dRICH test beams preliminary results

Simone Vallarino

December 21, 2021

INFN – Sezione di Ferrara

Università degli Studi di Ferrara

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Thanks to the INFN section of BO, CT, FE, LNF, LNS, RM1, TO, TS

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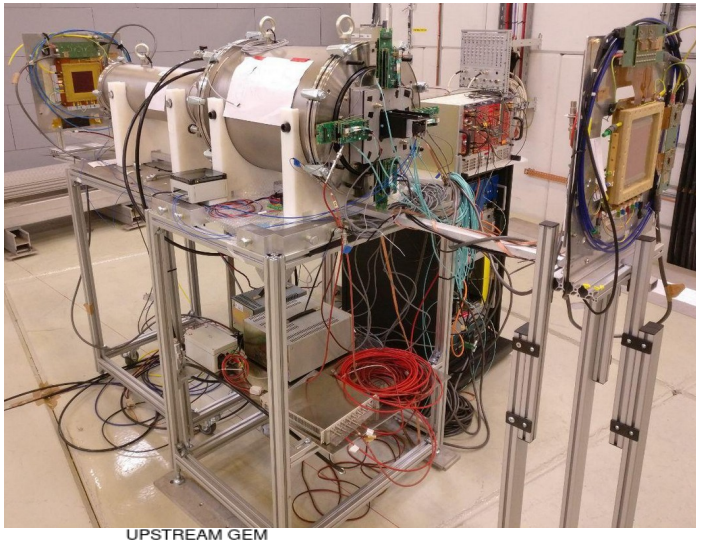
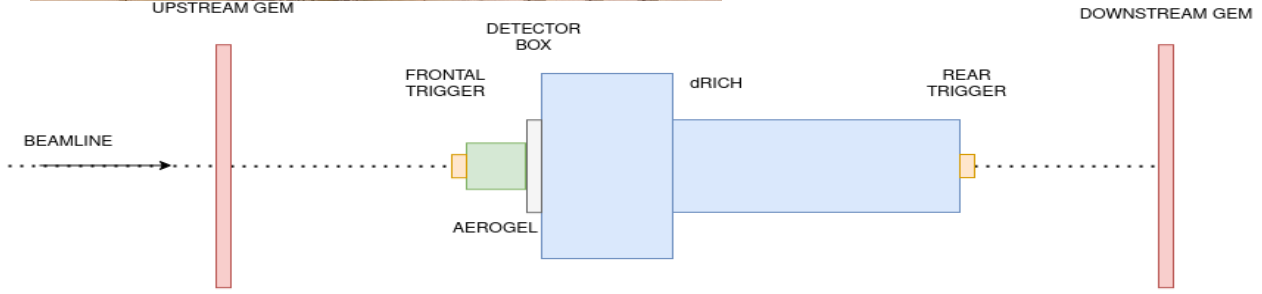
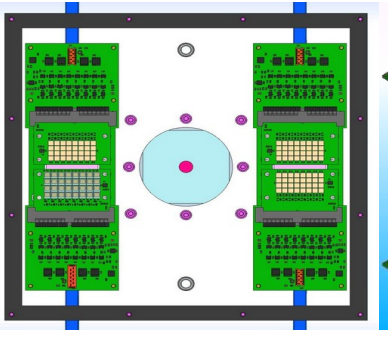
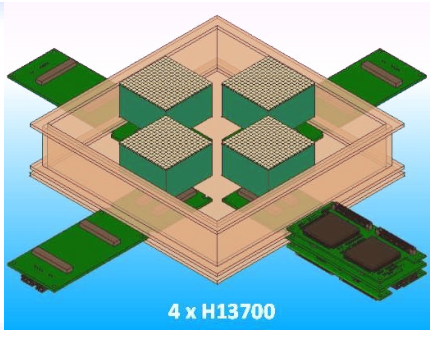
Experimental setup



Test	Cherenkov medium	Energy [GeV]	Beam	Photon detector and DAQ
September at SPS	Aerogel	40÷120	π^+ π^-	SiPM and ALCOR
October at PS	Aerogel and Gas (C_2F_6)	4÷12	p and π^+ π^-	MAPMT and MAROC



