WP3 – Monday, September 26

- Main focus on backgrounds
  - Dave Gaskell: Background sources and synchrotron radiation issues at JLAB
  - Hiroyuki Nakayama: Beam background and Machine-Detector Interface Design at KEKB/Belle-II
  - Ciprian Gal: Expected background sources, synchrotron radiation issues at EIC
  - Zhengqiao Zhang: Detector integration and dipole design at EIC

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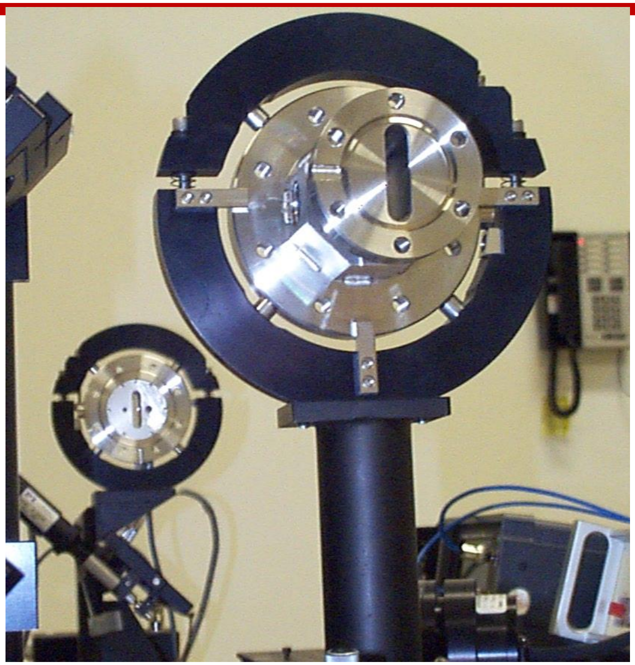
Compton Polarimeter Backgrounds at JLab

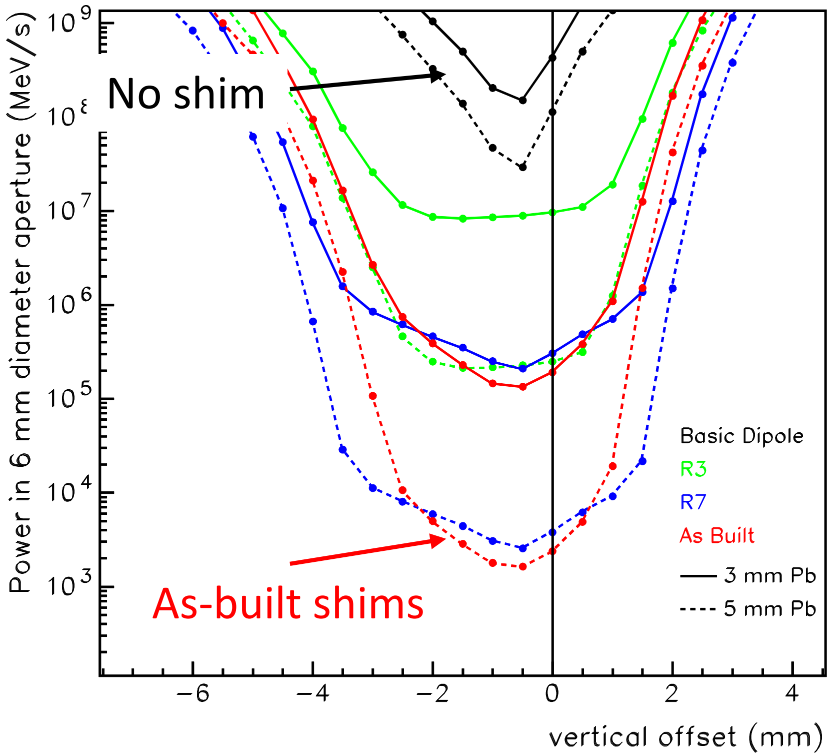
Backgrounds at JLab typically dominated by beam (halo) interactions with material in beamline

