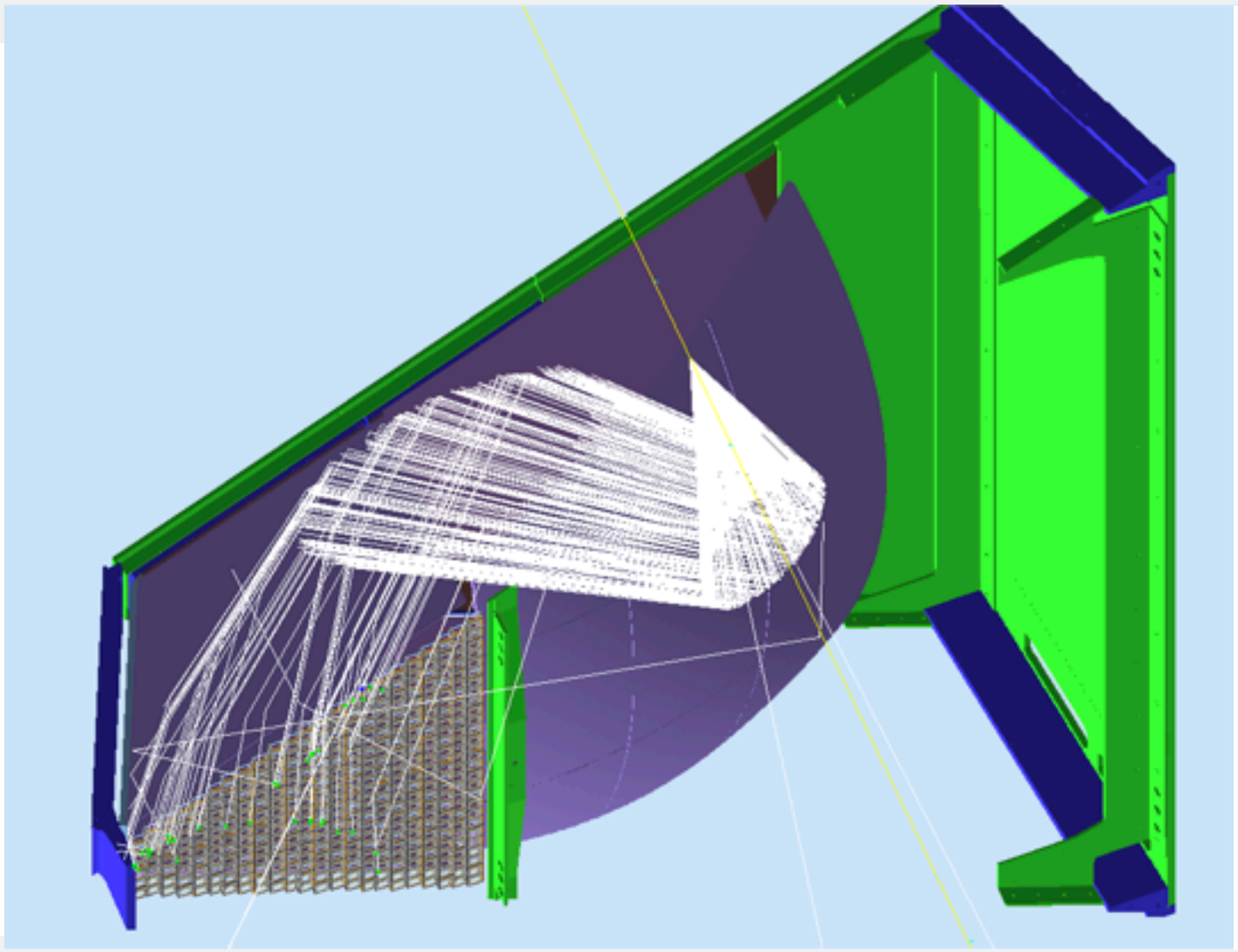
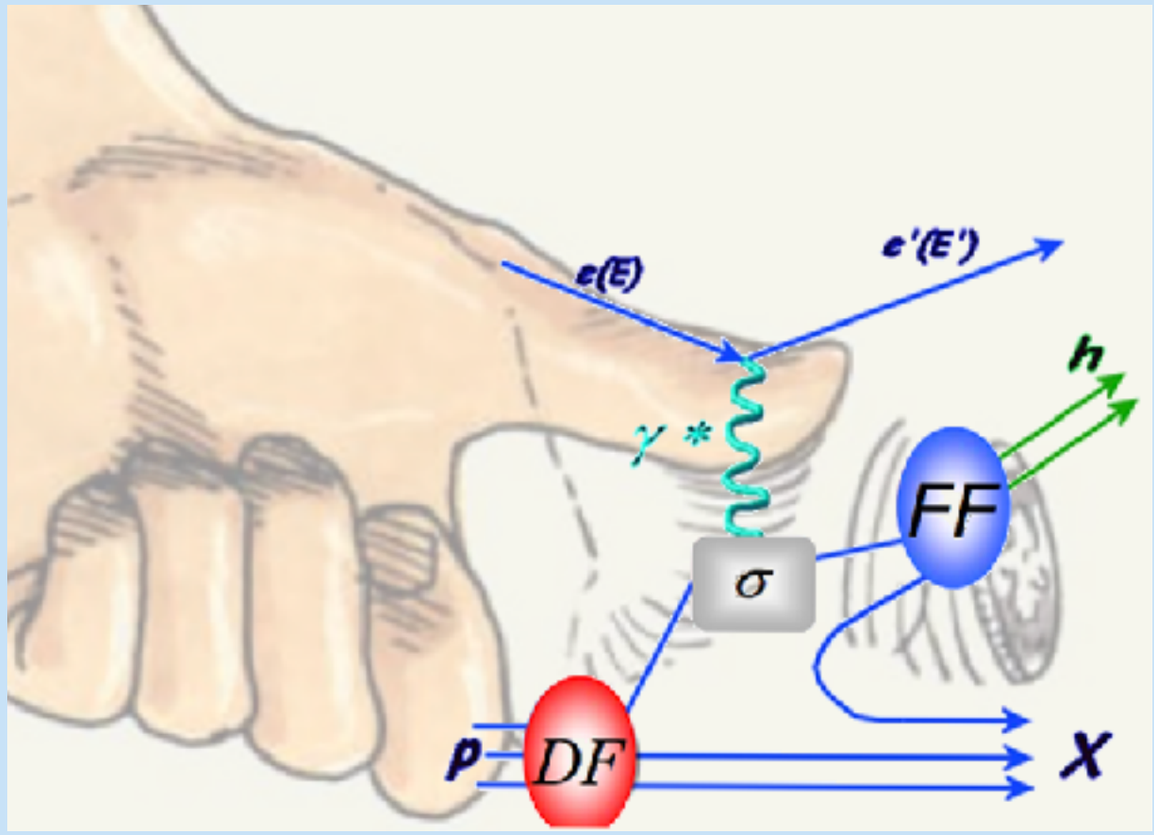
SIDIS with unpolarized Hydrogen target and Meson yields at CLAS12





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Outline

- A general introduction.
- My plan for SIDIS analysis within the CLAS12 collaboration.
- PID and my work on RICH detector.

