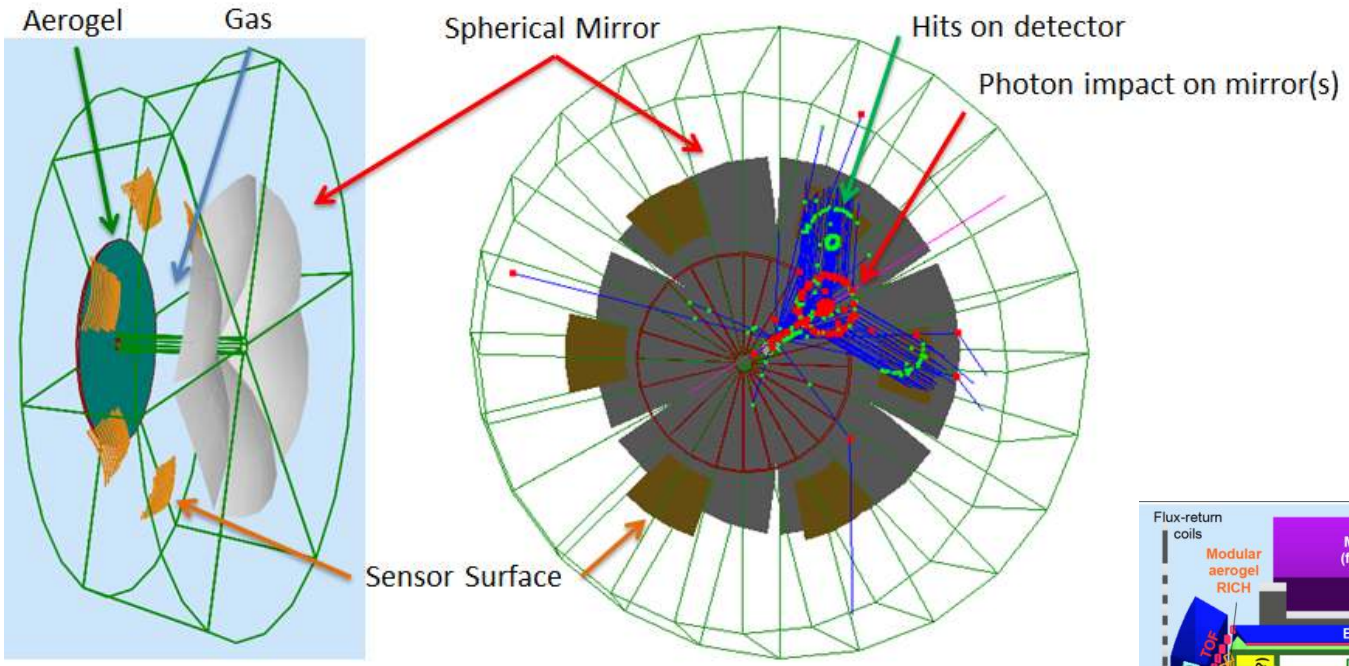
Status dRICh Simulation (and analysis)

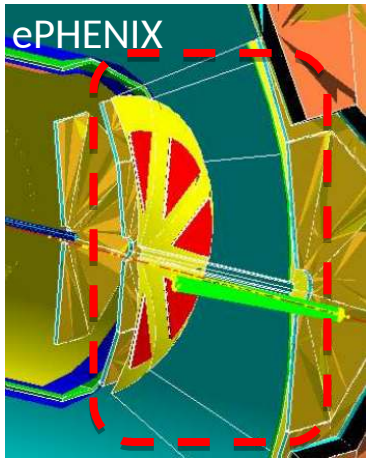
15/Apr/2021

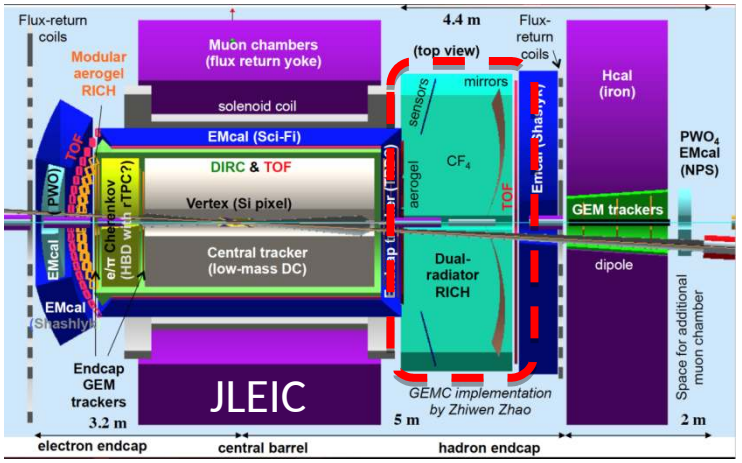
EIC_NET MonteCarlo

E. Cisbani

dRICh Overview







Radiators:

- Aerogel: 4 cm, $n_{(400nm)}$~1.02 + 3 mm acrylic filter
- Gas: 1.6m (1.1m ePHENIX), n_{C2F6}~1.0008

6 Identical Open Sectors (Petals):

- Large Focusing Mirror with R ~2.9m (~2.0m ePHENIX)
- Optical sensor elements: ~4500 cm^2/sector, 3 mm pixel size, UV sensitive, out of charged particles acceptance

Optimized for JLEIC, preliminary implementation in ePHENIX

Phase Space:
- Polar angle: 5-25 deg
- Momentum: 3-50 GeV/c

dRICh – Existing Software

Standalone Montecarlo (GEMC/Geant4 + ROOT) (Alessio Del Dotto)

- Model largely based on Perl scripts
- Cherenkov angle reconstruction by Inverse Raytracing Method (no uncertainty in detector geometry)
- Source code: github.com/EIC-eRD11/dualRICH_inMEIC

AI-driven Optimization (+Python code) (C. Fanelli)

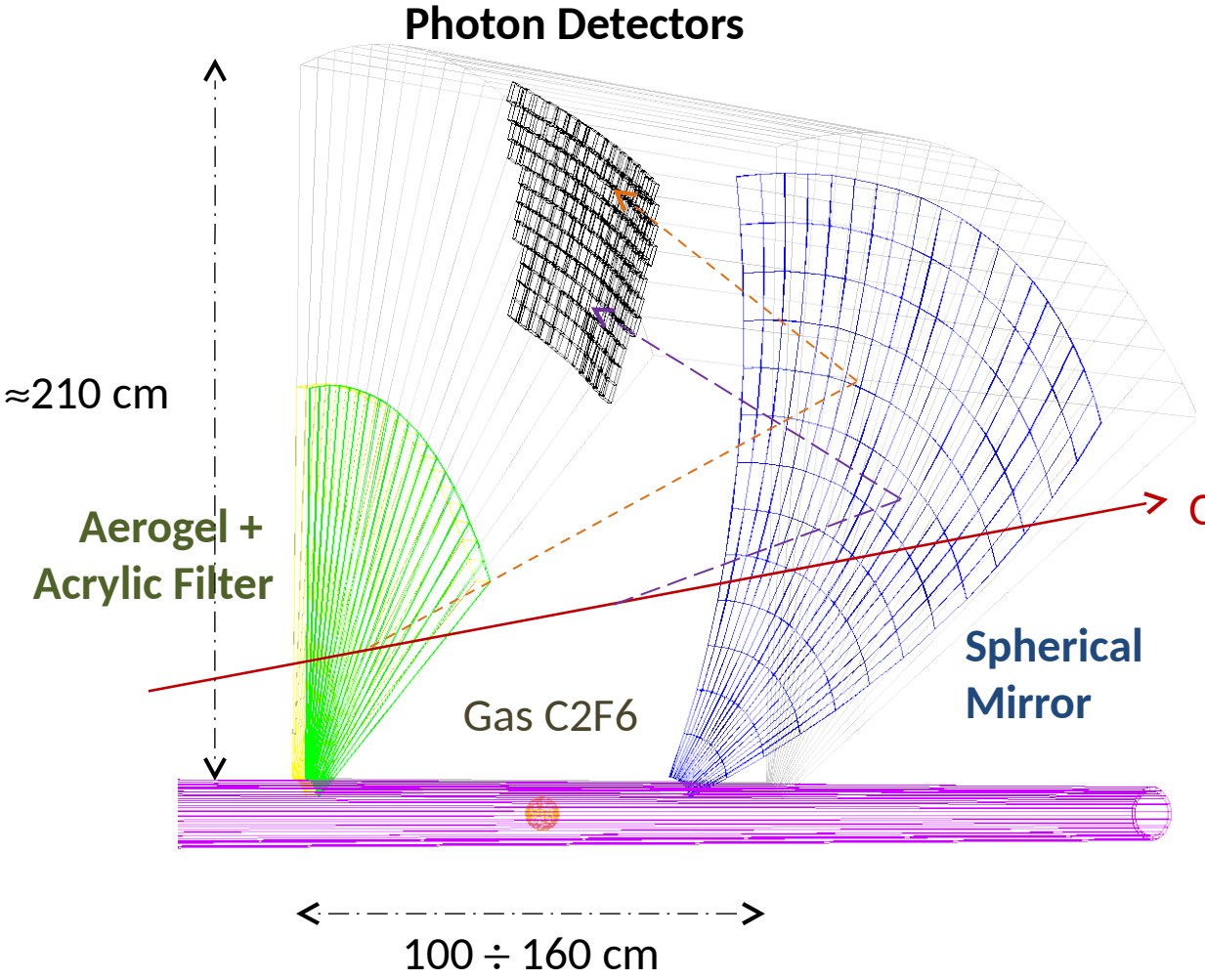
- Use Montacarlo model and an efficient maximization strategy of a figure of merit (e.g. for dRICH: combinations of nσ's in different momentum regions)
- Flexible tool, can be ported to different detectors and combination of them!