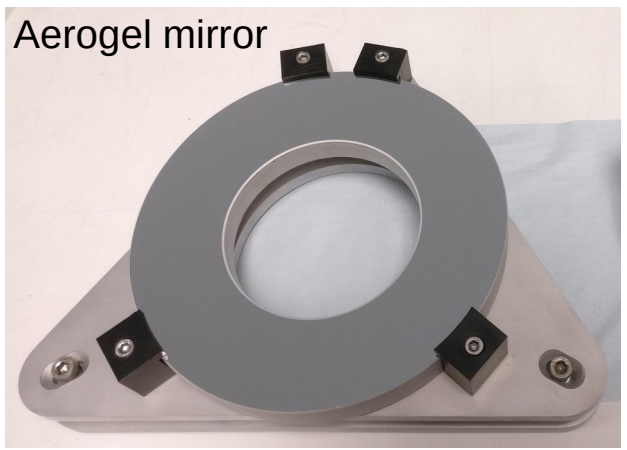




Prototype

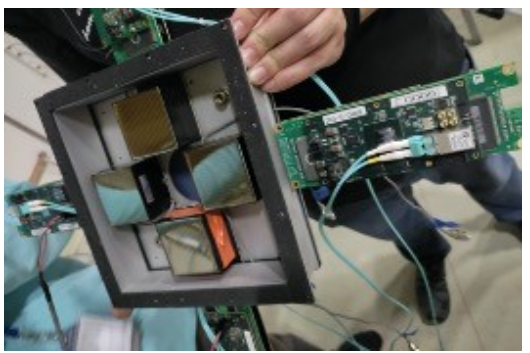

dRICH chamber


Gas mirror


Aerogel mirror

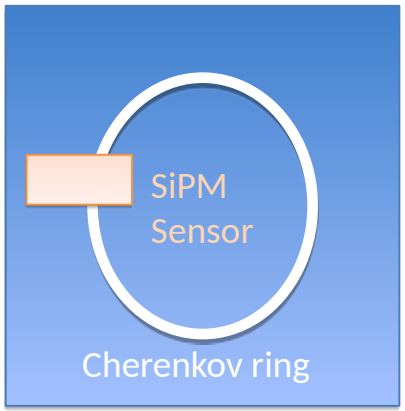

Frontal view

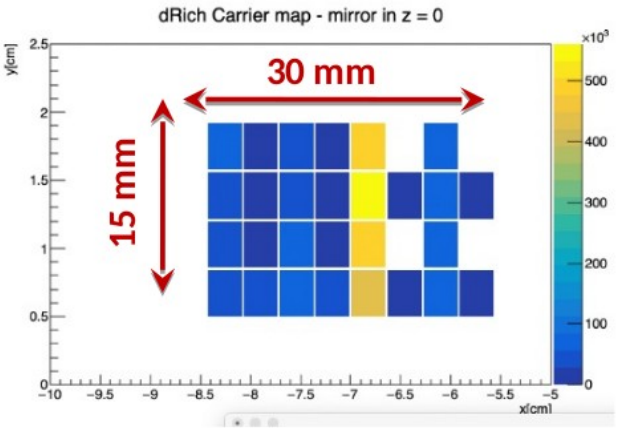

Support

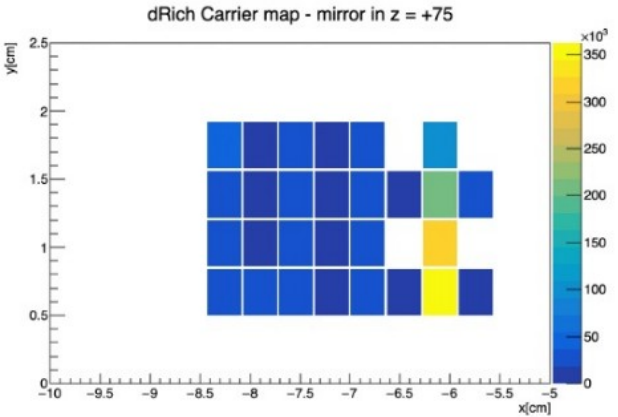

MAPMT detector box

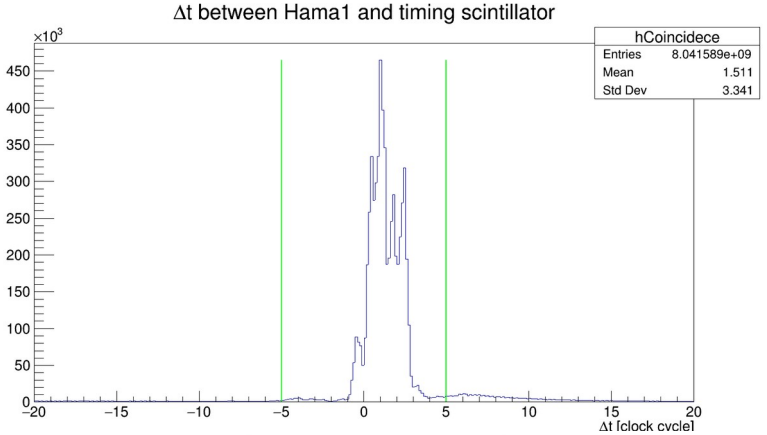
September test at SPS

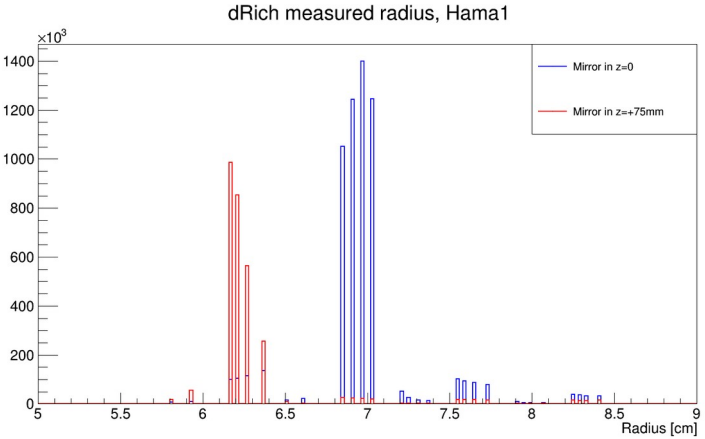
September test mainly involves the SiPM (R. Preghenella talk) and ALCOR (F. Cossio talk) on-beam implementation







