

Polarimetry and Ancillary Detector YR DWG Update

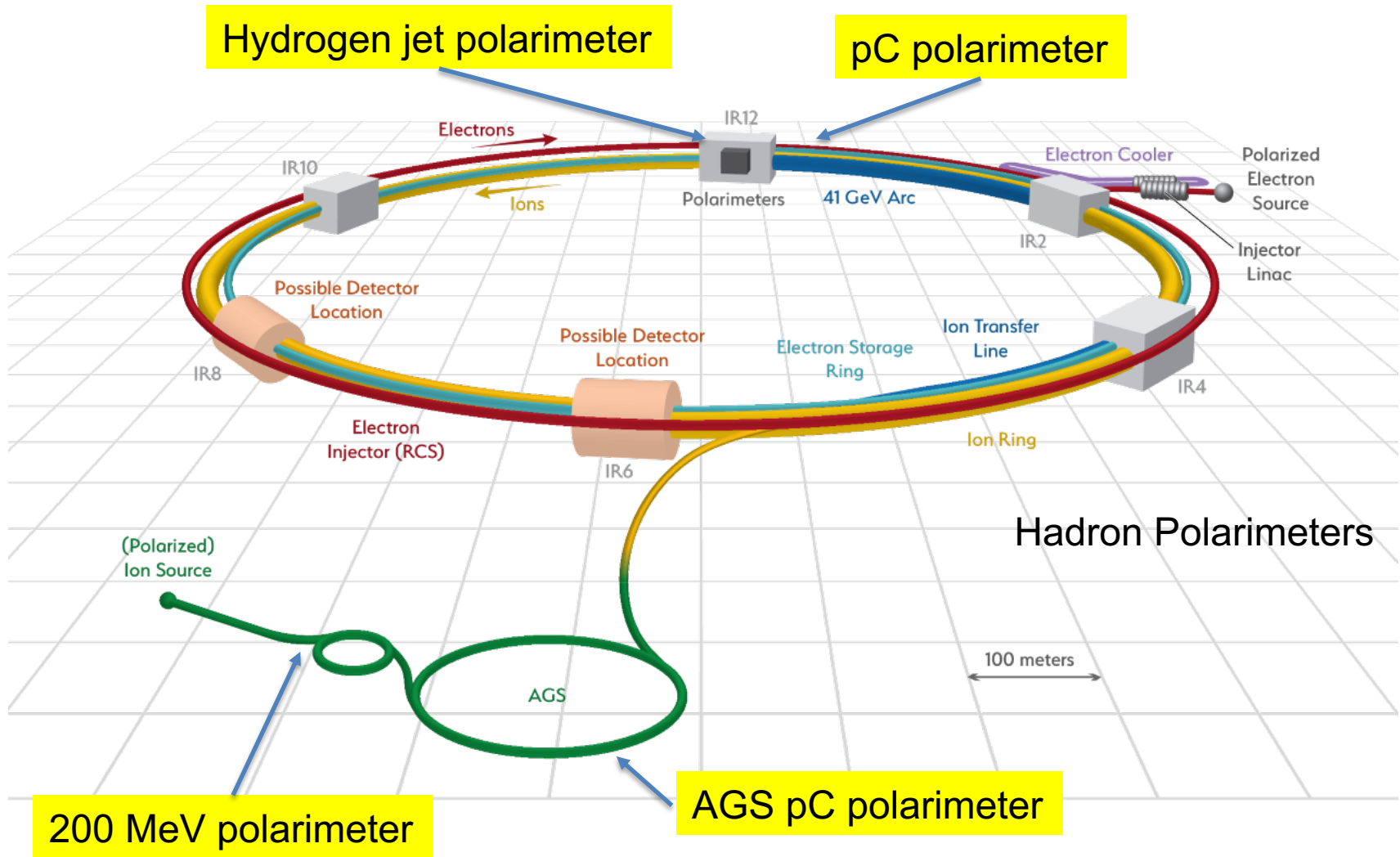
Conveners: Elke Aschenauer (BNL), Dave Gaskell (JLab)

May 22, 2020

Ancillary and Polarimetry Working Group

- Have been meeting monthly since early February
- Meeting information and links to other resources and earlier EICUG Polarimetry Meetings
<https://indico.bnl.gov/category/280/>
- At the moment, focus of most effort is on simulations
 - Compton polarimeter: Development of GEANT4 simulation of transverse Compton at IR12
 - Hadron polarimetry: Simulation of backgrounds (e.g. Pythia)
 - Lumi monitor: GEANT4 simulation mostly complete
- Additional discussions on elastic e-D scattering to measure tensor polarization of deuterons

EIC Layout with Polarimeters



Hydrogen jet polarimeter → Absolute polarization, but long measurements
 Carbon polarimeter → Fast, relative measurement – provides information on polarization vs. beam profile (longitudinal and transverse)

