First Look at MVT High Voltage Tables and RG-D Data

CLAS Collaboration Meeting

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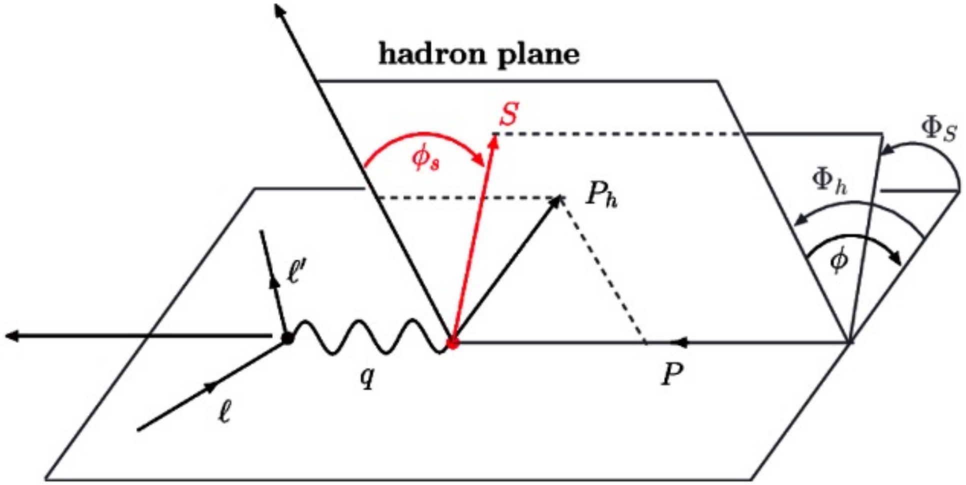
Semi-inclusive Deep Inelastic Scattering

✓ We consider the SIDIS process

$$e\ (l) + N\ (P) \rightarrow e\ (l') + h\ (P_h) + X,$$

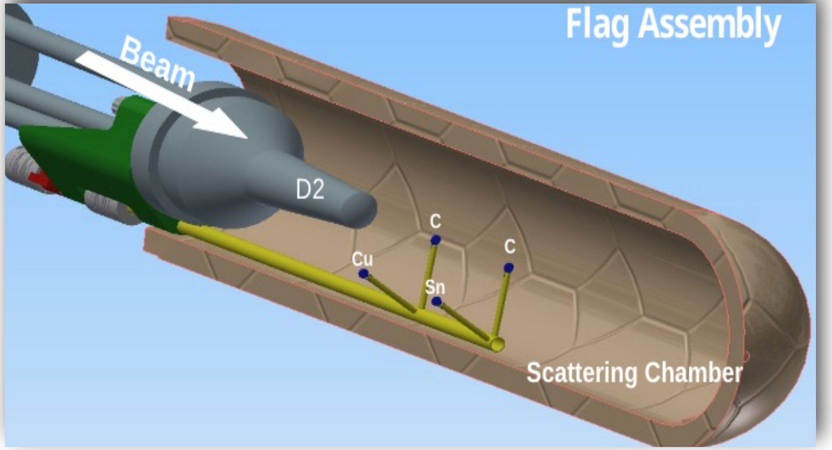
- Using RG-D data
- Interested hadron : π^-, or charged Kaons
- Measuring asymmetries : cos ϕ, sin ϕ, and cos 2ϕ
- Exploring nuclear TMDs



✓ Kinematic variables :