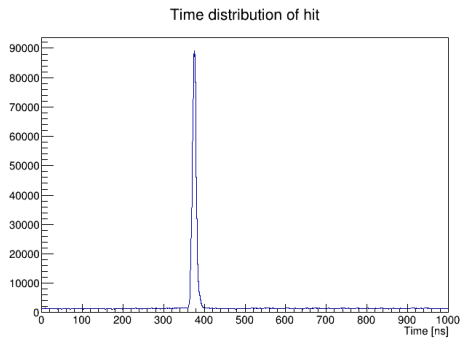


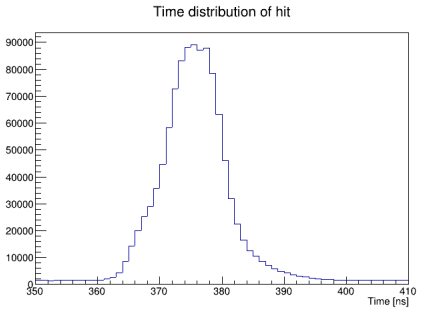


October test at PS

The goal was to operate the dual RICH by using both aerogel and gas. (spoiler: achieved)
But we was the first user after the PS upgrade, so: originally one beamline component was wrong, the beam was not optimized, the Cherenkov detector of beam didn't work.
Moreover, the MAPMs and DAQ arrived late because they were used in the overimposed modular RICH test beam at JLAB

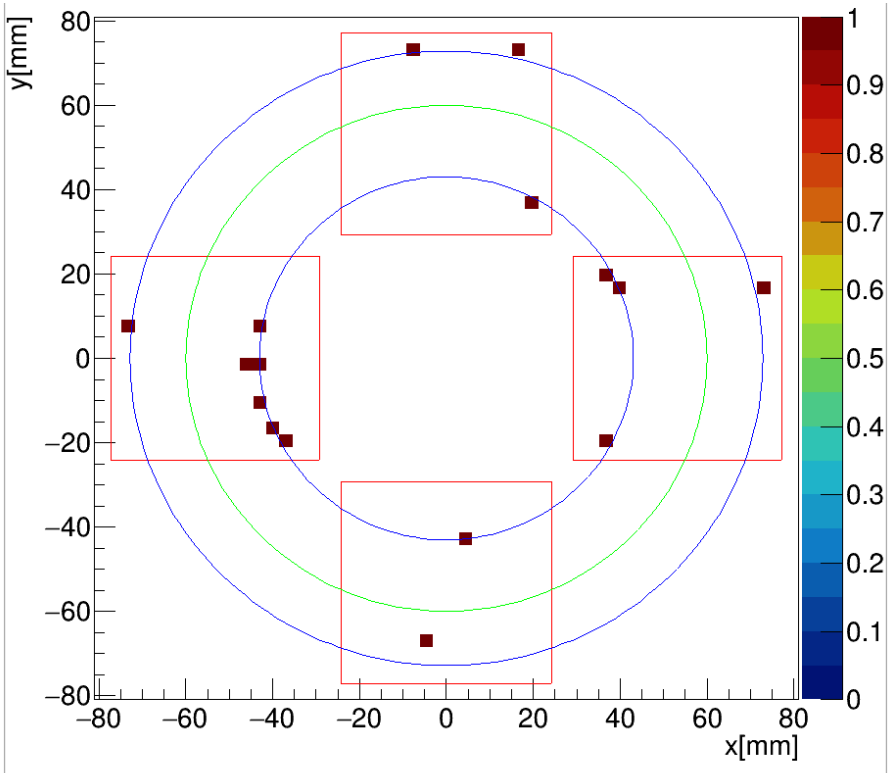
Distribution of time of hit, the coincidence peak is clearly visible. The system is not yet calibrated in time, so the peak is quiet large.



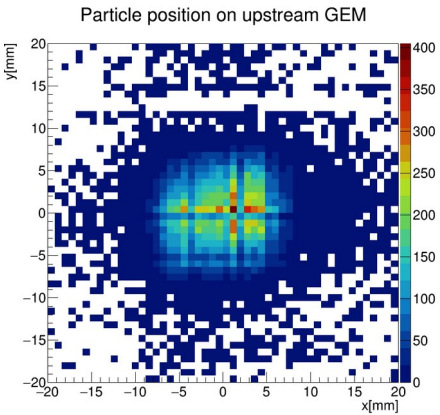


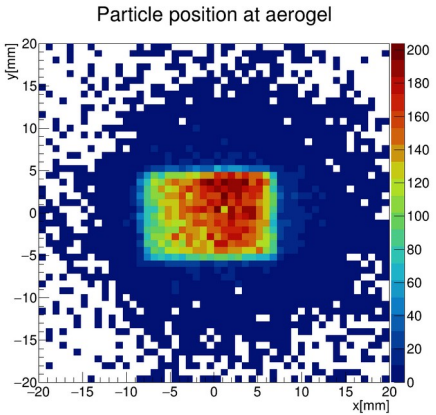
On right plot:

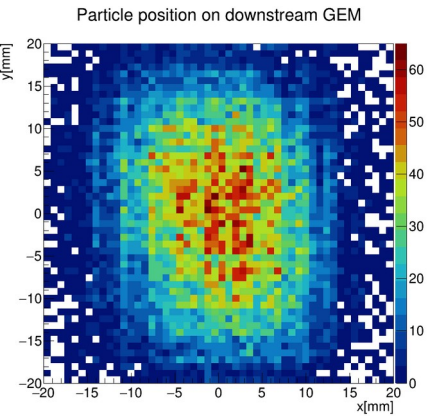
- Red, edge of MAPMTs.
- Green, geometrical cut applied to distinguish gas (inner) and aerogel (outer) photon.
- Blue, ring computed from gas and aerogel.