EIC Layout with Polarimeters

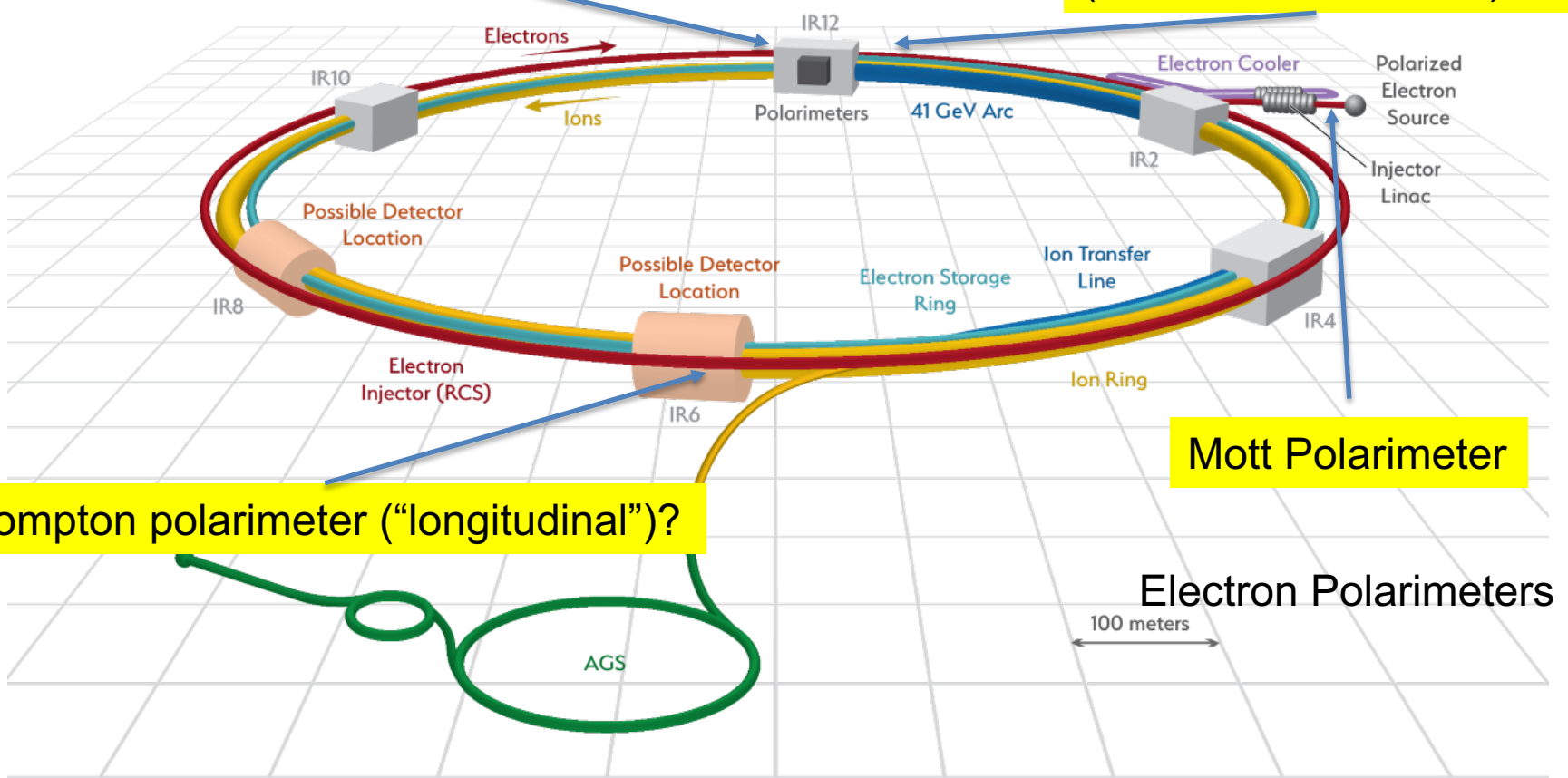
Compton polarimeter (transverse)

Møller Polarimeter (near RCS extraction)

Compton polarimeter ("longitudinal")?

