WP3 introdution: goals and programme

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Introduction: Physics requirements

Observable	statistics	$\Delta\sqrt{s}_{abs}$ 100 keV	$\Delta\sqrt{s}_{syst-ptp}$ **40 keV**	calib. stats. $200\,\mathrm{keV}/\sqrt{N^i}$	$\sigma_{\sqrt{s}}$ $85 \pm \mathbf{0.05}$ MeV
m_Z (keV)	4	100	**28**	1	–
Γ_Z (keV)	4	2.5	**22**	1	**10**
$\sin^2\theta_W^{eff} \times 10^6$ from $A_{FB}^{\mu\mu}$	2	–	**2.4**	0.1	–
$\frac{\Delta\alpha_{QED}(m_Z^2)}{\alpha_{QED}(m_Z^2)} \times 10^5$	3	0.1	**0.9**	–	**0.1**

High reproductibility of measurements for various sqrt(s) is critically needed

Extract as much information as possible from physics experiments themselves (crossing angle, luminosity, sqrt(s) spread)

Beam-based measurements in real time, including beams energy with resonant depolarization

24/7 operable measurement of depolarization

Blondel et al., arXiv:1909.12245

Resonant depolarization

Scan spin precession frequency with magnetic kicker

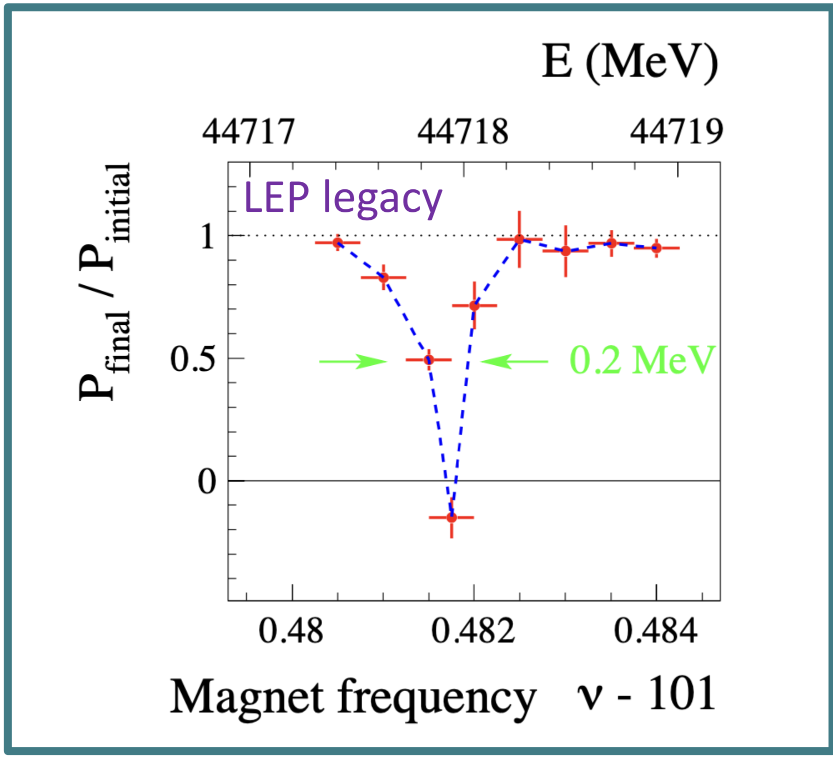
↓

Detect beam depolarization at resonance

beam energy spread too large for colliding beams
(smeared spin resonances)