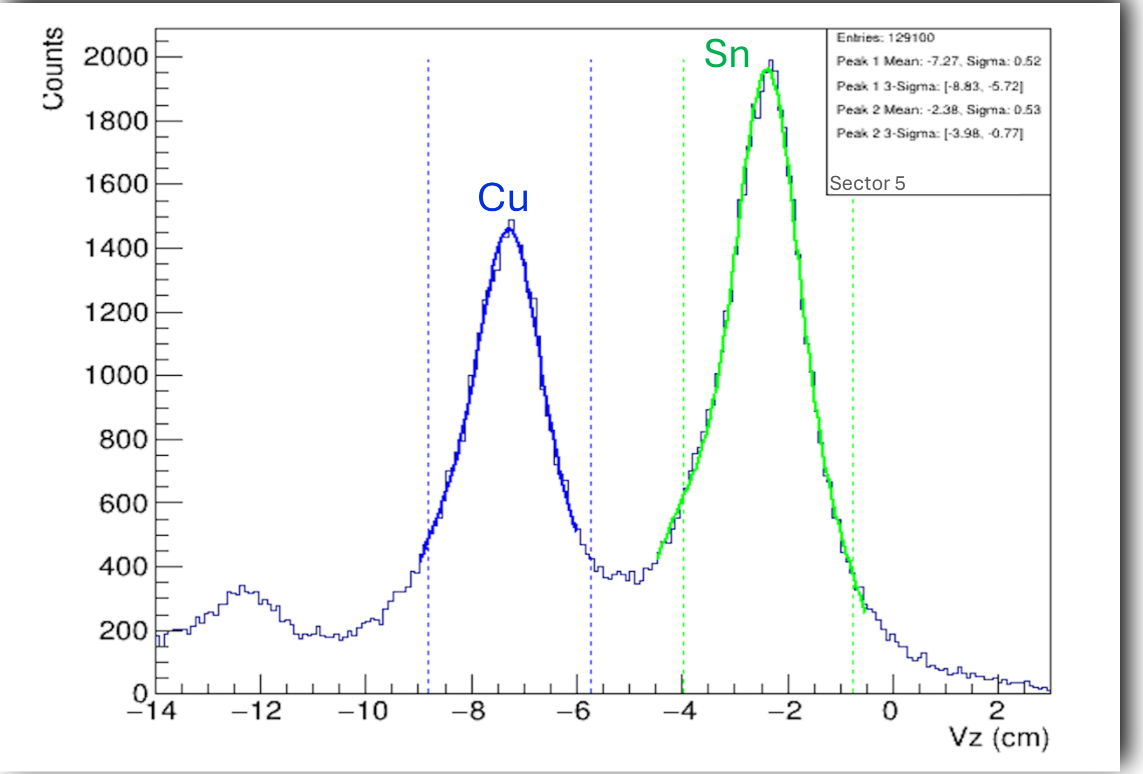
$$q = l - l',\ Q^2 = -q^2,\ x_B = \frac{Q^2}{2\,P.\,q},\ y = \frac{P\,.q}{P\,.\,l},\ z = \frac{P\,.\,P_h}{P\,.\,q}$$

RG-D Target Configuration



- ✓ Nuclear targets : LD2, Carbon (C), Copper (Cu), and Tin (Sn)
- ✓ Used cuts : 3σ cuts on Transverse vertex Vx & Vy, then Vz to select each solid-foil peak

- ➢ Developing analysis tools
- ➢ Involved in Service Work



z-vertex distribution for the CuSn solid-foil setup

Micromegas Vertex Tracker (MVT)

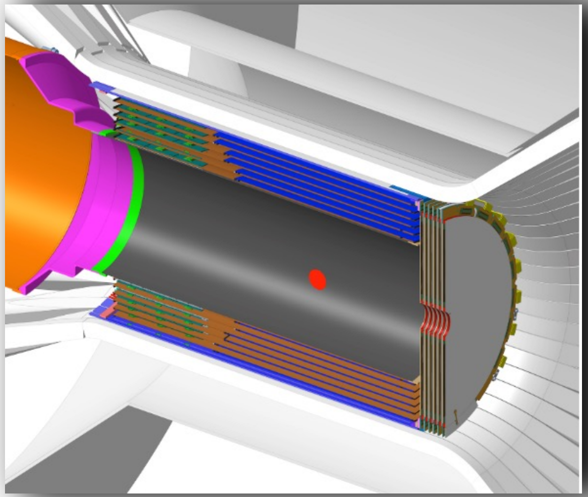
I. Why MVT?