Mott Polarimeter

Electron Polarimeters
100 meters

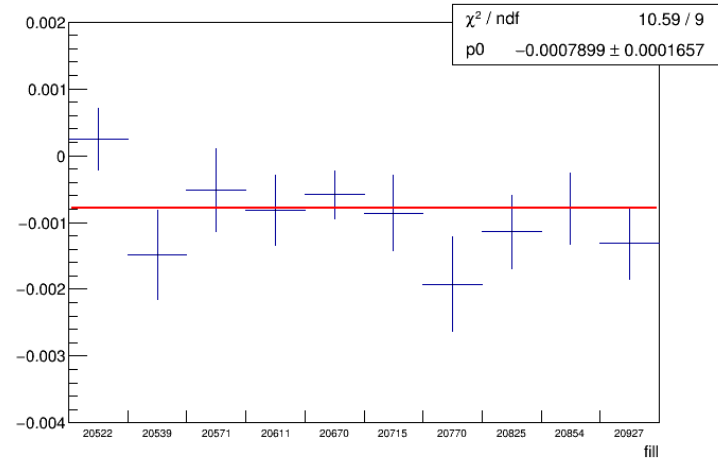
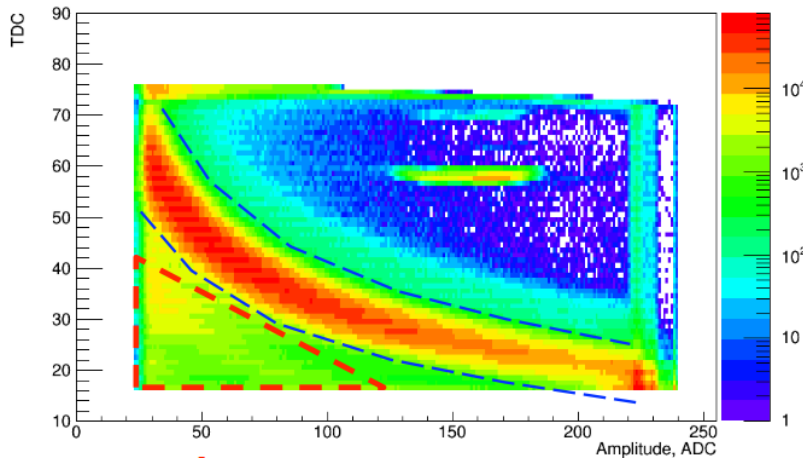


Transverse Compton at IR12

→ Exploring possible placement of additional Compton at IR6

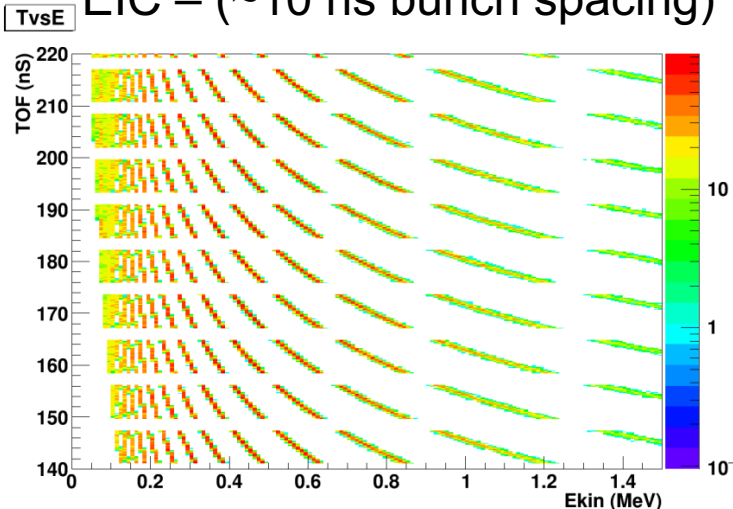
Hadron Polarimetry Challenges at EIC

RHIC – pC data (107 ns bunch spacing)



Background asymmetry, 10 measurements of
RHIC pC polarimeters in 2017

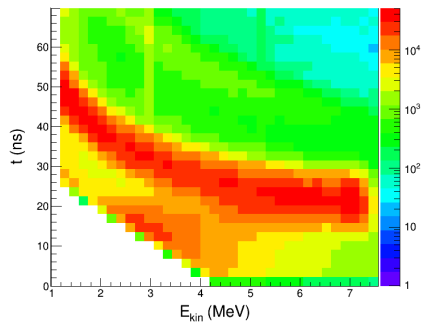
EIC – (~10 ns bunch spacing)



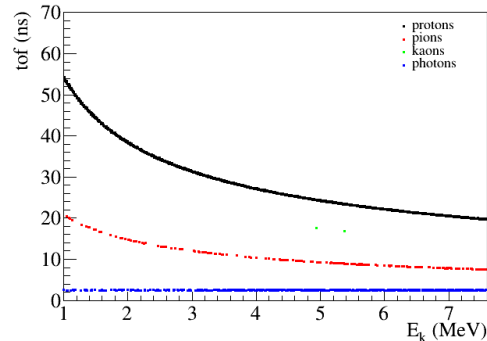
- Good events selected via Energy-time correlation → “banana plot”
- Shorter bunch spacing at EIC makes this problematic – more sensitive to backgrounds
- Prompt background may also carry some asymmetry

Hadron Polarimeter Backgrounds

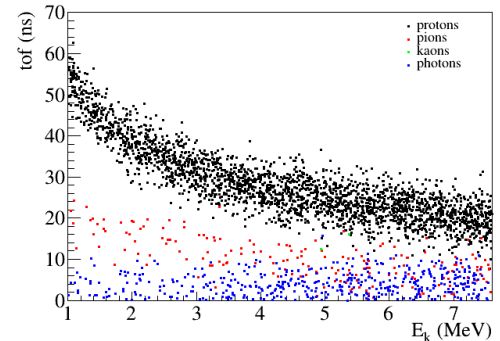
Work ongoing to simulate backgrounds and compare to existing RHIC data
→ Also took data with extra detector layer to see if that helps suppress low energy backgrounds - still under analysis