Introduction

Infer a biased coin structure from probability measurements.

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Description Using Classical Mechanics

How do I hit it ?

Function dependent on position and Force (Torque).

2 states + polarization

Good Identification of Final States

Experimentally easy to identify and count final states.

Let's put it into QCD

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We want to describe the structure of nucleon using QCD.

Coupling.

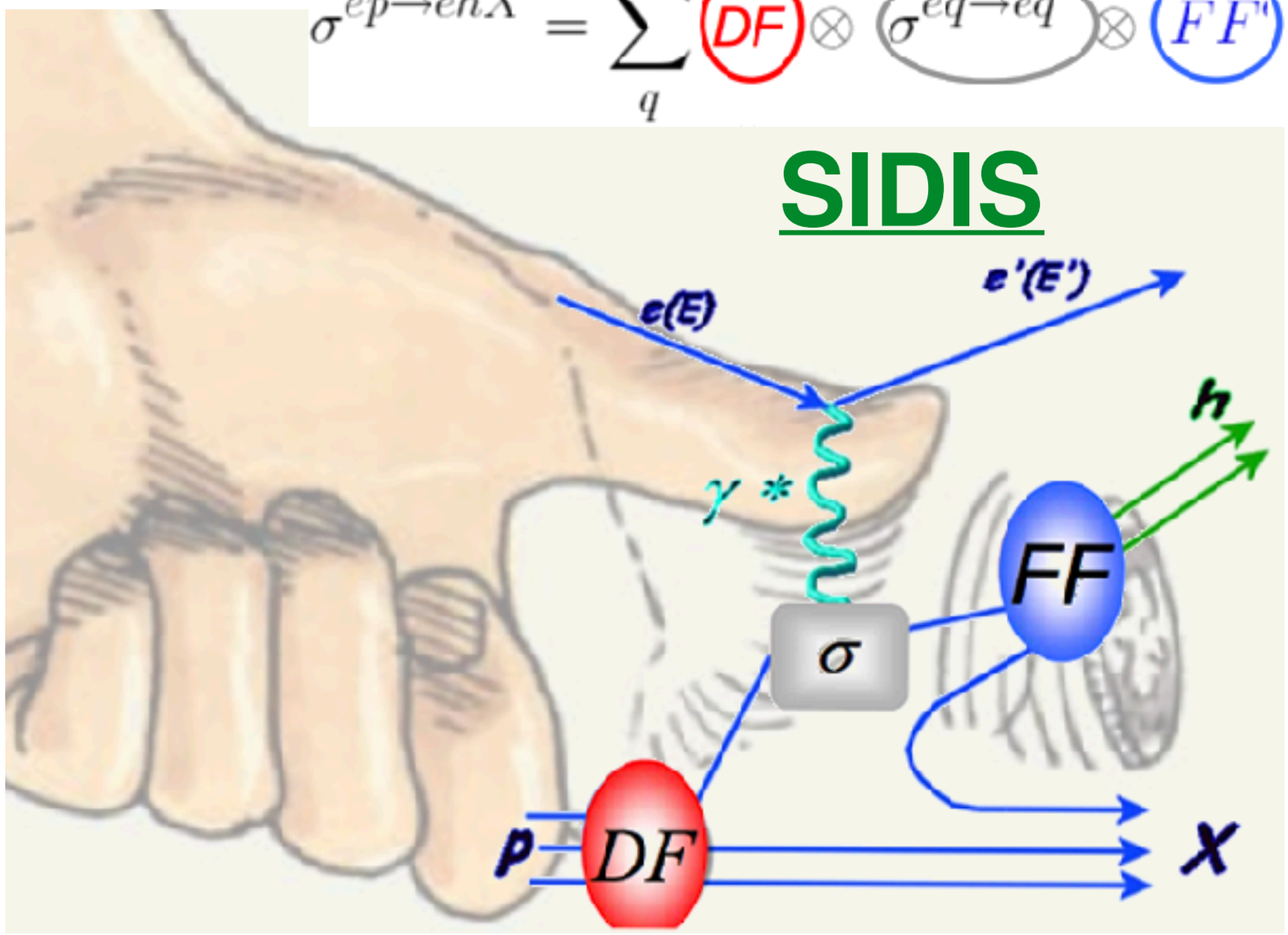
Gauge invariance.

Time invariance.

Parity invariance.

$$\sigma^{ep\to ehX} = \sum_q DF \otimes \sigma^{eq\to eq} \otimes FF$$

SIDIS



Leading order TMDs

Nucleon / Quark	Unpol.	Long.	Trans.
Unpol.	f_1		$f_{1T}^{\perp}$ -
Long.		g_{1L} -	g_{1T} -
Trans.	$h_1^{\perp}$ -	$h_{1L}^{\perp}$ -	h_{1T} - $h_{1T}^{\perp}$ -

Fragmentation Functions (FF)				
		quark		
		U	L	T
had.	U	D_1 Unpol. FF		$H_1^{\perp}$ - Collins FF

My working plan:

- **Analyze SIDIS data on <u>unpolarized hydrogen</u> target with π and K in final state.**

π and K for flavor decomposition

Beam-Spin Asymmetry

Study the higher-twist nature of the process and probe the transition from non perturbative to perturbative regimes in QCD

Boer-Mulders extraction

Studies of Boer-Mulders Asymmetry in Kaon electroproduction with Hydrogen and Deuterium Target (E12-09-008 A-)

- **Working on RICH reconstruction-simulation for PID.**

We want to have the best performances from our experimental set-up.