To improve the vertex and polar angle resolution

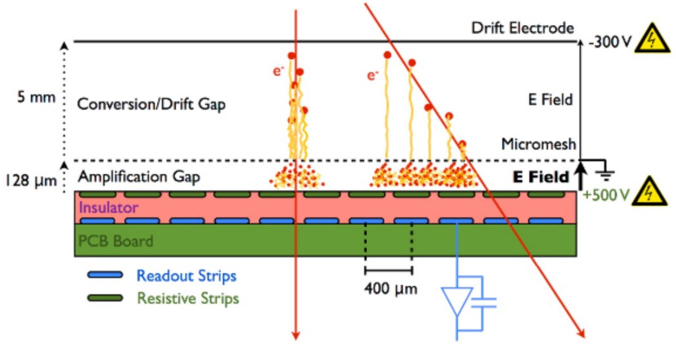
II. Geometry:

Barrel Micromegas Tracker (BMT in blue) and Forward Micromegas Tracker (FMT @ downstream right-end) form MVT.

- 6 cylindrical layers of BMT: 3 Z strips, 3 C strips.
- 6 Micromegas disks of FMT.
  - ✓ However, only 3 disks were used in RG-D.



III. Working Principle:



Micromegas detector

- **Ionization:** Charged particles ionize gas molecules in the conversion gap.
- **Electron Drift:** Electrons drift towards the micro-mesh.
- **Amplification:** Accelerated electrons create an electromagnetic shower.
- **Signal Collection:** Signals are collected by the readout strips.

Issues with BMT and FMT

❖ **High voltage (HV) operational stability**

- ❑ **Some MVT detectors**
  - could not operate at HV settings (especially with nuclear targets)
  - failed on strip and drift voltages
  - operated at reduced HV or were turned off in recent years

(HV was lowered for the sensors to run stable and avoid tripping)

- ❑ **Consequences of lowering HV:**
  - ▪ **Lower Strip Voltage:**
    - Results in lower hit efficiency
    - Affects track reconstruction
  - ▪ **Lower Drift Voltage:**
    - Results in larger cluster sizes in BMT-Z tiles due to larger Lorentz angle
    - Affects residuals

✓ Modified BMT gas setup improved stability and hit efficiency significantly
✓ Ongoing activity in Saclay: manufacturing more spare detectors for future CLAS12 experiments

MVT HV Table

Why HV Table?

❖ **To Track Hardware Status:**
- Monitor the operational state of Micromegas detectors
- Identify functional and non-functional detectors

❖ **To Match MVT Acceptance with GEant4 Monte-Carlo (GEMC):**
- Ensure simulations only include operational detectors
- Exclude non-operational detectors to match real experimental conditions.

❖ **To Match Hit Efficiency with GEMC:**
- Adjust simulated hit efficiency based on strip voltages. However, using HV tables to match GEMC detector hit efficiency has some limitations; thus, will be substituted by data-based hit efficiency tables
- Reflect real performance characteristics in simulated data

Workflow for HV Table Creation

❖ Procedure Followed Creating HV Table:

- ❖ Extracting HV values from the MYA DB and detecting changes in the values;
- ❖ Creating the HV tables in (sector, layer, component, and HV) format;
- ❖ Validate the table with the MYA stripchart plot;
- ❖ Uploading HV tables to the calibration constants database (CCDB)

Sector	Layer	Component	HV
1	1	0	450.0
1	2	0	440.0
1	3	0	439.9
1	5	0	0.0
1	6	0	459.7

sector	layer	component	HV1	HV2	HV3
1	1	0	400.0	450.0	470.0
1	2	0	420.0	450.0	470.0
1	3	0	430.0	480.0	500.0
1	4	0	380.0	440.0	460.0
1	5	0	420.0	450.0	470.0
1	6	0	430.0	470.0	490.0

❑ Reconstruction Code:

- ➢ Reads HV tables;
- ➢ Excludes detectors with strip HV below the 1st threshold (HV1);
- ➢ Simulates lower hit efficiency for voltages between 2nd (HV2) and 3rd thresholds (HV3)