→ Narrow apertures near Fabry-Perot cavity problematic

→ Mitigation sometimes requires extensive beam tuning

→ Bremsstrahlung contributes, but typically not significant compared to real Compton rate





At higher energies (after 12 GeV upgrade) synchrotron radiation becomes more significant

Two components to mitigation:

→ Shims added to dipoles in chicane to extend effective length of ~1 m dipoles

→ Remotely controlled collimation system to optimize signal/background

SuperKEKB/Belle-II

Sources of background:

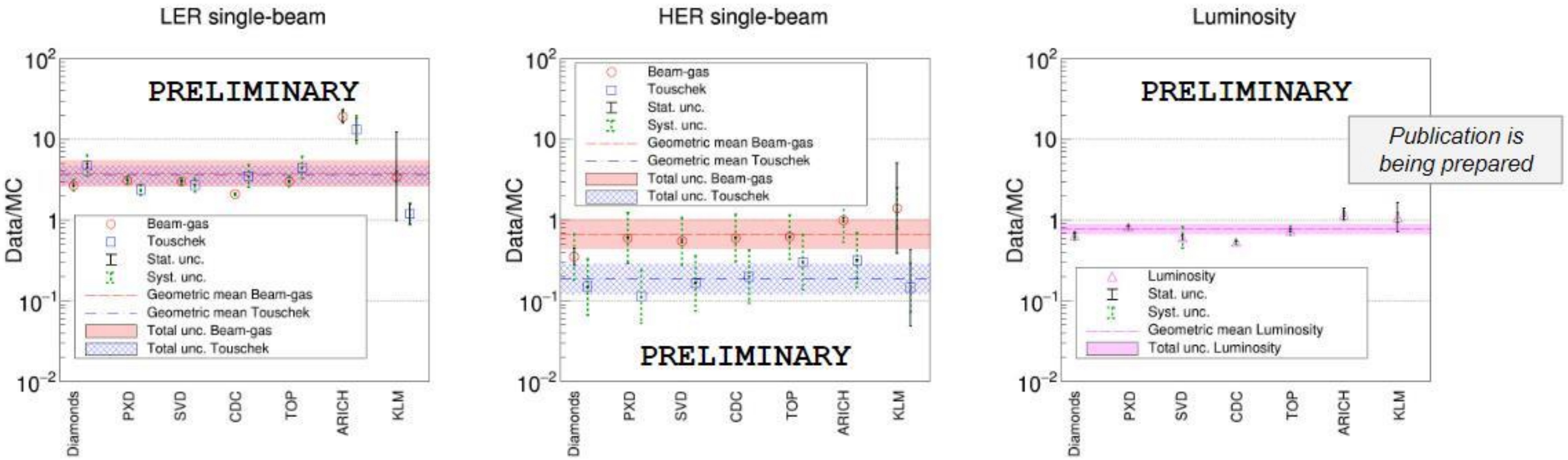
- *Single-beam BG*: Touschek, Beam-gas Coulomb/Bremsstrahlung, Synchrotron radiation, injection BG
- *Luminosity BG*: Radiative Bhabha, two-photon BG, etc..

Beam background mitigation via movable collimators and tungsten shielding at main beam loss points near detector

- 31 movable collimators
- Gradual reduction in background over 1+ year
- Original final focusing quad design - no room for shielding. Had to redesign once background simulations became more mature
- Extensive background measurements – allow comparison with detailed simulation

Instabilities in initial injection of top-off bunches lead to significant backgrounds

