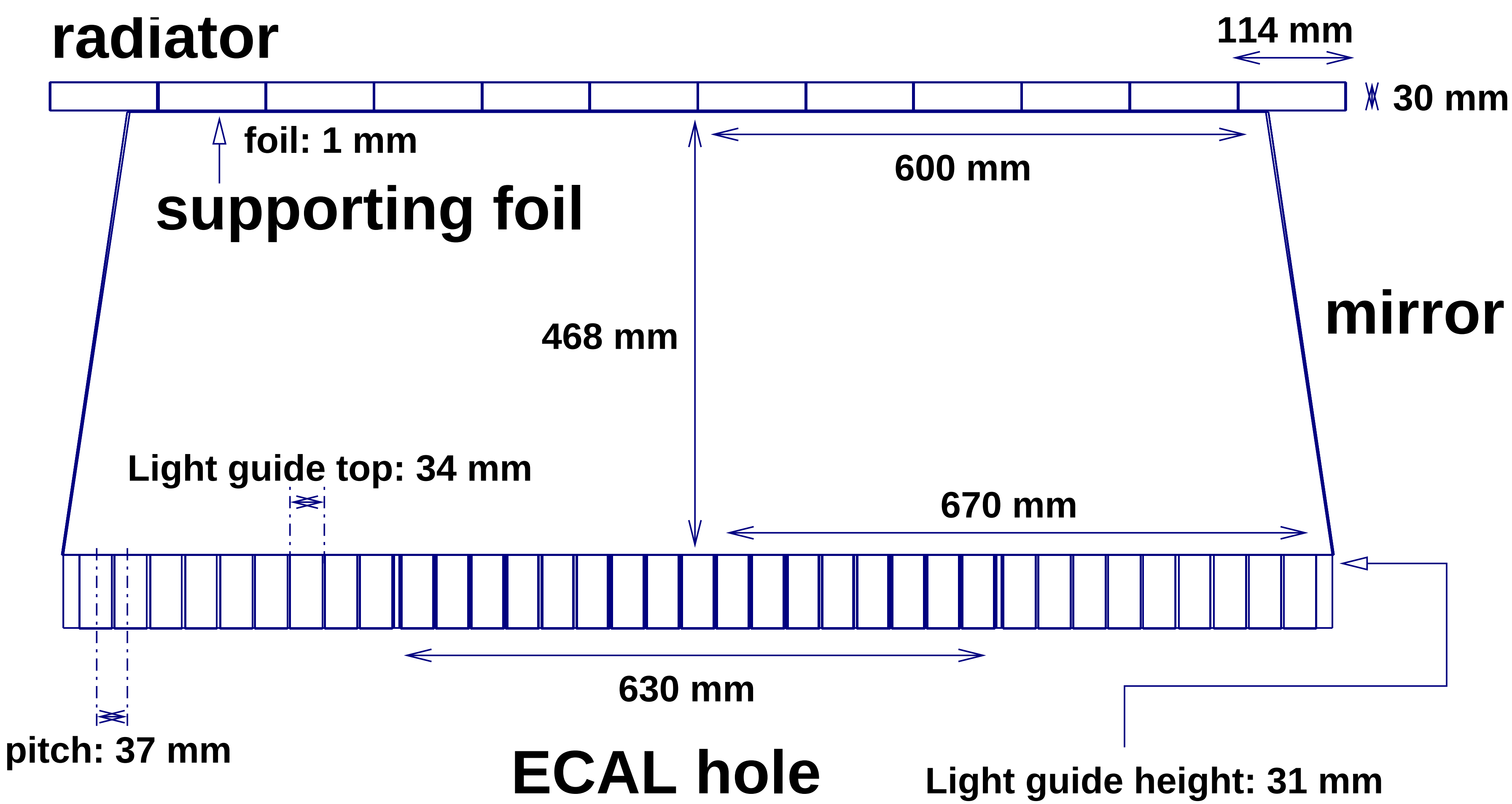
Current status of RICH Sim/Rec in AMS general code

C. Delgado

- Simulation.
- Reconstruction.
- Ntuple content.

