Simulations of RICH Prototype

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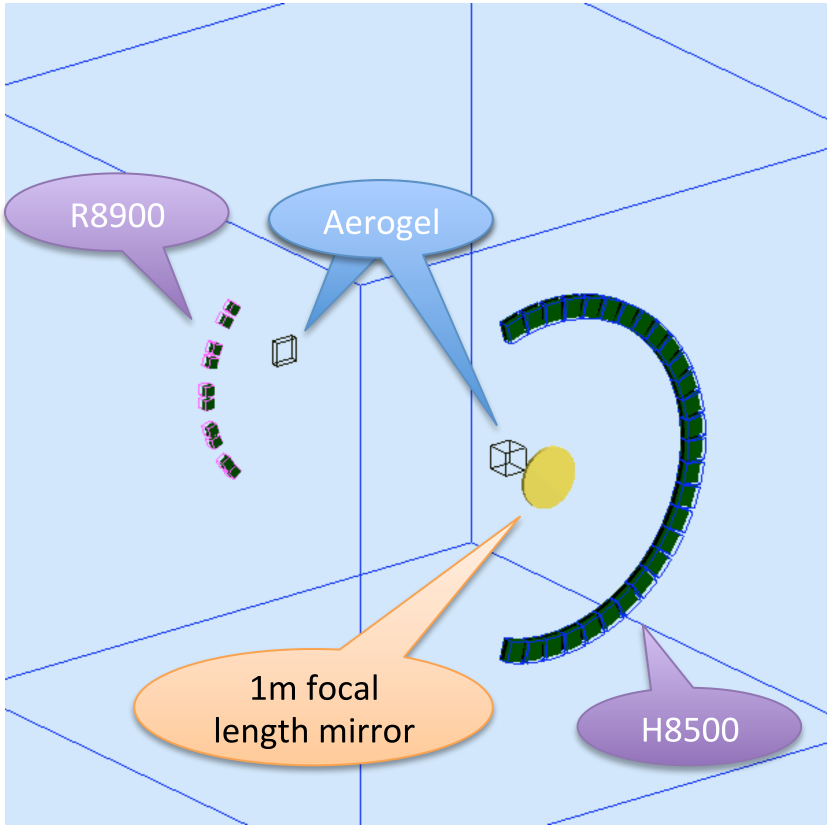
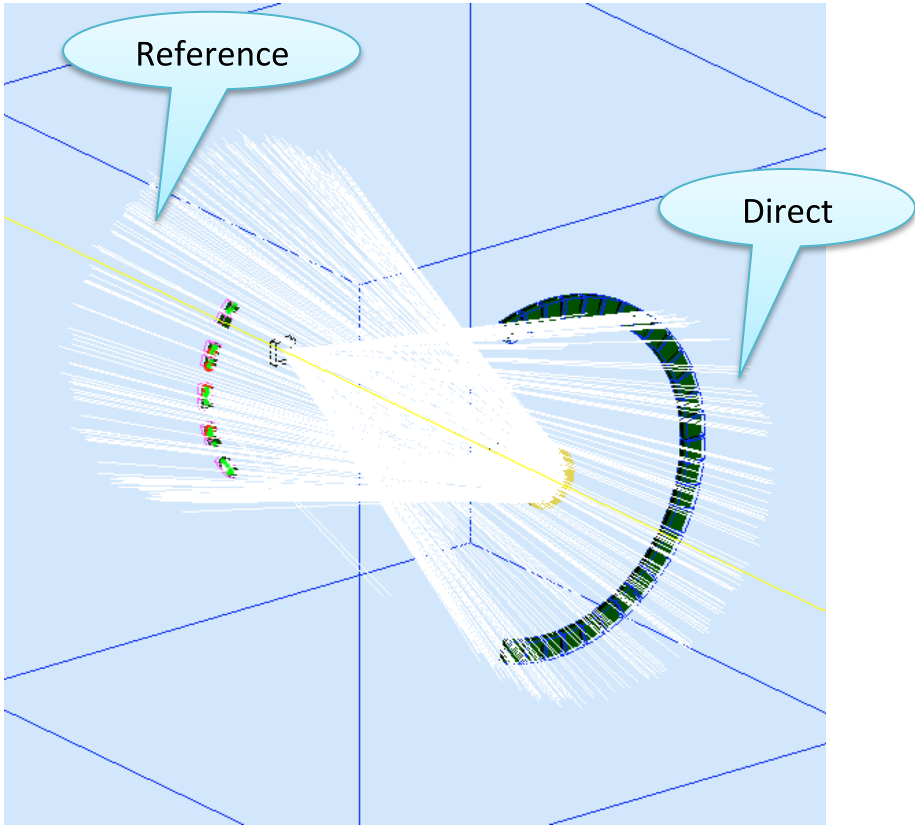
Direct Ring

Goal: test the RICH response at maximum momentum

Reference (ideal):
n=1.04-1.06, 6 cm thick aerogel
Focalizing mirror
R8900 designed for single photon

Proximity focusing RICH (realistic):
N=1.04-1.06, 2 cm thick aerogel
100 cm gap
H8500 as photon detector





Reflected Ring

Goal: validate the multiple-passage through aerogel concept

Reference (ideal):
n=1.04-1.06, 6 cm thick aerogel
Focalizing mirror
R8900 designed for single photon

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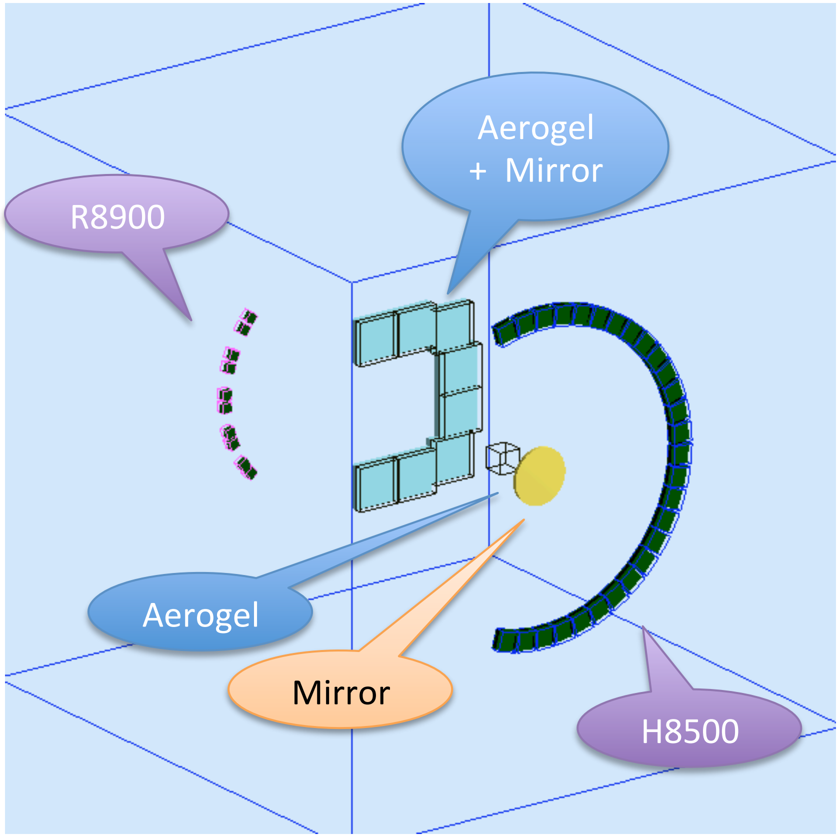
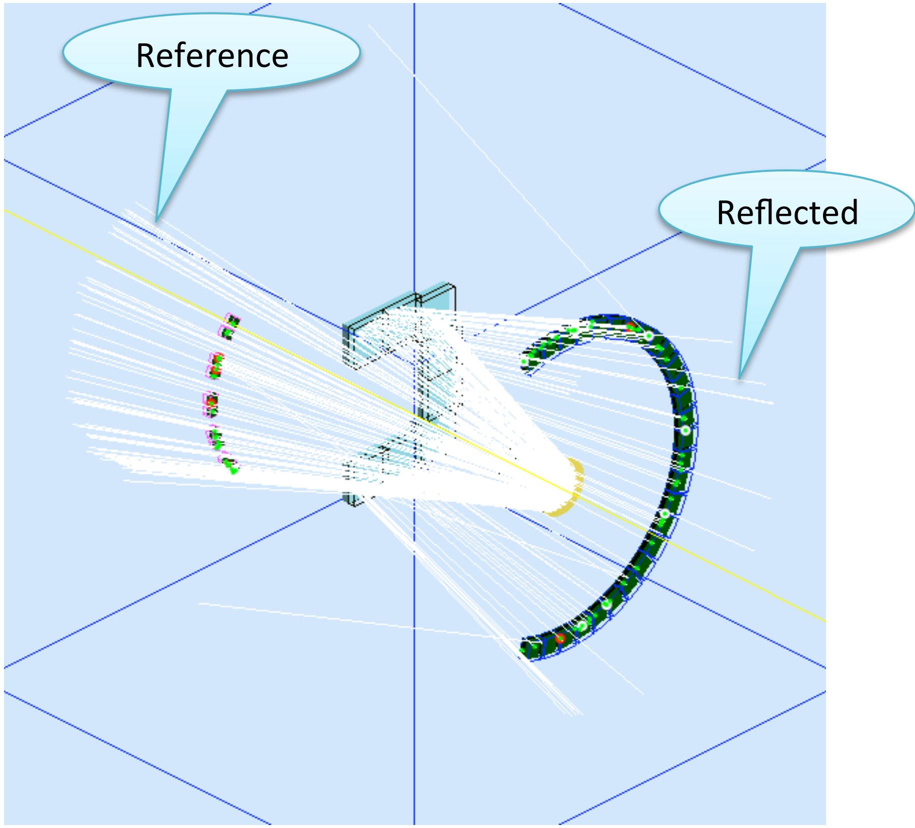
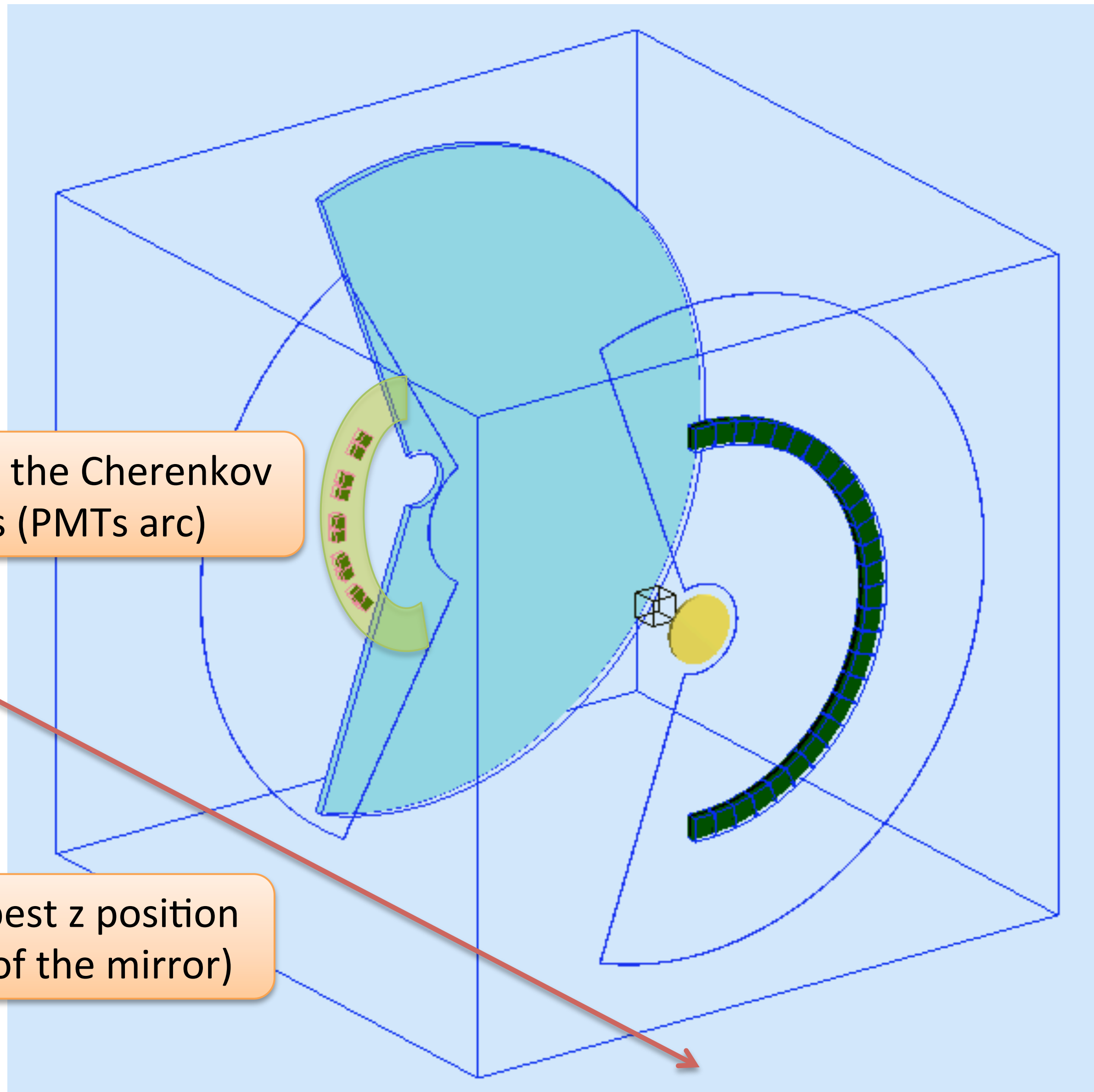
Light-reflected RICH (realistic):
n=1.04-1.06, 6 cm thick aerogel
Double passage through 2cm aerogel
H8500 as photon detector