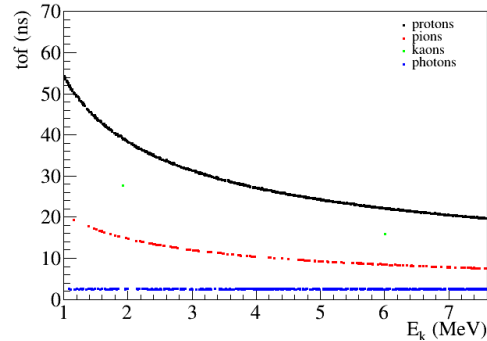
2017 Hjet data



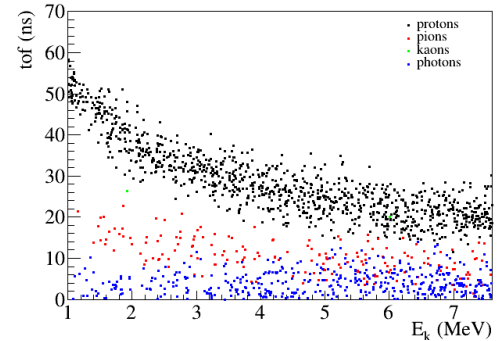
Pythia6 pp simulation
non elastic events, $\sigma_t = 0$



Pythia6 pp simulation
non elastic events, $\sigma_t = 3.7$ ns



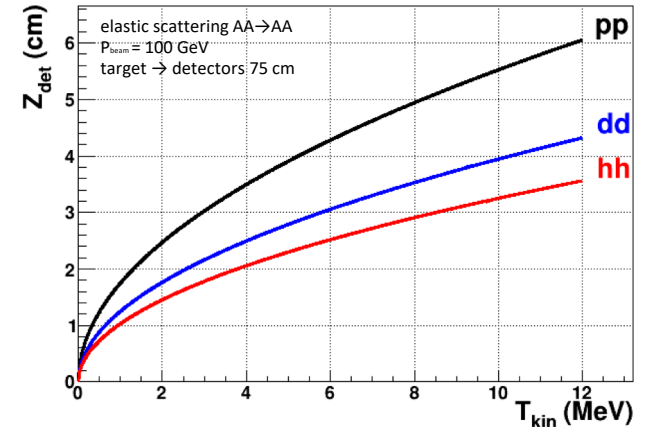
Dpmjet3 pp simulation
non elastic events, $\sigma_t = 0$



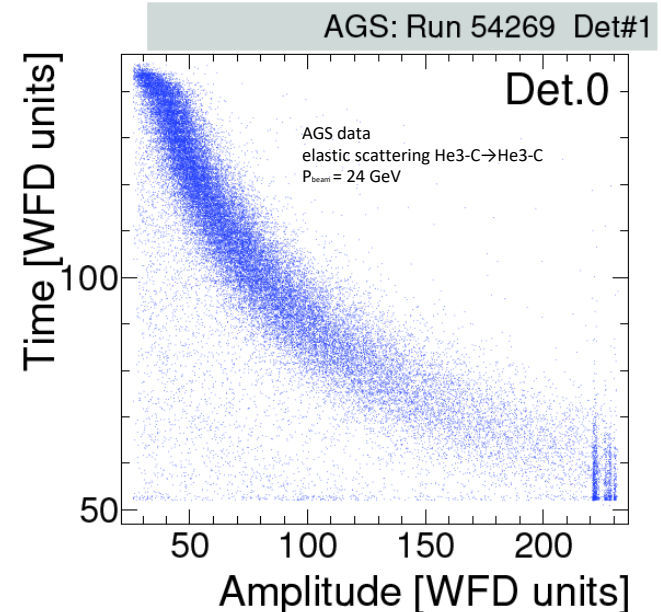
Dpmjet3 pp simulation
non elastic events, $\sigma_t = 3.7$ ns

D and He3 polarimetry challenges

- Elastic scattering kinematics similar to p => current RHIC polarimeters (“H-Jet” and “pC”) can be used
- **asymmetries** for dd, He3-He3, dC, He3-C **unknown** and expected to be smaller than for p (compared to p: 78% for He3, **8% for d**)
- event rates expected to be larger than for p (2x for He3-C measured at AGS)
- Upcoming RHIC runs:
 - **d (unpolarized), He3 (unpolarized and polarized) beams; d and He3 (unpolarized and polarized) jets**
 - confirm the scale of the analyzing power
 - measure the fraction of breakup compared to elastic scattering

