université PARIS-SACLAY

IJCLab Irène Joliot-Curie Laboratoire de Physique des 2 Infinis

ECT Workshop Trento 2026*

Coherent DVCS off ^{4}He with ALERT and CLAS at JLab

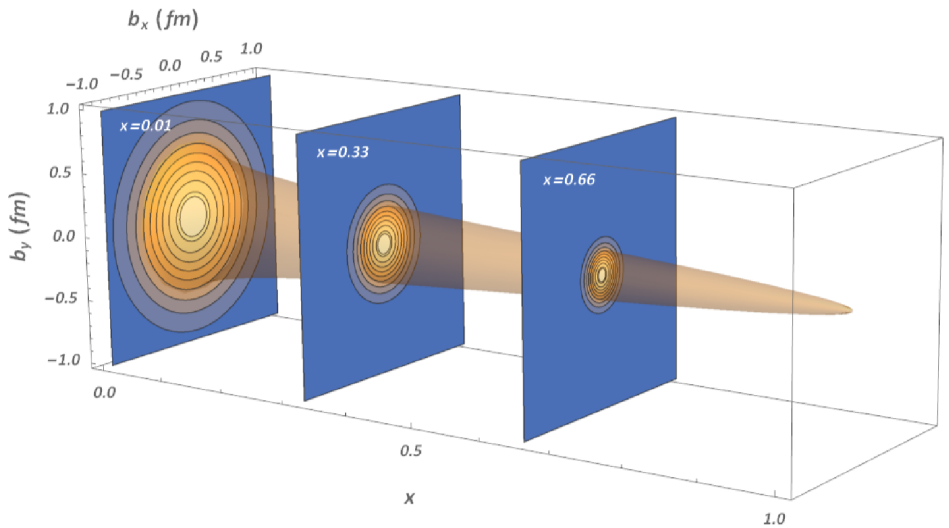
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November 10, 2026

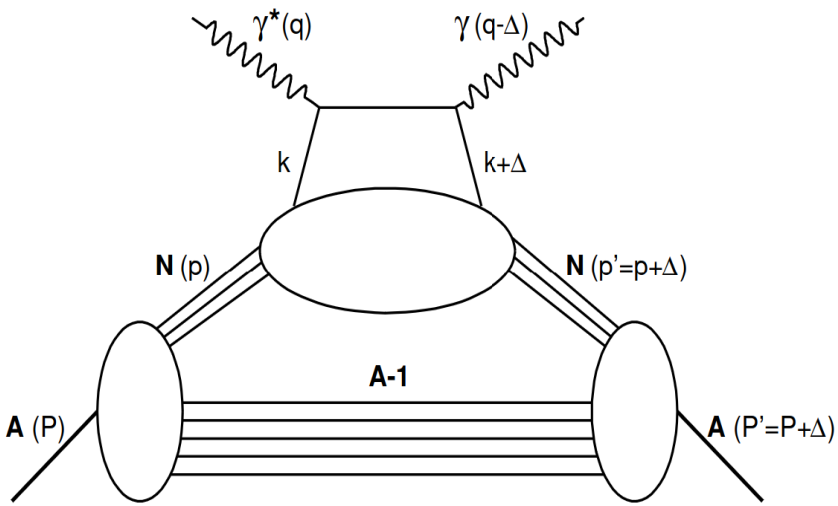
Nuclear GPDs

- The Generalized Parton Distributions (GPDs) combine the notion of PDFs and FFs, along with their correlations
- We can access GPDs off the free proton or off a nucleus
- A direct comparison of these distributions can reveal a variety of nuclear effects
  - *e.g.* modification of the quark confinement size, short range correlations
  - this will provide new insights into the understanding of the EMC effect

