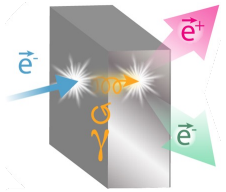


Physics of the Ce+BAF Positron Upgrade

- Precise understanding of the electromagnetic interaction
- Understanding the internal dynamics of hadrons
- Searching for New Physics

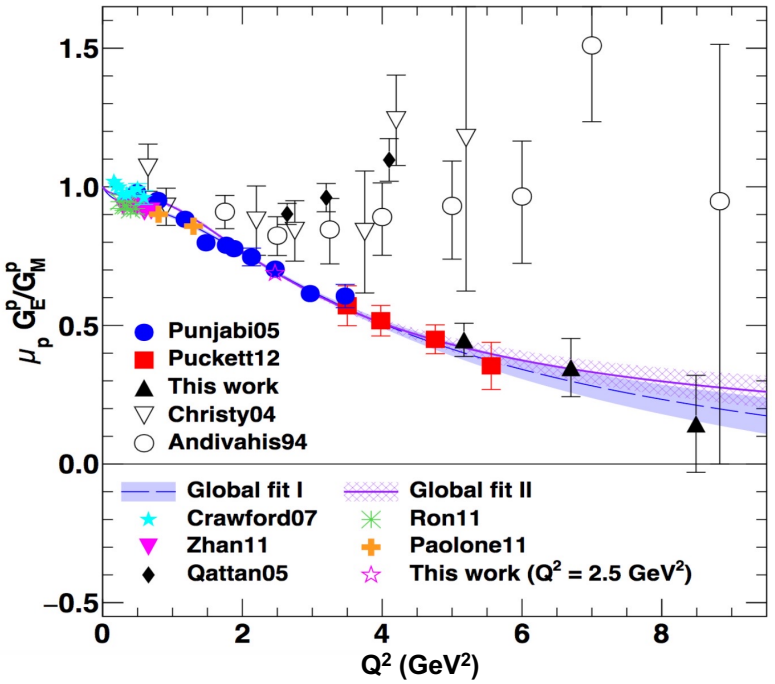


Electromagnetic interaction

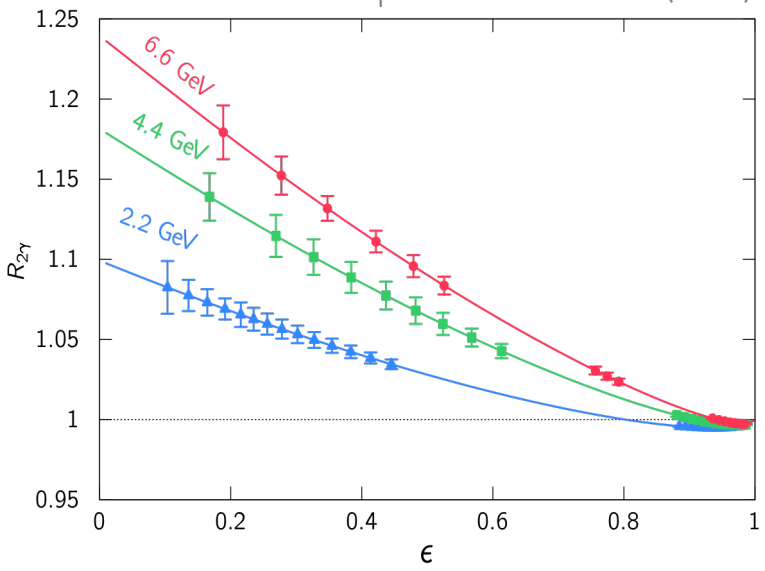
- **Measuring two-photon, multi-photon and dispersive effects by comparing e^- and e^+ induced scatterings.**

  ⇛ This concerns the **reliability and limitations of the physics information** obtained from **elastic**, **deep inelastic** (DIS), **semi-inclusive deep inelastic** (SIDIS) scatterings…

