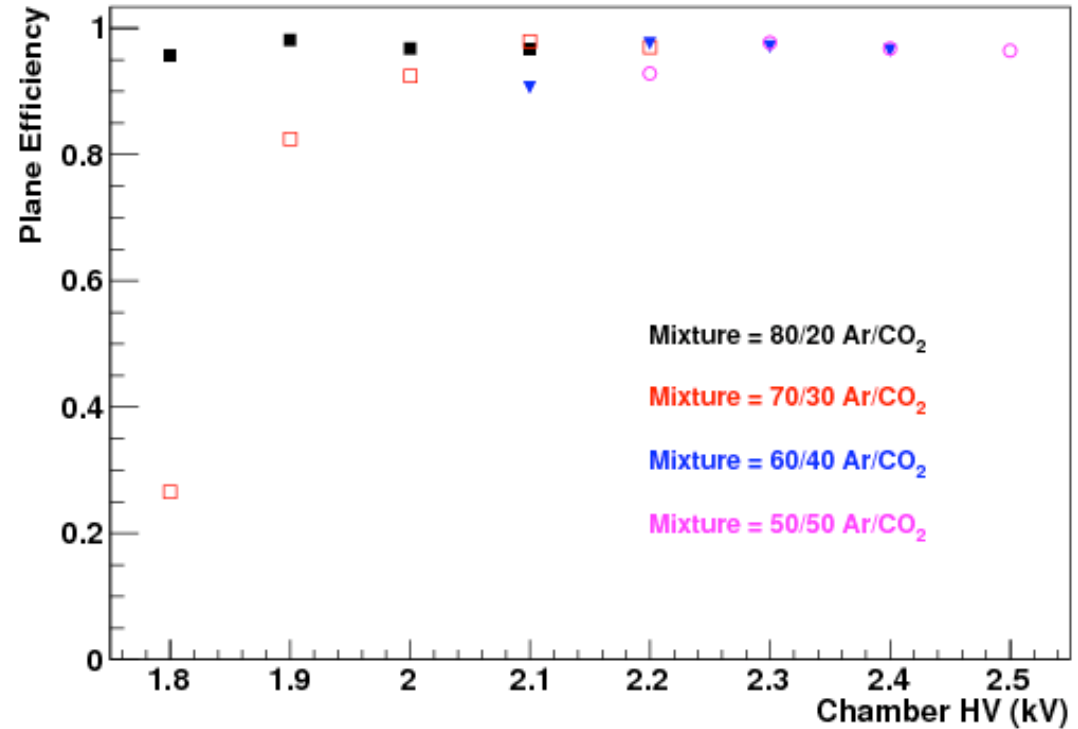
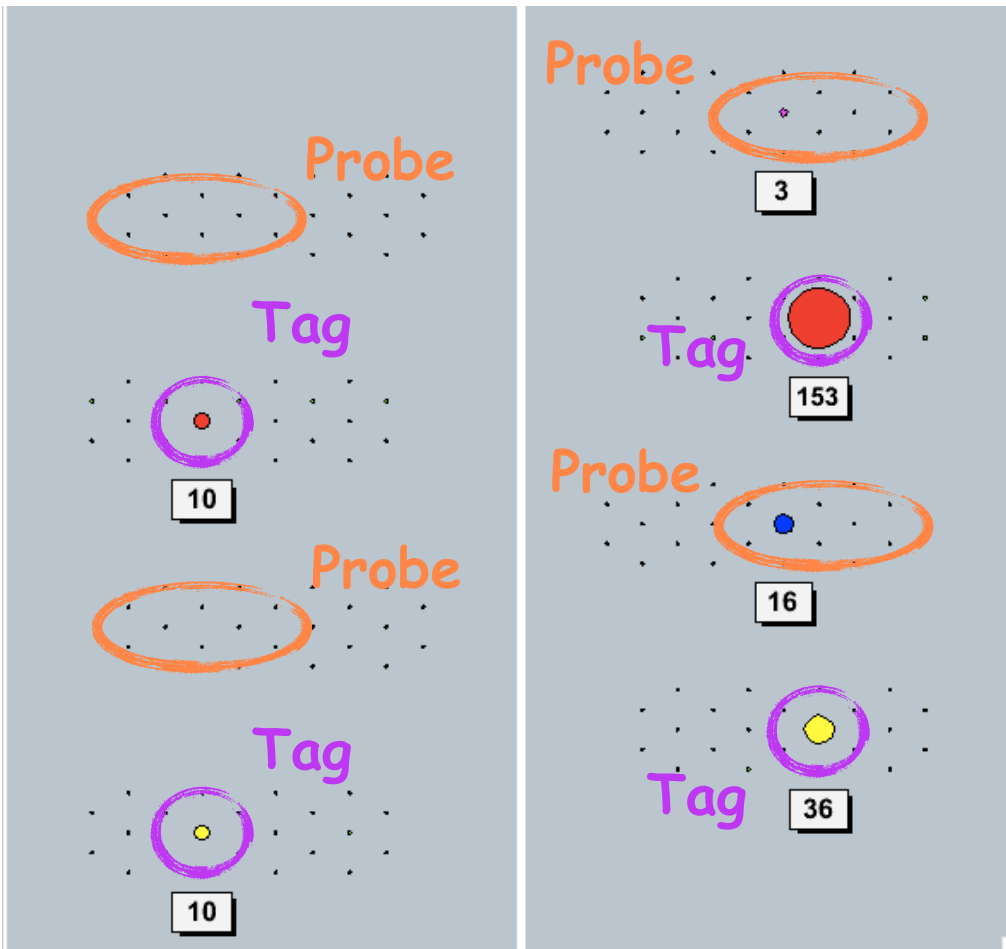


→ Performed different tests

- HV scan (1.8 - 2.5 kV)
- Different Ar/CO₂ gas mixtures
- Added Al layer (fragmentation effects)
- Changed the beam intensity