Boer-Mulders in SIDIS

cos(2ϕ) modulation

Azimuthal asymmetry at leading order on unpolarized target

$$\sigma_{UU}^{\cos 2\phi} \propto 2(1-y)\cos 2\phi \sum_{q,\bar{q}} e_q^2 x h_1^{\perp q}(x) \otimes H_1^{\perp q}(z).$$

Boer-Mulders

Spin asymmetry due to correlations between transverse spin and transverse momentum of a polarized quark inside an unpolarized hadron.

Collins FF

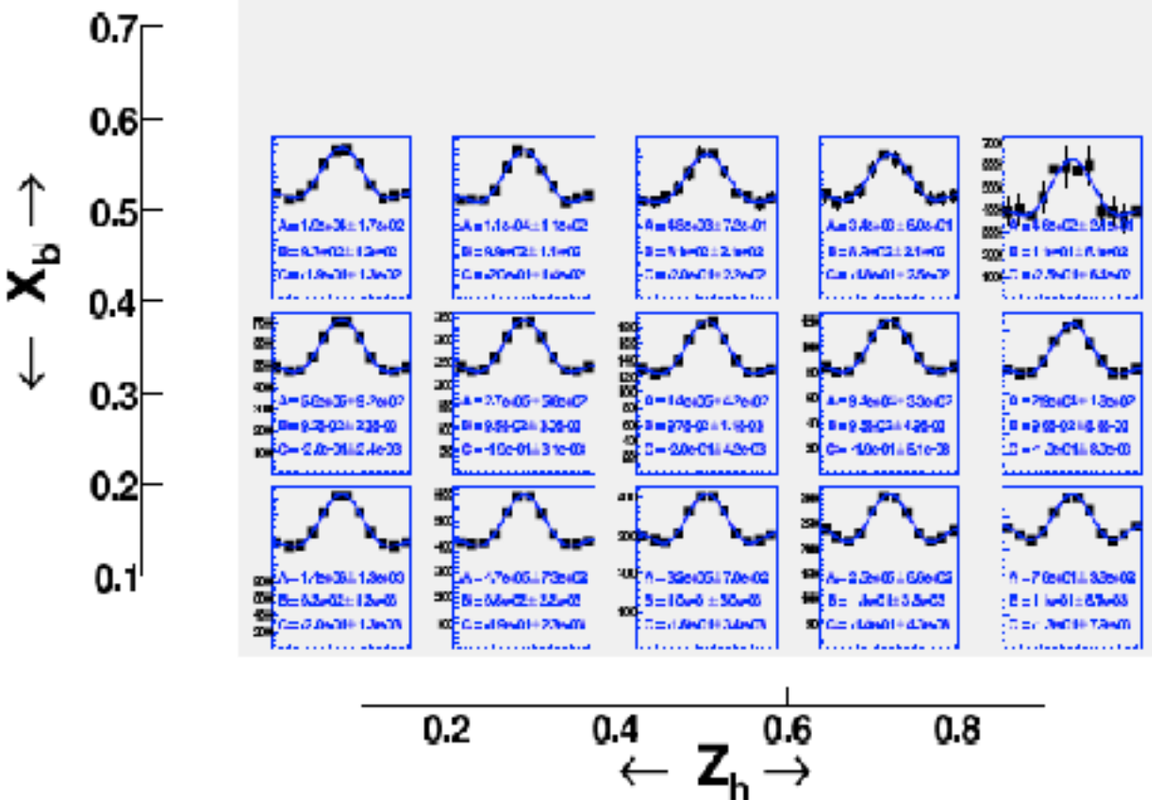
Measuring Boer-Mulders asymmetry for Pions and Kaons will give info on the rations of Collins function for pions and kaon

π^+ $A(1+B\cos 2\phi + C\cos\phi)$ $Q^2 = 2.00$

E 12-09-008:

Studies for pions, events generated with:

$$A^{\cos\phi} = -0.2,\ A^{\cos 2\phi} = 0.1, \text{ and } A^{\sin\phi} = 0.1$$



Reliable calculation of kinematic correction needed for the extraction.

