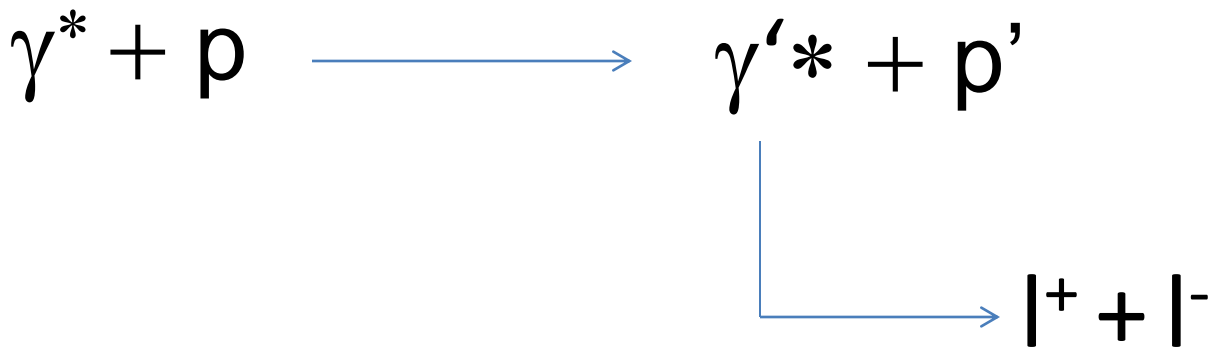
Possibility for Double DVCS measurement in Hall A