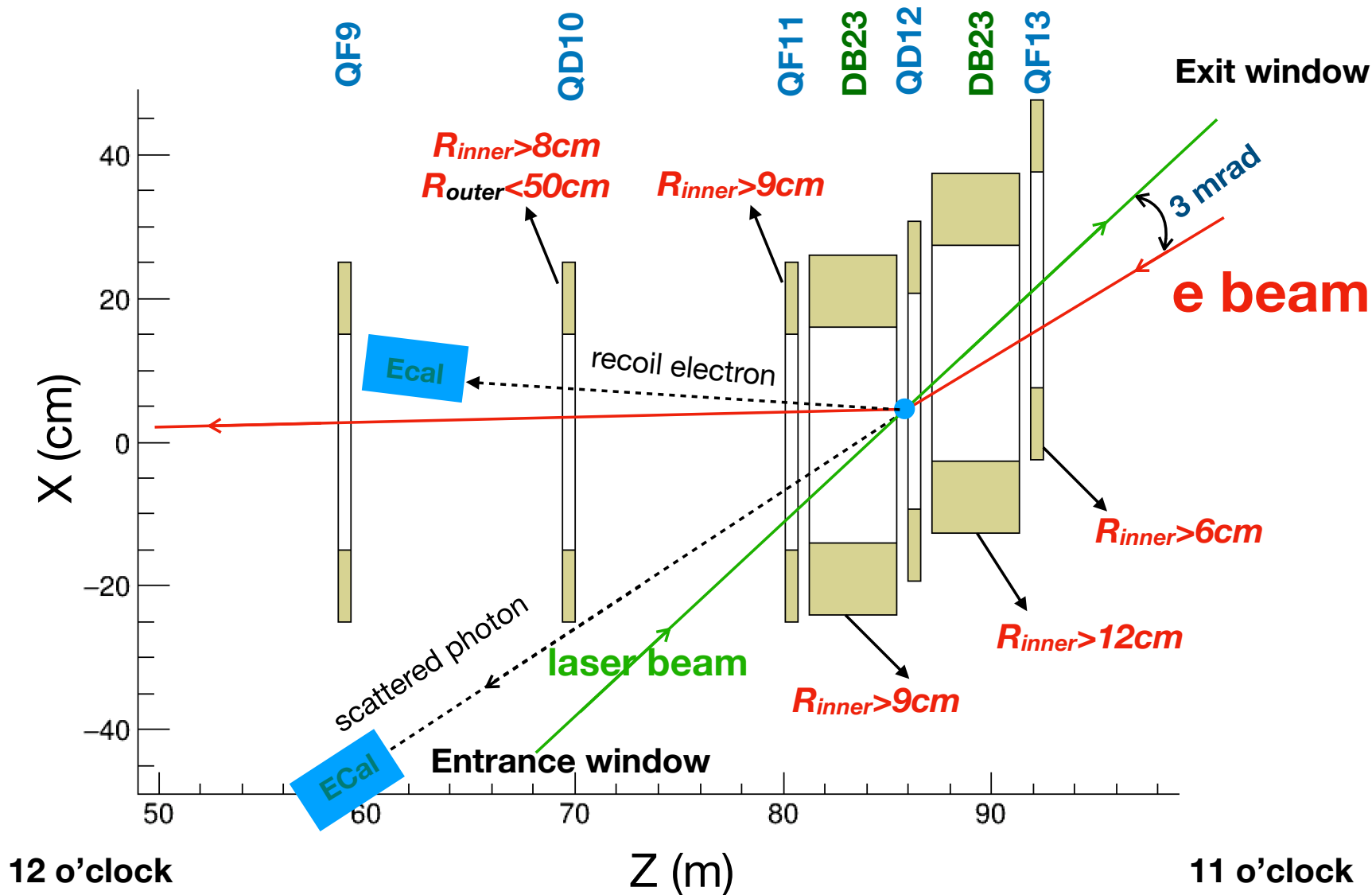


Bill Schmidke



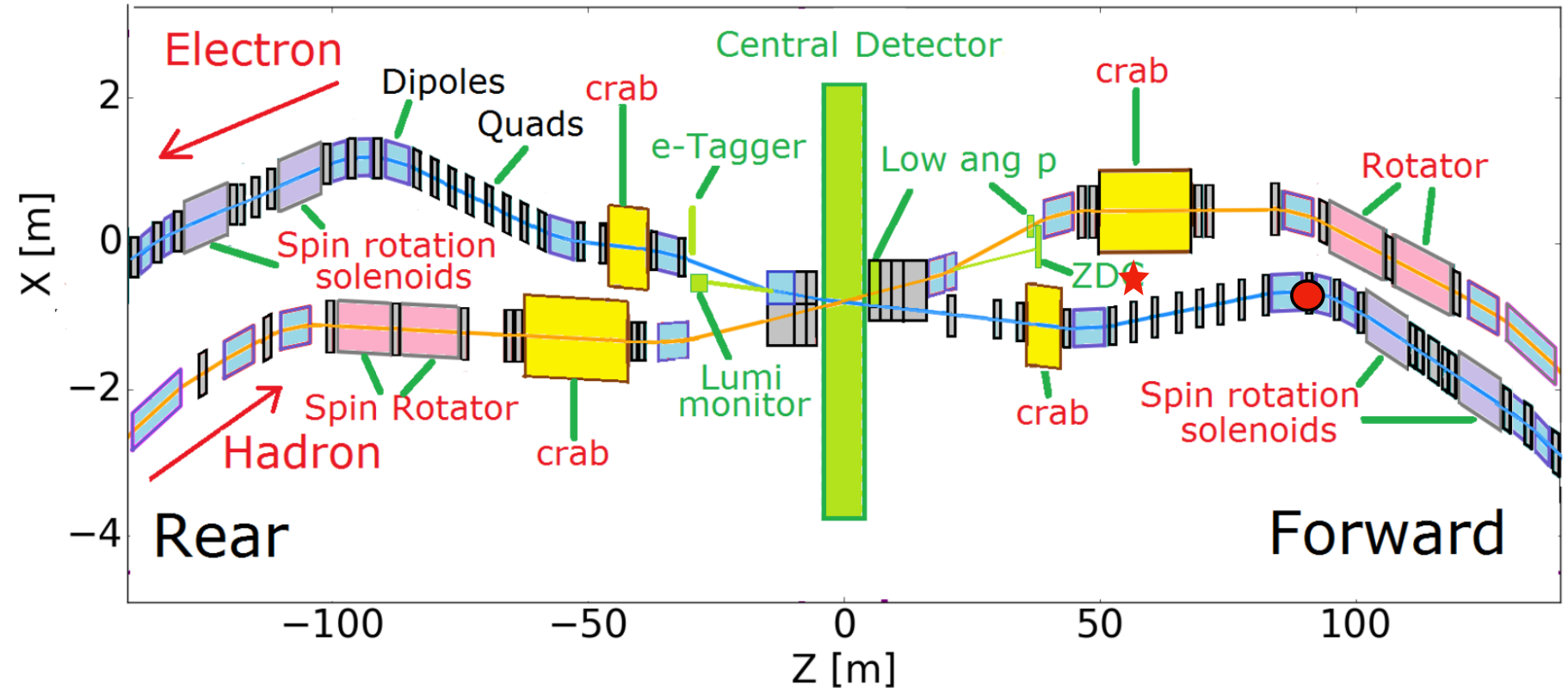
H. Huang et al., IPAC2014

Compton Polarimeter at IR12



Zhengqiao Zheng (BNL)

Compton Polarimeter at IR 6



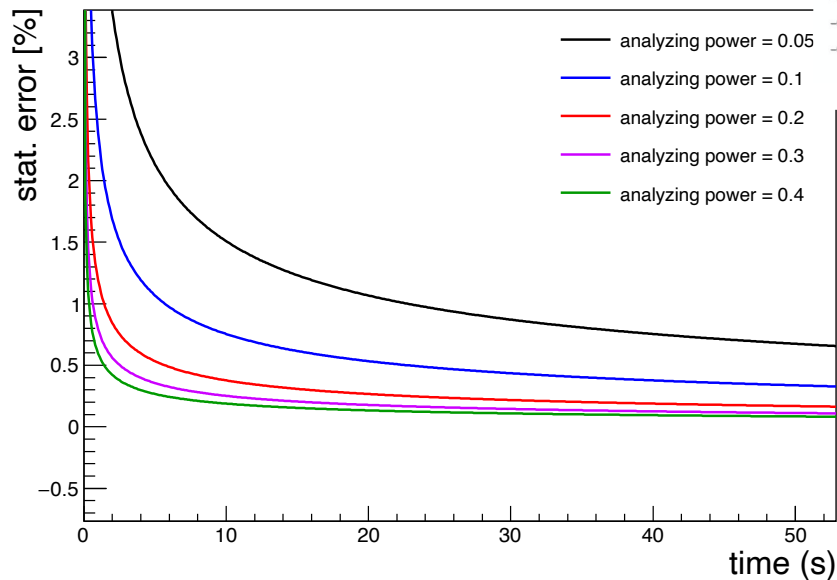