Idealized RICH elements



Reference Signal, n=1.04

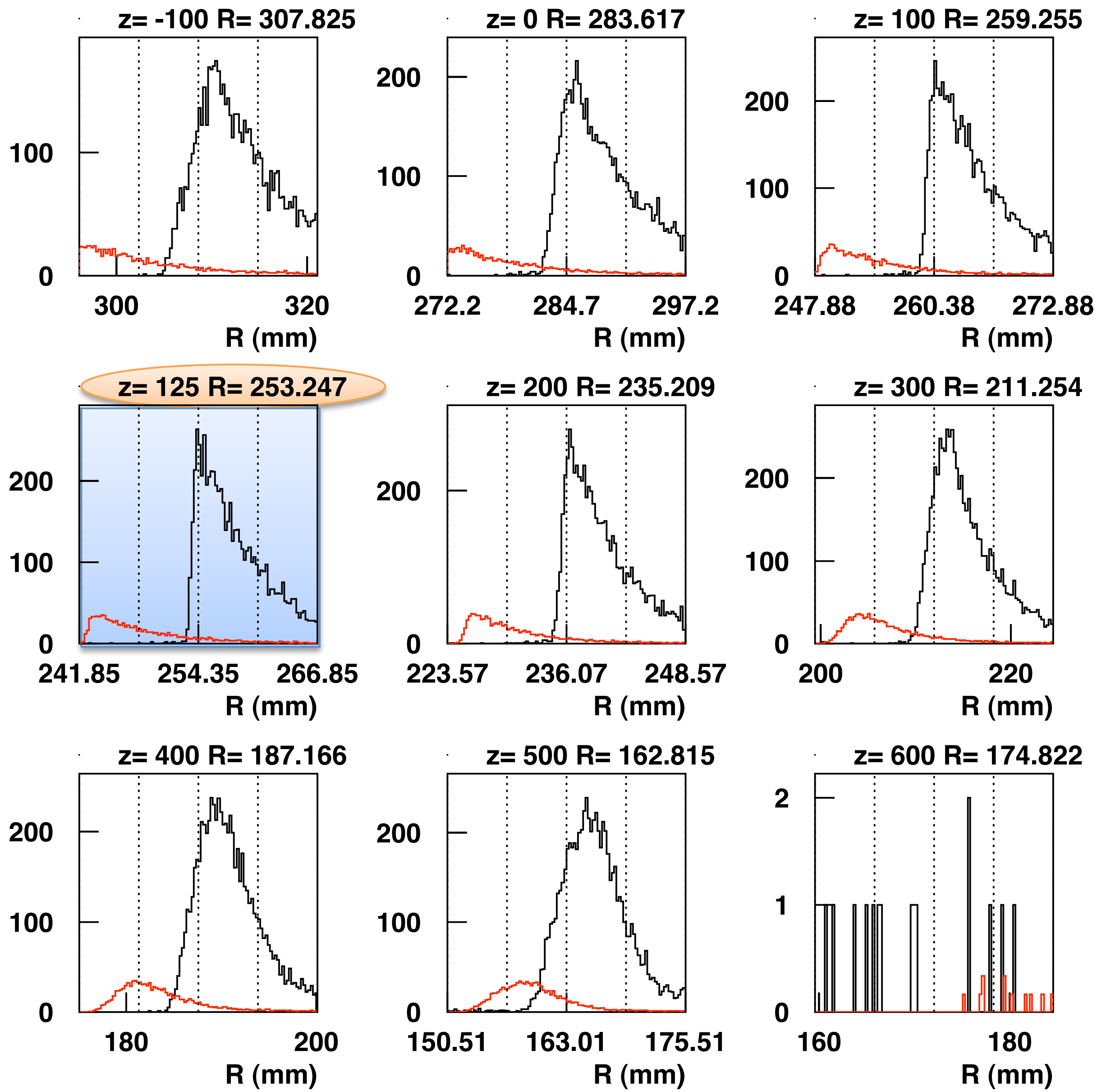
H9800

Each plot spans the H9800 width
vertical lines indicate the pixel edges

The z position at the entrance window and the radius of the H9800 arc is indicate on the top of each plot

The radius is the average of pion and kaon Cherenkov cone radii

Best value z = 100-200 mm



Reference Signal, n=1.05

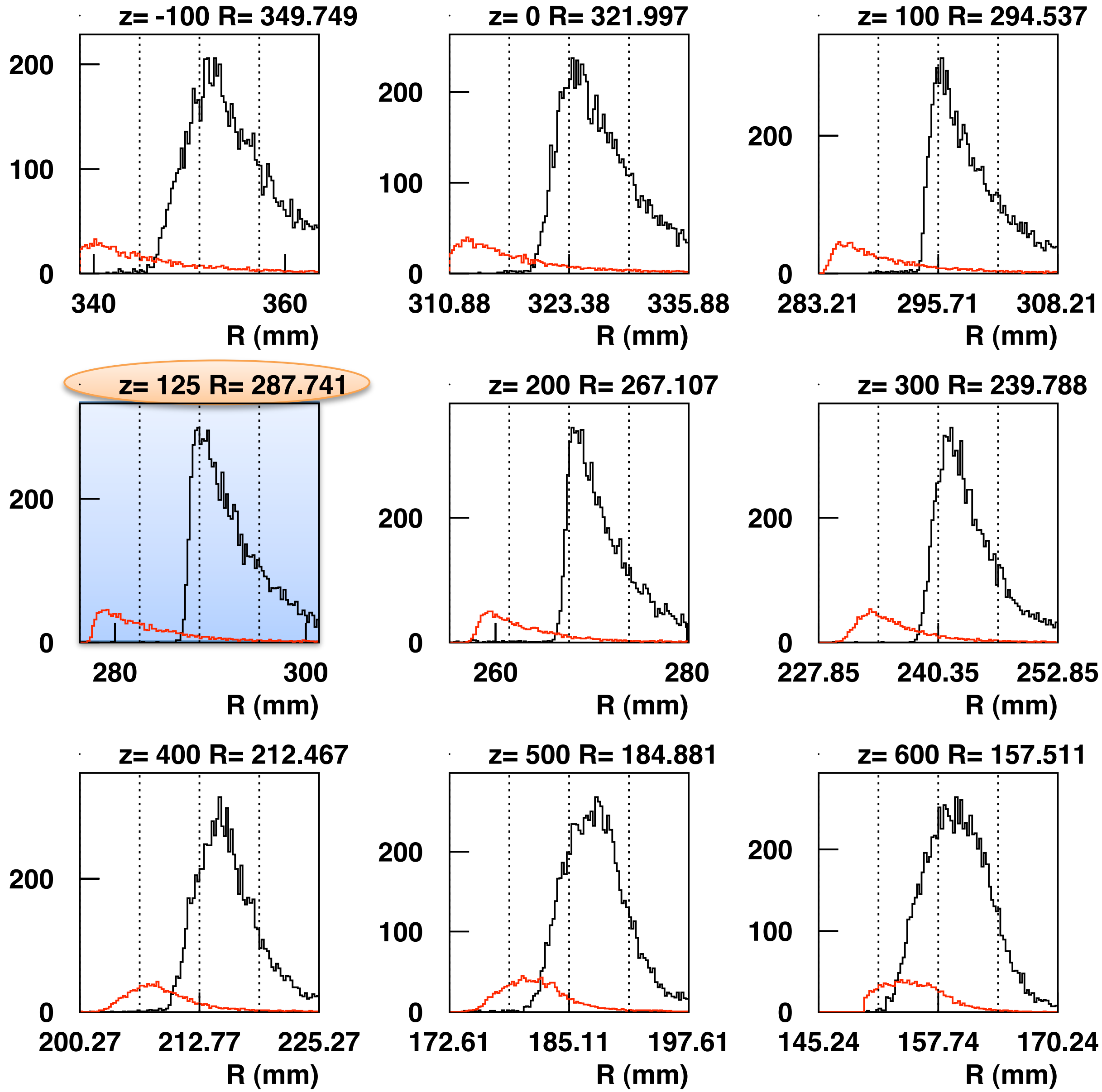
H9800

Each plot spans the H9800 width
vertical lines indicate the pixel edges

The z position at the entrance window and the radius of the H9800 arc is indicate on the top of each plot