"Plane" efficiency

Computed 'raw' efficiency
without fitting

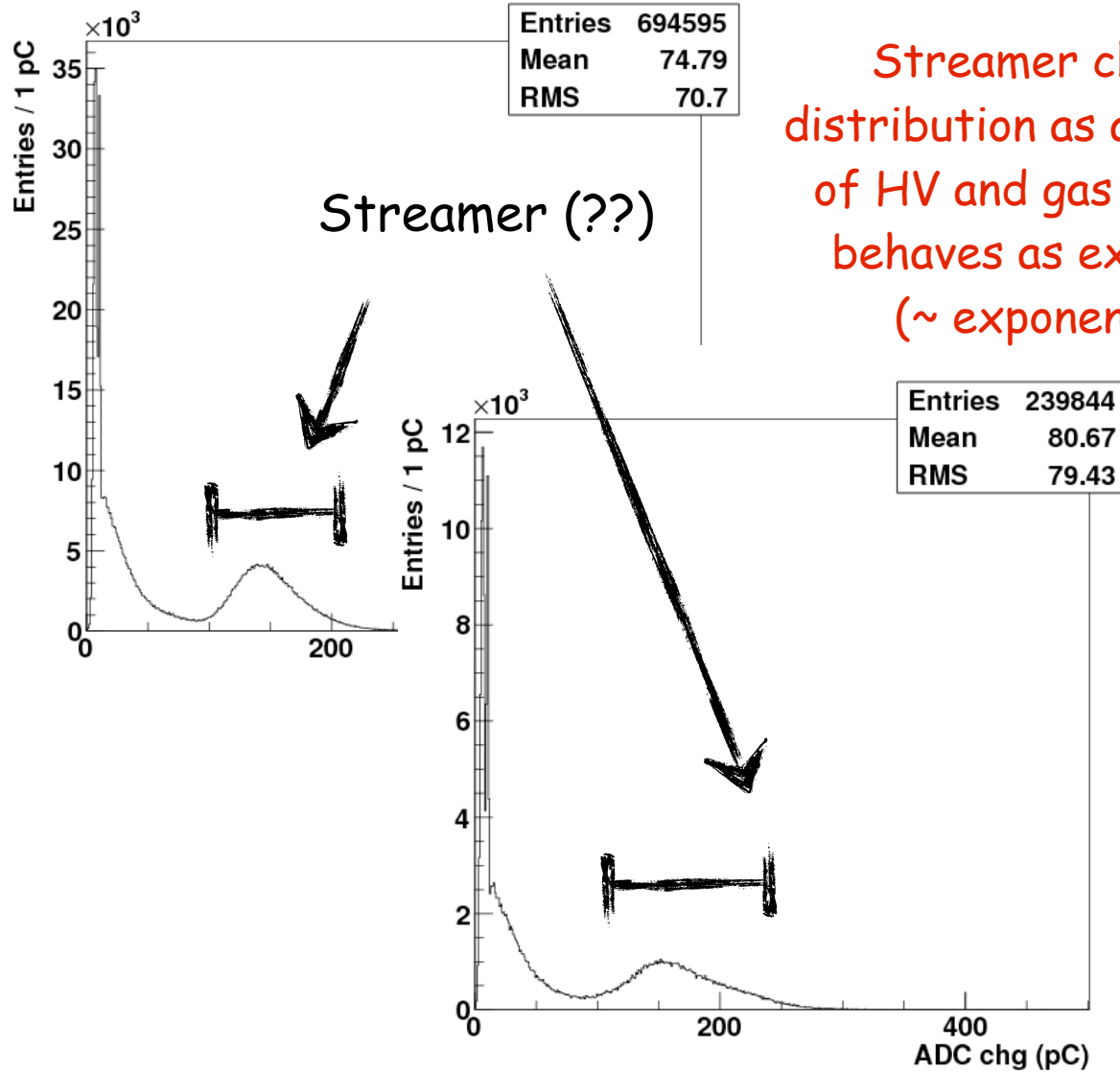


When 'Tag' is found,
'Probe' is searched!

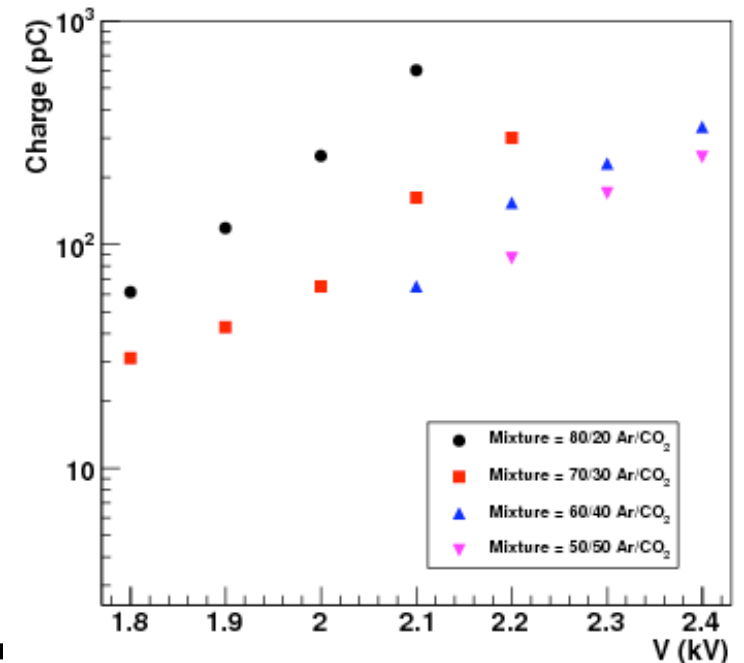
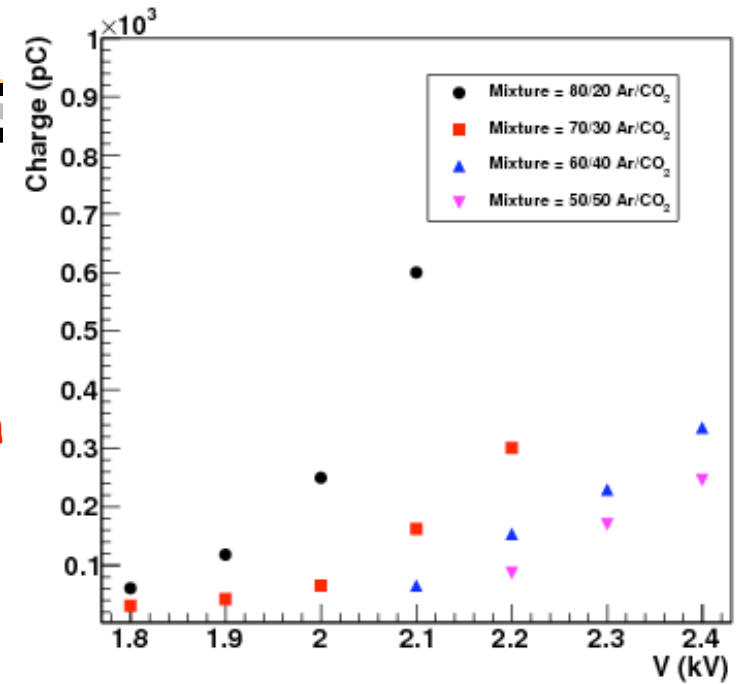
60/40 and 50/50 mixtures were
tested only in the plateau region