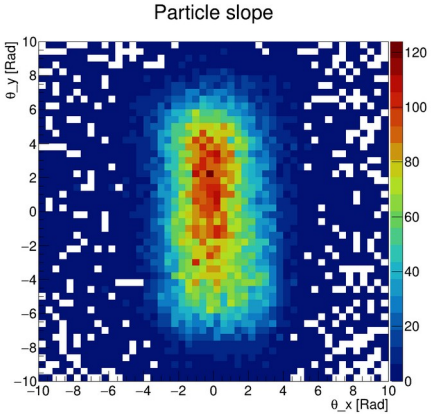


GEMs tracking

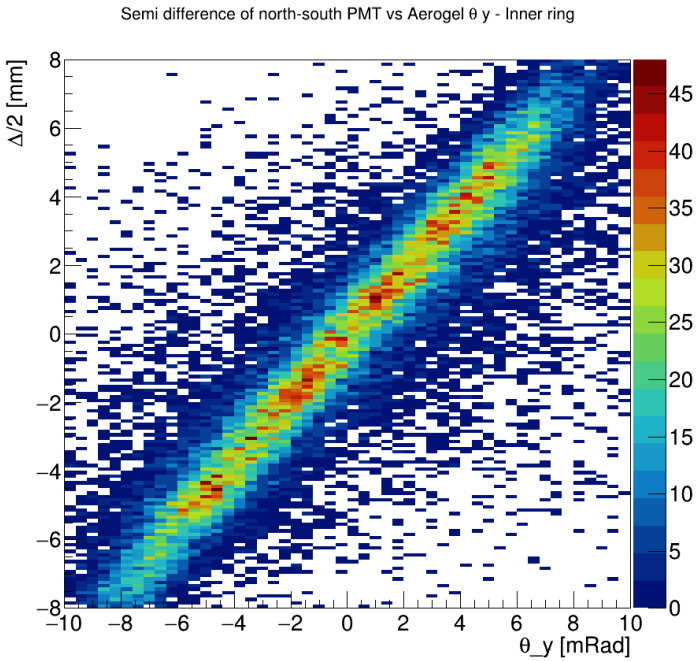






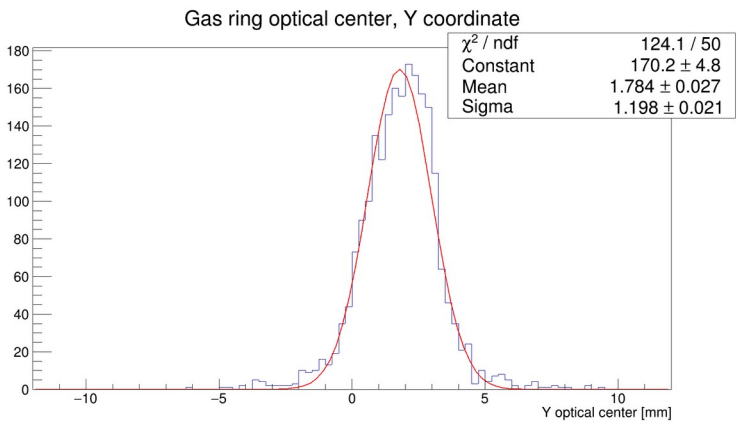


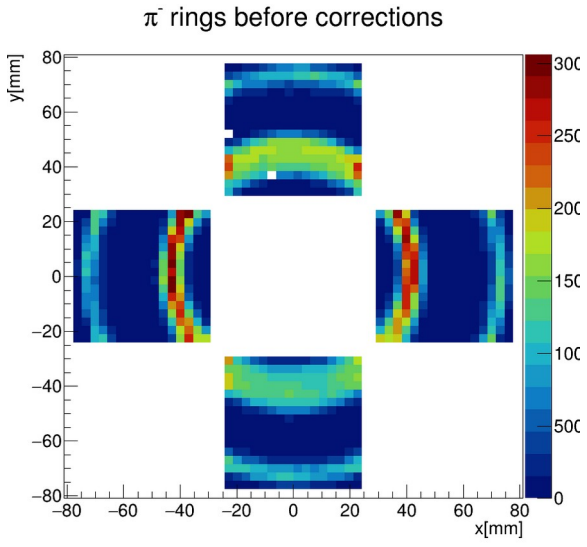
The GEMs provide the track of each event.
In this run, only the GEMs and the frontal scintillator were used as trigger.
We found a correlation between the semidifference of the radius measured from two opposite MAPMTs and the particle slope provided by GEMs.