The radius is the average of pion and kaon Cherenkov cone radii

Best value z = 100-200 mm



Reference Signal, n=1.06

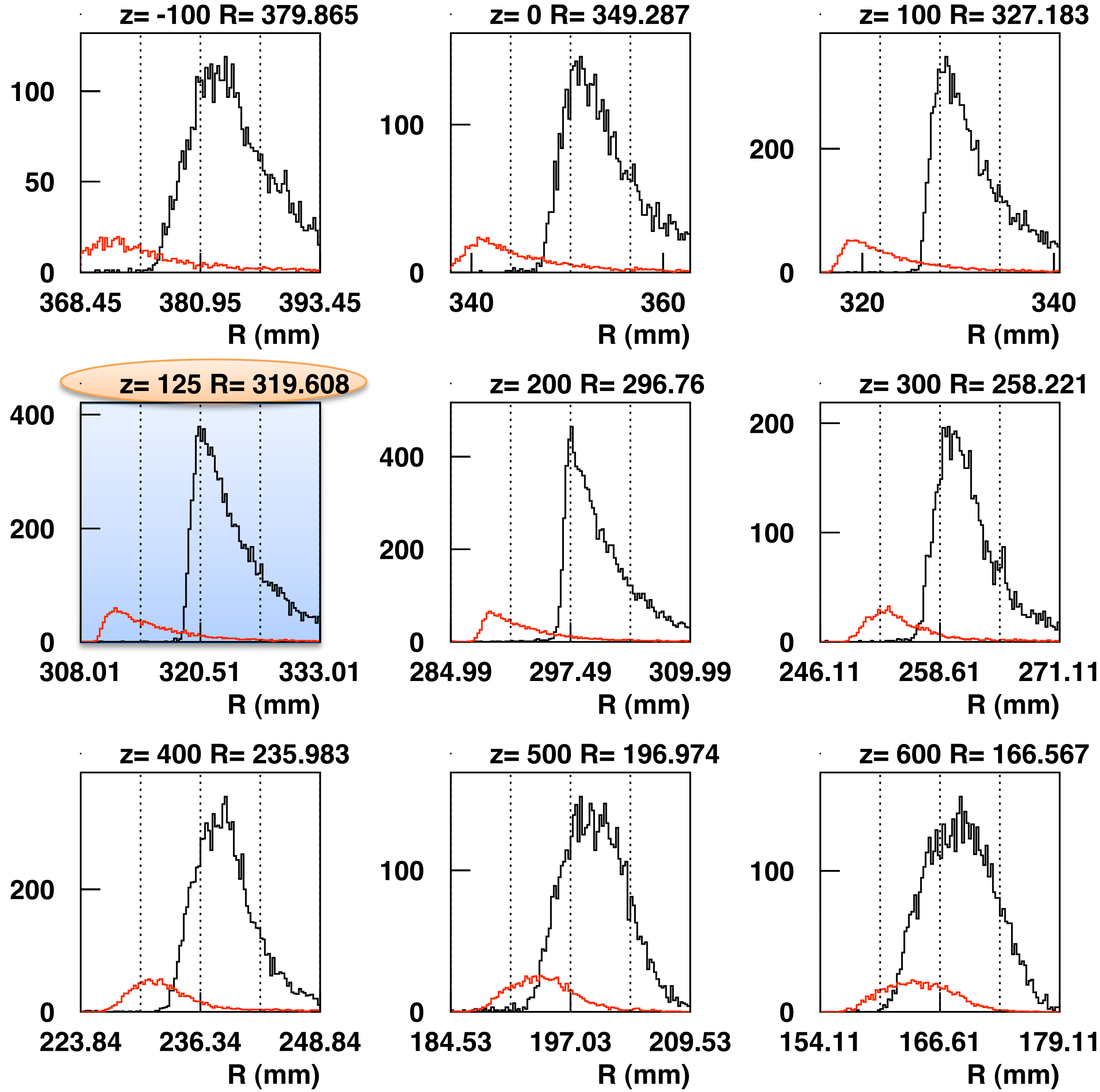
H9800

Each plot spans the H9800 width
vertical lines indicate the pixel edges

The z position at the entrance window and the radius of the H9800 arc is indicate on the top of each plot

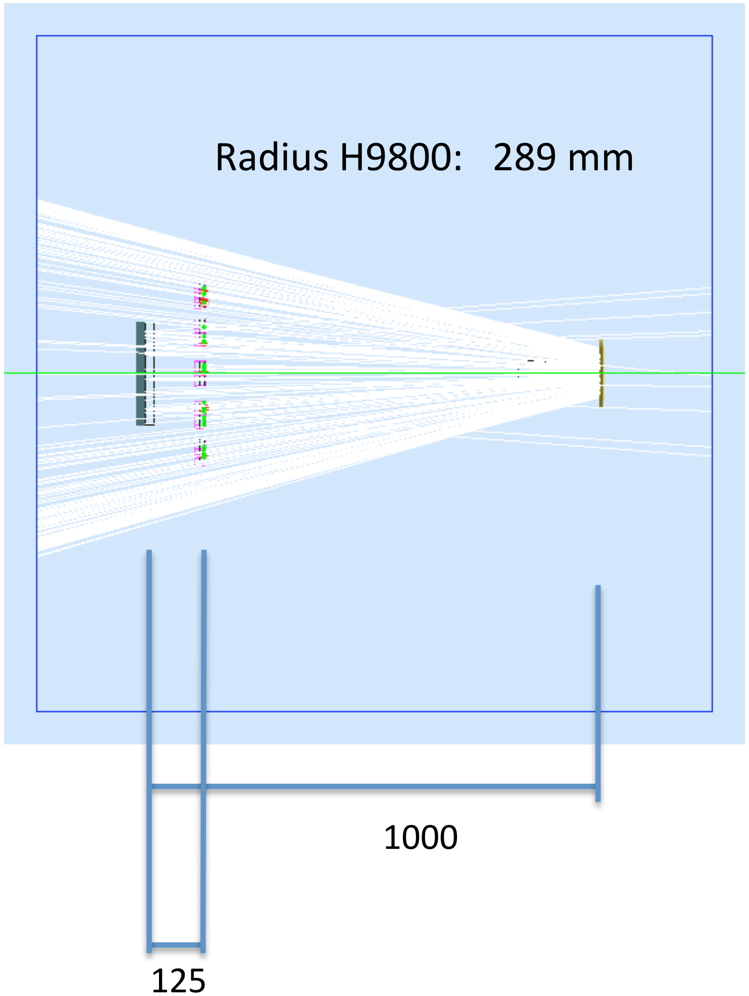
The radius is the average of pion and kaon Cherenkov cone radii