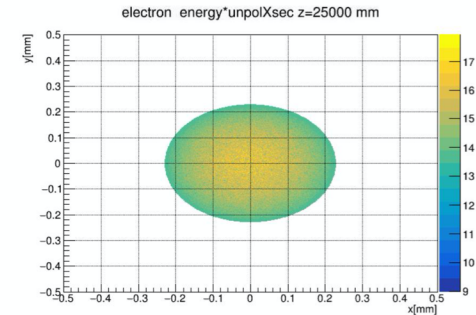
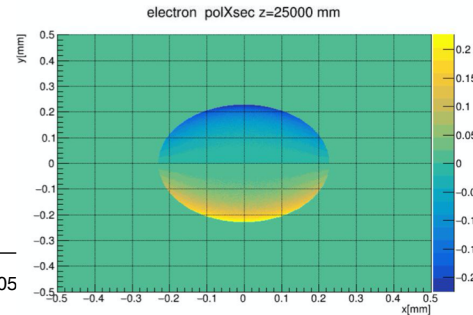
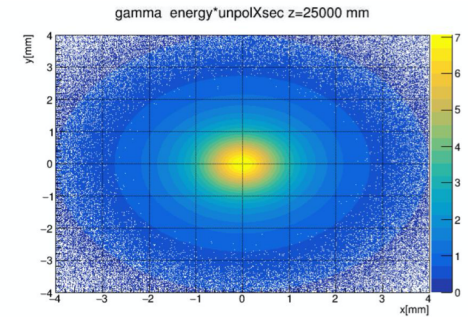
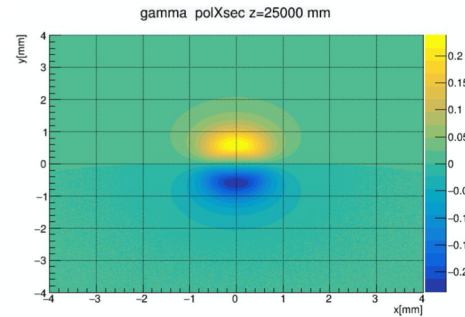
Investigating option of having additional polarimeter closer to IR