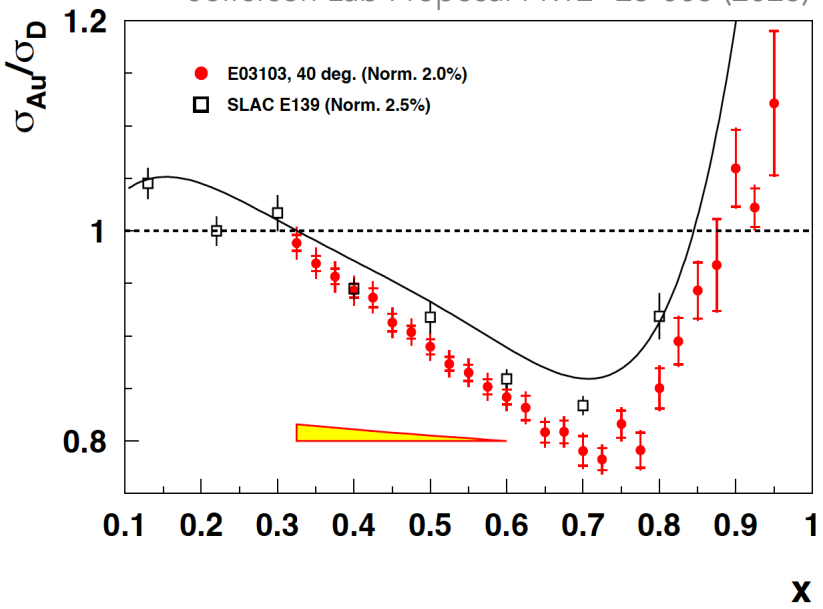
A.J.R. Puckett et al. PRC 96 (2017) 055203



A. Schmidt et al.
Jefferson Lab Proposal PR12+23-008 (2023)

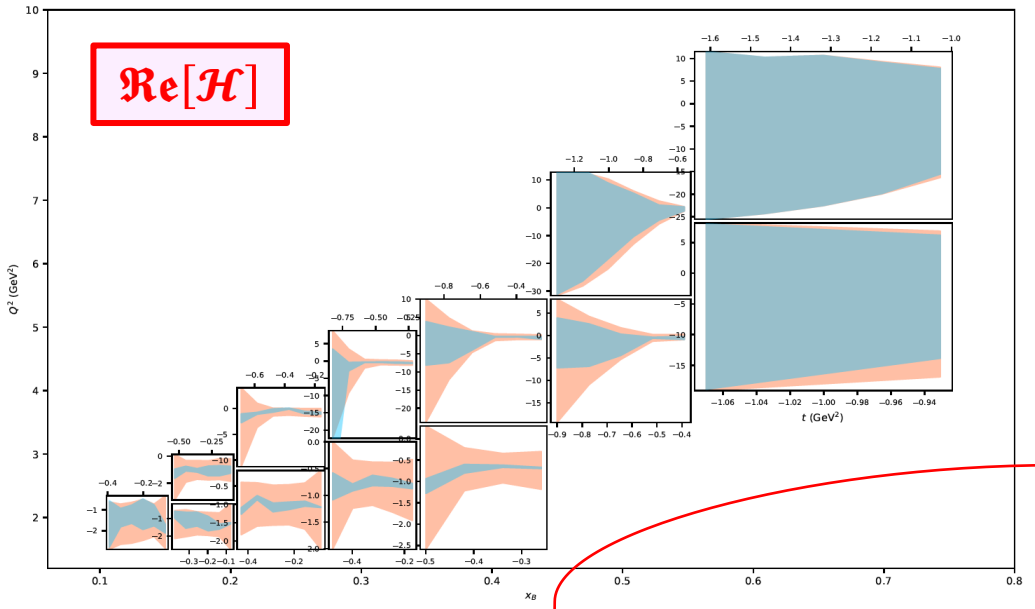


D. Gaskell et al.
Jefferson Lab Proposal PR12+23-003 (2023)



- **Separating** the unknown reaction amplitudes of the $(e^{\pm}, e'^{\pm}\gamma N)$ process by comparing **e⁻** and **e⁺** induced **DVCS**.

H. Dutrieux et al. EPJ A 57 (2021) 300



$$d^5\sigma^{e}_{P0} = d^5\sigma_{BH} + d^5\sigma_{DVCS} + P\, d^5\tilde{\sigma}_{DVCS} - e\,[d^5\sigma_{INT} + P\, d^5\tilde{\sigma}_{INT}]$$