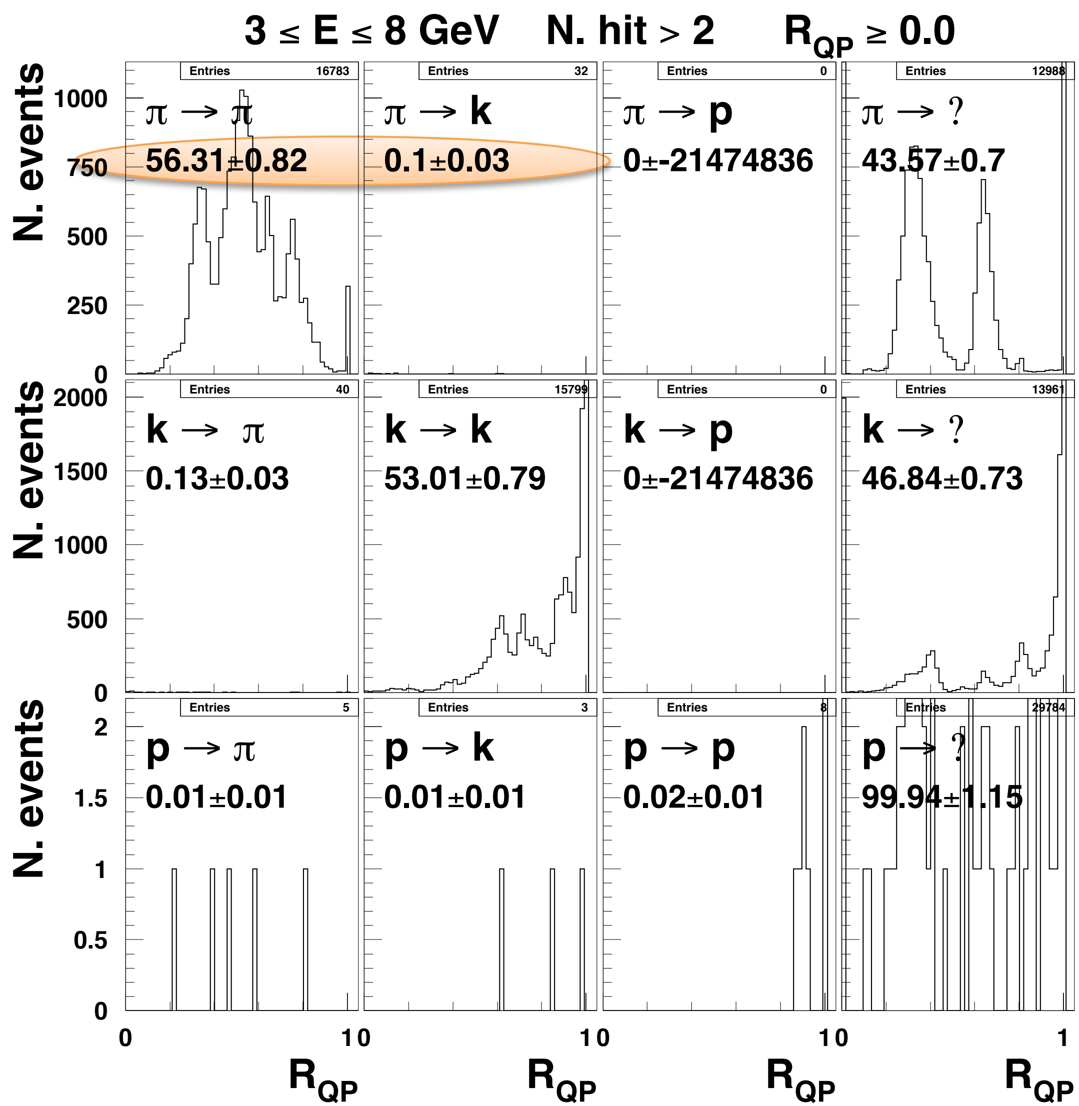
Best value z = 100-200 mm



Prototype Response @ 6 GeV

(0.0) is at the centre of radiator
Mirror: Edmund 1000 focal lenght





Mirror reflecting face at +1000 mm
H9800 entrance window at +125 mm

Realistic Signal, n=1.04

H8500

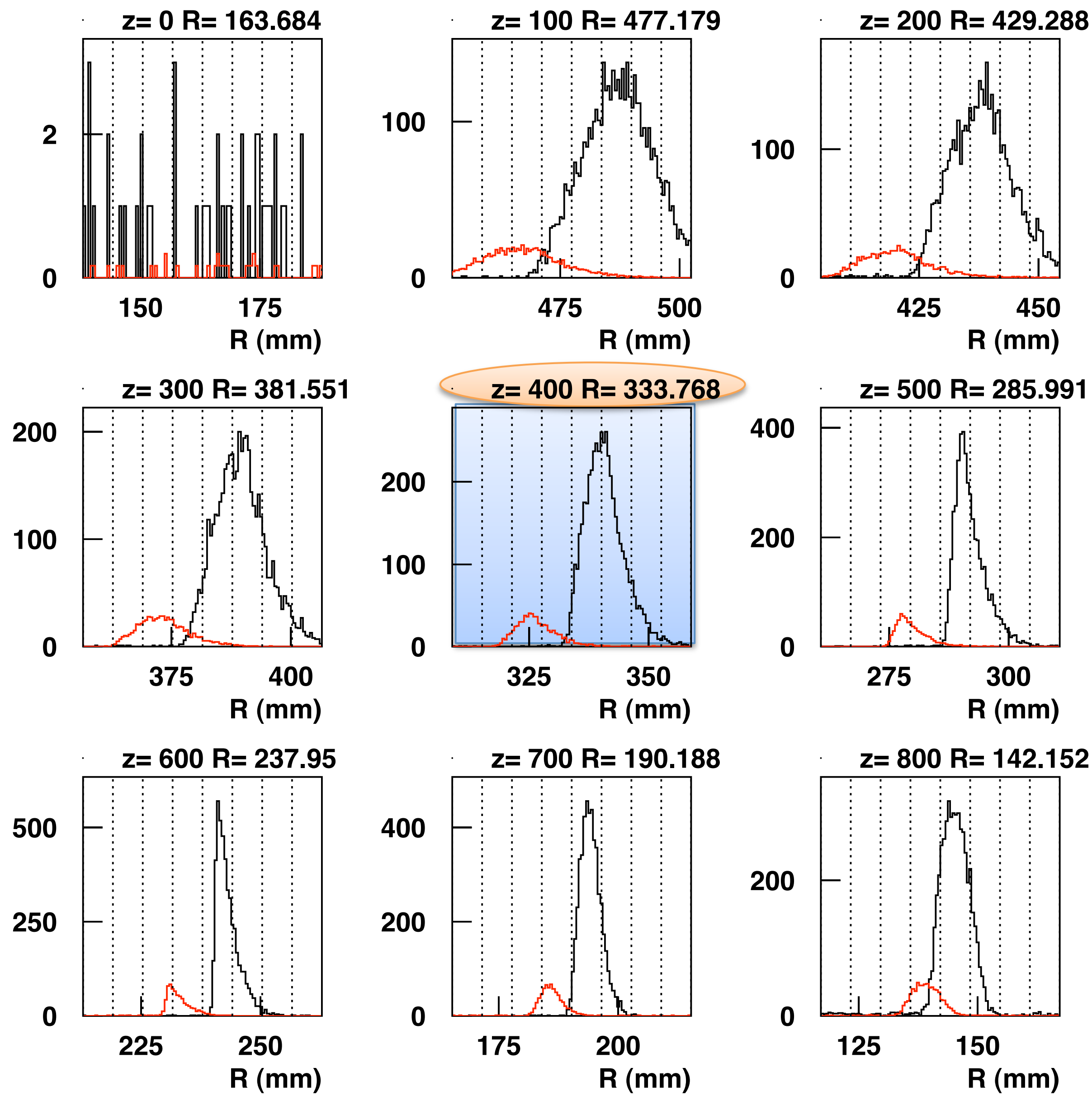
Each plot spans the H8500 width
vertical lines indicate the pixel edges

On top of the plot there is :
- the radius of the H8500 arc
- The reflecting aerogel+mirror z position (corresponding to the center of the aerogel)

The z position at the entrance window of the H8500 is 1000 mm

The radius is the average of pion and kaon Cherenkov cone radii

Best value z ~ 400 mm



Realistic Signal, n=1.05

H8500

Each plot spans the H8500 width
vertical lines indicate the pixel edges

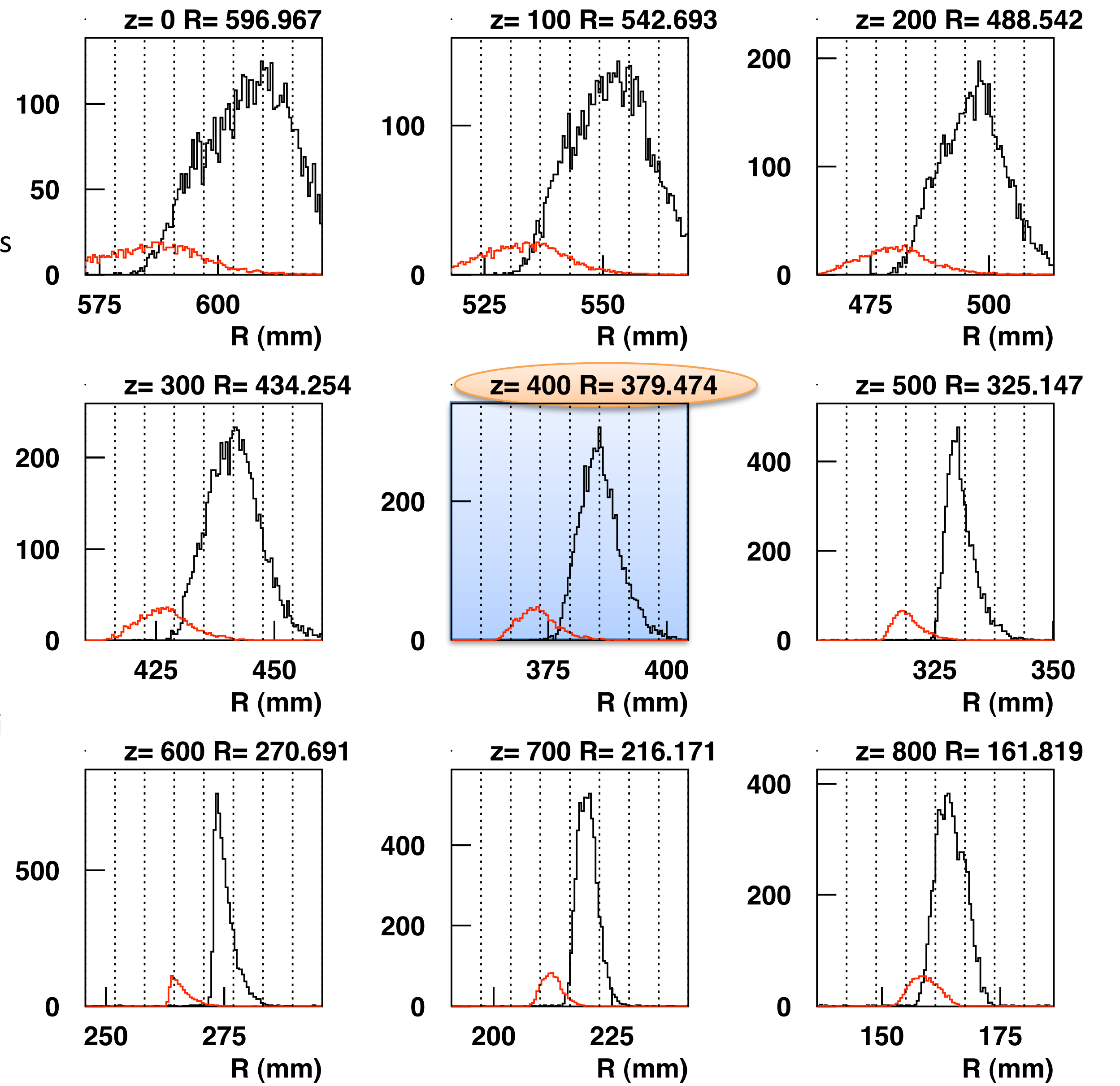
On top of the plot there is :

- the radius of the H8500 arc
- The reflecting aerogel+mirror z position (corresponding to the center of the aerogel)

The z position at the entrance window of the H8500 is 1000 mm

The radius is the average of
pion and kaon Cherenkov cone radii

Best value z ~ 400 mm



Realistic Signal, n=1.06

H8500

Each plot spans the H8500 width
vertical lines indicate the pixel edges

On top of the plot there is :

- the radius of the H8500 arc
- The reflecting aerogel+mirror z position (corresponding to the center of the aerogel)