Locations for HV Thresholds and Tables

BMT:

❖ **Strip HV Thresholds:**
- /calibration/mvt/bmt_strip_voltage_thresholds

❖ **Strip HV Tables:**
- /calibration/mvt/bmt_strip_voltage

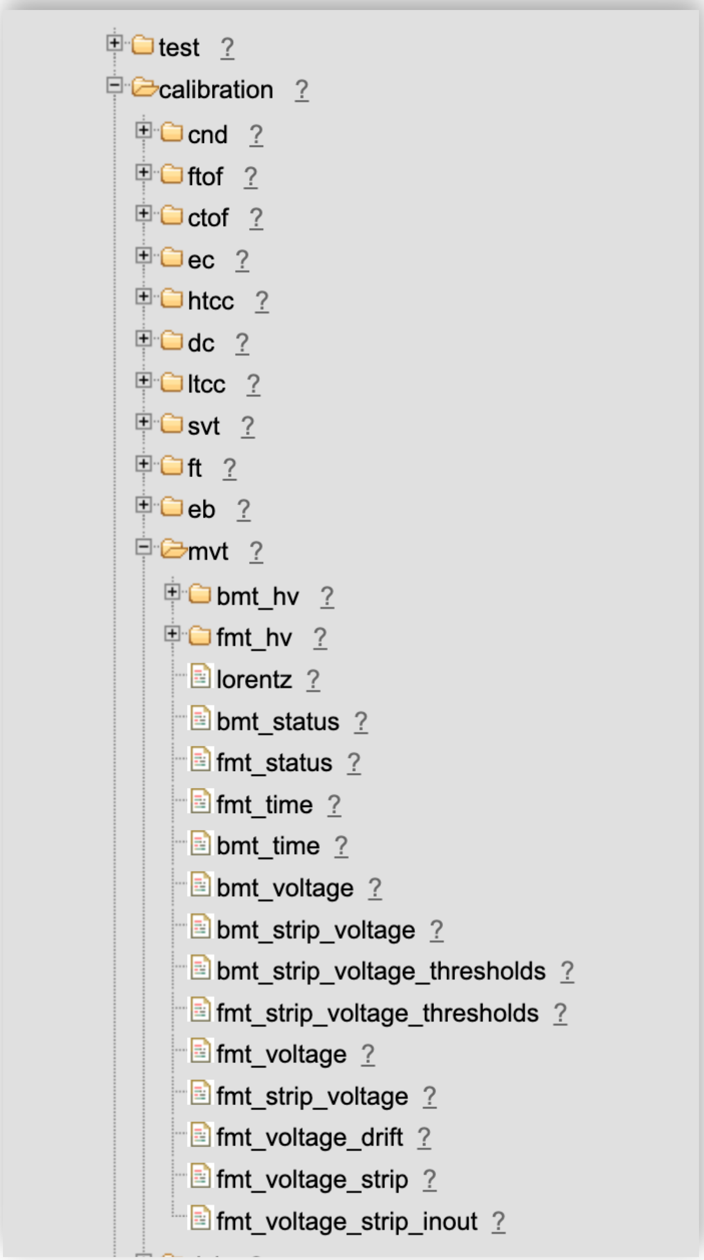
❖ **Drift HV Tables:**
- /calibration/mvt/bmt_voltage

FMT:

❖ **Strip HV Thresholds:**
- /calibration/mvt/fmt_strip_voltage_thresholds

❖ **Strip HV Tables:**
- /calibration/mvt/fmt_voltage_strip_inout

❖ **Drift HV Tables:**
- /calibration/mvt/fmt_voltage_drift



Summary and Outlook

❖ **Analysis Work:**

- Measure asymmetries and explore nuclear TMDs using the SIDIS process using RG-D data
  - ✓ Developing analysis tools

❖ **Importance of HV Tables:**

- Crucial for accurate hardware monitoring and simulation

❖ **Code Development and Debugging:**

- Finalize and test the new hit efficiency calculation code

Acknowledgement

Thank You