Alexandre Camsonne

Hall A Collaboration Meeting

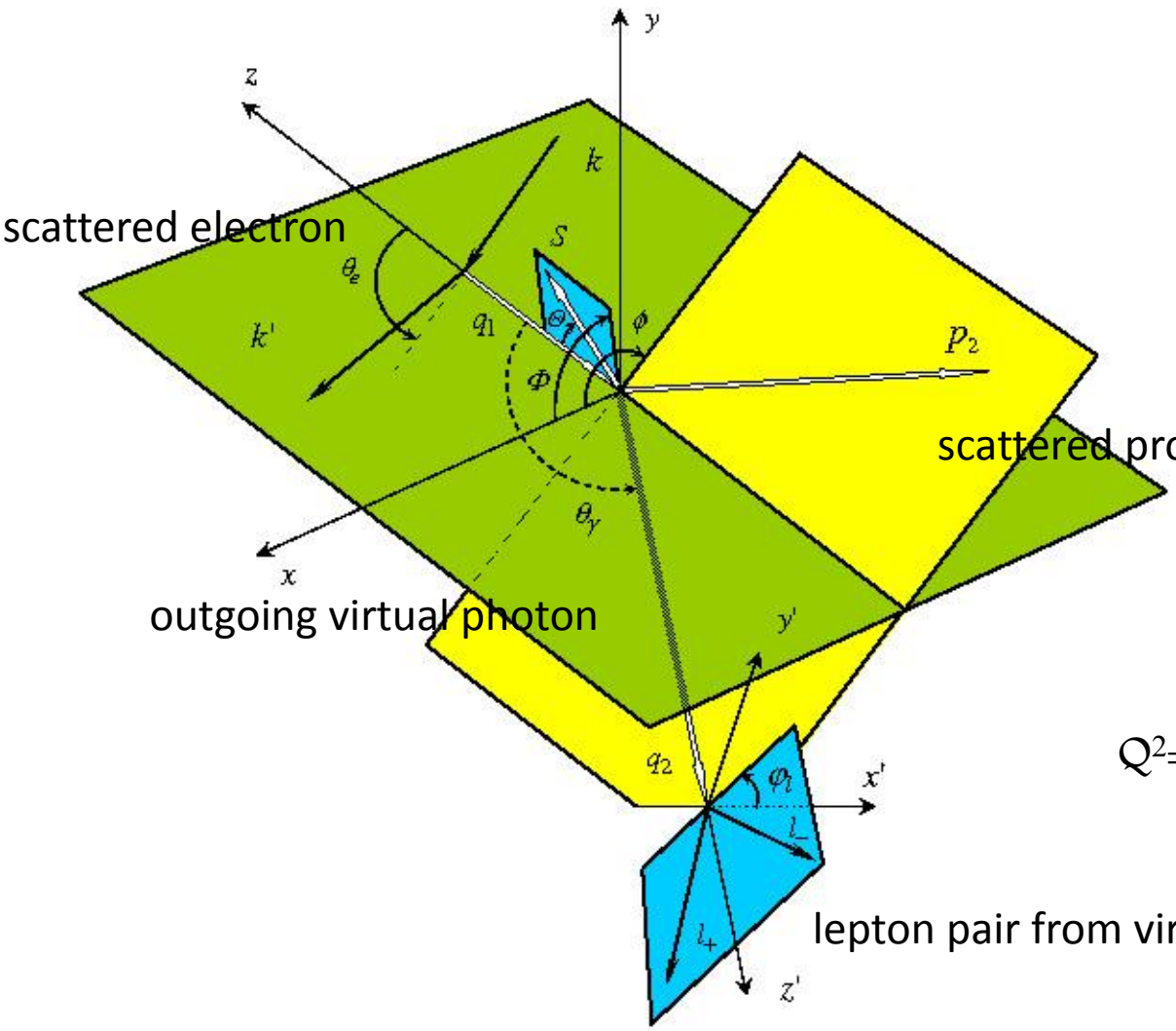
December 12th 2012

Double DVCS



Guidal and Vanderhaegen : Double deeply virtual Compton scattering off the nucleon (arXiv:hep-ph/0208275v1 30 Aug 2002)
Belitsky Radyushkin : Unraveling hadron structure with generalized parton distributions (arXiv:hep-ph/0504030v3 27 Jun 2005)

Double Deeply Virtual Compton Scattering



Δ = p1-p2 = q2-q1

p = p1+p2

q = ½ (q1+q2)