↓

Use pilot bunches instead

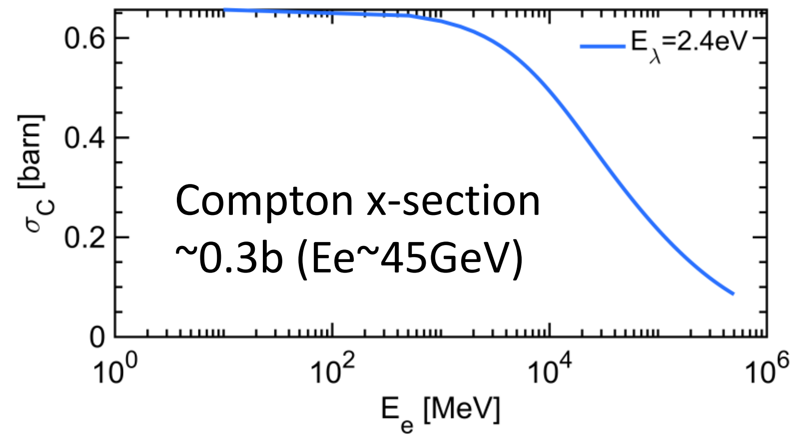


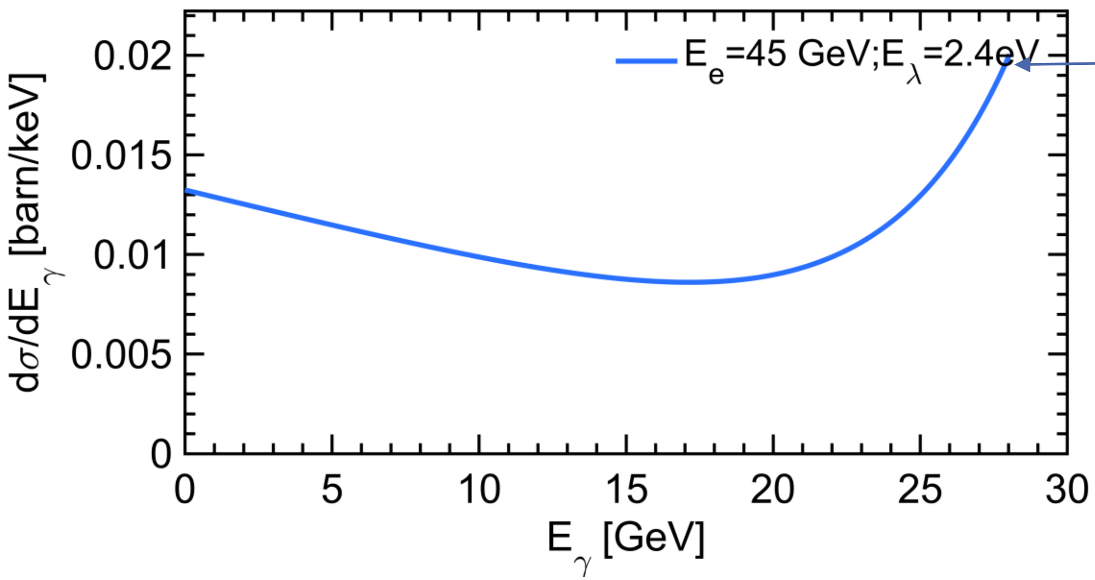
24/7 operable Compton polarimeter for pilot bunches

Assman et al., Eur. Phys. J. C 6, 187–223 (1999), Blondel et al., arXiv:1909.12245; Baier & Khoze, Sov. J. Nucl. Phys. \textbf{9}, 238-240 (1969)

The Compton process

Fig. 1. Tree diagrams for $e^-\gamma \to e^-\gamma$





Kinematic edge

Klein O. and Nishina Y., Z. Phys. 52(1929) 853; Ginzburg I. et al., Nucl. Instr. Methods in Phys. Research 219 (1984) 5, V. B. Berestetskii, E. M. Lifshitz, L. P. Pitaevskii (1982). Quantum Electrodynamics. Vol. 4 (2nd ed.)