PID reconstruction (beta) of MC data (+PYTHIA) (Zhiwen Zhao contrib.)

- Event based reconstruction (from Indirect RayTracing Method)
- Provide confusion/Migration matrix (tested on PYTHIA DIS events)

Fast Parameterized Model (C++) (R. Preghenella)

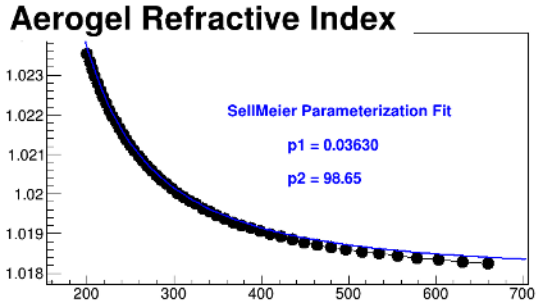
dRICH model geometry

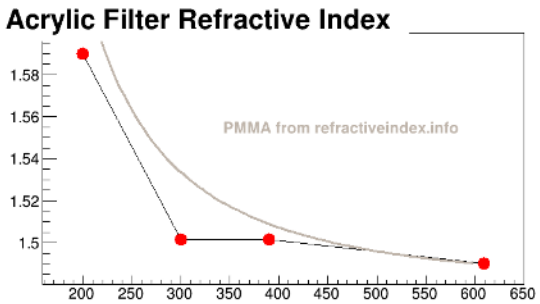


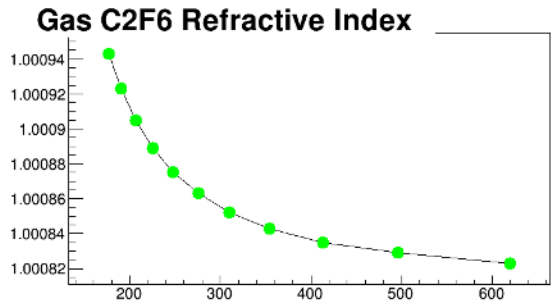
Quick modeler based on ROOT:TGeoManager

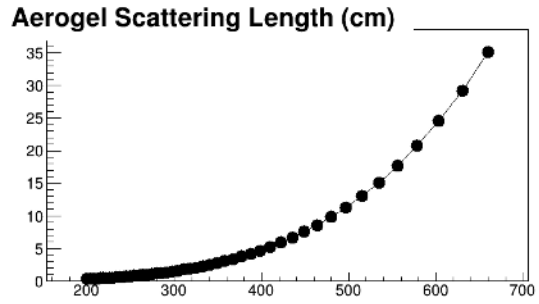
Preliminarily ported on ESCalate/g4e by Dmitry (PS: demonstrate framework flexibility)