Charge distributions

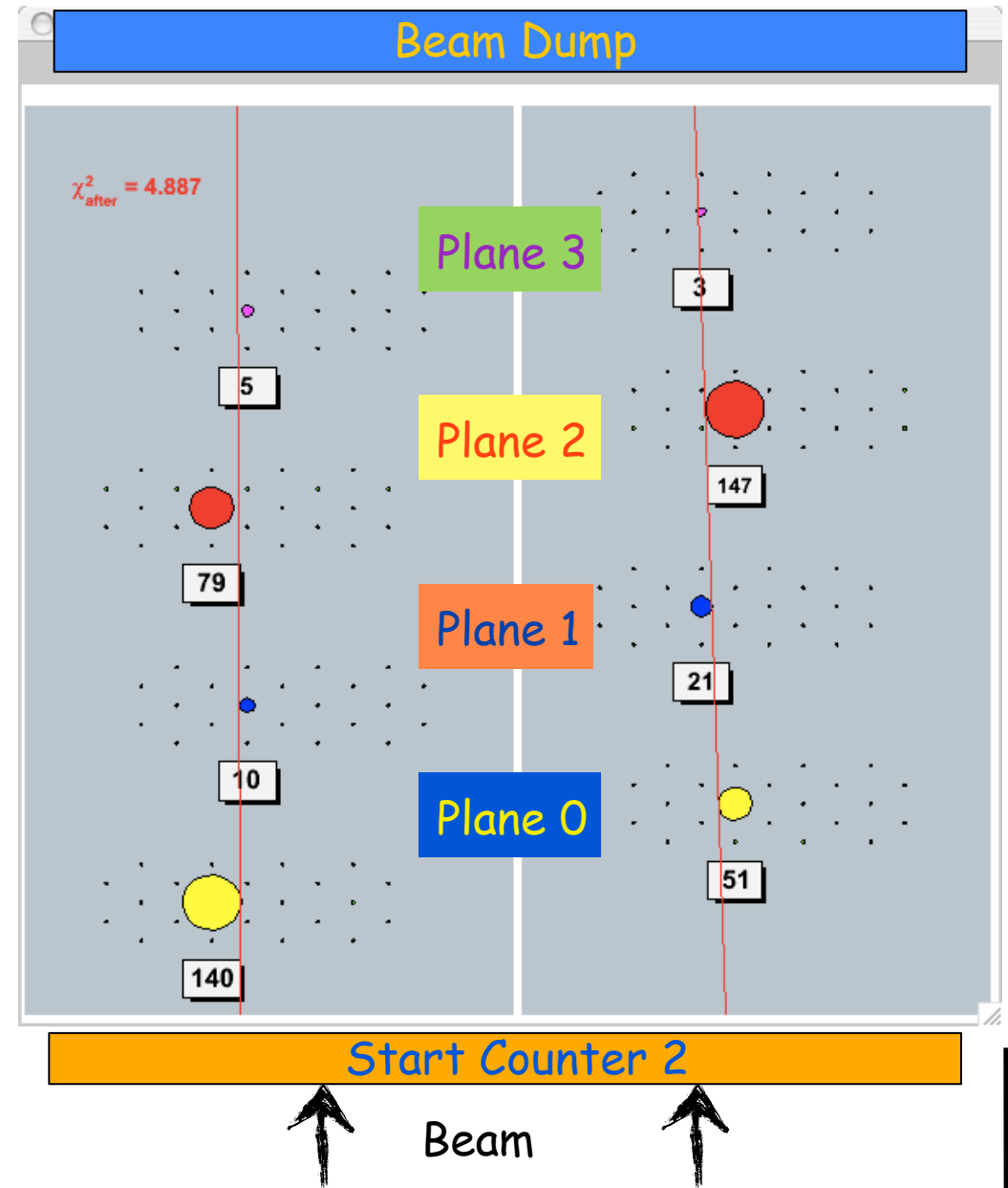
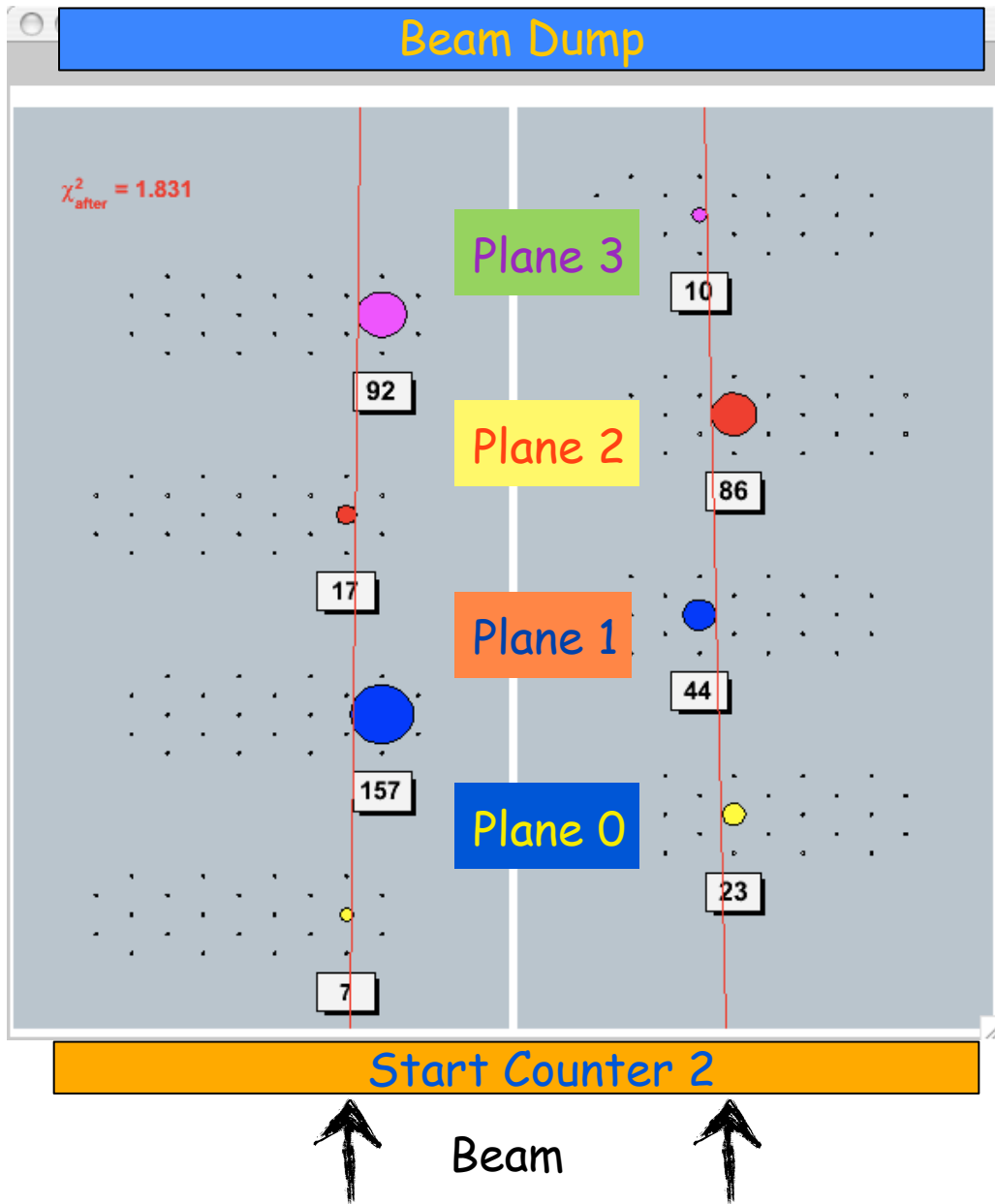
1 BM channel was sent to the ADC (Caen 265)