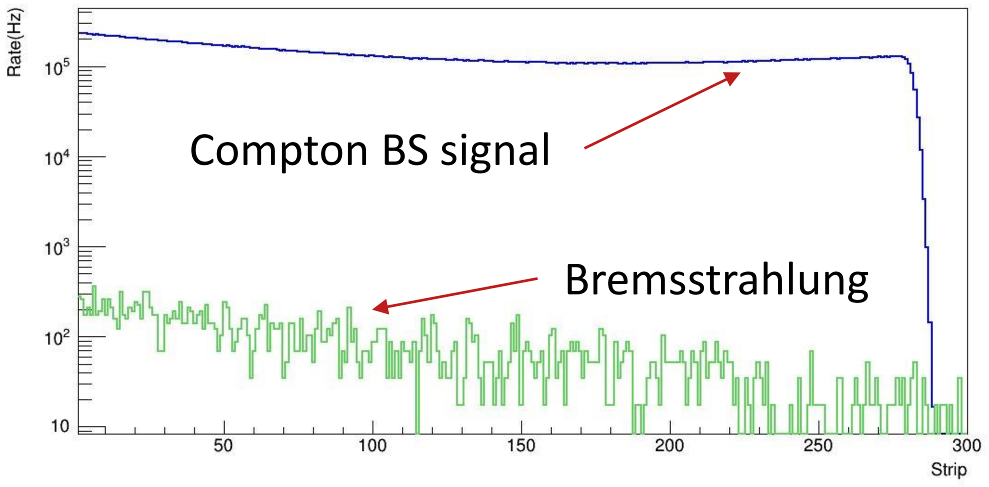
Ratios of measured (**data**) to simulated (**MC**) backgrounds based on dedicated studies in 2020-2021



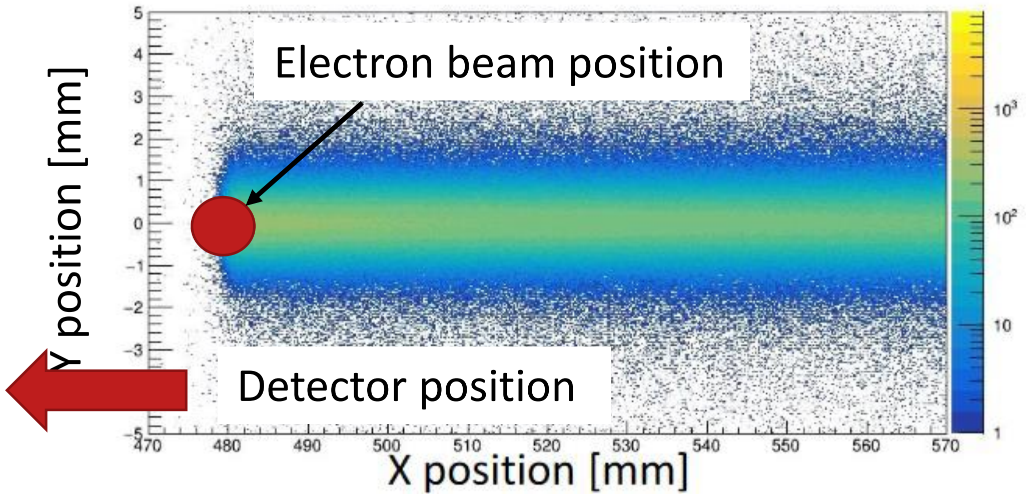
Expected Compton Polarimeter Backgrounds at EIC

Bremsstrahlung not expected to be dominant concern at EIC

Synchrotron radiation a significant concern
→ Two dipoles upstream of detectors that could contribute
→ Initial calculations performed w/GEANT4 – some cross cross-checks using semi-analytical methods (Mike Sullivan (SLAC)
→ No direct synchrotron radiation on electron detector
→ Synchrotron power impinging on photon detector about 6.9 W/mm²
→ Cooling needed for exit window – shielding for detector



Simulation from JLEIC design – to be updated



SR power on photon detector

- Estimate of the bend radiation power
  - 5 cm of photon detector window

	W	fan ht (mm)	W/mm²	Kc (keV)	E/bun (keV)	#γ/bun	#γ>20 keV
From D3	274	4.5	1.2	67	1.7e11	1.7e10	5.1e9
From D2	716	2.8	5.7	63	4.5e11	2.3e10	6.1e9