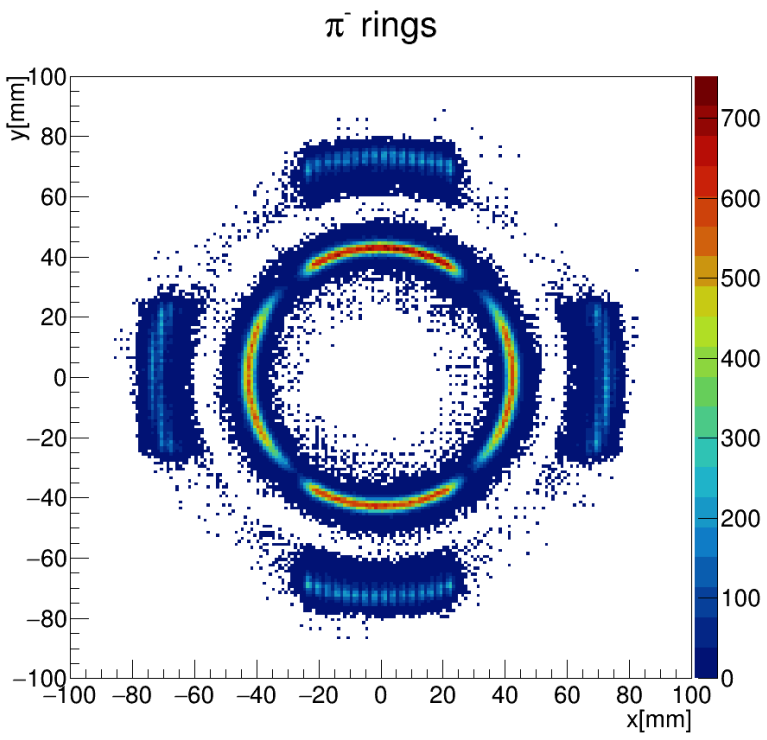


Computing the dRICH alignemenet

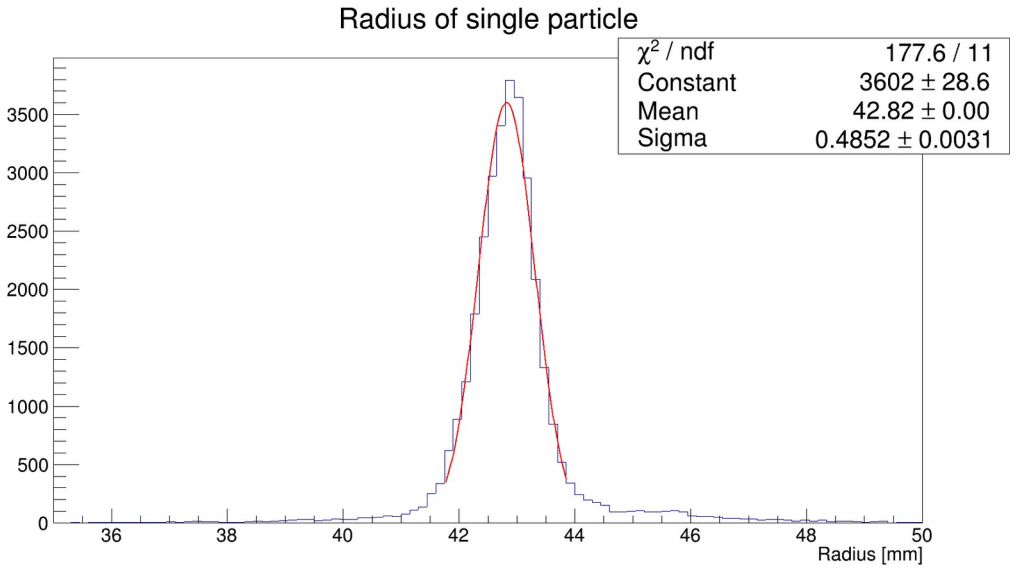
We define the coordinate of the dRICH-optical center as the mean value of the semi-difference between the radius measured in two opposite PMTs, evaluated by using only small angle events (slope < 1 mRad). This is a dRICH optical property, and the values are the same for each run (unless change on the mirrors orientation).
The coordinates of the single event center are provided by the sum of the optical center and the product of particle slope and length of path inside dRICH.