Compton polarimeter layout

Blondel et al., arXiv:1909.12245

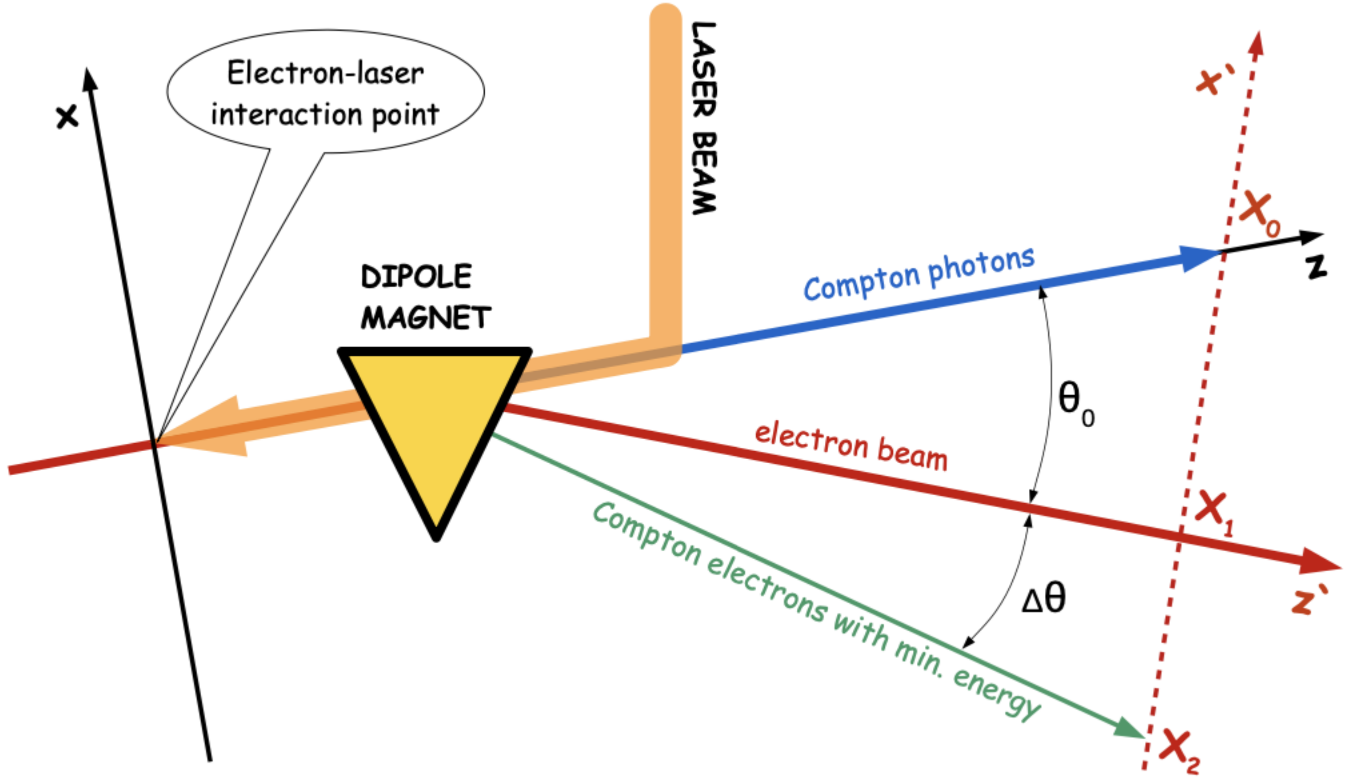


Figure 25. Regular layout of ICS experiments realization.

Redundancy: measure both electrons and photons

Compton cross-section

Fig. 1. Tree diagrams for $e^- \gamma \rightarrow e^- \gamma$

Berestskii & Lfshitz QED textbook

$$x = \frac{2E_0\omega_0}{m^2}(1+\cos\alpha) \qquad y = \frac{E_\gamma}{E_0}$$

The Compton cross-section averaged over scattered particles spins:

Differential cross-section

Transverse laser polarisation: nuisance parameter to minimize and keep under control