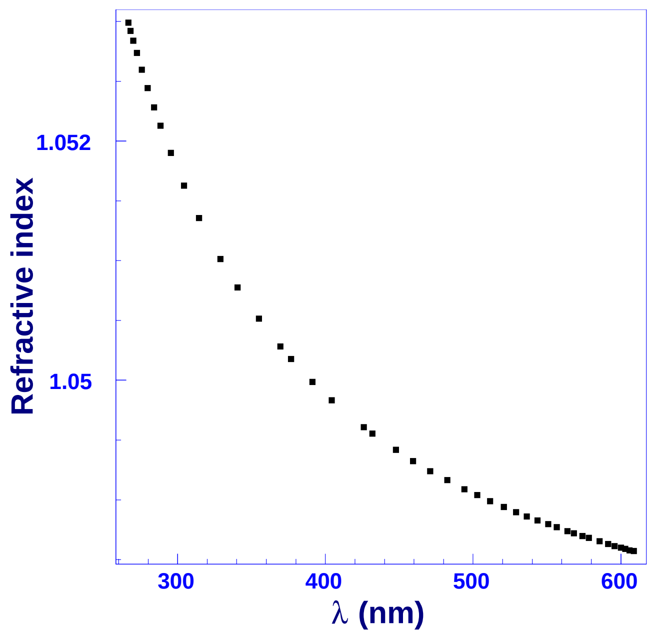
Simulation: geometry

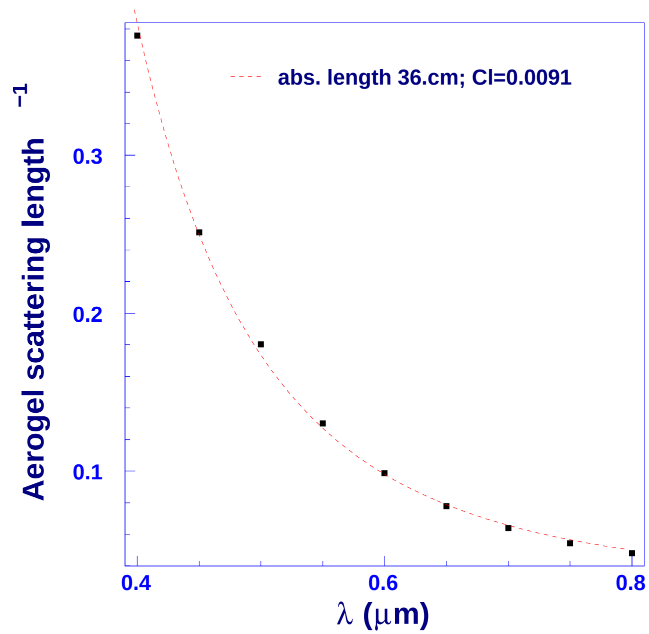


Number of PMTs: 680 → 10880 channels

Simulation: optical properties

- Radiator: Aerogel
  - Mean refractive index: 1.05
    The chromatic dispersion is assumed to be the one from fused silica scaled.
  - Absorption length: 36 cm
  - Clarity: $0.0091 cm^{-1} \mu m^4$
    Values obtained fitting the forward transmittance of the Matsushita commercial sheets.





- **Light guides and radiator supporting foil:**
  Each one of the group of 16 light guides is separated by vacuum.
  - Mean refractive index: 1.49
    According to fit to CIEMAT measurements.
  - Absorption length: $>$ 100cm for $\lambda > 400nm$
    Best fit value to CIEMAT measurement.
- **Mirror:**
  - Reflectivity: 85%
- **Photocathode window:** Borosilicate
  In optical contact with light guide.
  - Mean refractive index: 1.458
  - Transmittance: convolutionated in quantum efficiency
    Hamamatsu's tables.

Simulation: Digitalisation

- **Pedestal:**

  All the channels with the same gaussian one:

  – Mean value: 0.0 ADC counts.

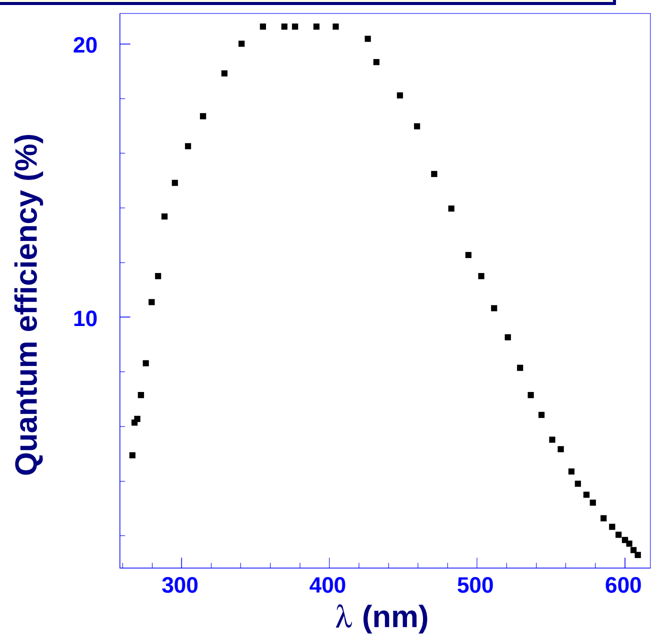
  – σ_{ped}: 0.53 ADC counts.