RICH simulation

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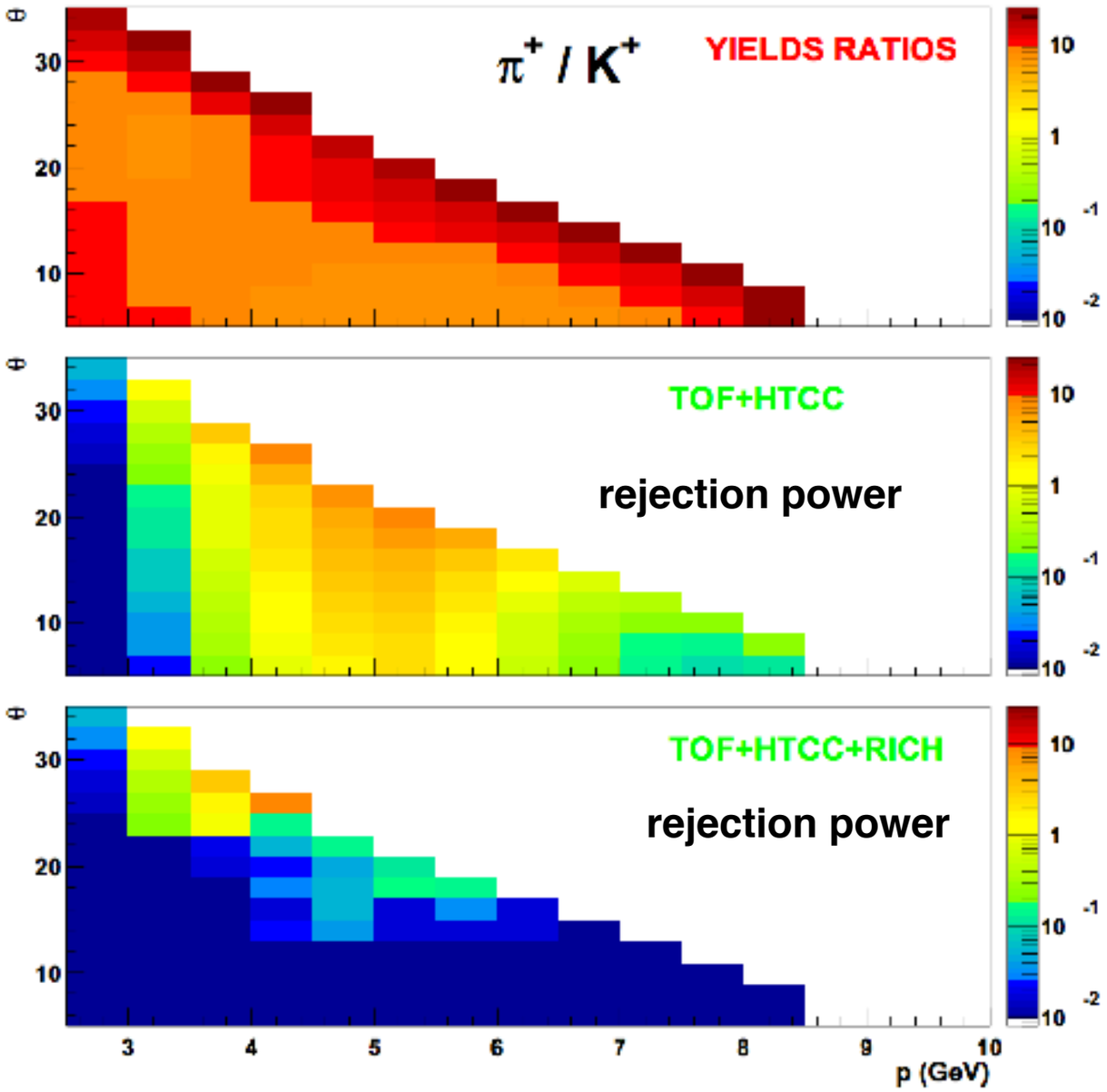
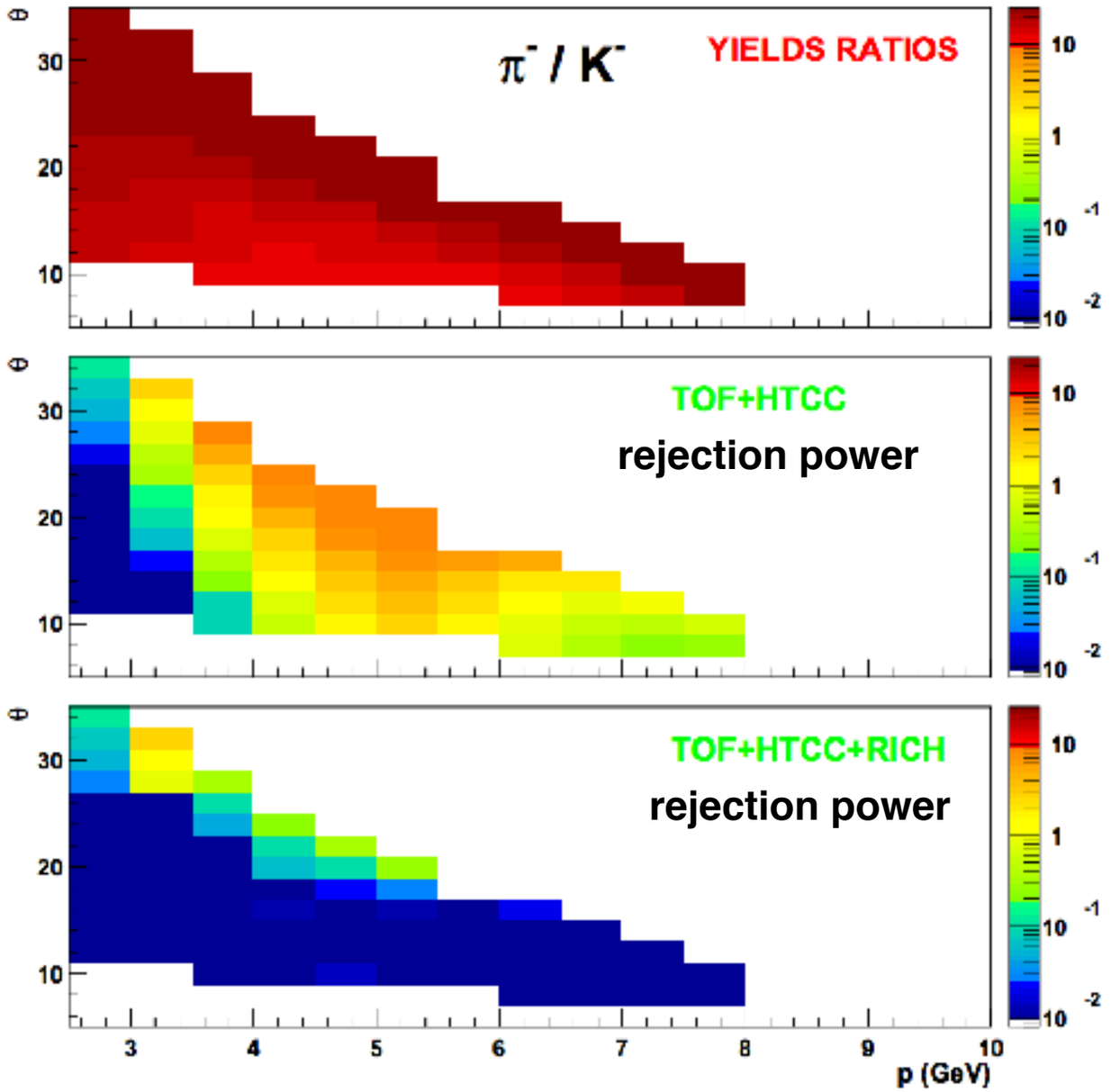
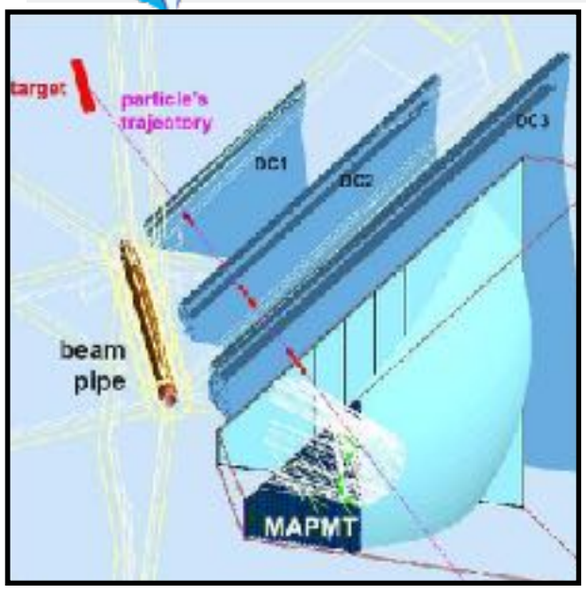
From the RICH Technical Design Report (2013):





We need to update it.