Transverse electron beam polarisation: intervenes as an asymmetry in the transverse plane

$$\frac{d\sigma}{dy d\varphi_{obs}}(x,y) = \frac{d\sigma_0}{dy}(x,y) + \frac{d\sigma_\perp}{dy}(x,y)\cos\big(2(\varphi_{obs}-\varphi_{las})\big)\mathcal{P}_\perp^{las} + \frac{d\sigma_\parallel}{dy}(x,y)\mathcal{P}_C^{las}\big(P_T f_T(x,y)\cos(\varphi_{obs}-\varphi_{elec}) + P_L f_L(x,y)\big)$$

Electron beam polarization independent — *Electron beam polarization dependent*

⚠ But small opening angle of scattered particles:

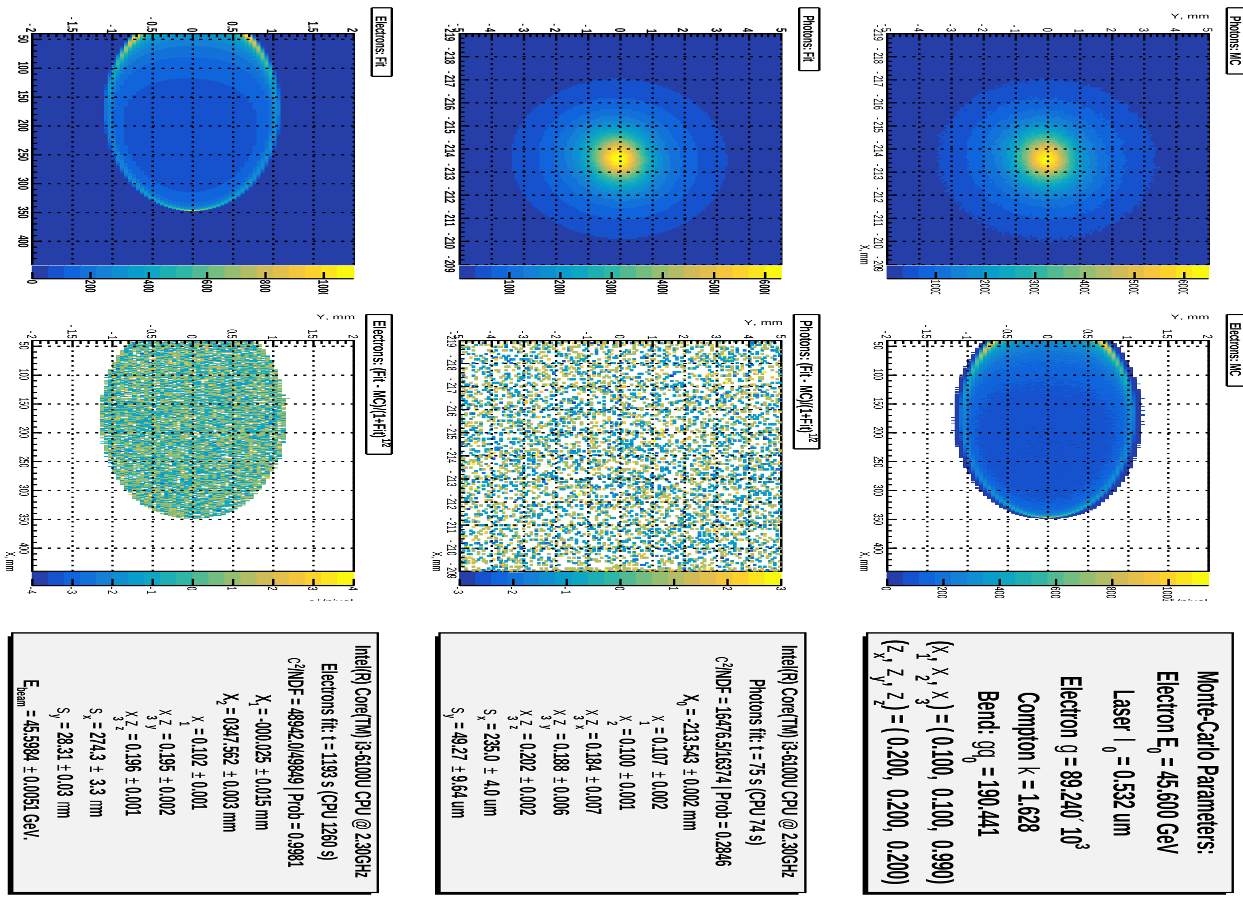
- Electrons → spectrometer
- Photons → difficult to measure asymmetric distribution of a narrow spot → long lever arm needed

in a few seconds for pilots

Transverse distributions

Nickolai's presentation

Based on measurement of scattered particles transverse distributions (p... detectors)