→ Electron beam would be significantly longitudinal – less spin transport to extract polarization at IP

→ Region very crowded – needs very careful consideration of detailed geometry

Compton Polarimetry Studies

Studies at event generator level can be used to estimate measurement times and event/asymmetry distributions towards optimizing measurement

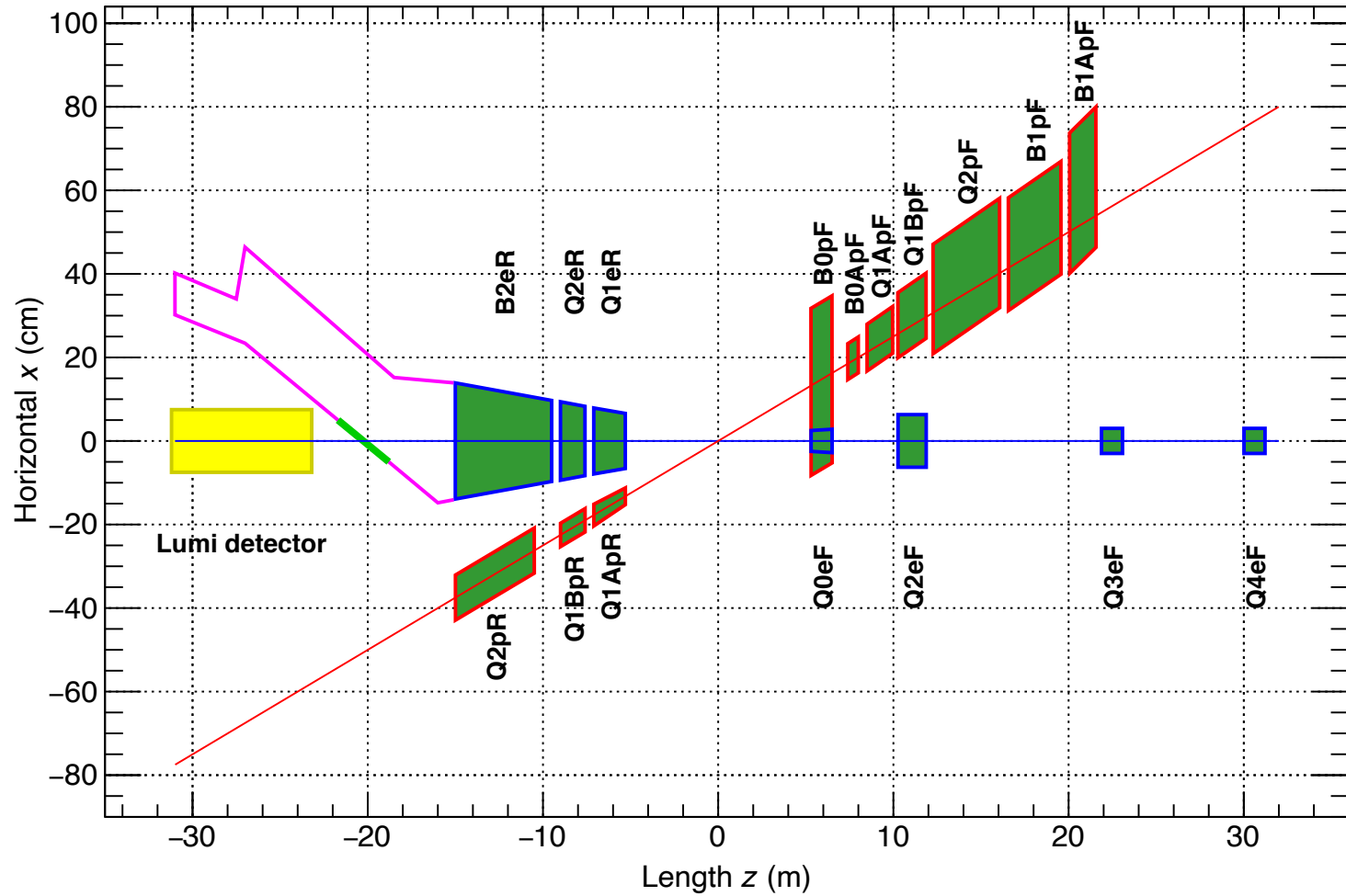


$$\beta_x = 10m; \beta_y = 50m;$$

Initial MC studies have used EICRoot, but developing GEANT4-based MC with full detector response