The z position at the entrance window of the H8500 is 1000 mm

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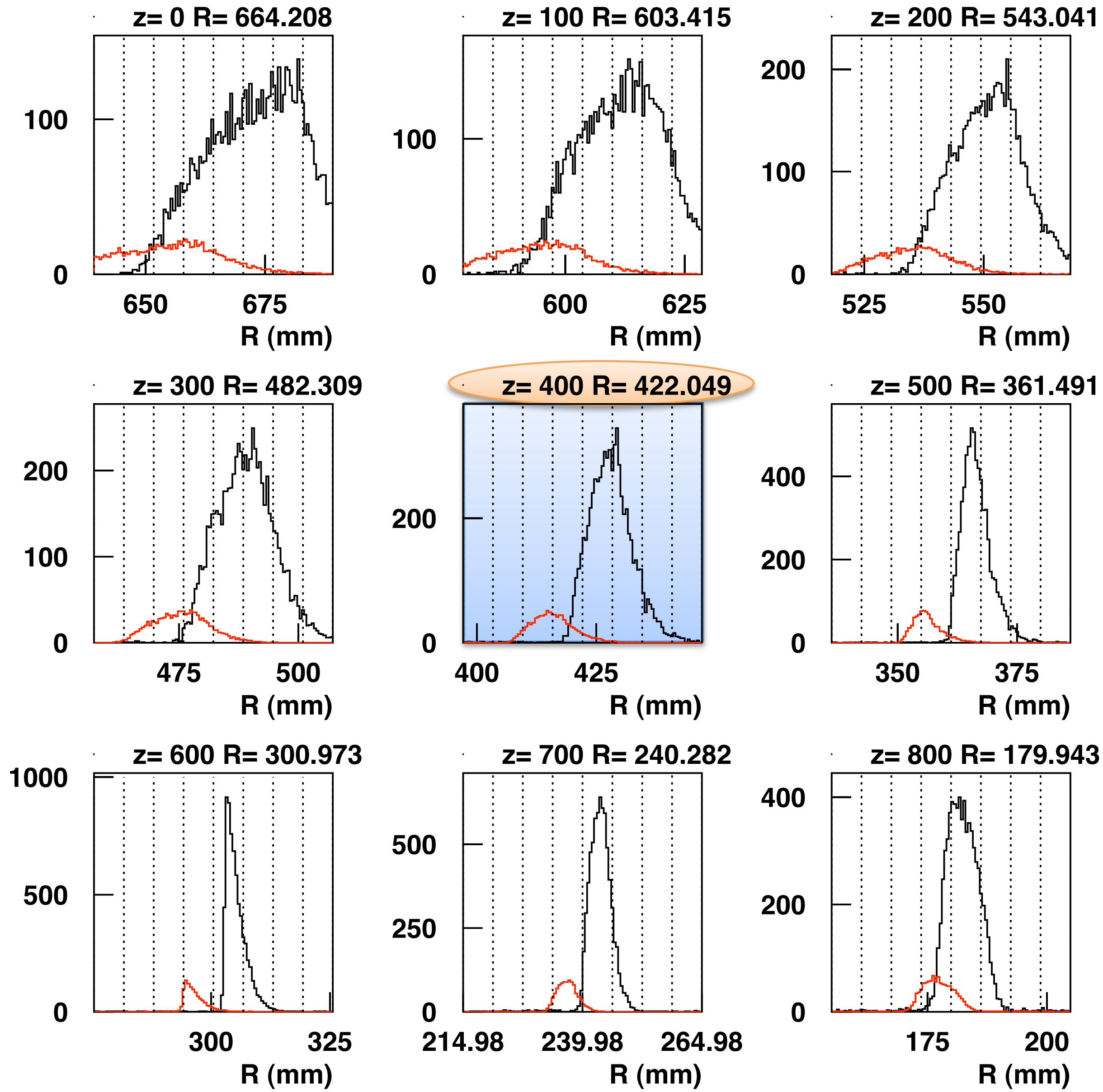
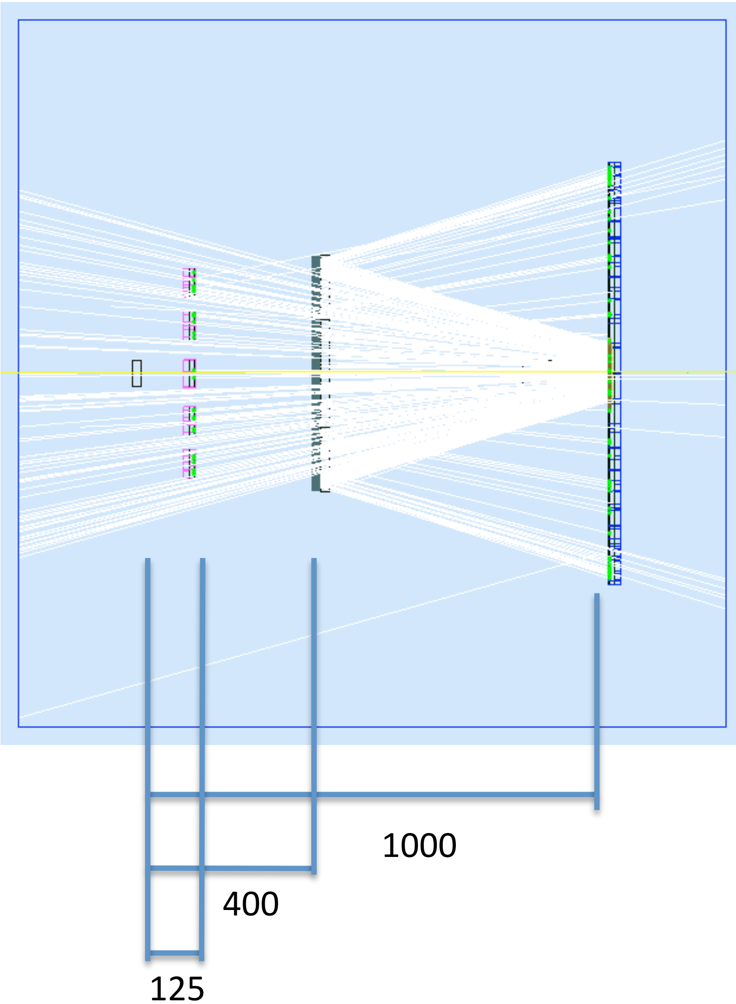
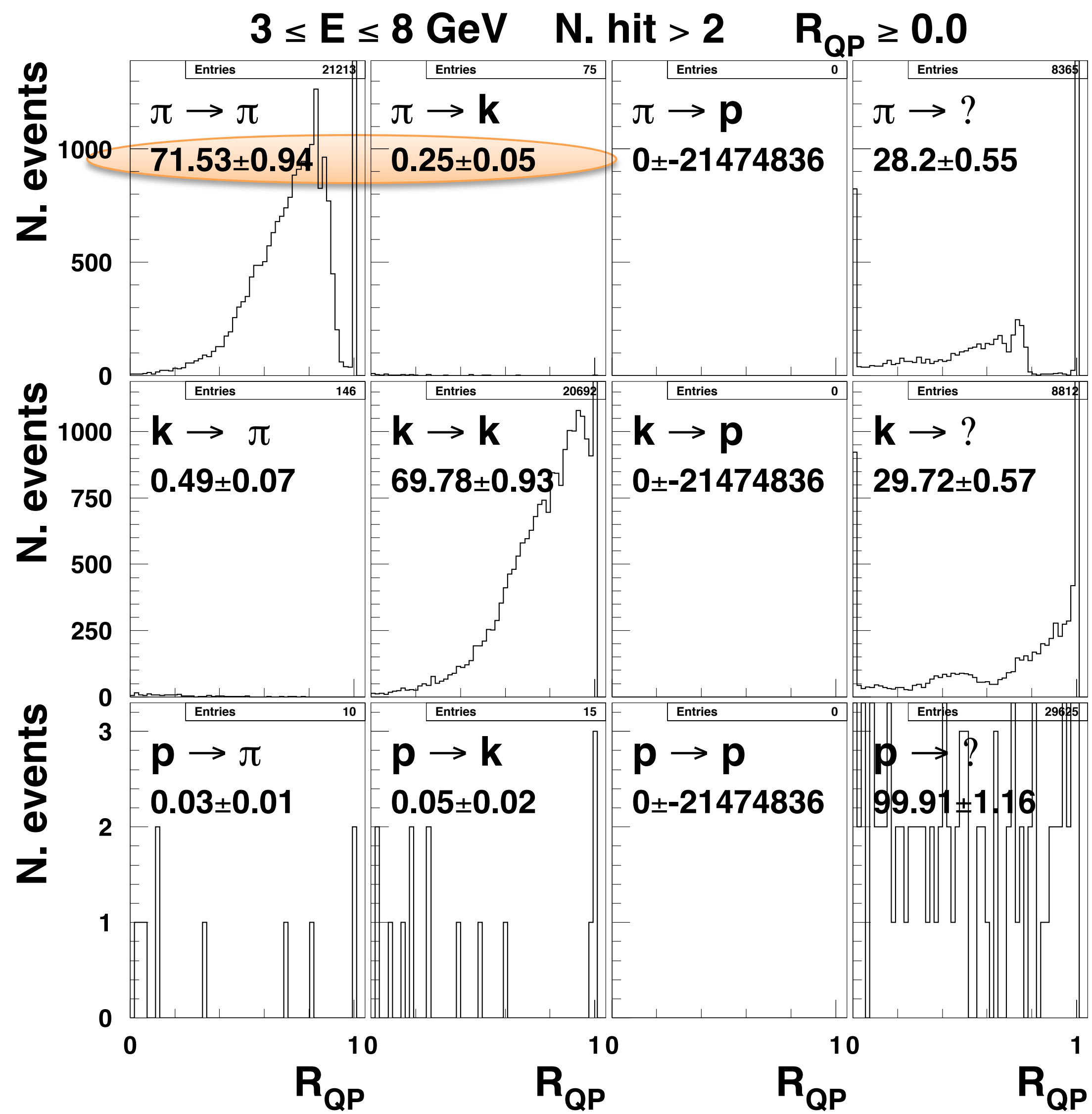