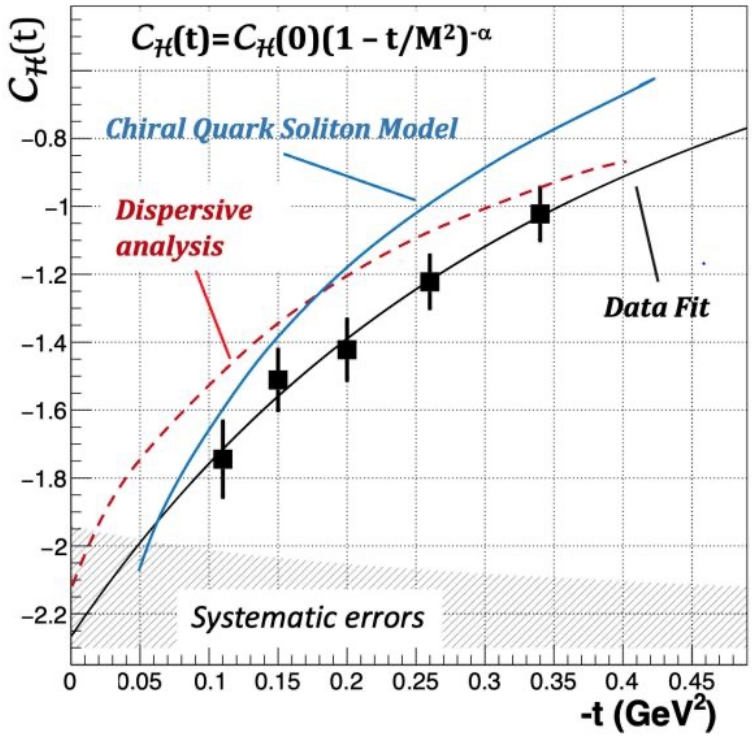
Access to the nucleon Gravitational Form Factor

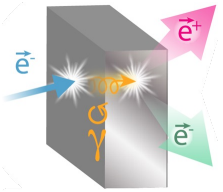
$$\mathfrak{Re}[\mathcal{H}(\xi,t)] \overset{\text{LO}}{=} C_{\mathcal{H}}(t) + \mathcal{P}\left\{\int_{-1}^{1}\left[\frac{1}{\xi - x} - \frac{1}{\xi + x}\right]\mathfrak{Im}[\mathcal{H}(x,t)]\, dx\right\}$$

Beam Charge

Beam Polarization

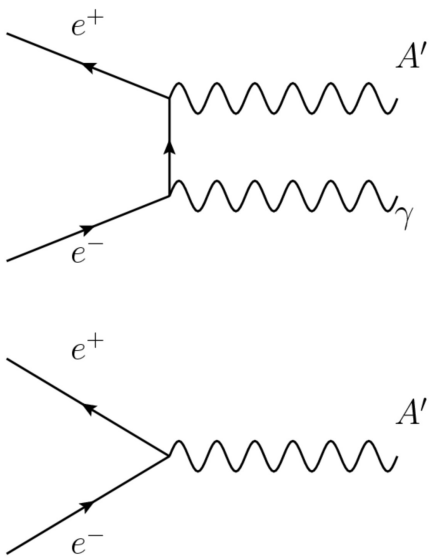
V.D. Burkert et al. RMP 95 (2023) 041002