Streamer charge distribution as a function of HV and gas mixture behaves as expected (~ exponential)

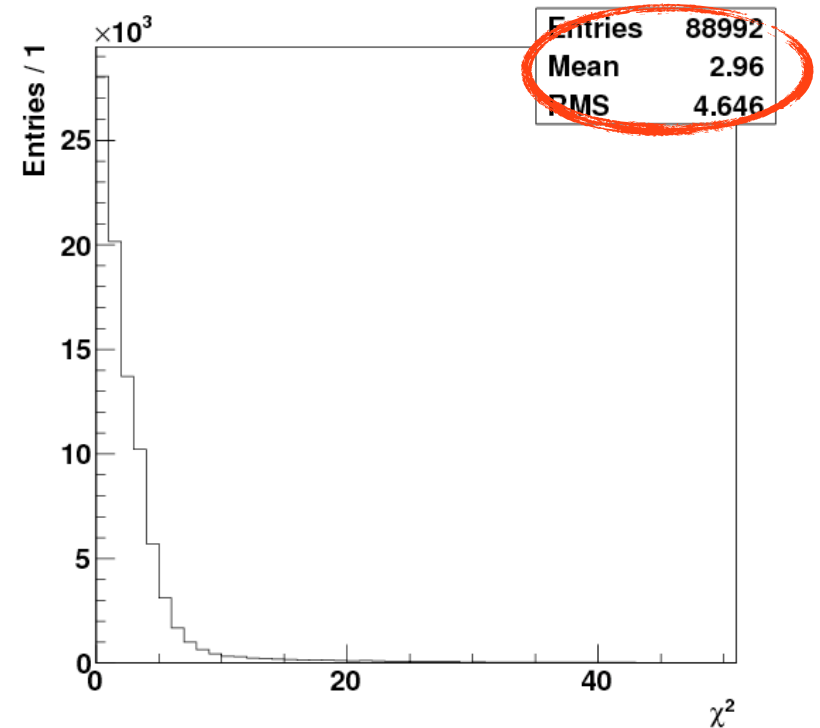
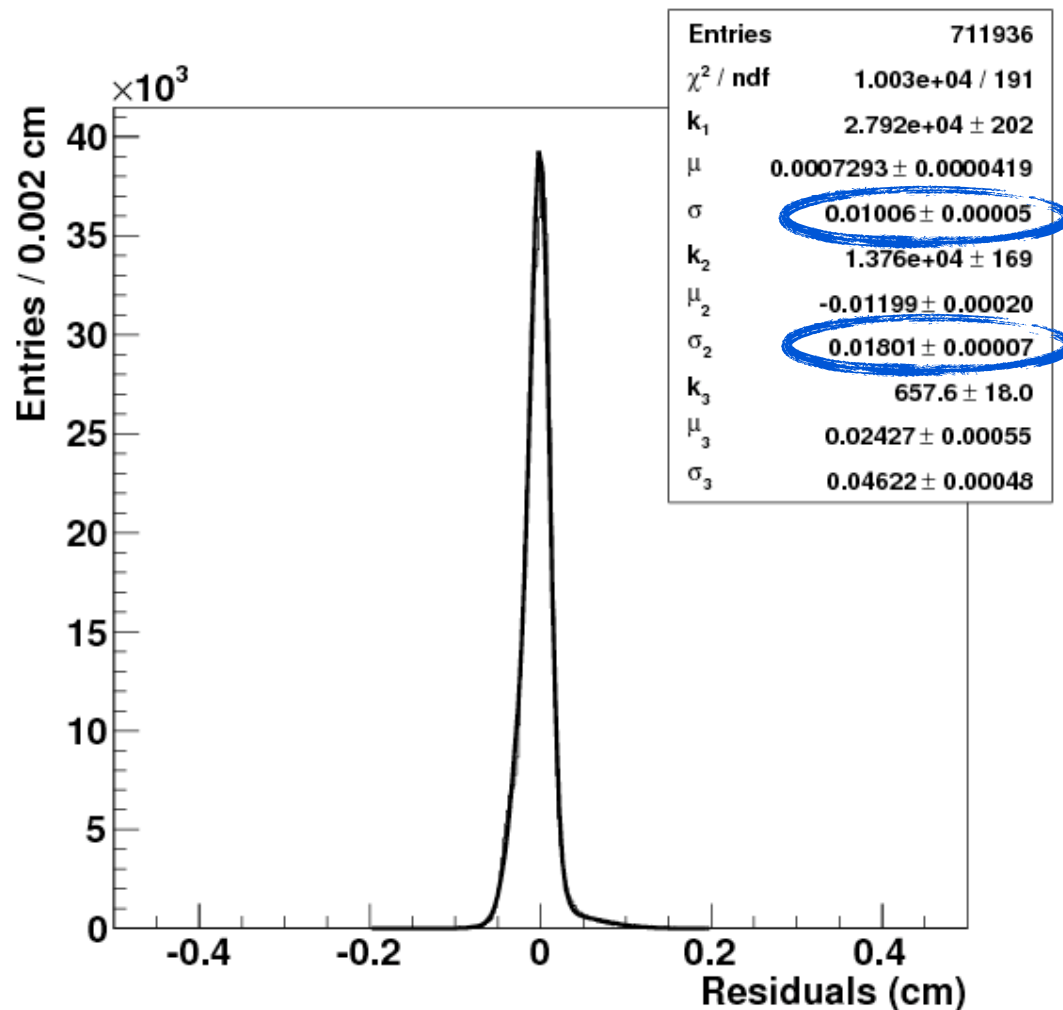