Prototype Response @ 6 GeV

Radius H8500: 379.5 mm

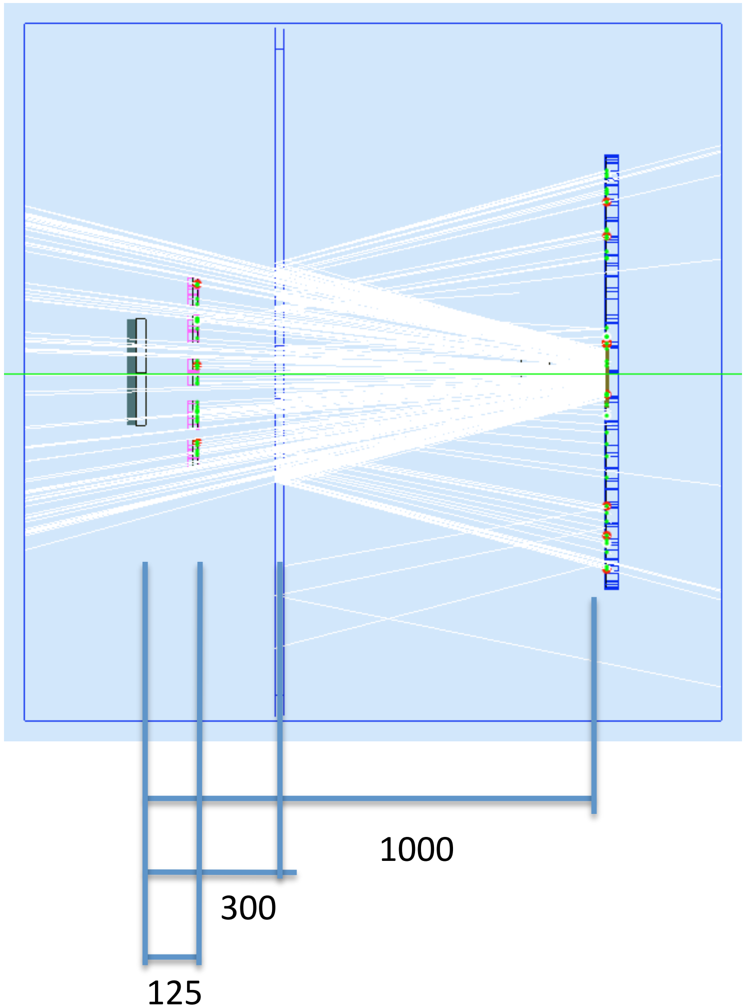


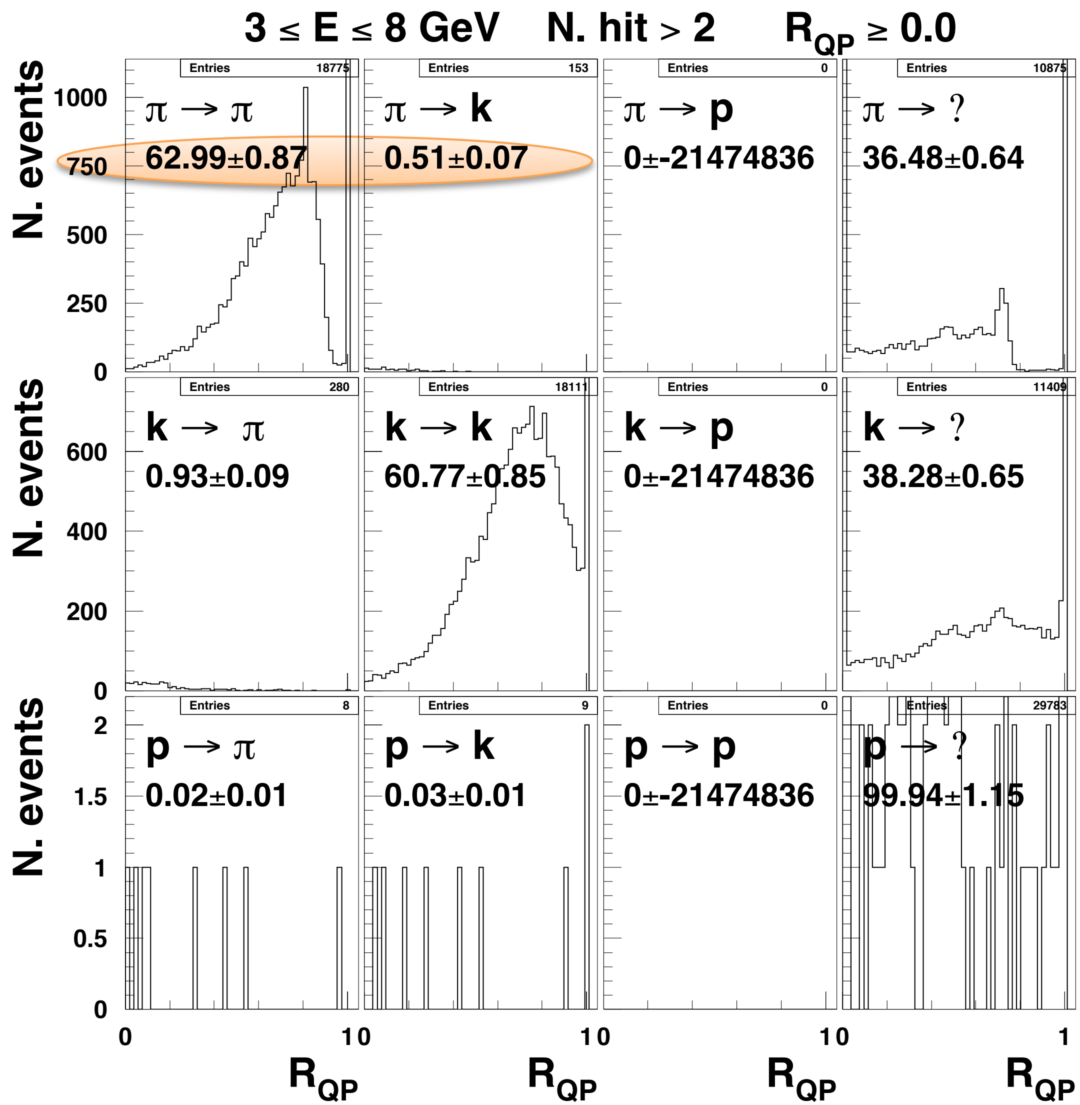


Aerogel-mirror system at +400 mm
H8500 entrance window at +1000 mm

Prototype Response @ 6 GeV

Radius H8500: 441.6 mm

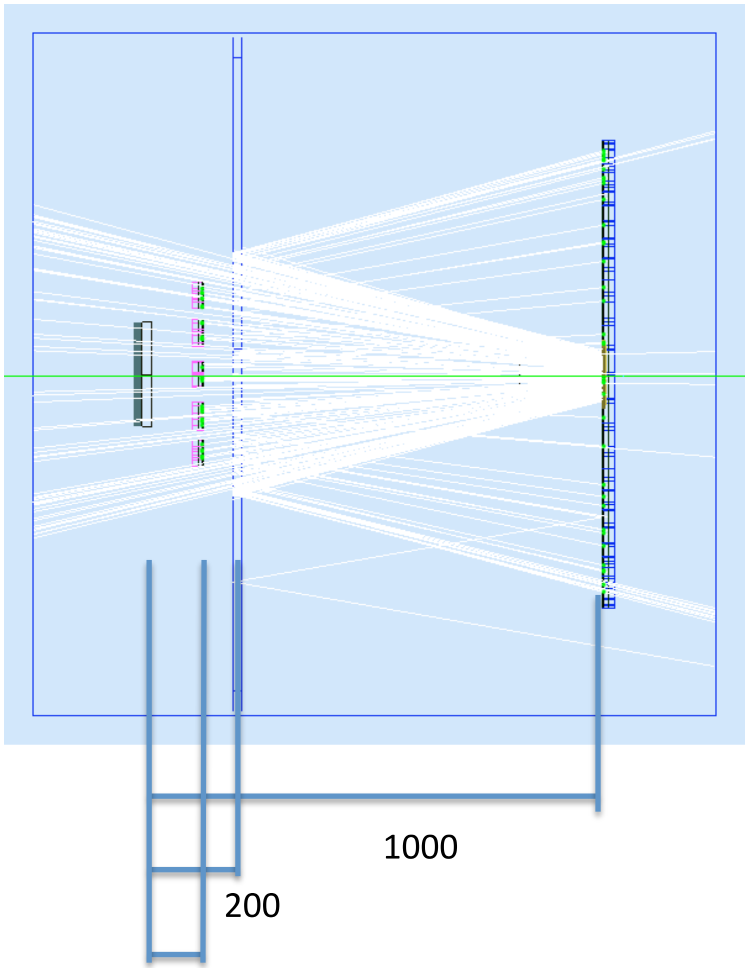


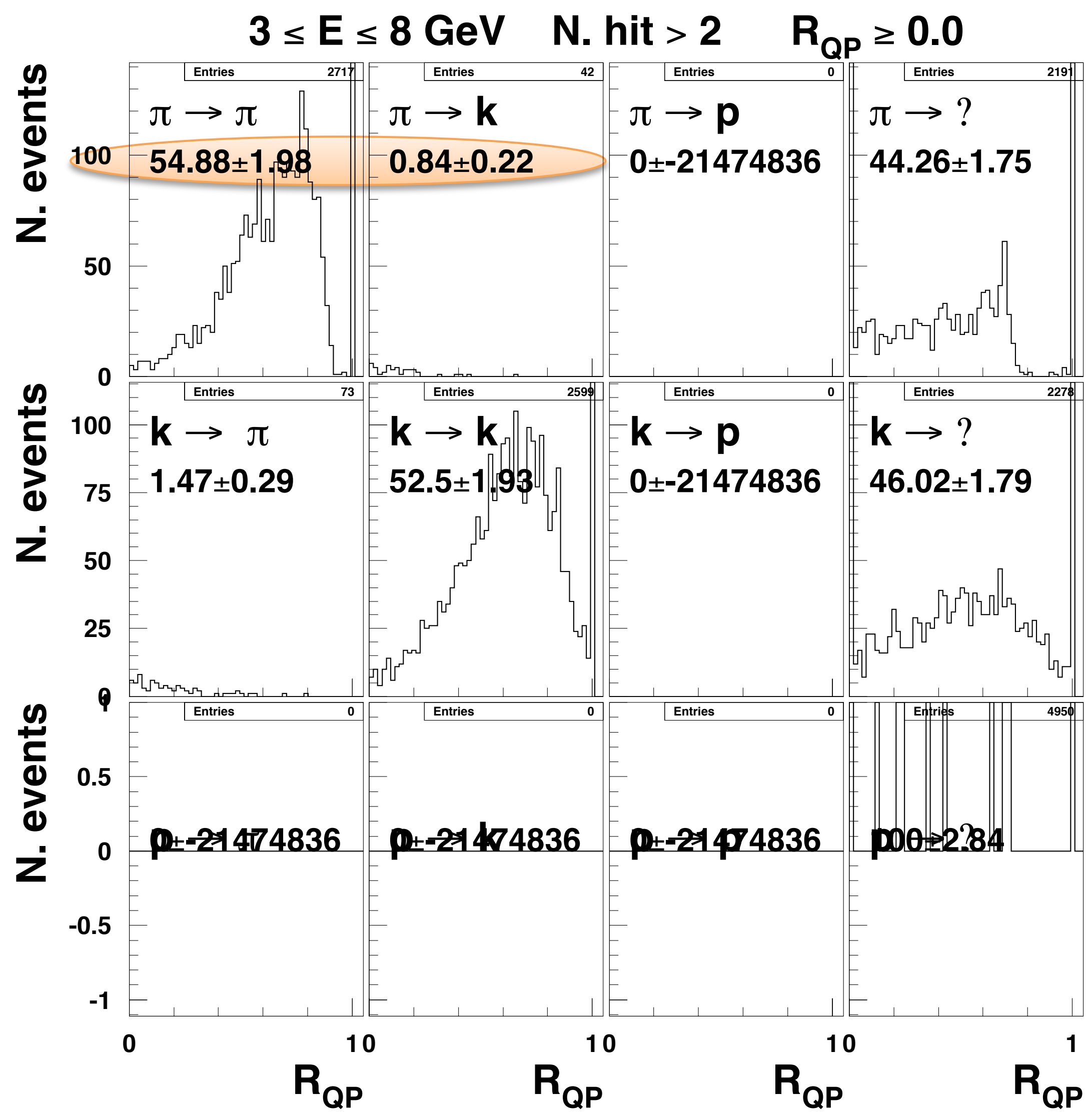


Aerogel-mirror system at +300 mm

Prototype Response @ 6 GeV

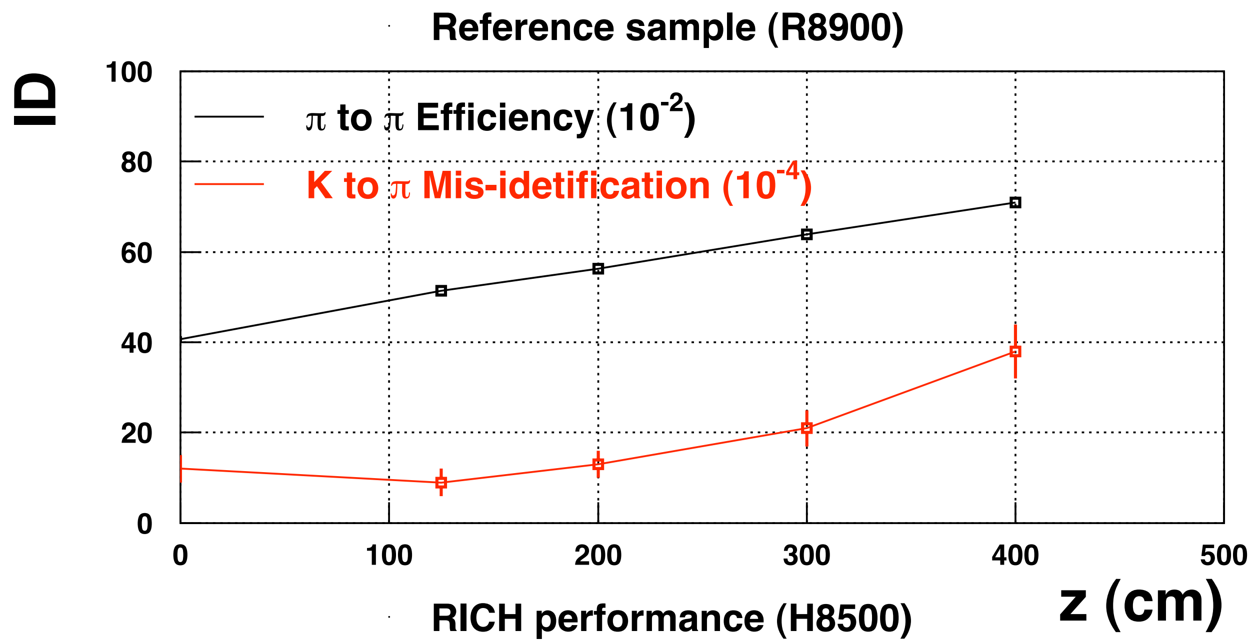
Radius H8500: 488.6 mm

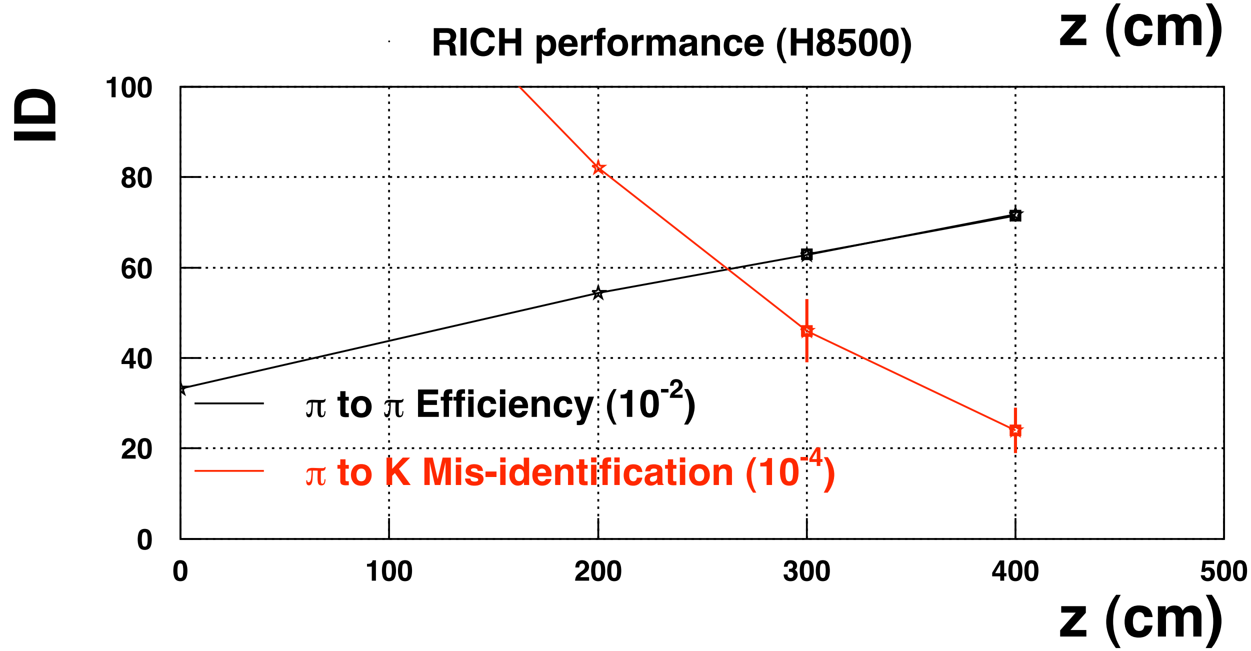




Aerogel-mirror system at +200 mm
H8500 entrance window at +1000 mm

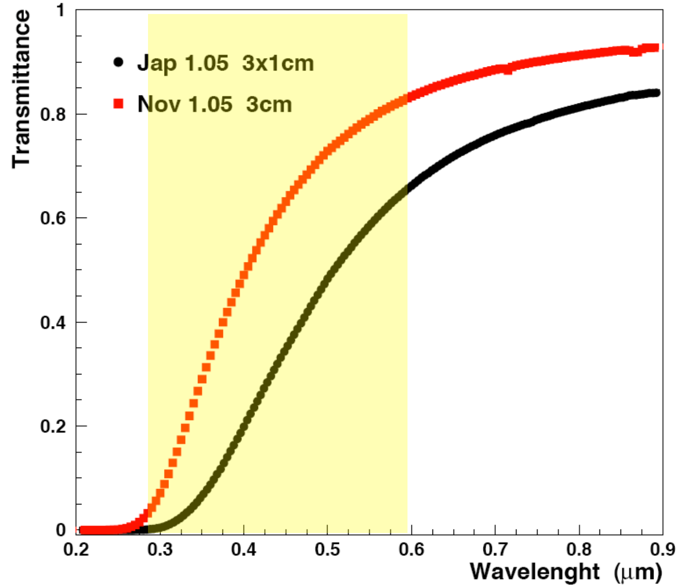
Prototype Response @ 6 GeV



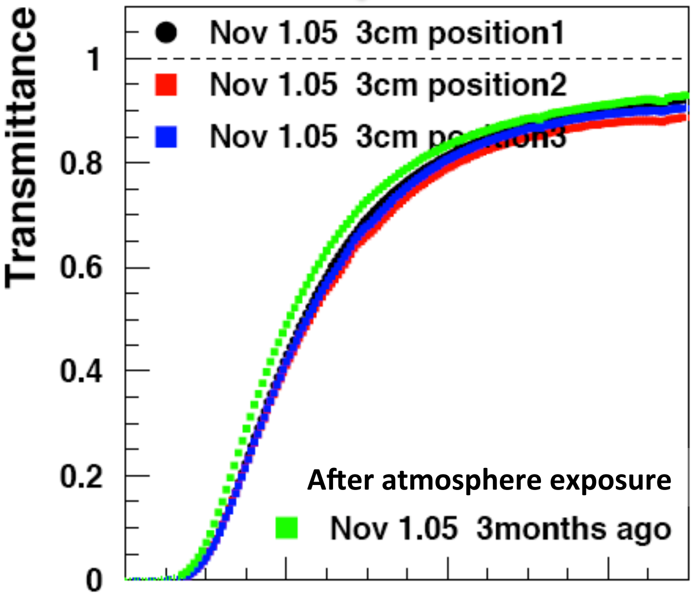