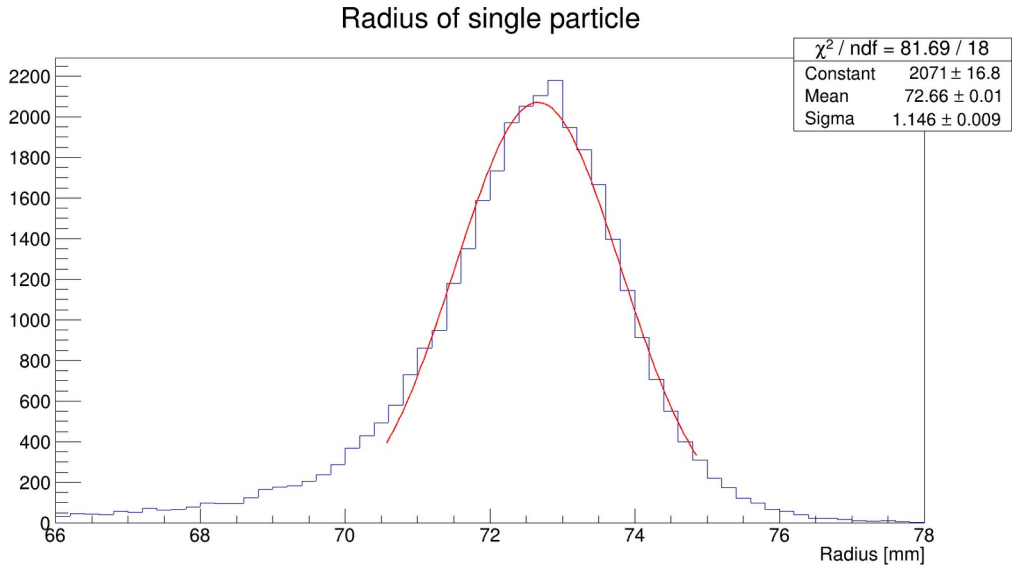




Results

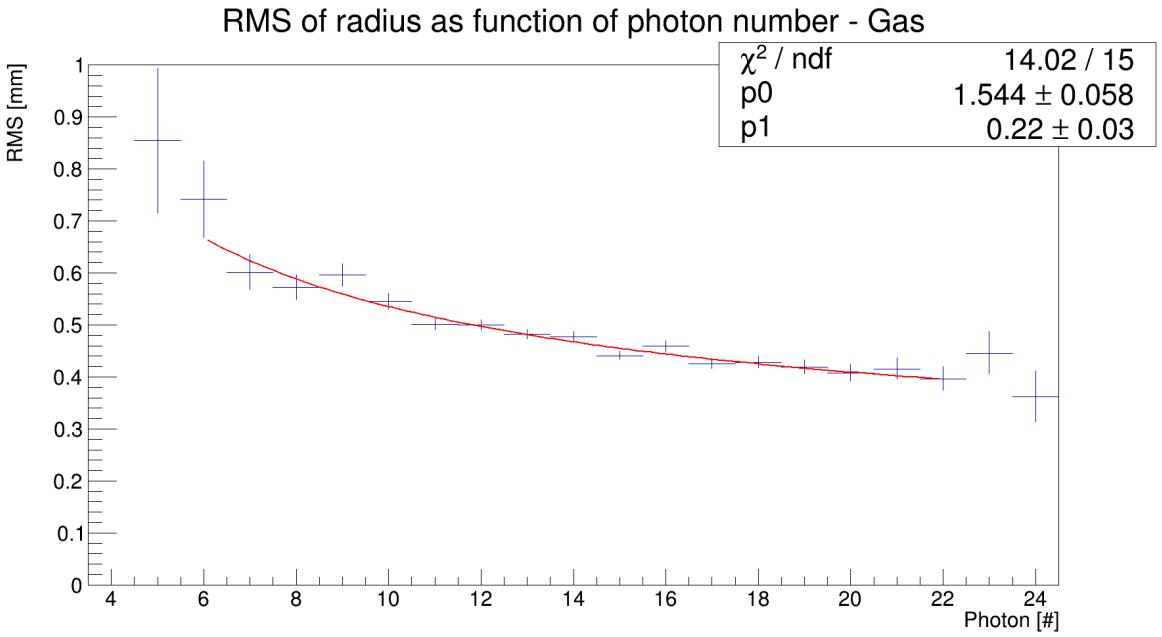


Radius of ring produced from 12 GeV π^- by crossing the gas



Radius of ring produced from 12 GeV π^- by crossing the aerogel

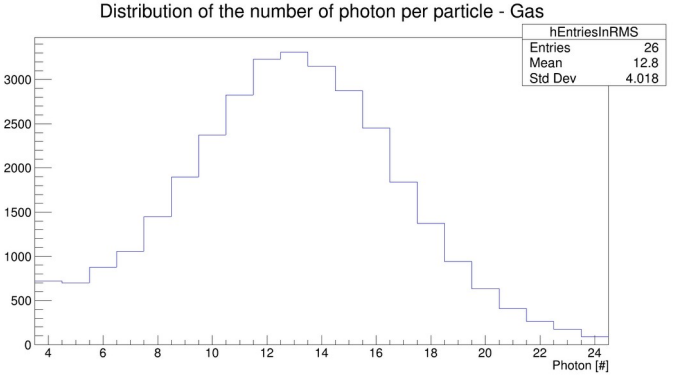