$Q^2 = -q^2$

$$\xi = \frac{Q^2}{2p.q}$$

$$\eta = \frac{\Delta.q}{p.q}$$

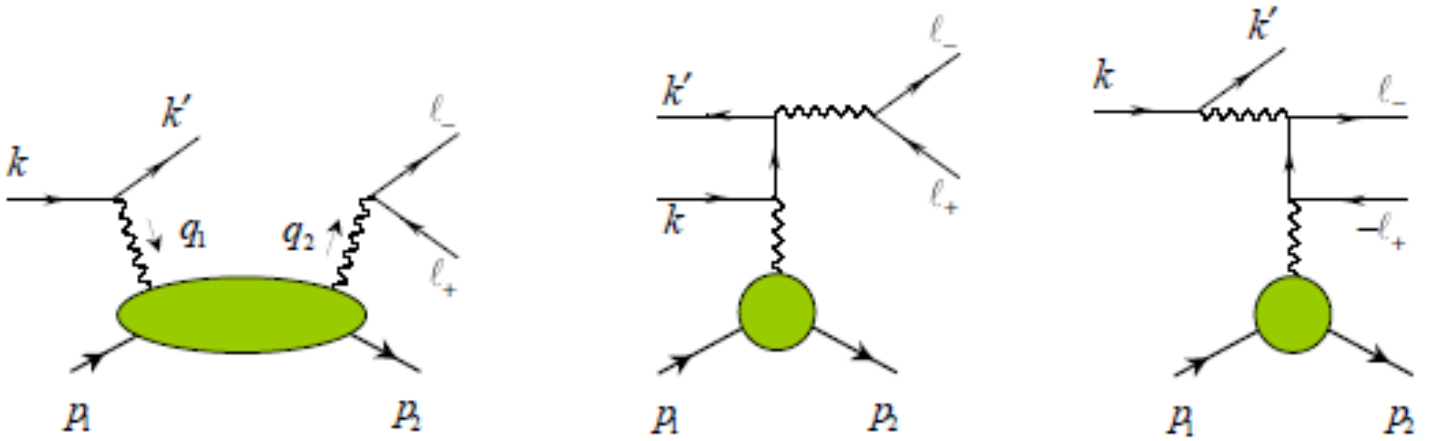
$Q^2 = -(k-k')^2$

$$x_{bj} = \frac{Q^2}{2p_1q_1}$$

Double DVCS

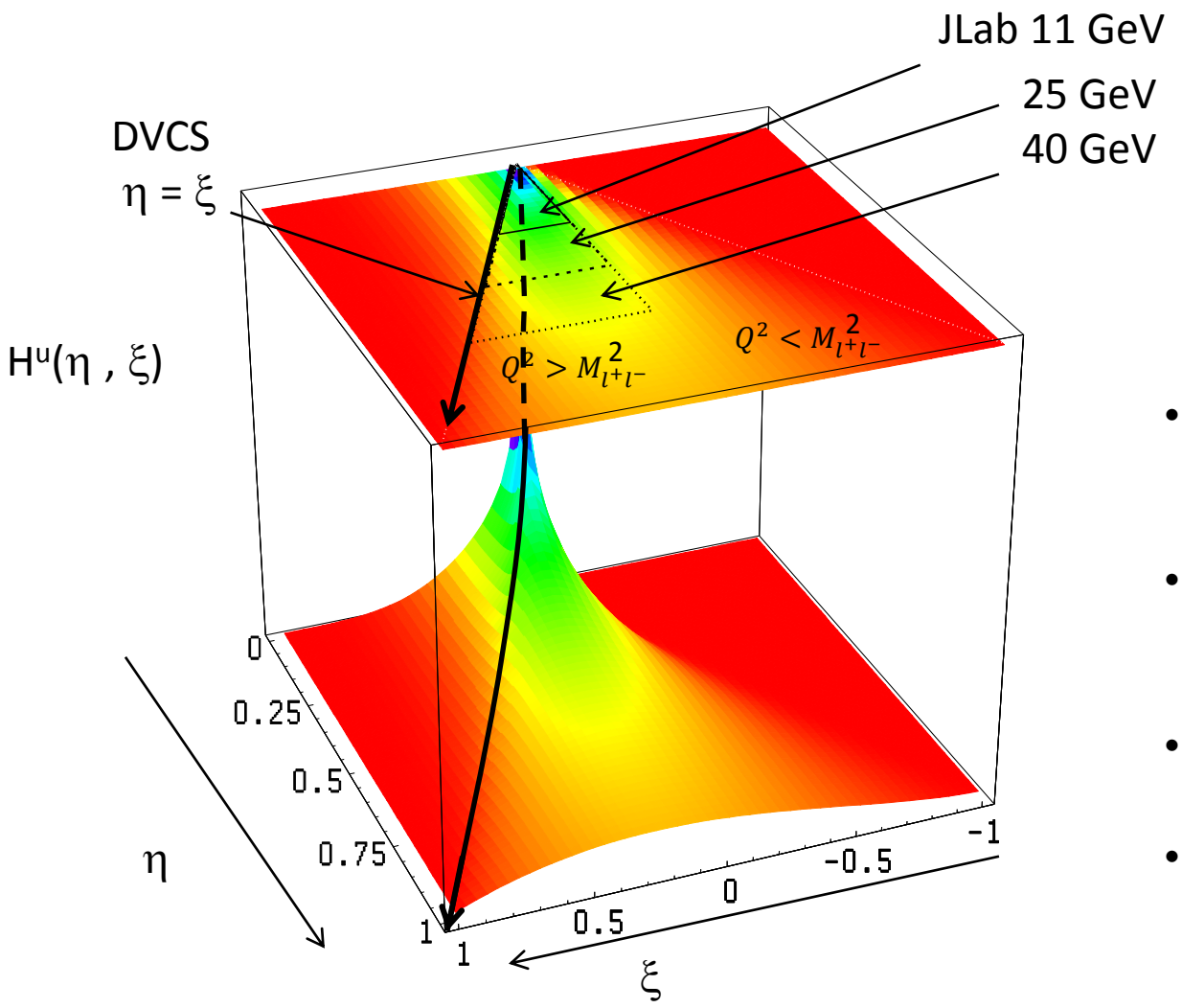
- Detect dilepton pair instead of real photon
- Allow to vary skewness ξ of the reaction
- Charged particle in final state can use spectrometer to measure momentum
  (less requirement on calorimeter energy resolution)
- Muon channel can go through large amount of material, possibly clean trigger with coincidence