RICH software status



The RICH collaboration developed simulations and reconstruction algorithms.

We are working to better describe the detector and integrate/improve algorithms into CLAS12 Common-Tools.

Last summer I initiated the use of CAD files for better geometry description (implemented thanks to M. Ungaro).

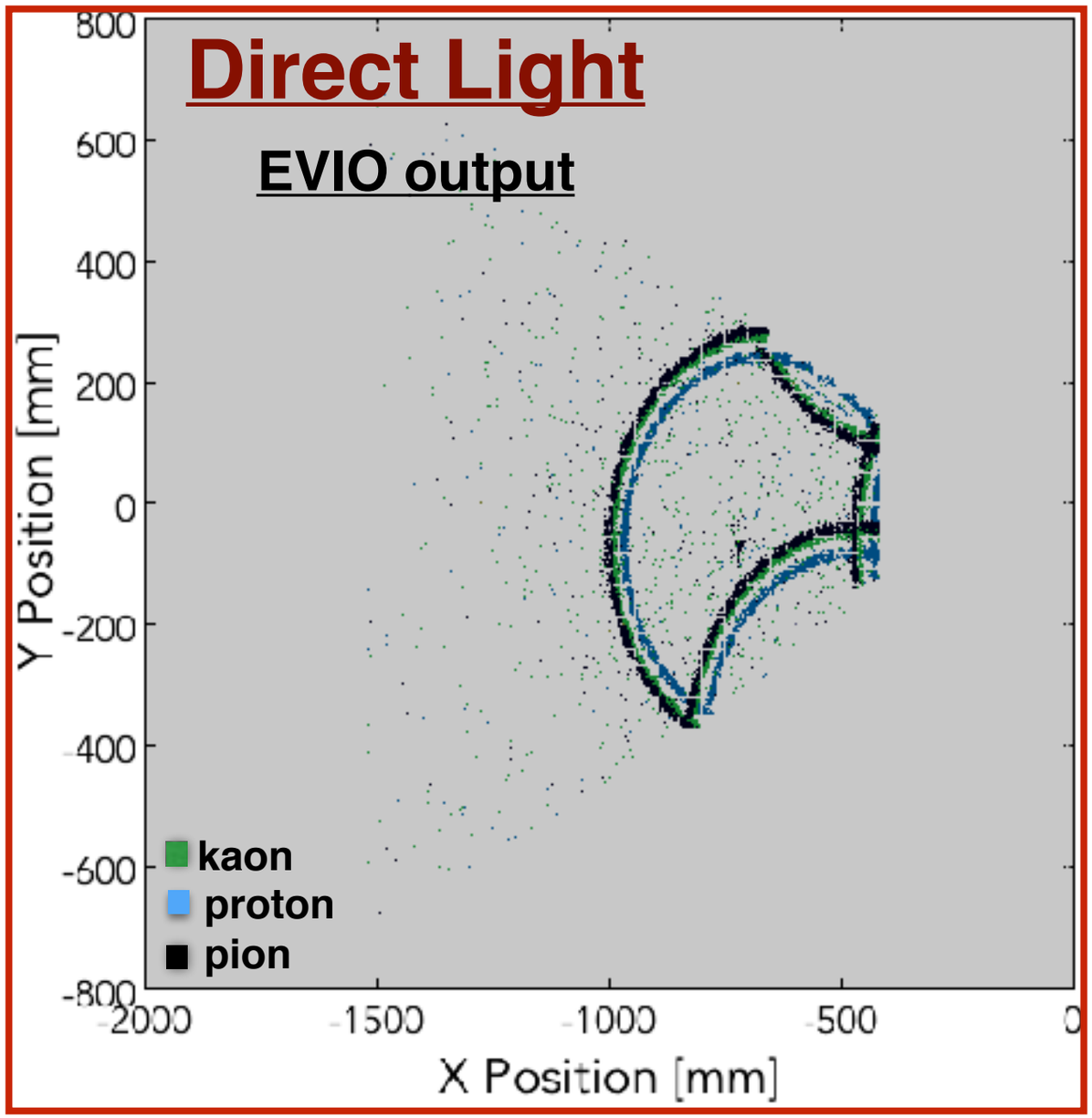
Successful for several detectors

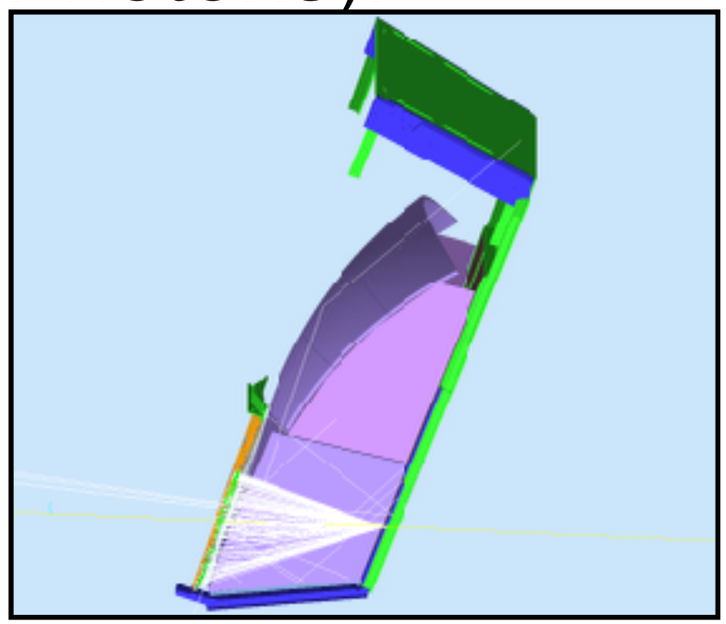
<u>However</u>, today we have still problems with GEMC. Optical photons and CAD volumes hierarchy not working: we cannot integrate our software until we have everything available.