- **Threshold:**

  Set to $3.75\sigma_{ped}$ for all the pedestals.

  This yields $\approx 9 \times 10^{-5} channel^{-1} event^{-1}$ noisy hits.

- **PMT quantum efficiency:**



The one from Hamamatsu's information sheets for the R7900-M16 with a borosilicate window.

- Single p.e. PMT response

  Gaussian truncated below the pedestal.

  The same for all the channels:

  - Mean value: 23.04 ADC counts.
  - σ: 12.10 ADC counts.
  - $\frac{\sigma}{Q}$: ≈ 0.52

To increase the simulation speed, the quantum efficiency is applied at photon generation inside the radiator or the light guides.

Reconstruction: algorithm description

Currently the only reconstruction algorithm implemented is the CIEMAT β reconstruction using the reconstruted track information.

Brief description

For each reconstructed track provided by the tracker:

1. For each hit, back trace the photon trajectory using a semi-analytical solution for all the possible paths.
   - One without reflection.
   - Two with reflection
2. Look for a cluster in the reconstructed βs for each hit such that:
   - Each hit only contributes with the closer path to the cluster center, if it is close enough.
   - The cluster width is compatible with the expected one.
   - The number of hits contributing to the cluster is maximum.

Ntuple: RICH related variables

Block	Variable	Description
EVENTH	RICMCClusters	Number of clusters which can give rise to a digitalised hit.
EVENTH	RICHits	Number of digitalised hits
PARTICLE	prichp(1:npart)	Pointer to the ring associated to the reconstructed particle
PARTICLE	pbeta(1:npart)	Reconstructed particle's β (TOF+RICH)
PARTICLE	coorich(3,2,1:npart)	Particle track extrapolation to RICH radiator and RICH PMT array.
PARTICLE	pathrich(2,1:npart)	Estimated fraction of emitted photons within RICH acceptance for $\beta = 1$ for direct and reflected cases.
PARTICLE	lengthrich(1:npart)	Estimated pathlengh of particle within RICH radiator
RICMCCL	nsignals	Number clusters which can give rise to a digitalised hit.
RICMCCL	sid(1:nsignals)	Geant ID code of the particle originating this cluster. • -666: pedestal noise • 50: Čerenkov photon

Block	Variable	Description
RICMCCL	rimcorg(3,1:nsignals)	Birth point of the particle's cluster
RICMCCL	rimcdir(3,1:nsignals)	Birth direction of the particle's cluster
RICMCCL	rimcstatus(1:nsignals)	Cluster status: for Čerenkov hits: additive word with 1 if suffered rayleigh scattering +10 × number of reflections in mirror +100 if mother is not primary Special values -1 PMT noise -2 generated in photcathode window -3 not Čerenkov photon -5 generated in light guide
RICMCCL	rimcnphg	Number of Čerenkov photons generated in radiator.
RICMCCL	rimcphit(1:nsignals)	Pointer to one hit if any
RICEVENT	Rhits	Number of digitalised hits
RICEVENT	Rchtch(1:Rhits)	Channel Id
RICEVENT	Rchtadc(1:Rhits)	ADC counts
RICEVENT	Rchtx(1:Rhits)	X coordinate on top of LG
RICEVENT	Rchty(1:Rhits)	Y coordinate on top of LG

Block	Variable	Description
RING	nrings	Number of reconstructed rings
RING	rcritrkn(1:nrings)	Pointer to the associated track
RING	rcrihu(1:nrings)	Total number of hits in the ring
RING	rcrimhu(1:nrings)	Number of hits in the ring associated to a trajectory with reflection
RING	rcribeta(1:nrings)	Reconstructed β
RING	rcriebeta(1:nrings)	Estimated error in β
RING	rcrichi2(1:nrings)	$\chi^2/Ndof$ for the ring