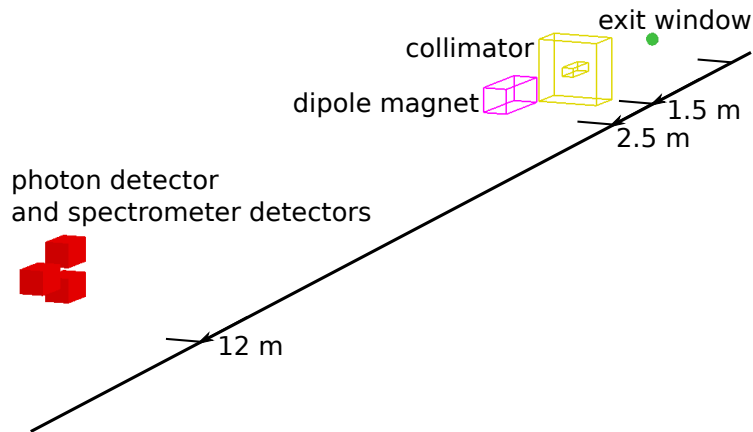
Some discussion of using a framework that facilitates detailed detector simulation and beamline magnets easily (Fun4All)

Lumi Monitor Layout

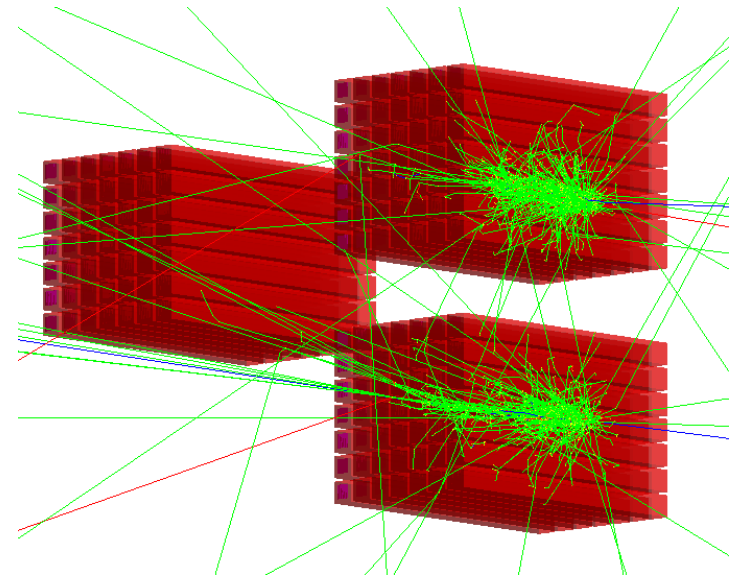


Lumi Monitor Progress

- Development of event generator based on generators from H1 and Zeus
- Detailed GEANT4 Monte Carlo including
 - Photon exit window
 - e+e- spectrometer
 - Electron, photon calorimeters
 - Detector response



Layout



Spectrometer and photon detectors

Future plans

- Hadron polarimetry
 - Continue MC studies of backgrounds with the aim of developing scheme for their reduction
 - Studies for using elastic e-D scattering for measuring tensor polarization of deuterium
- Compton polarimetry
 - Continue development of full GEANT4 simulation (first IR12 then IR6)
 - Determine required detector segmentation, resolution, etc. towards choosing optimal technology → need to develop analysis machinery to fully study systematic uncertainties
- Luminosity monitor
 - Continue optimization of simulation, system layout

CFNS Workshop – Polarization and Polarimetry

<https://indico.bnl.gov/event/7583/>

June 26, 29, July 1, 2020

....The aim of this workshop is to bring together experts in electron and hadron beam polarimetry as well as experts in polarized beams in accelerators. The program will include several invited talks, but contributed submissions are also welcome. Abstracts may be submitted through the conference web site

(<https://indico.bnl.gov/event/7583/abstracts/>) and will be accepted until May 31.

Due to the ongoing COVID-19 pandemic, we will hold the workshop online (through Zoom). To facilitate a wider collaboration we have decided to split the workshop over 3 separate days with a reduced schedule (June 26th, June 29th and July 1st). Please register in order to get connection information.

Organizing Committee:

Elke Aschenauer (BNL), Ciprian Gal (Stony Brook), Dave Gaskell (JLab), Haixin Huang (BNL), Vasiliy Morozov (JLab) Vadim Ptitsyn (BNL) and Ferdinand Willeke (BNL)