All components extracted with ~0.001 precision in few seconds

Beam energy may be extracted too! → redundancy

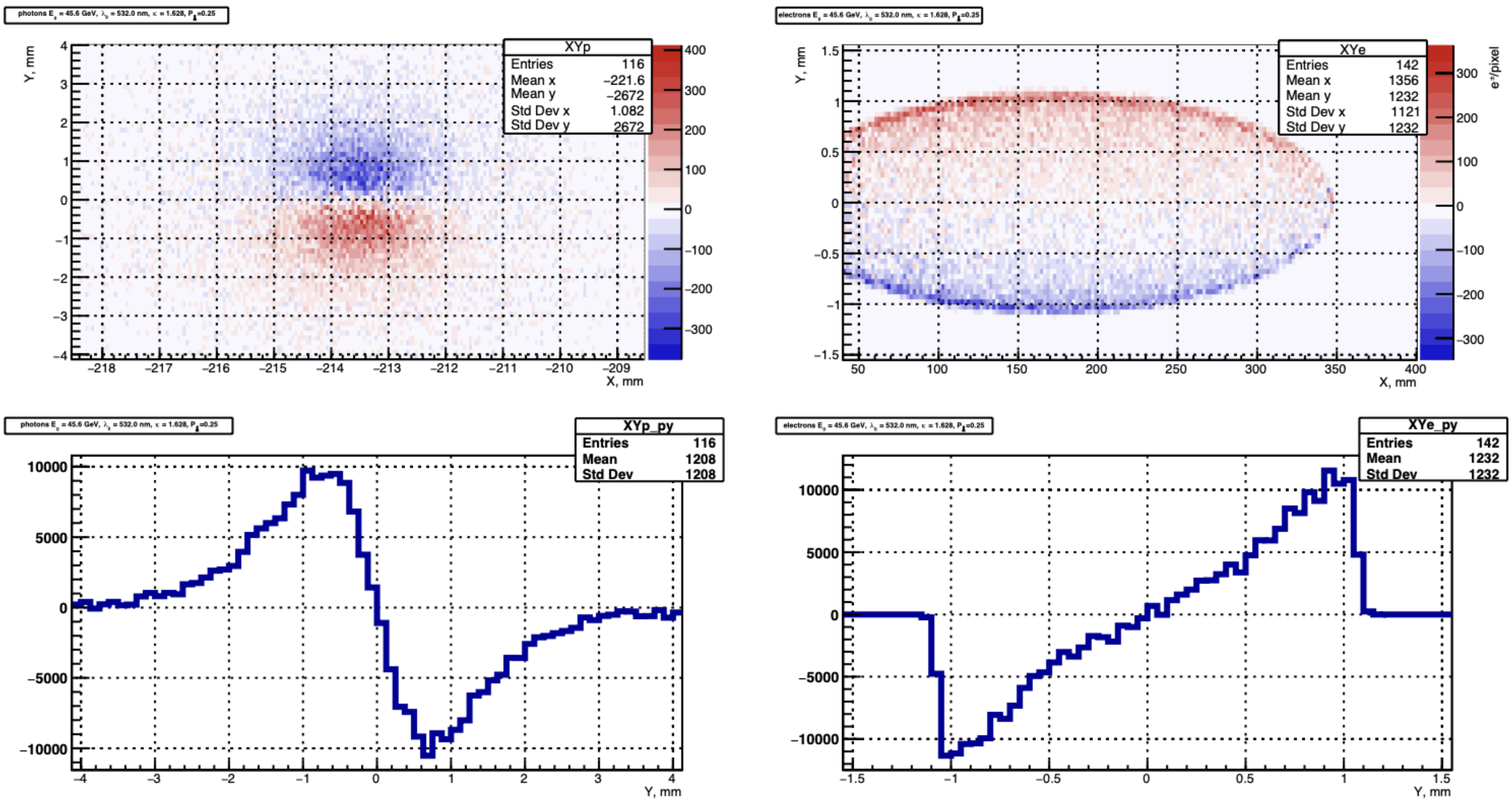
Realistic detector specifications to be drawn