Result: Gas resolution



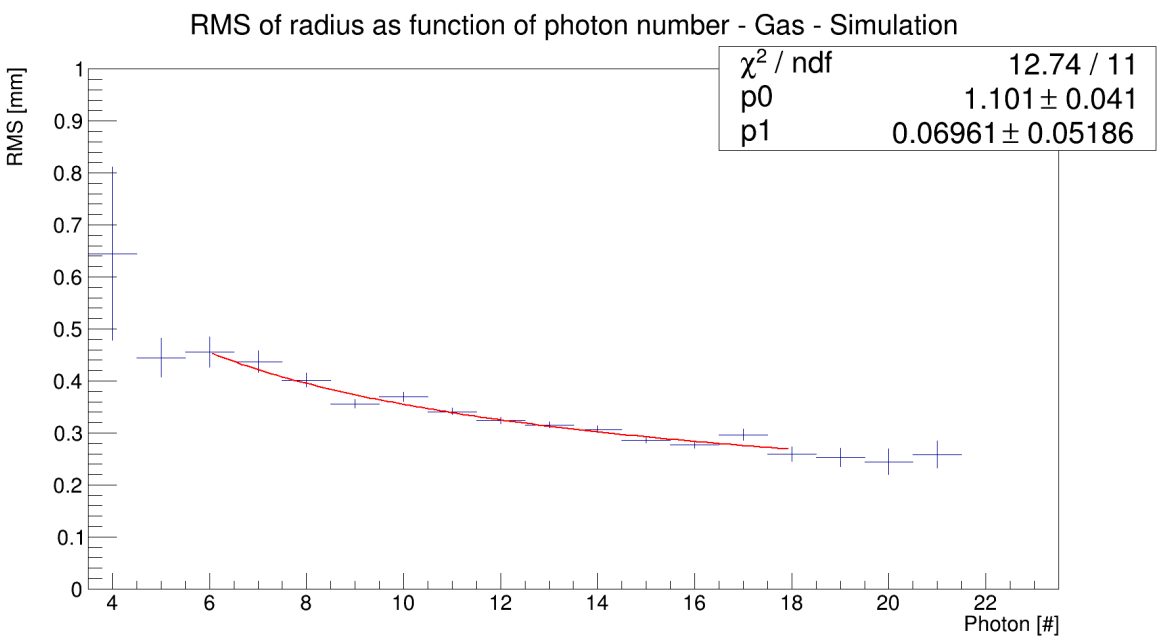
Fitting function: $y = \sqrt{\frac{p_0^2}{x} + p_1^2}$

p_0 = single photon resolution

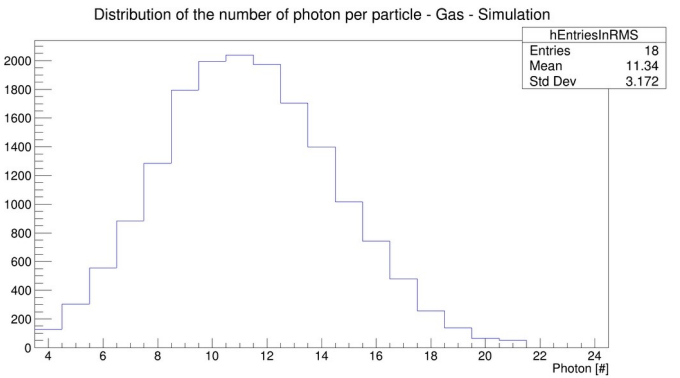
p_1 = asynthotical single particle resolution