Event Display



Tracking

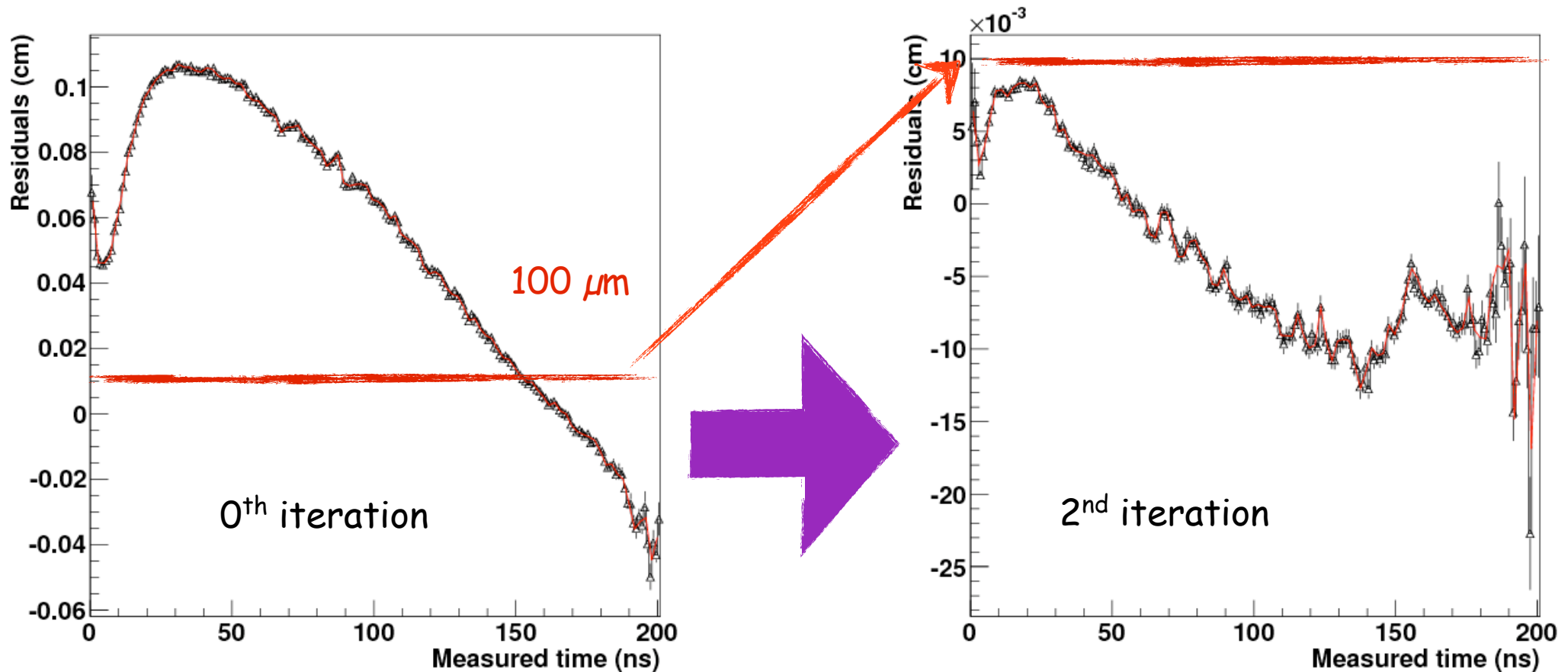
→ Simple χ^2 minimization (P. Avery)
with "clever" starting point



Spatial resolution of right order of magnitude $O(100-200) \mu\text{m}$ is obtained (no R-T correction, no precise wire positioning, poor gas mixture knowledge)