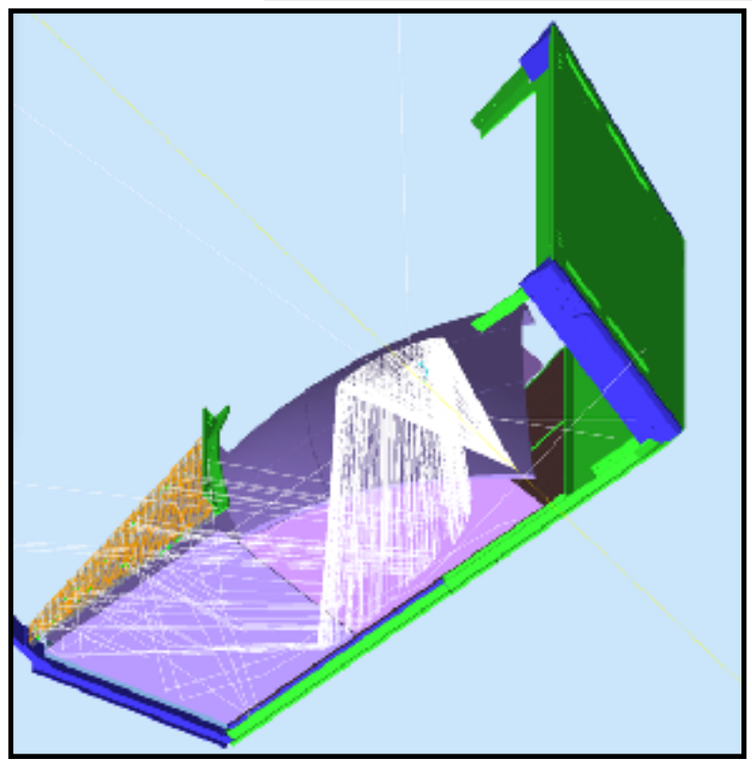
Maurizio Ungaro is working on that issue.
We started the software development outside CLAS12, in a stand alone way!

RICH software status

Now we have a better description of the detector
that will give us better performances
(but we need Optical Photons).



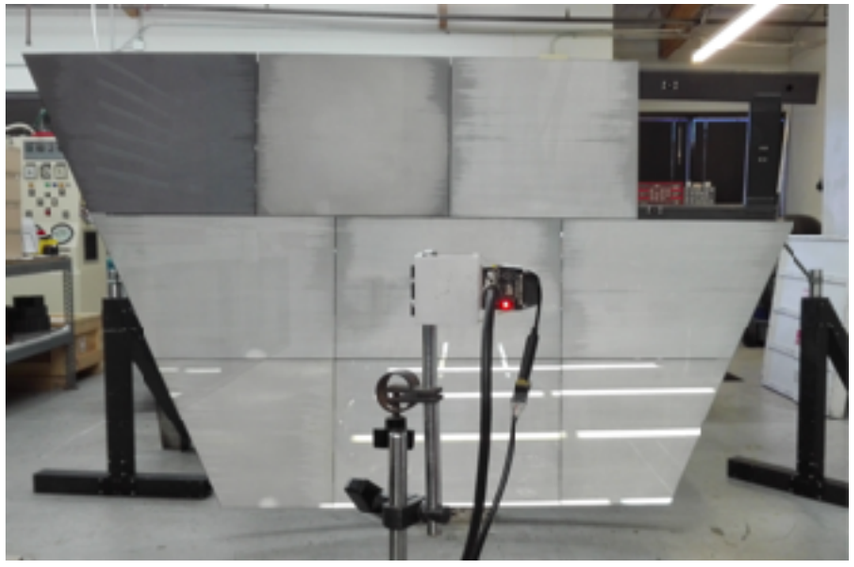


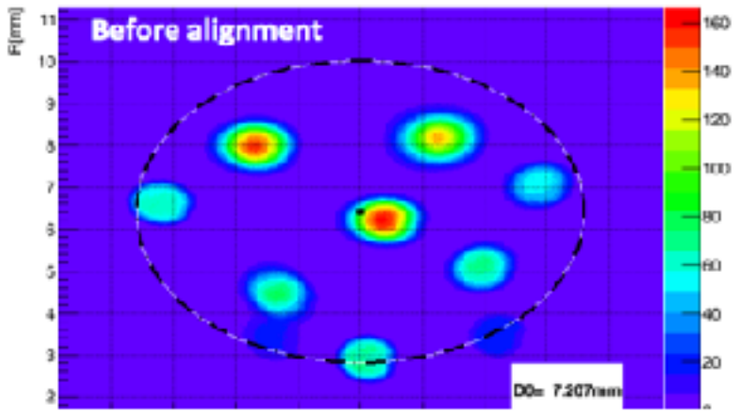


RICH stand-alone CAD-Geometry

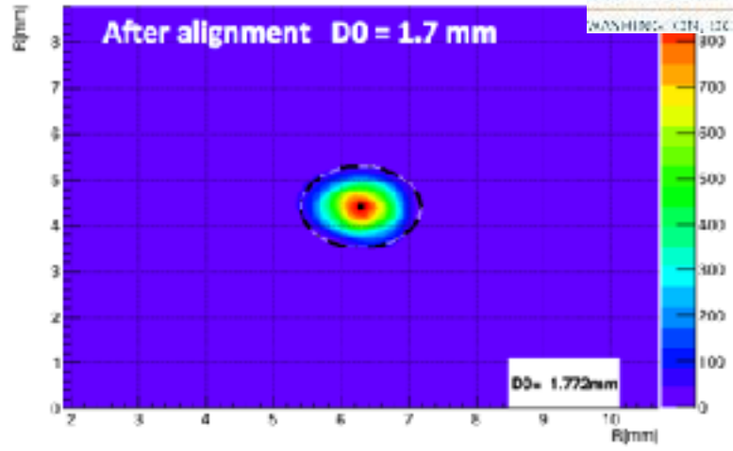
RICH software status

Mirror description study.