Open questions: detector spatial resolution, longitudinal sampling, rates, combined fits, laser polarization flips,…

Blondel et al., arXiv:1909.12245

Laser helicity asymmetries

Nickolai's presentation



Reproductible and well known laser helicity flip is required

Blondel et al., arXiv:1909.12245

Workshop goals

1. Clarify running scenarii (input from other WPs)
   - Do we need polarimetry for colliding bunches ? With what precision ?
2. Review and update laser pulse parameters (wavelength, spectrum/pulse duration, crossing angle, polarization switching/rotating, beam size at IP) able to cope with various scenarii with most recent lattice parameters
   - Will need validation with 3D-polarimeter fits
3. Draw a first rough sketch for the laser integration
   - Laser room, transport, interaction chamber
   - Identify difficulties
   - Possibly important cost driver
4. Determine required detector performance and review technologies used in similar contexts
5. Specify deflecting magnet performance and necessary calibration accuracy
6. Start identify possible problematic backgrounds
7. Start to list prioritize systematics to be studied at a later stage

Workshop programme

Tuesday: EIC, FCC and history

67 - EIC Polarimetry Overview	Ciprian Gal	15:30 - 15:55
68 - FCC-ee 3D Polarimetry	Nikolai Muchnoi	15:55 - 16:20
69 - VEPP Polarimeters	Stepan Zakharov	16:20 - 16:45
Break		
70 - HERA TPOL	Stefan Schmitt	17:00 - 17:25
71 - SLD Compton Polarimeter	Mike Woods	17:25 - 17:50
72 - JLab Compton Polarimeters	Dave Gaskell	17:50 - 18:15
73 - LEP polarimeter overview	Jorg Wenninger	18:15 - 18:40

Wednesday: laser and optics

57 - LUXE laser diagnostics	Gianl … ri	15:30 - 15:55
58 - HERA LPOL2 laser system and polarization control	fabian zomer	15:55 - 16:20
59 - SuperKEKB, ILC and GammaFactory lasers systems	Aurelien Martens	16:20 - 16:45
Coffee break		
60 - CERN STI/LP operational experience	Bruce Marsh et al.	17:00 - 17:25
61 - JLAB and EIC laser design	Ciprian Gal	17:25 - 17:50
62 - EIC integration challenges	Zhengqiao Zhang	17:50 - 18:15

Thursday: detectors

98 - JLab Compton Detectors - Lessons Learned	Dr Alexandre Camsonne
99 - EIC Compton Detectors	James Fast
100 - ILC detectors and ideas for T-POL at ILC	Jenny List
101 - SuperKEKB photon detector: a proposal.	Aurelien Martens
Break	
102 - LUXe electron and positron detectors	Louis Helary
103 - L4 emittance meter.	Federico Roncarolo
104 - LHC luminosity monitors	Stefano Mazzoni
105 - Timepix3 based detectors	James Storey

Monday: backgrounds

63 - Background sources and synchrotron radiation issues at JLAB	Dave Gaskell	15:30 - 15:55
64 - Machine background at SuperKEKB	Hiroyuki NAKAYAMA	15:55 - 16:20
65 - Expected backgorund sources, synchrotron radiation issues at EIC	Ciprian Gal	16:20 - 16:45
66 - Detector integration and dipole design at EIC	Zhengqiao Zhang	16:45 - 17:10