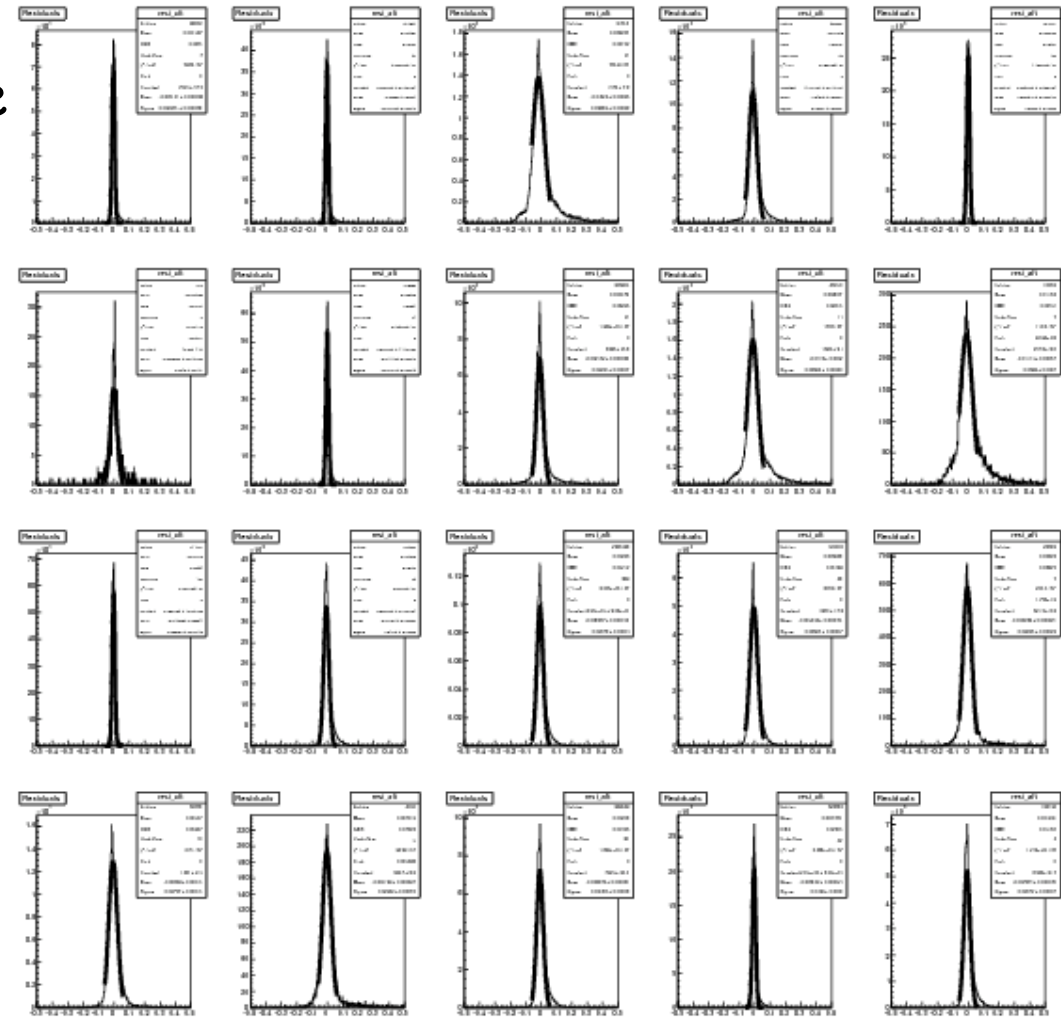
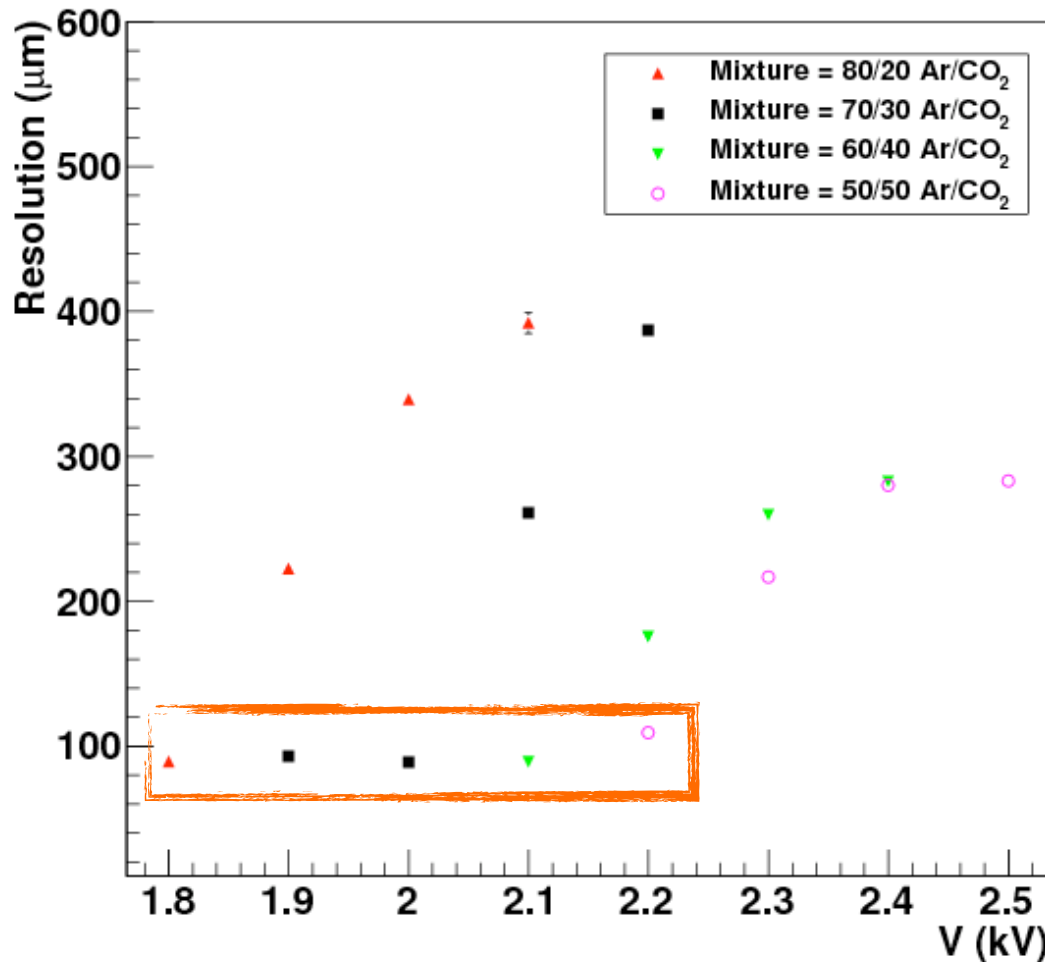
Space time relations

- Starting from a $v_{\text{drift}} = \text{const}$ initial assumption, space-time (ST) corrections have been extracted from the residuals $[s_{\text{fit}} - s_{\text{meas}}]$ vs time distribution:
 - $S = v_{\text{drift}} * t + \text{residual}(t)$ where residual(t) is taken from histos below