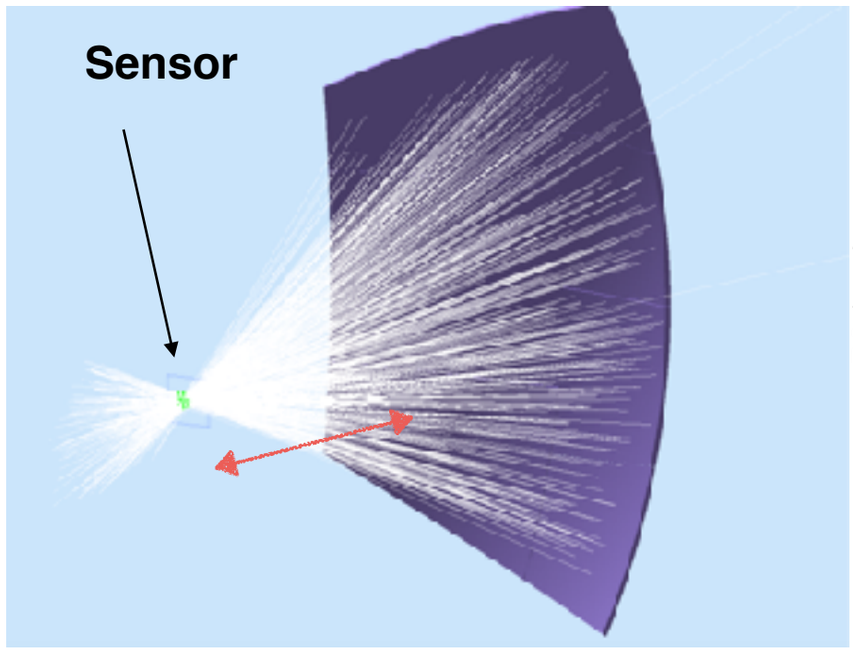


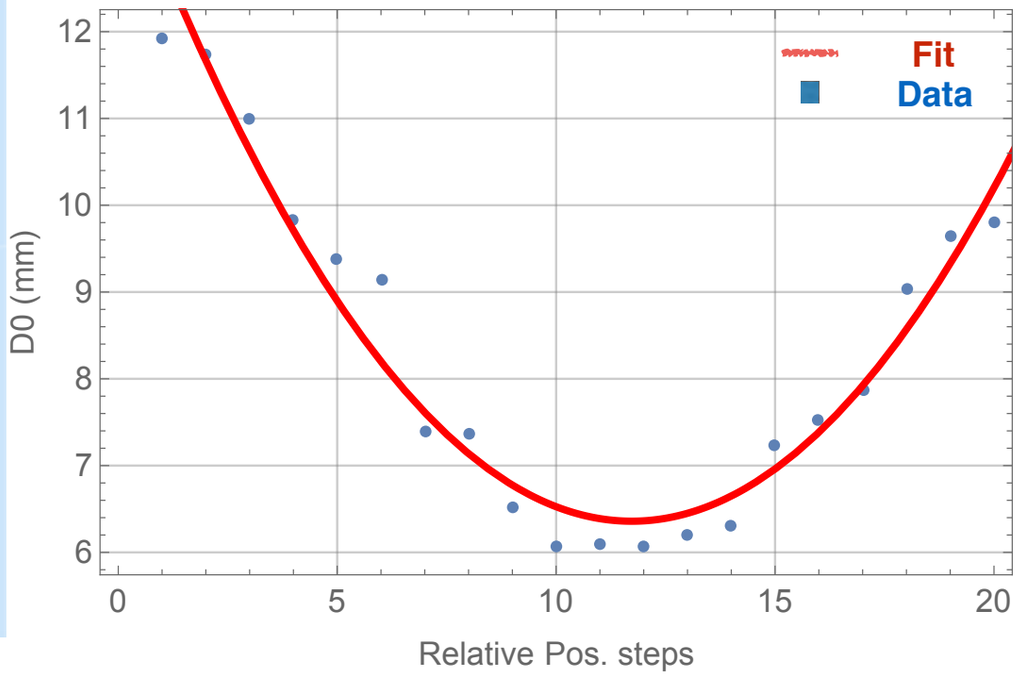


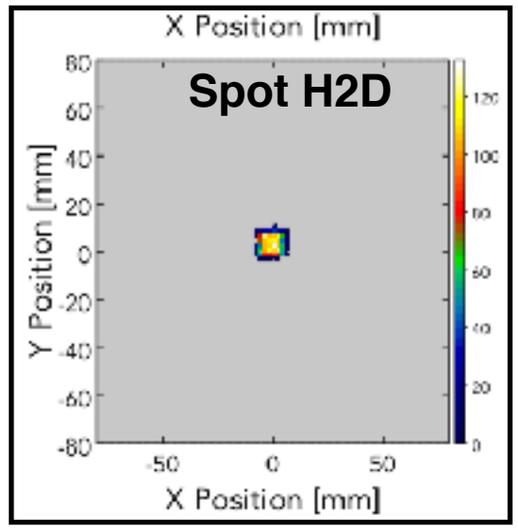
D0 of
7.2 mm (0.33 mrad)



D0 of about
2 mm (0.1 mrad)