Double DVCS and Virtual Bethe Heitler



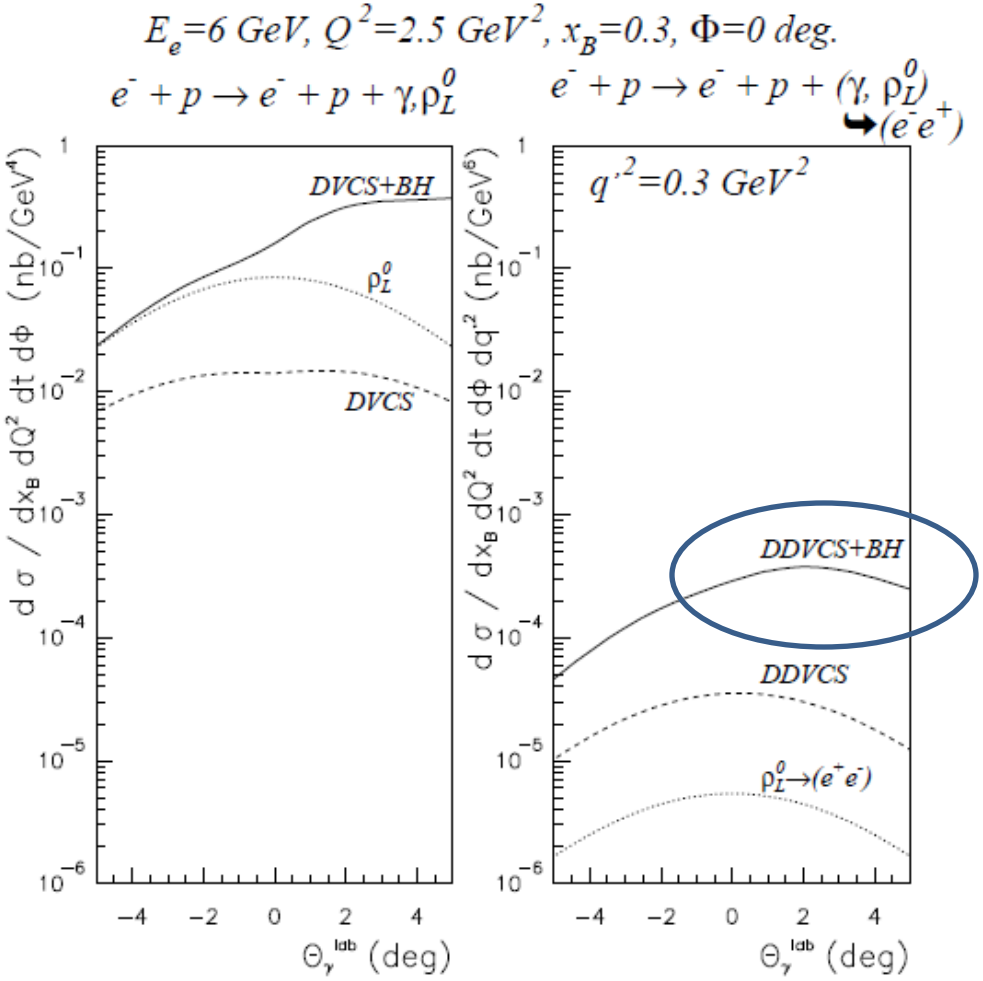
- Interference of Double DVCS and virtual Bethe Heitler