Spatial resolution

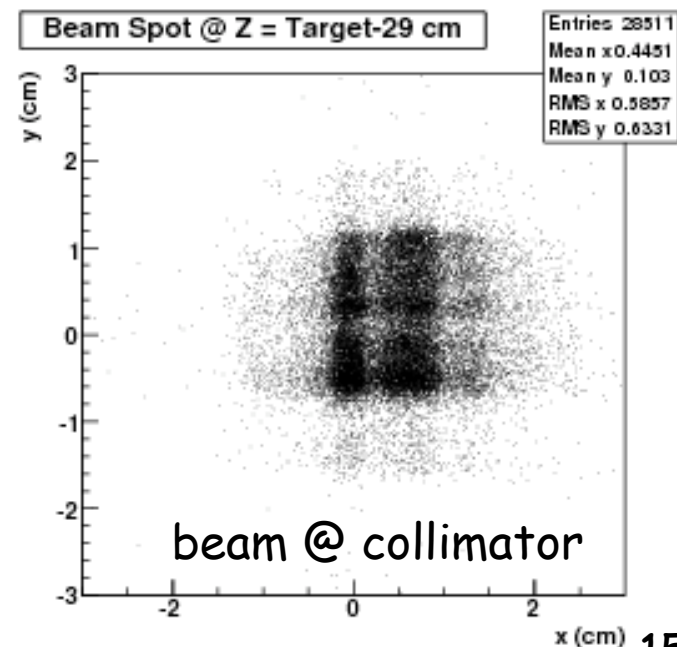
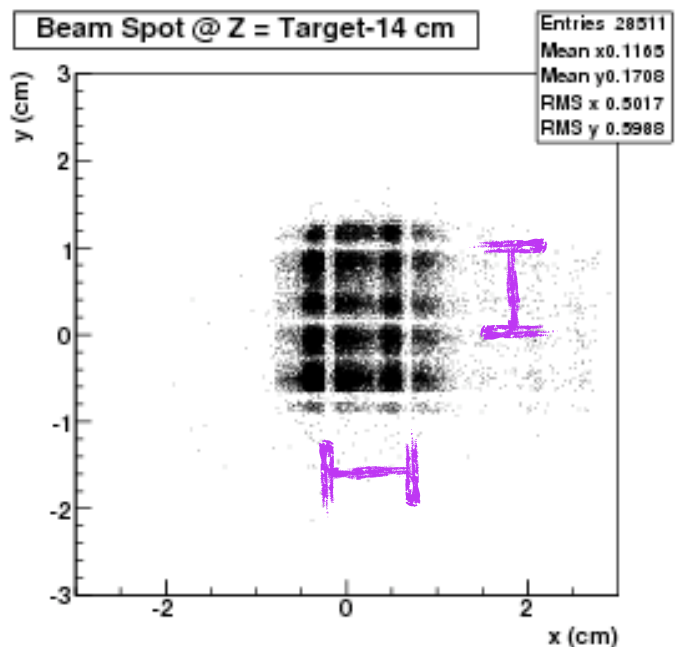
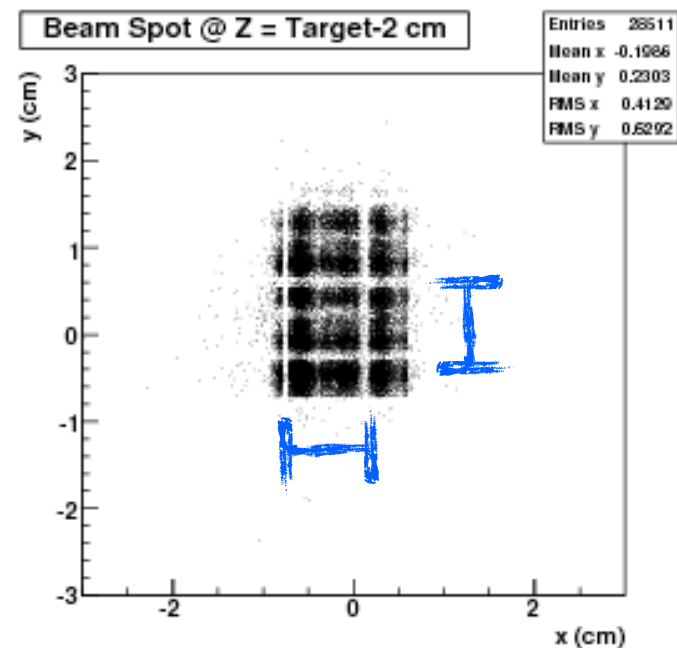
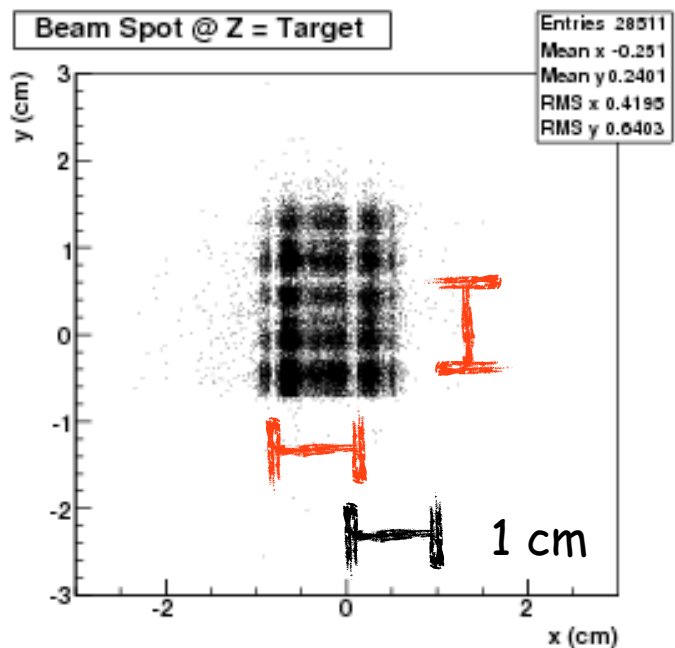
→ Residuals distributions have been fitted with a Gaussian PDF: the core gaussian σ measures the resolution