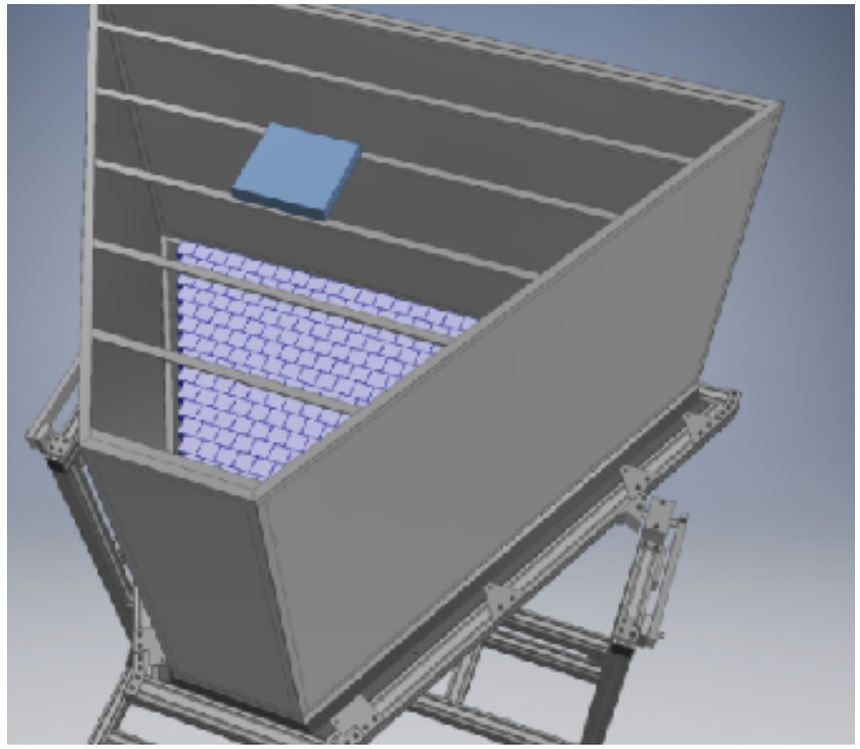


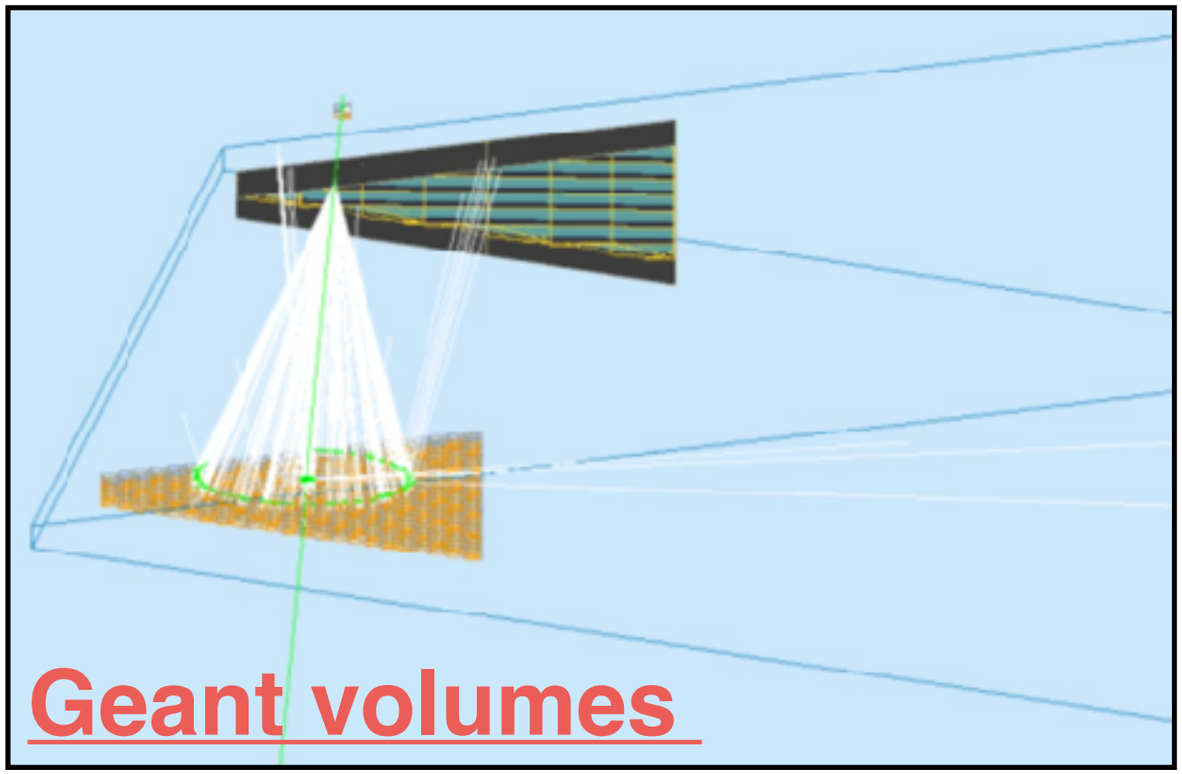


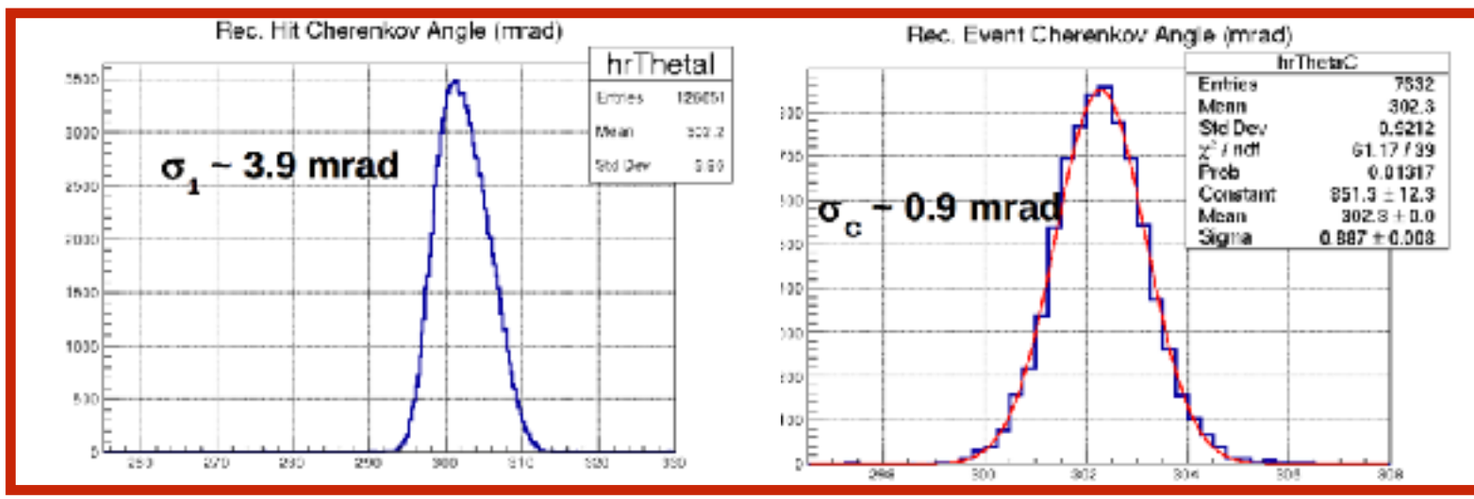
D0 of about
6 mm (0.28 mrad)

RICH software status

Cosmic rays test







Test at CERN single photon resolution was 4.5 mrad

I am working on implementing everything using COAT-Java

Conclusion

I am planning to analyze SIDIS data with unpolarized hydrogen target, to measure Beam Spin Asymmetry and extract Boer-Mulders distribution for π/K.

We are refining simulation in order to obtaining better performances but we need optical photons together with the whole CLAS12.

I am writing the RICH reconstruction within the Java framework.