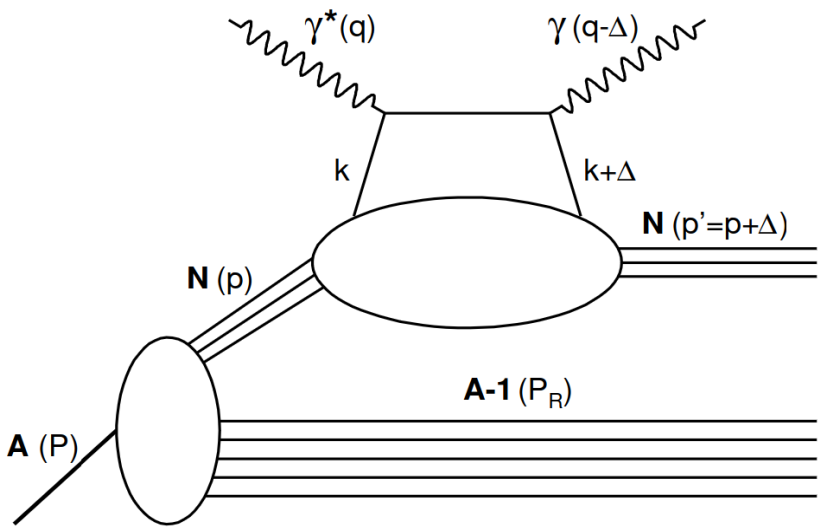


Nuclear DVCS

- We can access quark GPDs in Deeply Virtual Compton Scattering (DVCS)
- For a nuclear target, the DVCS can be coherent or incoherent