Kinematical coverage



- DVCS only probes η = ξ line
- Example with model of GPD H for up quark
- Jlab : $Q^2>0$
- Kinematical range increases with beam energy (larger dilepton mass)

DDVCS cross section



- VGG model
- Order of ~0.1 pb = 10^{-36}cm^2
- Virtual Beth and Heitler
- Interference term enhanced by BH
- Contributions from mesons small when far from meson mass

DDVCS measurement

- Need high luminosity
  - Hall B : 10^{35}- 10^{36} $cm^{-2}s^{-1}$
  - mEIC : 1.5x 10^{34} $cm^{-2}s^{-1}$
  - Want $10^{38}cm^{-2}s^{-1}$ ideally 10^{39} $cm^{-2}s^{-1}$

- Pair detection and vertex reconstruction : clean trigger

- Ideally look at muons channel to avoid ambiguity with initial electron
  (muon source low luminosity)

DDVCS measurement

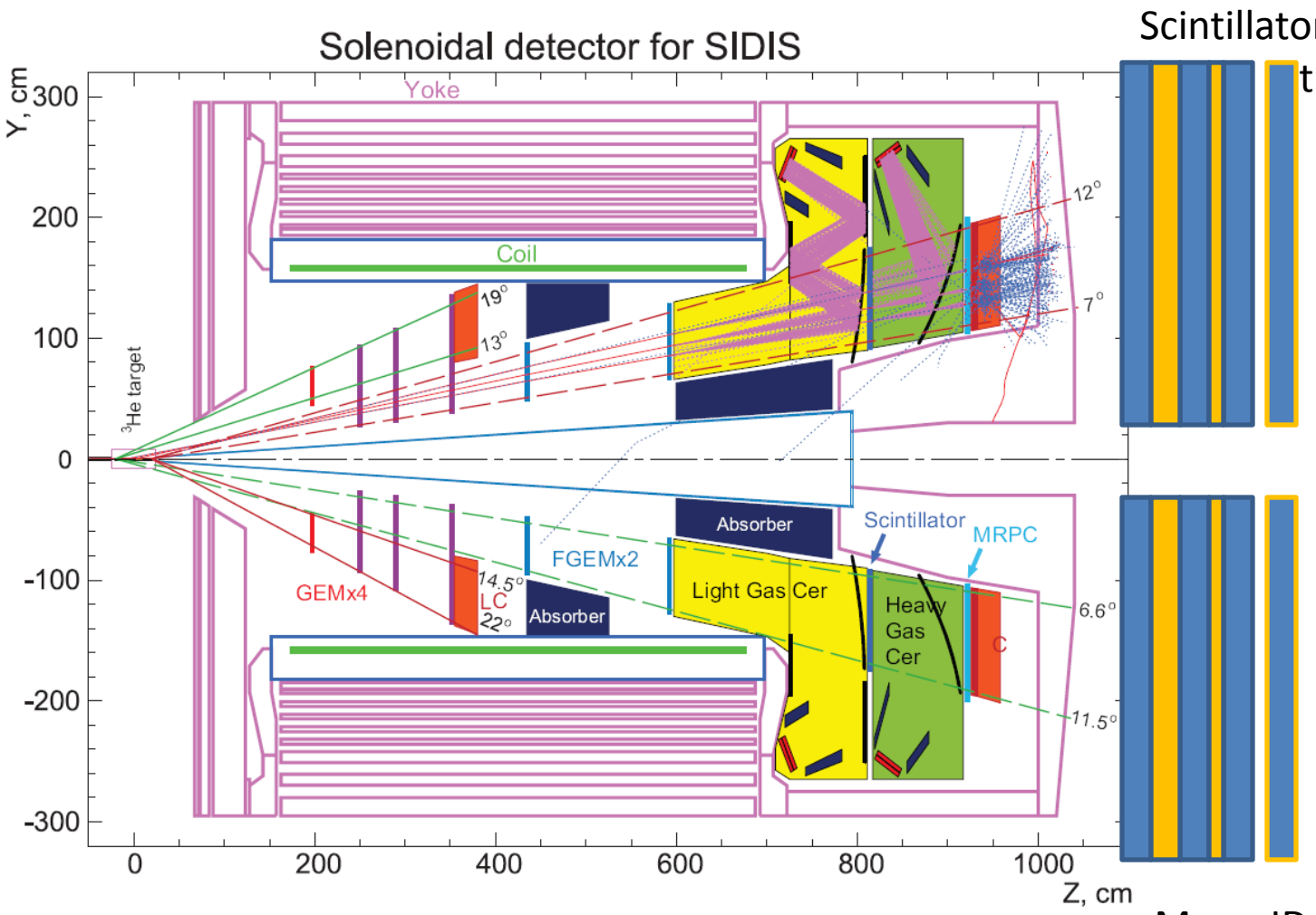
- Large acceptance to get the whole angular coverage of the pair