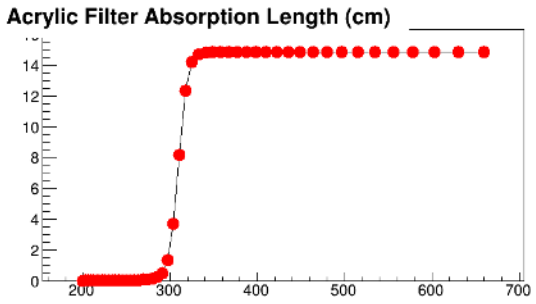
dRICh main optical characteristics

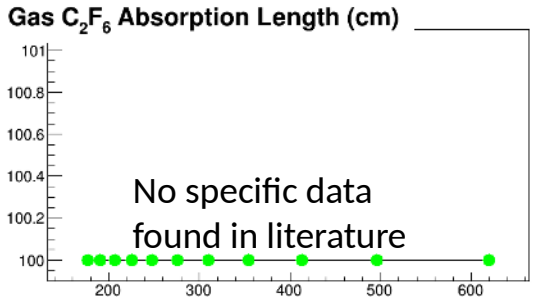


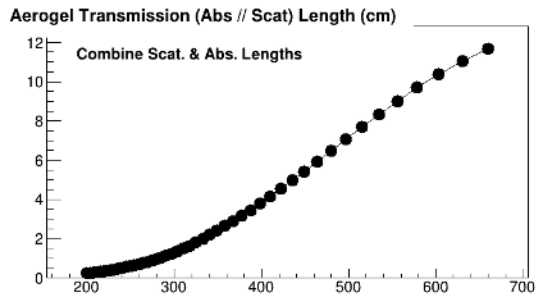


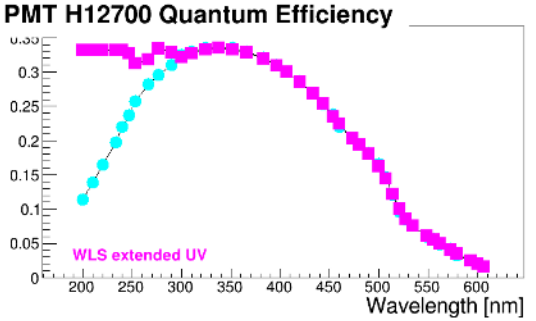


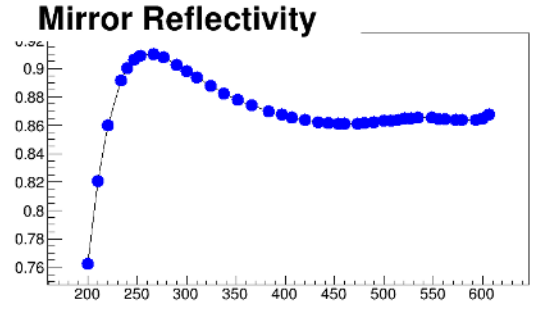












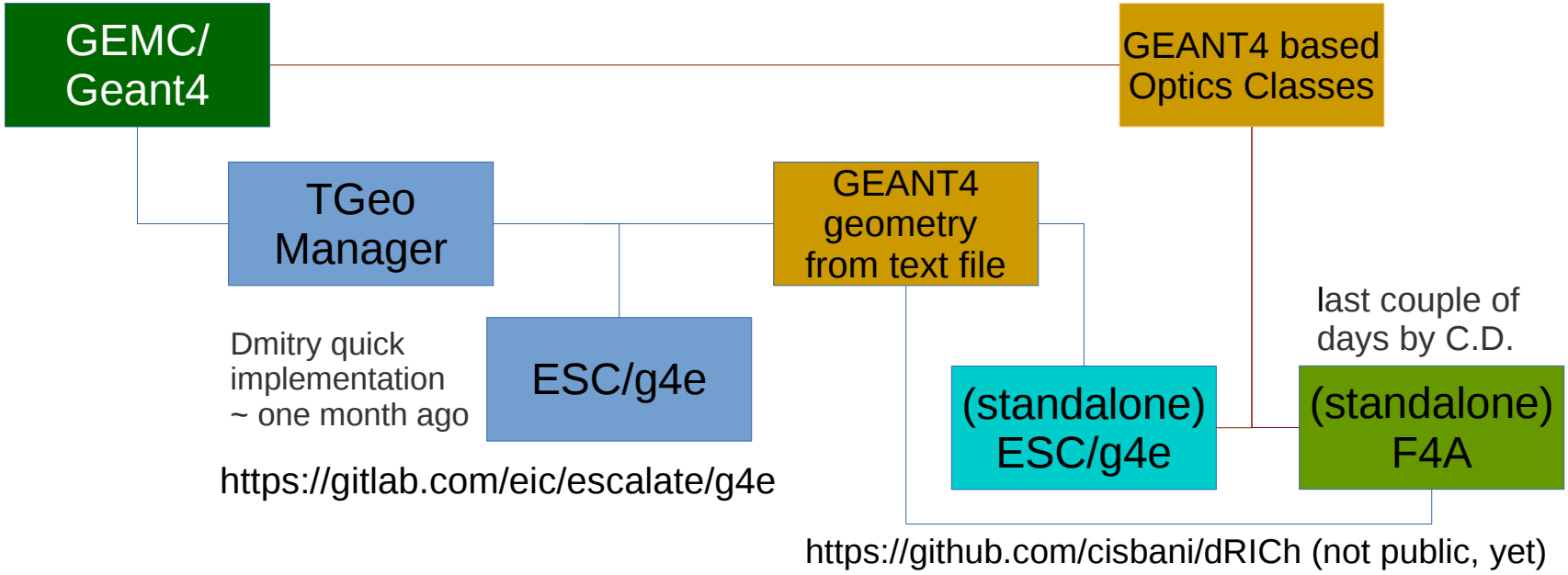
Shall be reasonably parameterized in order to test different configurations

dRICh Model porting to …?