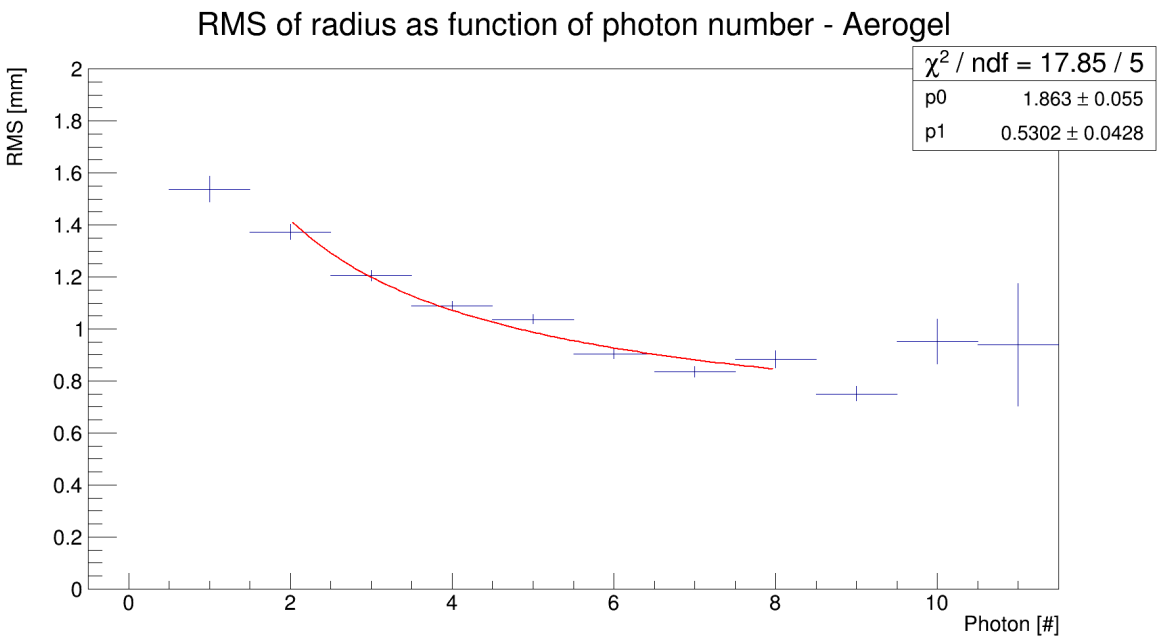
Simulation: Gas resolution



Gas	Data	Simulation
p_0	1.5	1.1
p_1	0.22	0.07
Photon	12.8	11.3



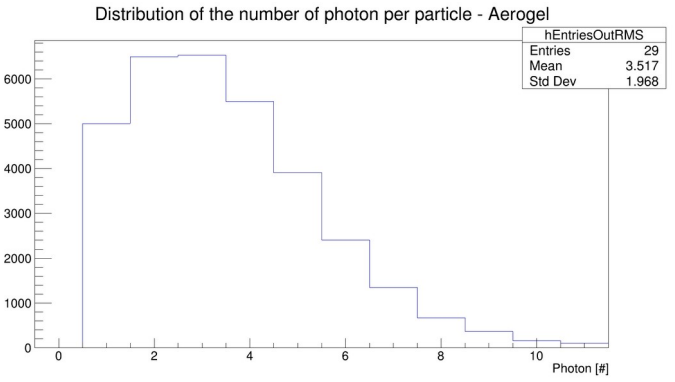
Result: Aerogel resolution



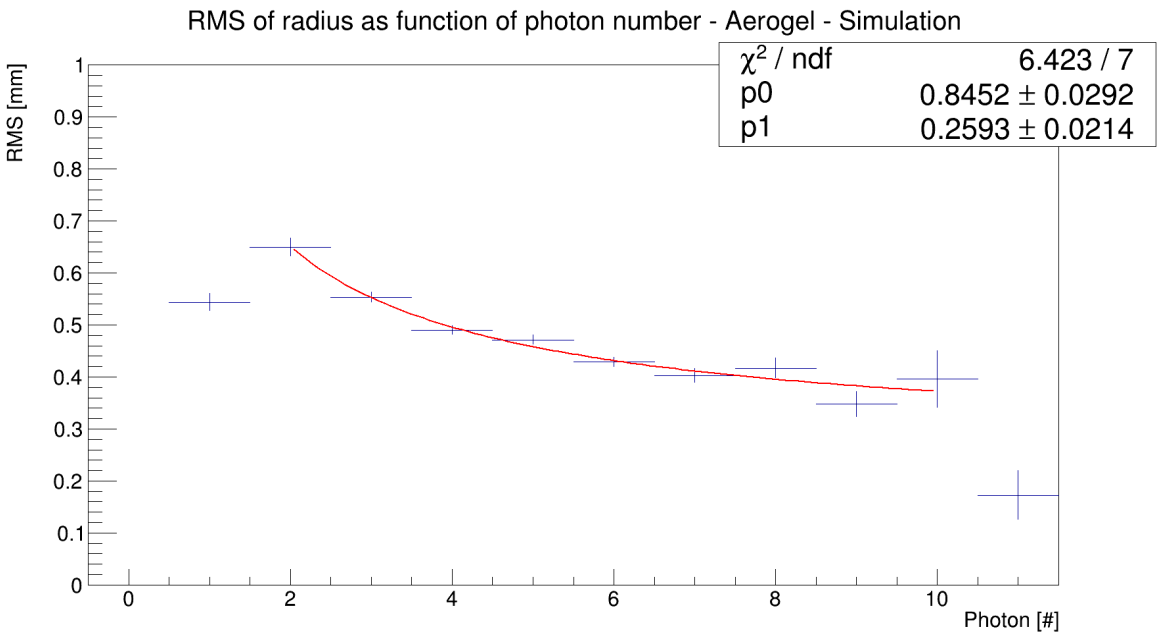
Fitting function: $y = \sqrt{\frac{p_0^2}{x} + p_1^2}$

p_0 = single photon resolution

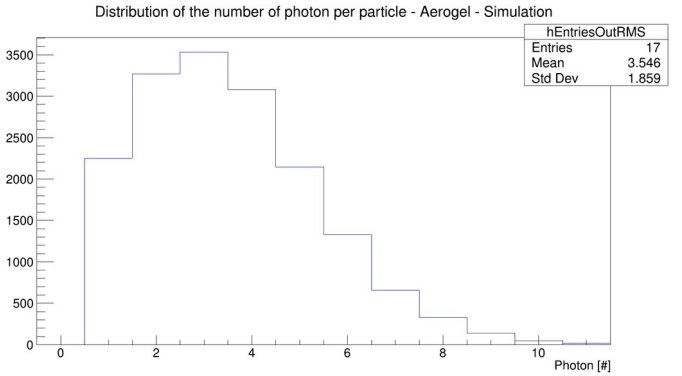
p_1 = maximum single particle resolution



Simulation: Aerogel resolution



Gas	Data	Simulation
p_0	1.9	0.8
p_1	0.53	0.26
Photon	3.5	3.5



Conclusion and future perspective

1) We achieved the main goal of operate the dRICH and all its subsystems, collecting data to compare with simulations.
2) The data from gas are quite in agreement with the simulations, even if there is still an offset in the resolution not yet understood.
3) The data from aerogel apparently are more different from the simulations.

A) Optical component characterization, in particular by measuring trasparency and riflectivity with the spectrometer,
B) Improve the simulation, by introducing the measured values.
C) Develop the possibility of reconstruct dRICH data by using the CLAS12 RICH reconstruction.

The end

Thanks for your attention