- Forward angle for increase of Bethe and Heitler interference

SoLID

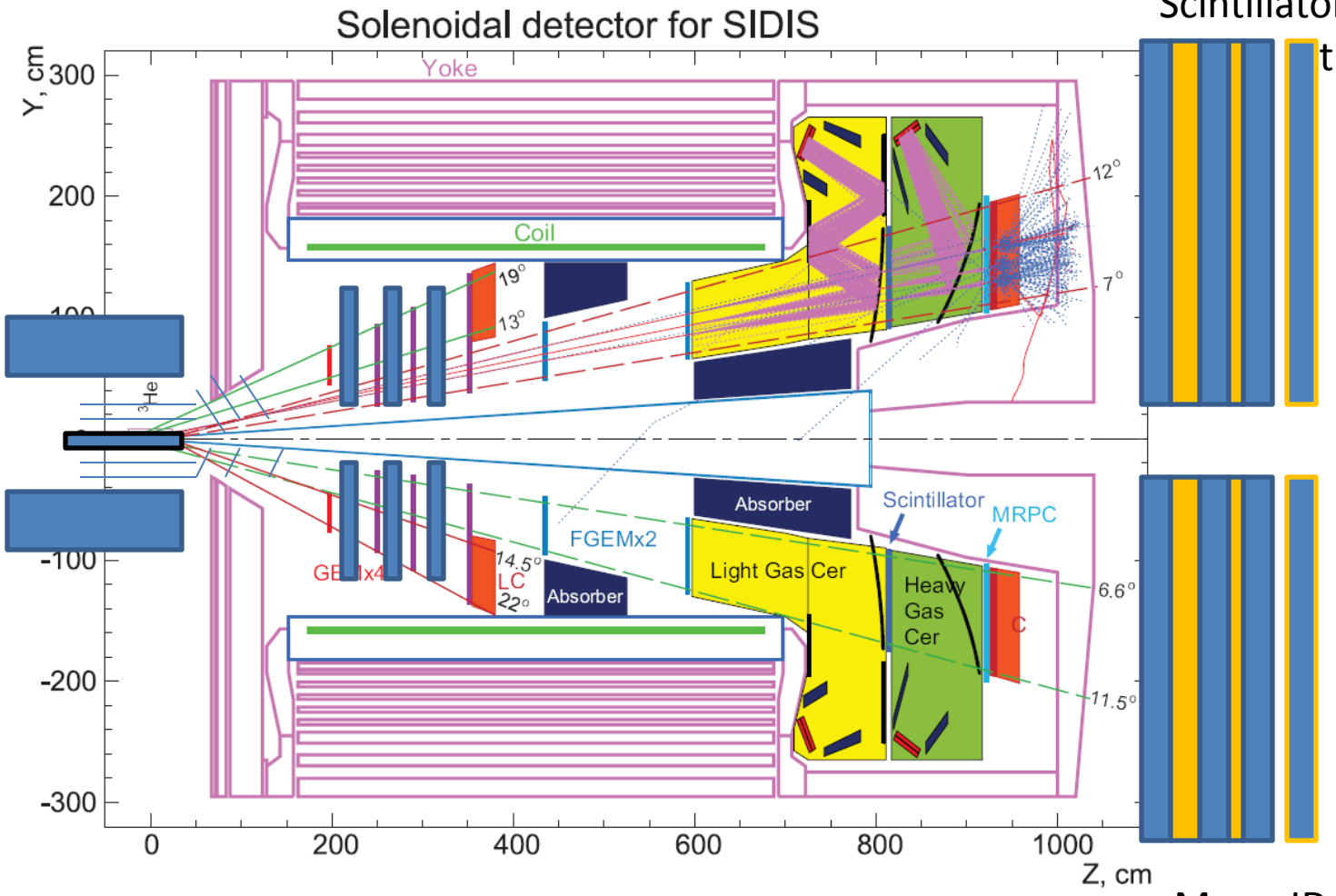
- Full azimutal coverage
- Small angle in SIDIS configuration
- Solenoidal field contains low energy background : should allow increase current to look at high
- Possibility of use of baffles similar to PVDIS
  - Increase electron current
  - Though will reduce resolution on muons pairs