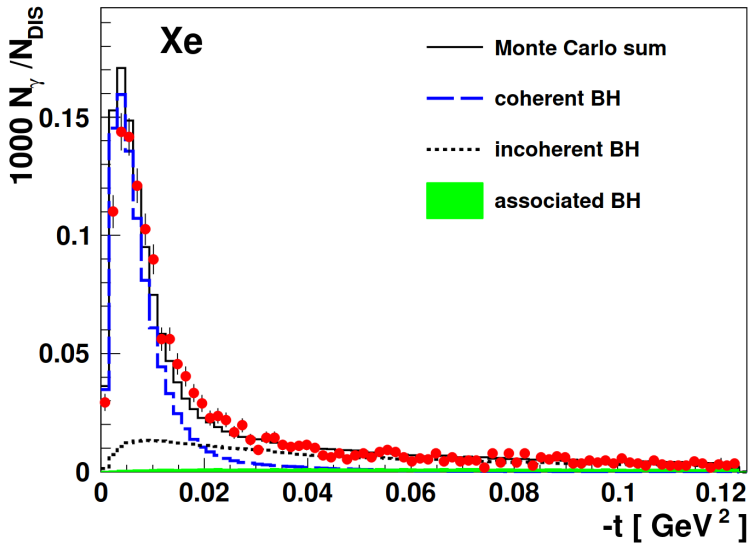
Coherent



Incoherent

HERMES results

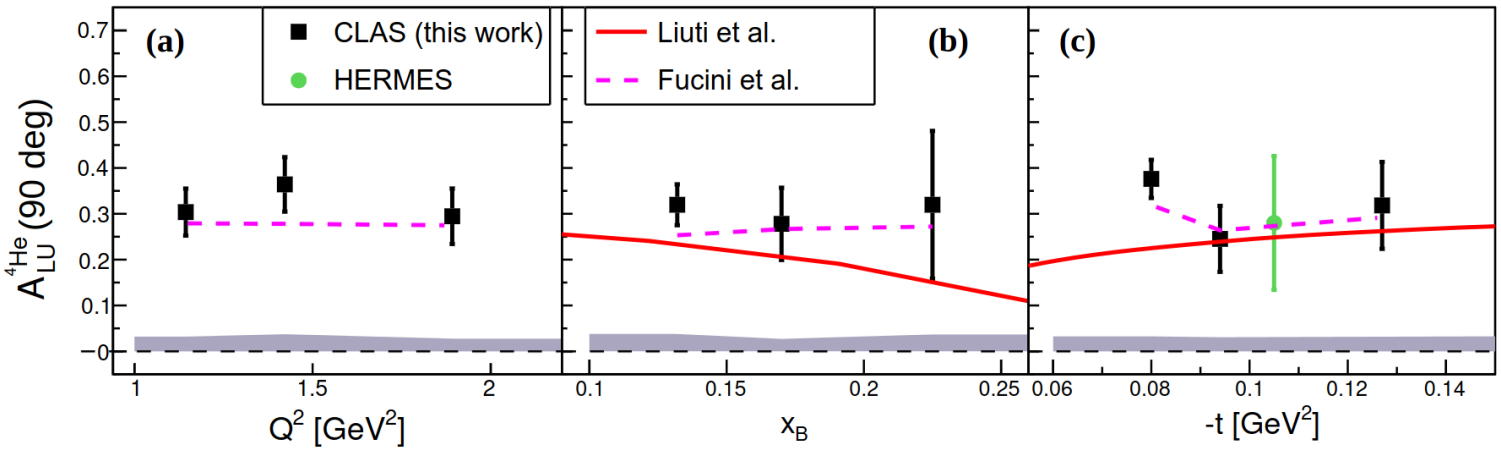
- The first nuclear DVCS measurements were performed by the HERMES collaboration at DESY
- They studied the hard exclusive photon production: $eA \to e\gamma X$
  - They used various targets (H, He, N, Ne, Kr, Xe)
  - The recoiling system was not detected
- There were unable to directly separate the coherent and incoherent channels
  - They used a $|t|$ based threshold to separate the channels
- The measurements were affected by large uncertainties and no nuclear dependence of the coherent Beam Spin Asymmetry (BSA) was found



A. Airapetian, et al, arxiv:0911.0091

CLAS eg6 results

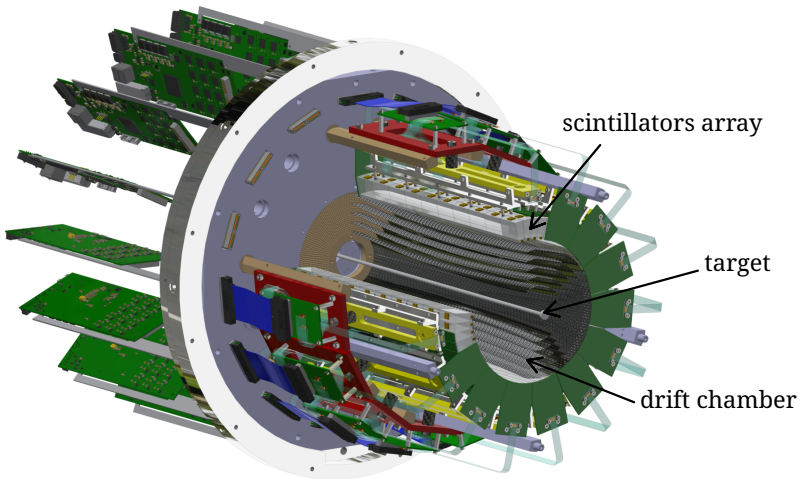
- The CLAS eg6 experiment at JLab successfully measured the first coherent DVCS off ^{4}He
- In contrast to HERMES, the DVCS process was fully exclusive
  - The recoil nucleus was detected
  - Coherent and incoherent channels were well isolated
- The extracted coherent BSA was twice the one measured on the free proton