Aerogel from Novosibirsk

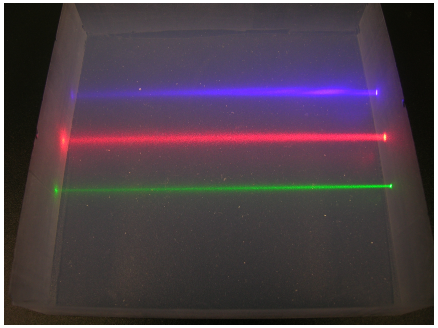
Collaboration with Budker Institute for high-transmission aerogel

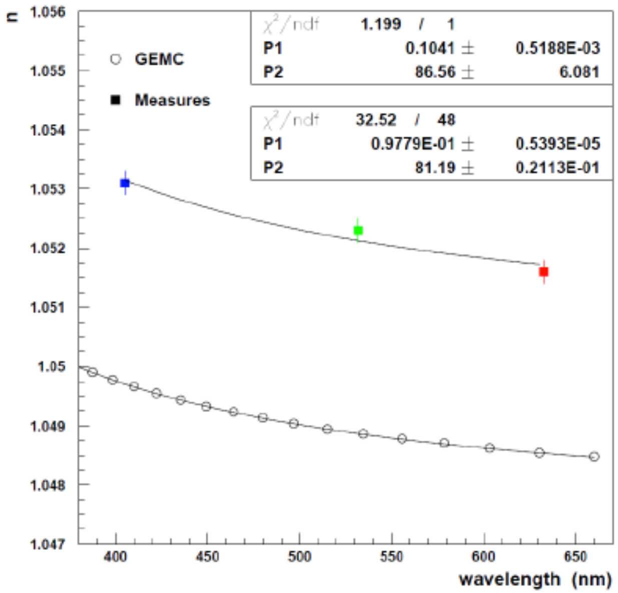


Despite the hygroscopic aerogel transmission length seems not so sensitive to humidity



Dispersion measurement to verify MC inputs





The SiPM Alternative

- **MA-PMTs are an almost plug and play device good to accomplish one sector before CLAS12 starts physics measurements**

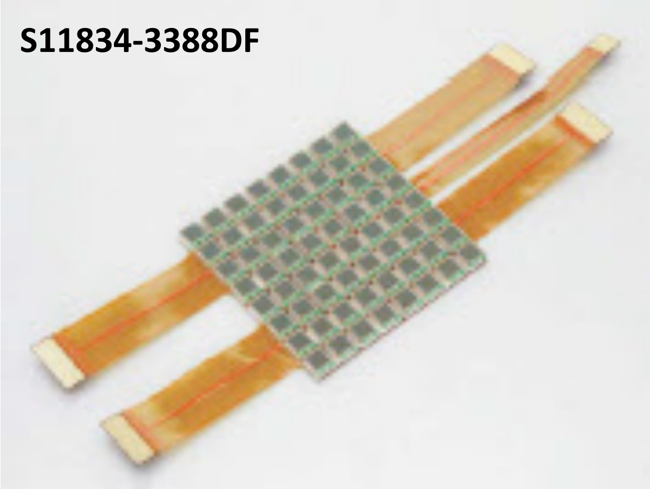
SiPM:
Fast develop ongoing
- 10 → 1 MHz dark counts
- cost rapidely reducing

Major issues

- **Their material budget, cost and magnetic field sensitivity limit the alternatives for better detector configurations**