σ of 90-100 μm can be obtained for all gas mixture with a proper HV

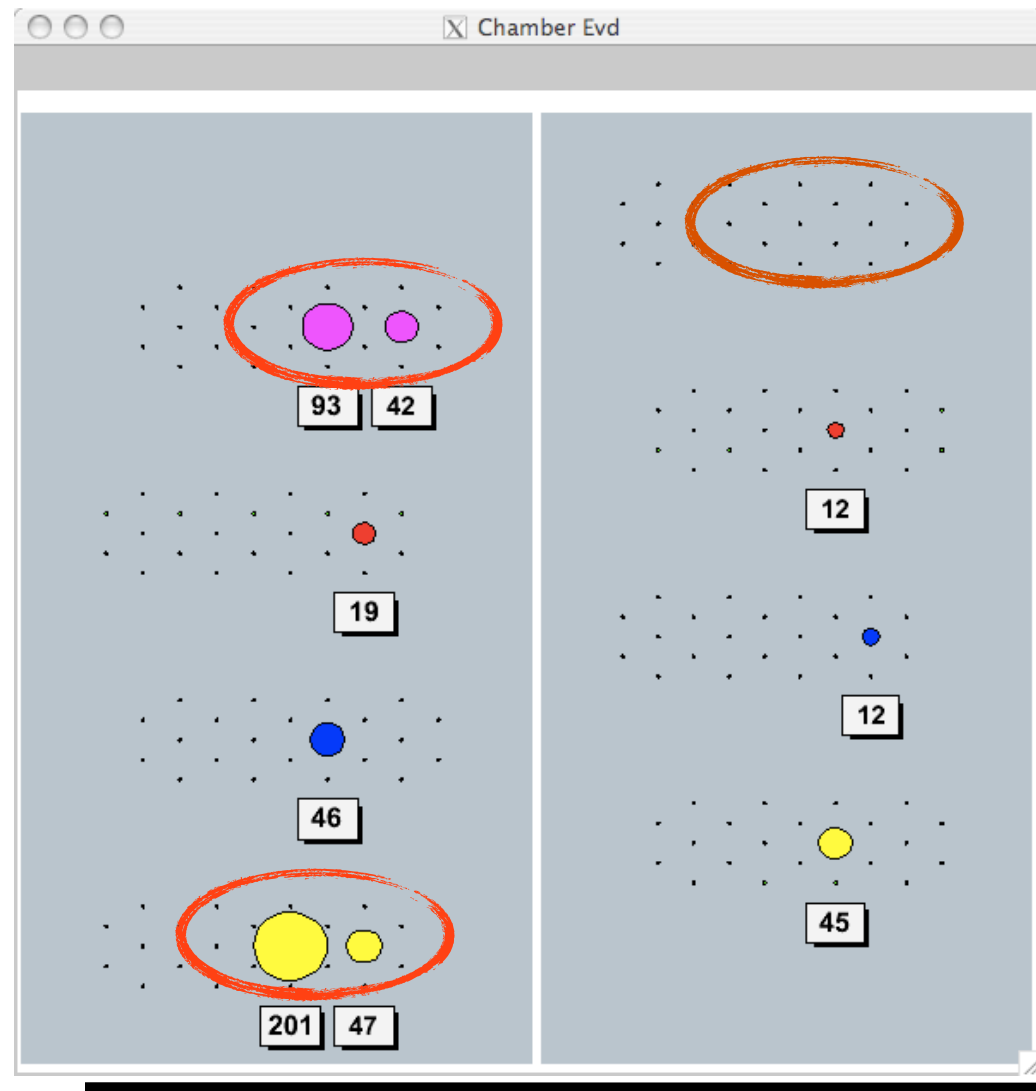
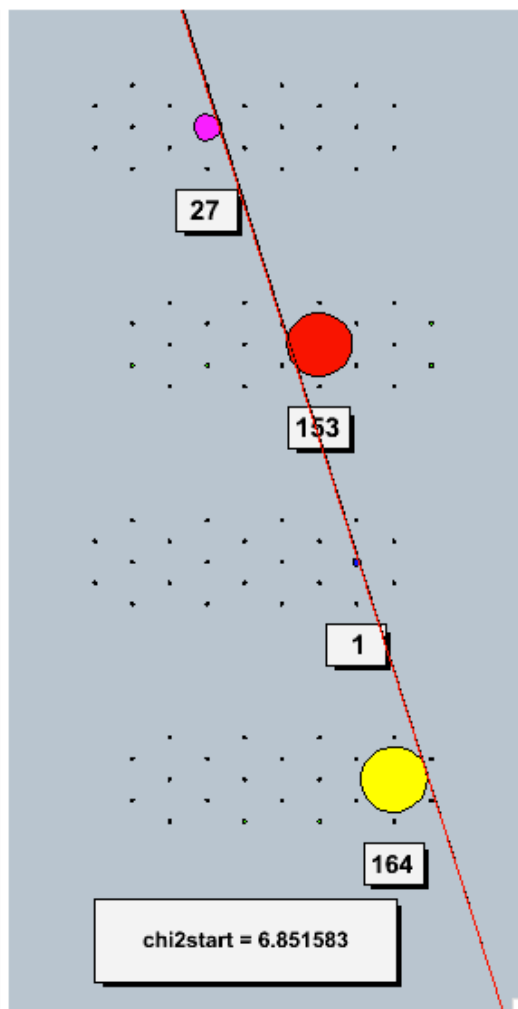
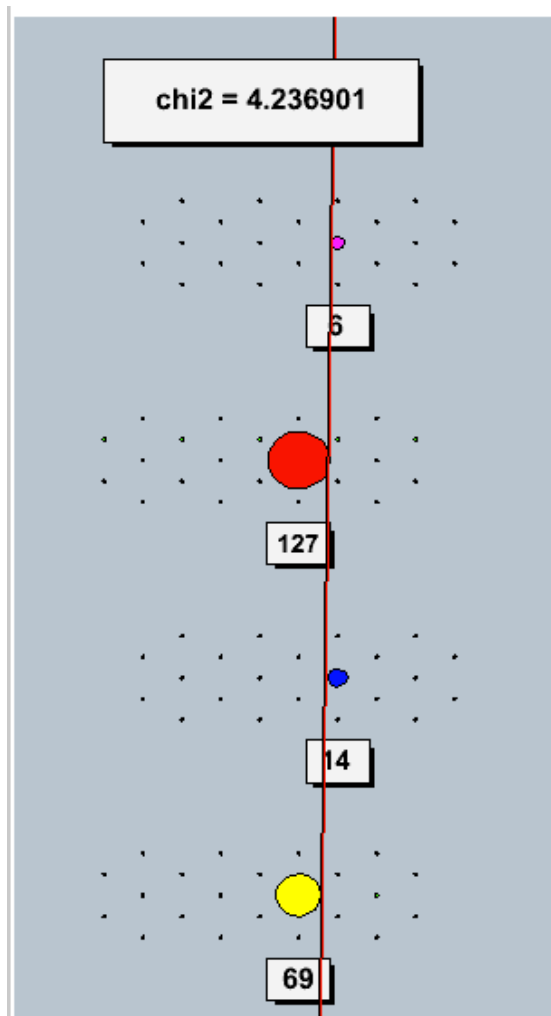
Beam monitor

- We see the chamber wires! :(
 - Beam 'pictures' obtained for several Zs (distances from target)
- Nice image of the beam @ collimator obtained through extrapolation
 - Chamber was not 'perfectly' aligned with beam: mean x (y) moves from 0.44 (0.10), closer to collimator, to -0.25 (0.24), closer to target



Work in progress...

- Focused, so far, on 'clean' events. Work on 'un-typical' events just started in order to understand noise, **multiple-hits**, **inefficiencies**...



Beam



FIRST meeting

- Thanks to the LARGE EFFORT @ LNS we were able to collect significant amount of data with different detector setup conditions!
- Several important measurements performed
 - Start Counter tested on beam for the first time
 - Light output lower than expected: work in progress to recover it
 - Time resolution spoiled by electronics: optimization under way
 - Beam Monitor tested on beam for the first time
 - Charge distributions show indications of 'streamer' like operation
 - Efficiency consistent with expectations, studies as a function of gas/HV
 - First implementation of Track fitting shows reasonable results:
 - χ^2 distributions and residuals looks good!
 - Spatial resolution of 100 μ m achieved
- Still digesting LARGE amount of data... of paramount importance while preparing the next Catania TB!