Volunteers:

- Cristiano Fanelli (JLab/MIT)
- Christopher Dilks and Anselm Vossen (Duke)
- E.C. and Guido Urciuoli

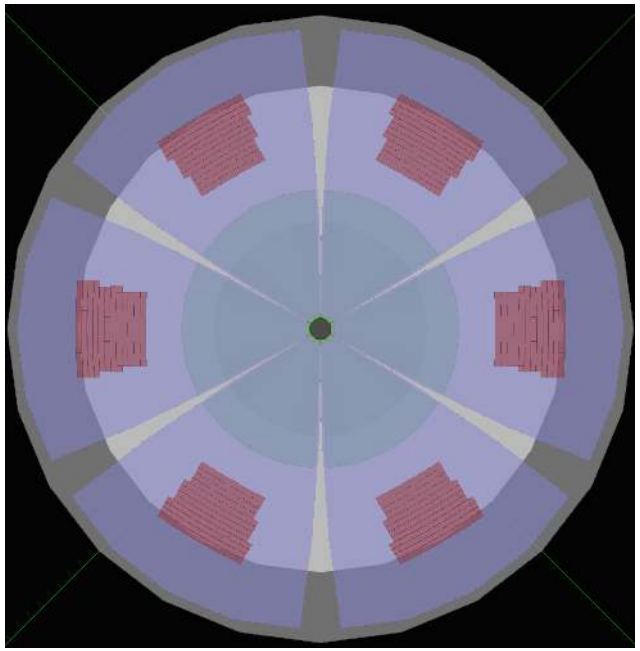
Support from Dmitry Romanov (JLab) and A. Del Dotto (LNF)

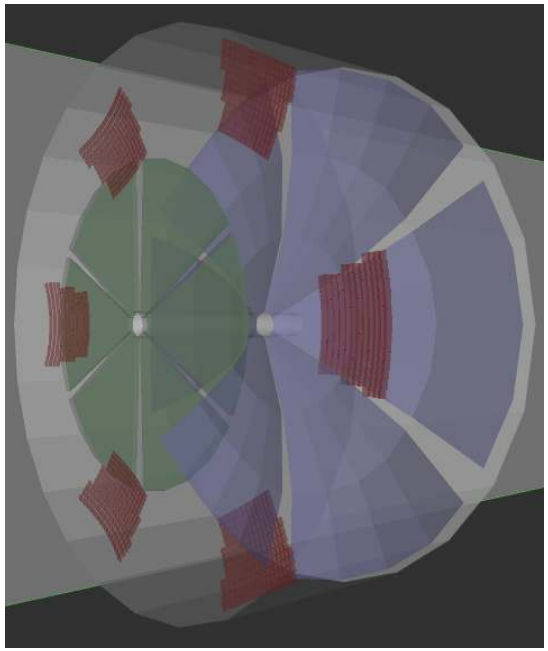


Naive approach (dictated by the current uncertain software situation and R&D on detector):

- dRICh description (geometry, material, optics) uses common libraries as much as possible (e.g. GEANT4 directly) and avoid framework specific methods
- Model configuration is parameterized in geometry text file and GEANT4 macros

Simulation Status





ESC/g4e standalone dRICh rendering

ESC/g4e: model exists and work, at least in standalone version

- TO DO:
  - implement method(s) to store hits info from sensitive volumes
  - test “minimal” integration
  - then move to the official repository

F4A: Christopher started implementing the F4A version; all main methods defined, including stepping action

- TO DO:
  - complete methods implementation,
  - test standalone
  - then move to common repository

Further steps

Defined “best” porting for the analysis and reconstruction codes

Interface to/from the specific framework simulated data format (framework specific)

Then keep analysis methods as much as possible framework “agnostic”

- Digitization of the sensor (… better out of simulator for flexibility)
- Single photon angle reconstruction (Inverse Ray Tracing Method)
- Estimate typical metrics (angular resolution …)
- Event based reconstruction procedure
- Develop other PID methods …

Start looking at det. performance

Start studying impact on physics cases

It would be also very useful to have the Bayesian Optimizer implemented at a certain point!