SoLID SIDIS layout



Option with CLAS DVCS solenoid

CLAS DVCS Solenoid



Scintillator + trackers

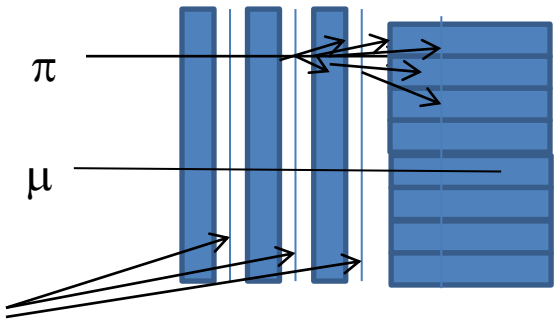
Muon ID and trigger

Double DVCS

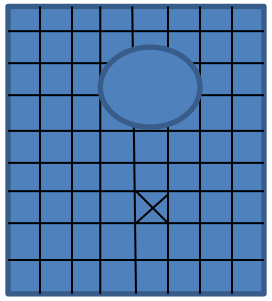
- Challenges
  - Pion muon discrimination
    - Record shower profile
  - Vertex reconstruction
  - Need detector without shielding for accurate momenta and vertex resolution (GEM)

Muon identification

- Add material to stop other electromagnetic process
- Scintillator planes for muon trigger
- Use sampling calorimeter to look at shower : layers of material + GEM or Micromegas with pads and digital readout (CALICE, SdHCAL, dHCAL)



GEM or MicroMegas



Pion showers

Muon only does energy loss

To do for proposal

- Optimize luminosity
  - Baffle ?
  - Occupancy in detector
- Study background in muon detector
- Systematics on cross section measurement (tracking and muon detection efficiency)
- Best compromise price vs luminosity
  - vertex tracker
  - baffles
  - Bonus type TPC (lower rate /less channels) vs high segmentation tracker

Conclusion

- Opportunity to measure double DVCS at JLab12 GeV in dimuon channel with high statistics
- SoLID detector suitable to make a high statistical accuracy easurement
- Simulation work and detector R&D for proposal