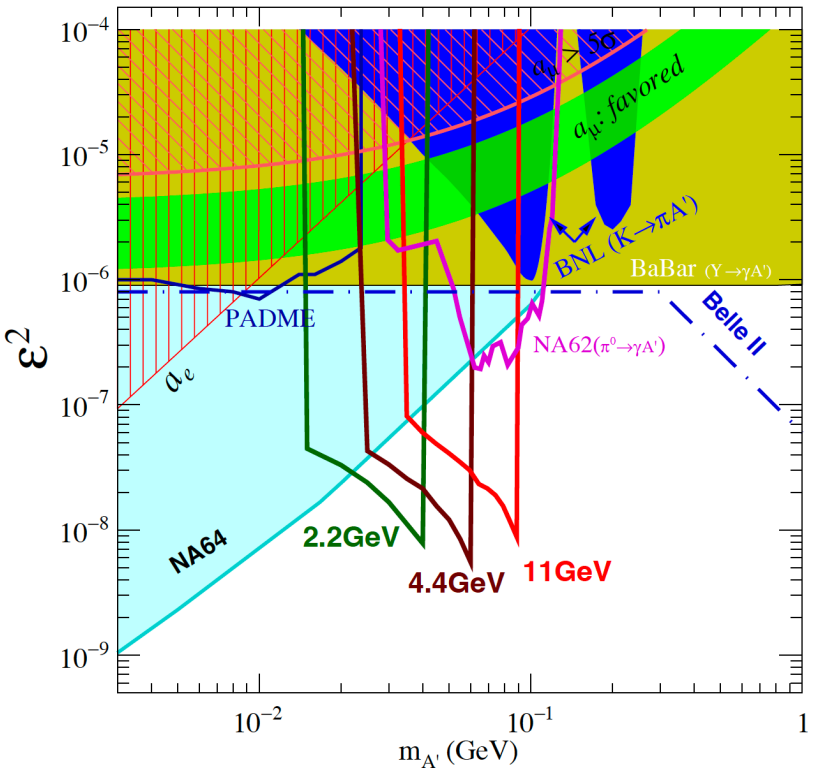


New physics

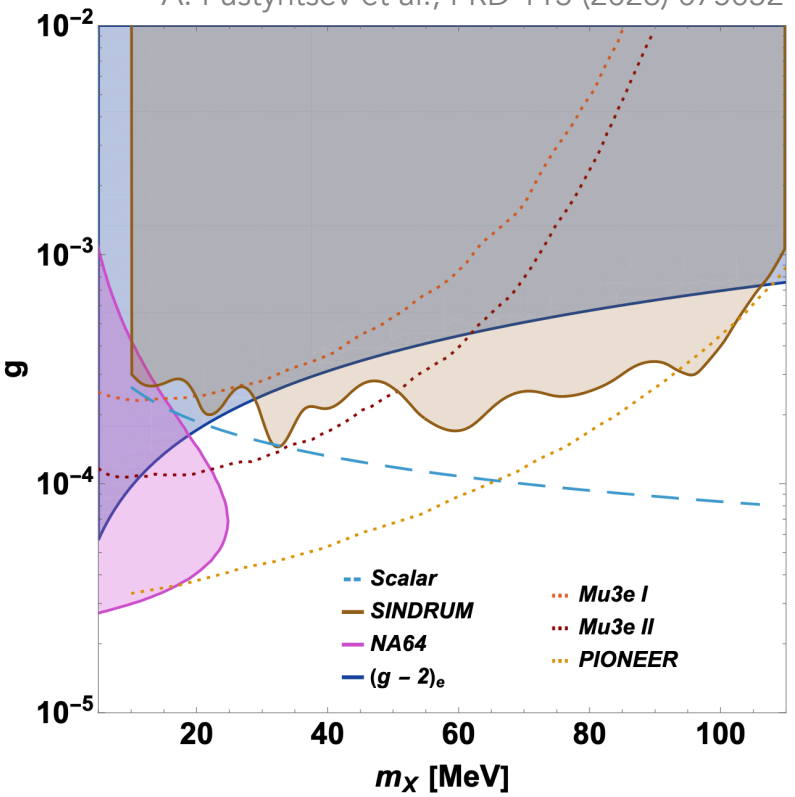
- **Searching** for a **New Physics** signal in **Standard Model processes only accessible** to **unpolarized/polarized e^+** as positron annihilation (**A' invisible decay**), Bhabha scattering (A_T)…

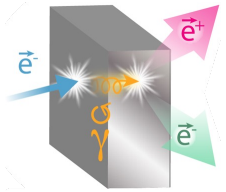


B. Wojtsekhowski et al., JLab Proposal PR12+24-005 (2024)



A. Pustyntsev et al., PRD 113 (2026) 075032





Capabilities

NUMBER	TITLE	PHYSICS THEME	CONTACT PERSON	HALL	DAYS AWARDED	SCIENTIFIC RATING	PAC DECISION
PR12+23-002	Beam Charge Asymmetries for Deeply Virtual Compton Scattering on the Proton at CLAS12	GPDs	Eric Voutier	B	100	A-	C1
PR12+23-008	A Direct Measurement of Hard Two-Photon Exchange with Electrons and Positrons at CLAS12	TPE	Axel Schmidt	B	55	A	C1
PR12+24-005	A dark photon search with a JLab positron beam	BSM	Bogdan Wojtsekhowski	B	55	A-	C1

CLAS Collaboration Proposals

- Polarized and unpolarized positron beam
- The CLAS12 spectrometer as existing today (GPDs, TPE) and a PRad based detector (BSM)
- Positron polarimeter
- Electron/positron beam charge measurement

What positron beams can add to the existing CLAS12 Experimental Program ?

What is unique to positron beams and CLAS12 ?