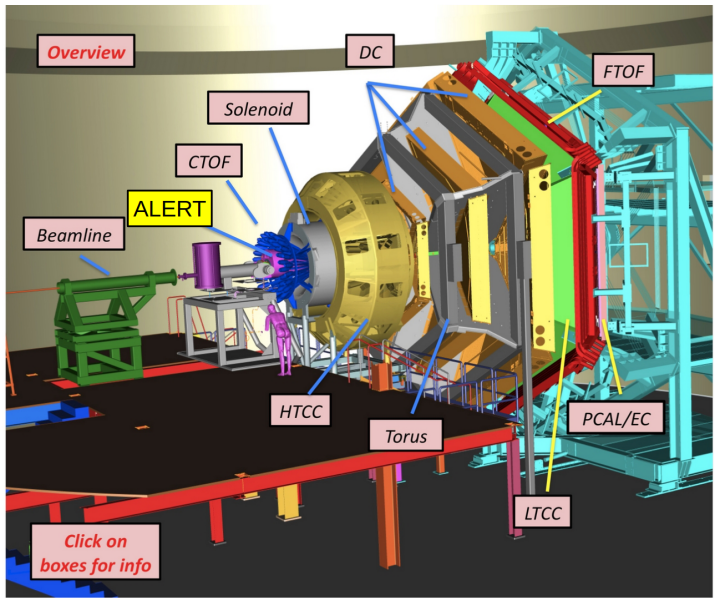


R. Dupré, M. Hattawy et al., arxiv:2102.07419

ALERT experiment

- ALERT is an extension of CLAS eg6 at higher luminosity, 12 GeV era at JLab
- It based on a new detector, *A Low Energy Recoil Tracker*
  - Along with the ^{4}He, identify the two isobars ^{3}He et ^{3}H
  - With kinematics: $70 < p < 400$ MeV/c, $\theta > 45°$
  - To be placed inside a 5T solenoid magnet
  - To be transparent to the particles detected by CLAS
- ALERT is a combination of a drift chamber (AHDC) and an array of scintillators (ATOF)





ALERT run period

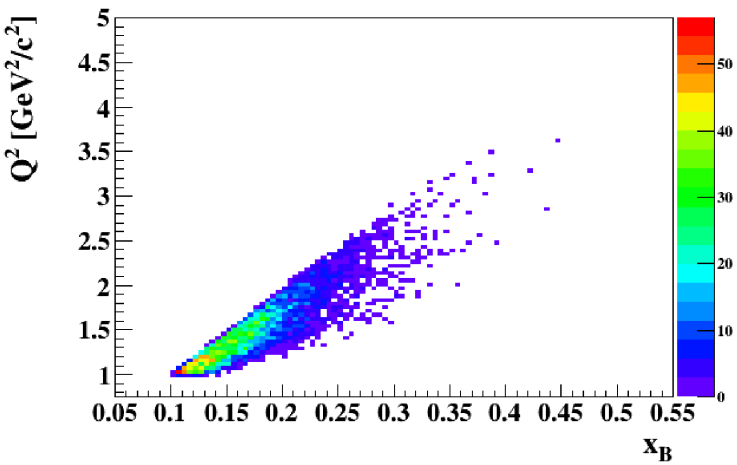
- The run period took place from April 2025 to September 2025 at JLab
- Run summary
  - Various targets, various beam energies
  - Total number of trigger events: 6.54×10^{10}
  - Beam current: up to 325 nA
  - Average event rate: 10 kHz

Target \ Beam	10.68 GeV	6.47 GeV	2.24 GeV	**Total**
^{4}He	58.06	7.32	2.11	67.49
^{2}D	27.13	0.07	2.06	29.26
p	0.21	0.62	1.93	2.76
empty	0.28	0.21	0	0.49
Total	85.68	8.22	6.1	**100 %**