- **Cost:**
  - ✔ *Reduce active area*
  - ✔ *Operate with cheaper devices*

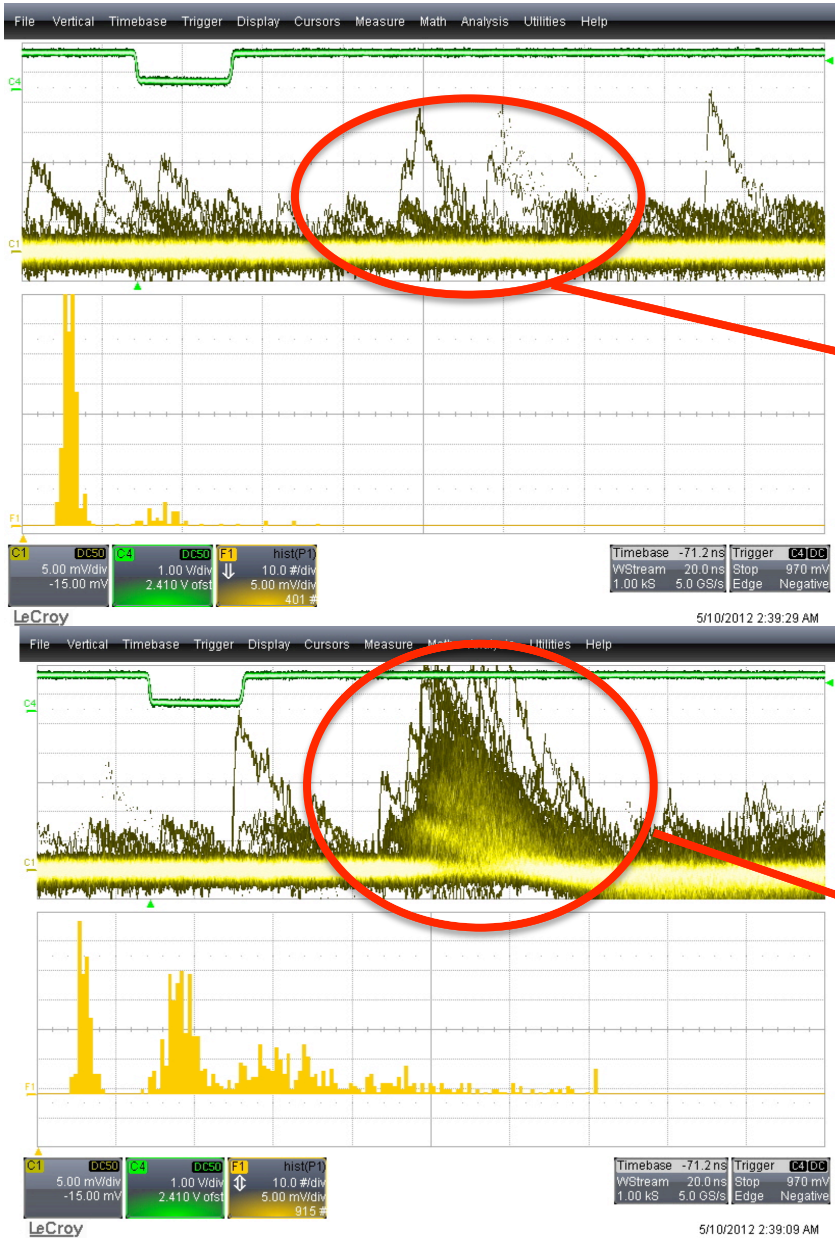
- **Average number of photoelectrons:**
  - ✔ *Increase quantum efficiency*
  - ✔ *Move QE peak toward green*
  - ✔ *Change configuration*

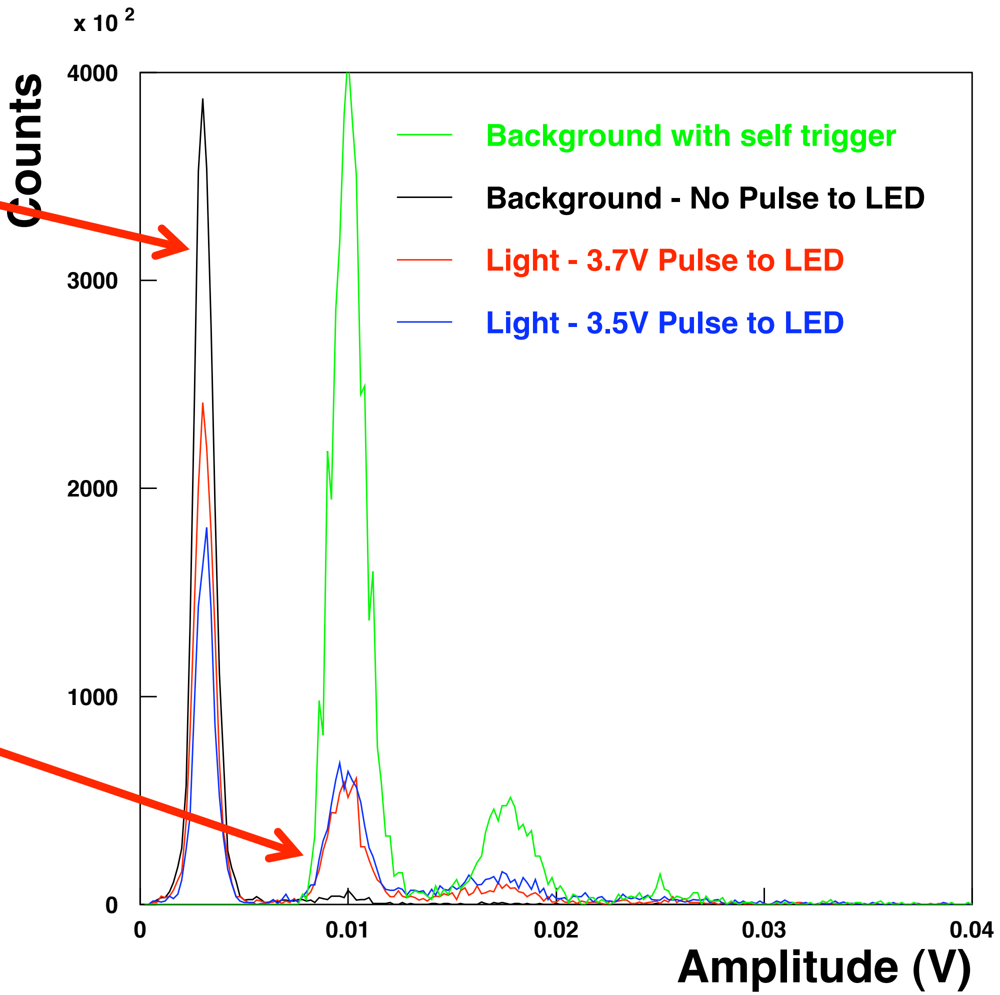


SiPM might offer a cheaper and more efficient solution expecially in a longer time perspective for the other sectors

- **Important to test them before the TDR write-up**

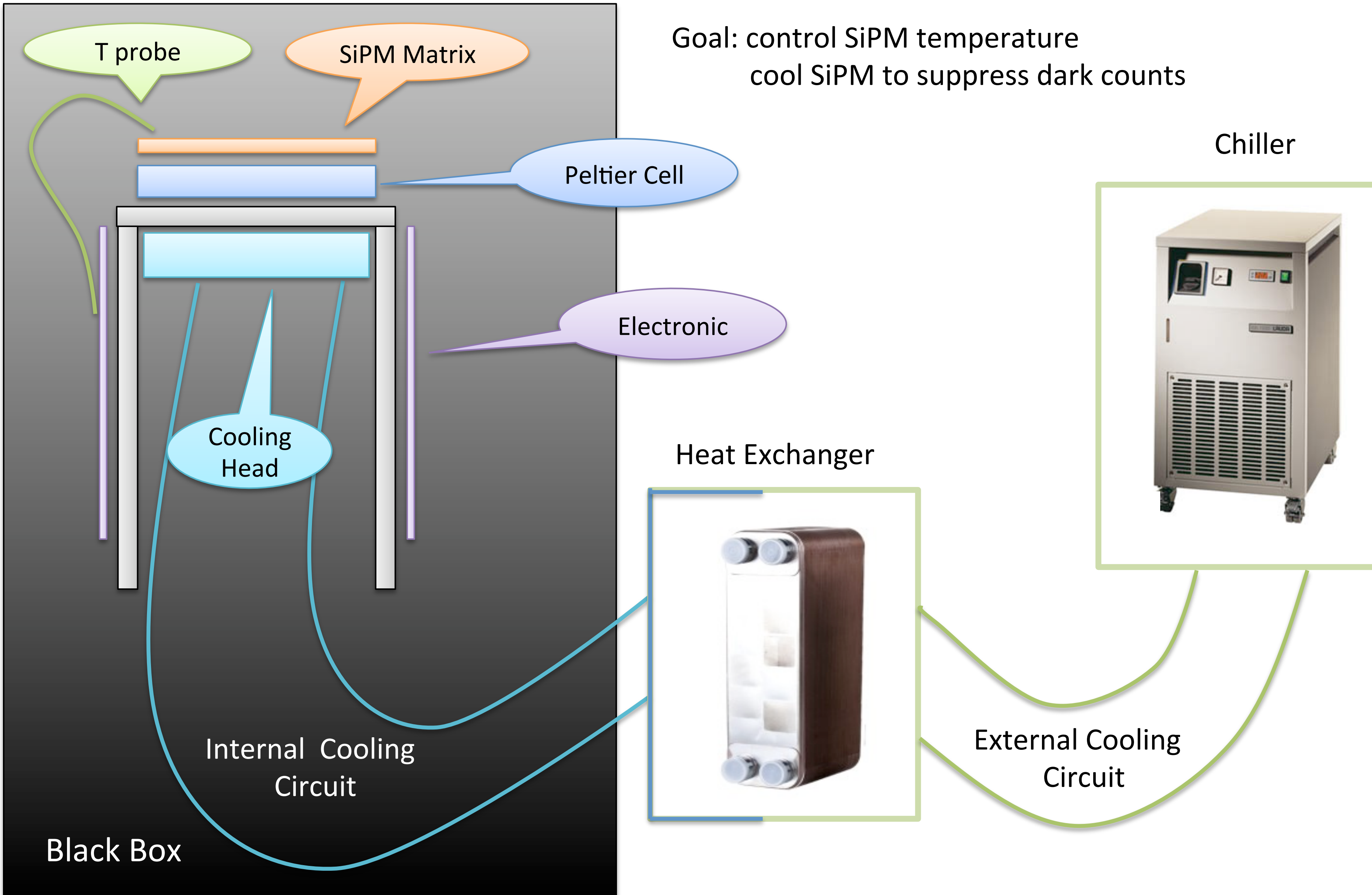
SiPM few-photons detection





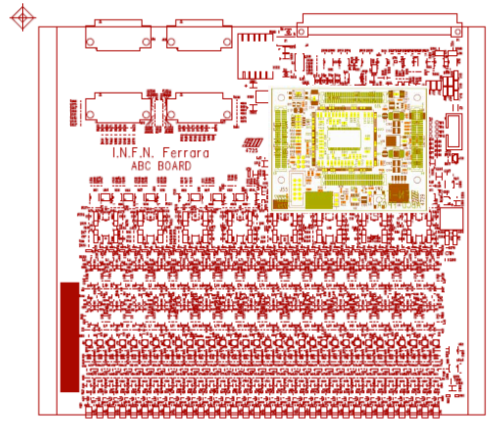
SiPM Cooling System

Goal: control SiPM temperature
cool SiPM to suppress dark counts



SuperB DAQ

- **32 channels**
- **Each channel with programmable**
  - **bias voltage**
  - **discriminating threshold**
- **Time resolution dominated by rise-time variations (goal ~ 1 ns)**
- **Digital output to TDC as standard**



"IFR_ABCD" mother board