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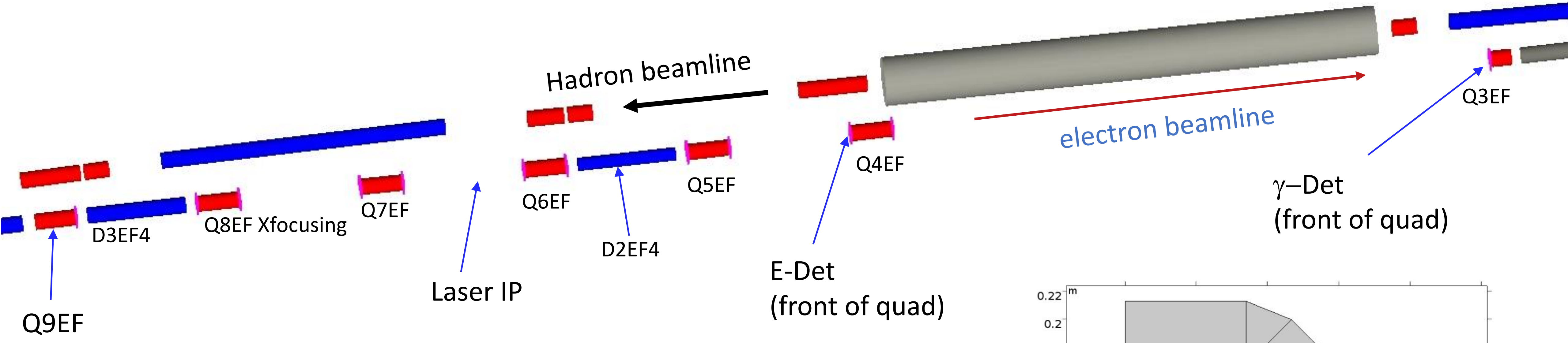
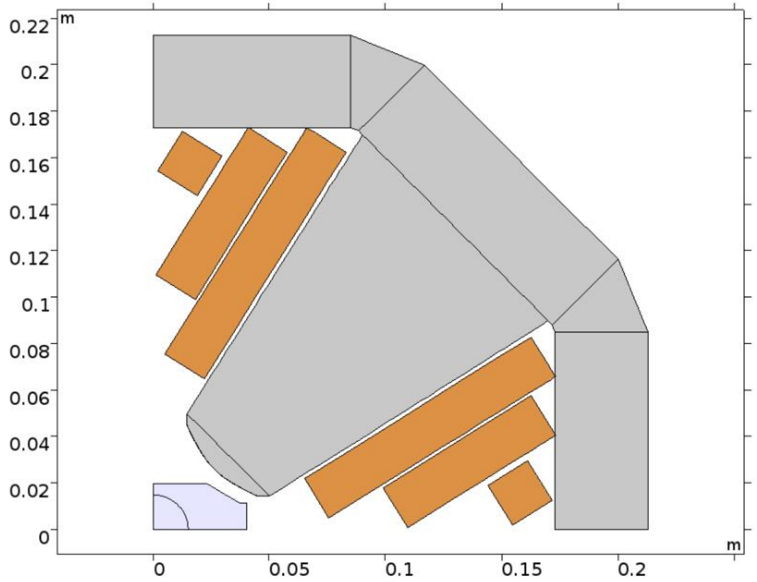
Detector Integration at EIC



- Laser IP 72 m upstream of detector IP – significant spin precession to detector
- Electron detector 9.7 m downstream of laser IP
- Photon detector 29 m from laser IP
  - Photon exit likely at end of dipole (D2EF4)
  - Simulations of exit window thickness/materials (Al, Be)
- Photons will need to pass through gap/hole in yoke – EIC machine group indicates this should be ok
- Detailed detector response simulations to be done



(a) Geometry of the arc quadrupole magnet