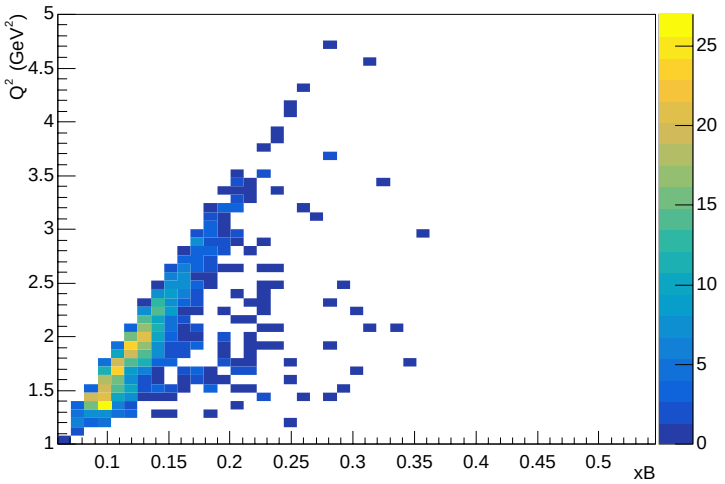
Table: Distribution of the number of events in percentage.

Preliminary results

- Since the end of the data taking, efforts are mainly focused the calibration of the data and the improvement of the reconstruction software
- While incomplete, we can already see some coherent DVCS events off ^{4}He
- Phase space comparison
  - ALERT covers lower x_B and higher Q^2 values



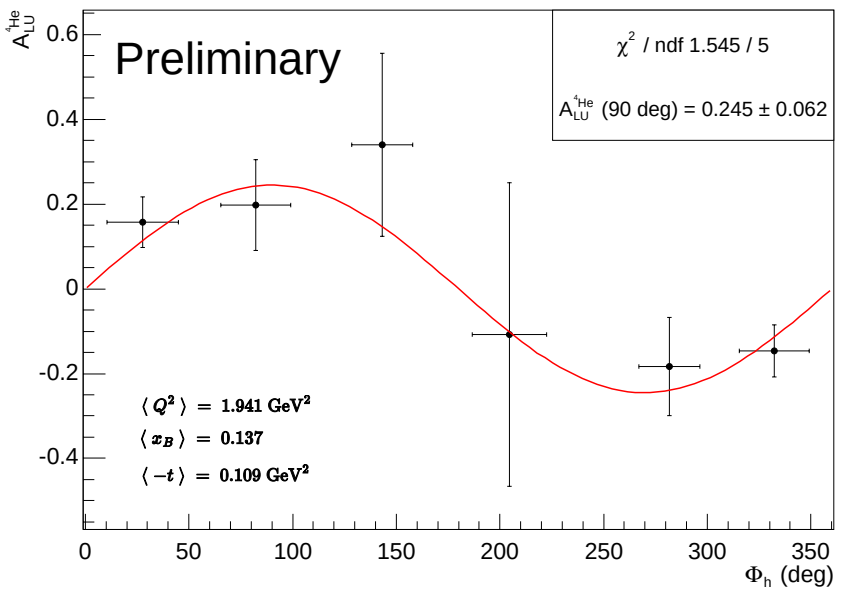
CLAS eg6



ALERT

Preliminary Beam Spin Asymmetry

- **Warnings**
  - The AHDC reconstruction is not completed
  - The calibration is still ongoing (ALERT and CLAS)
  - We made basic selection cuts
  - The BSA has been integrated over Q^2, x_B and $-t$
  - The errors are only statistical (no π^0 background subtraction)
  - The study has been done on 7.53 % of the dataset
- However, we can already see an asymmetry



Summary

- The study of nuclear GPDs will provide new insights into the QCD description of the nuclear structure
- The results by HERMES and CLAS eg6 highlight the need to ensure the full exclusivity of the nuclear DVCS process in order to separate the coherent and the incoherent channels
- The ALERT experiment is an extension of CLAS eg6 (higher luminosity, various beam energies, various targets)
- One year after the run period, the calibration is still ongoing, and the reconstruction software is evolving
- However, we can already isolate some processes of interest (*e.g* coherent DVCS off ^{4}He in this talk)
- For the upcoming year, we plan to finalize the calibration of the data and to perform a more complete DVCS analysis