Proton Magnetic Form Factor

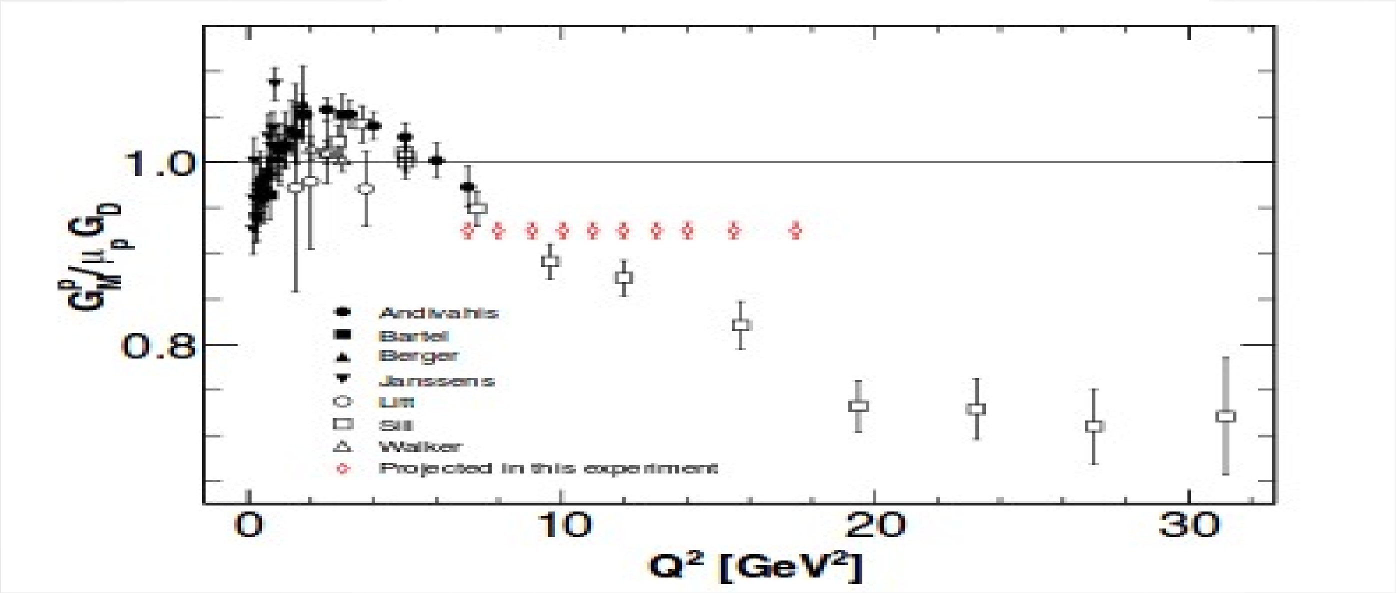
- Nucleon electromagnet form factors describe the spatial distribution of electric charge and current inside the nucleon and thus are related to its internal structure.
- G_E^P and G_M^P are two form factors that are the Fourier transforms of charge and magnetization current density inside the nucleon.
- They are just the combinations of Dirac F_1 and Pauli F_2 form factors as,

$$G_E^P = F_1 - \frac{Q^2 F_2}{4M^2} \quad \text{and} \quad G_M^P = F_1 + F_2$$

Where,

$$Q^2 = 4\mathrm{EE}'\sin^2(\theta/2)$$

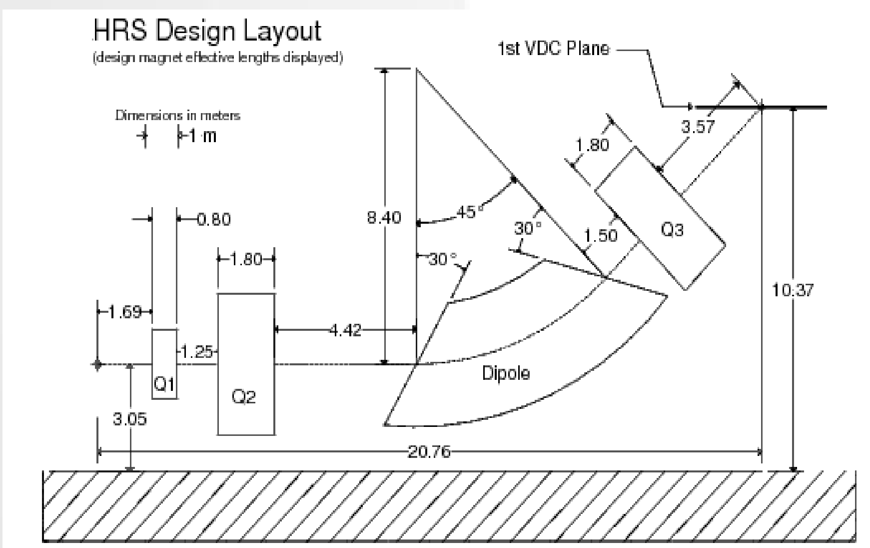
- G_M^P experiment aims to measure the elastic e-p cross-section in the Q^2 range from 7 to 17 GeV^2 with high precision better than 2%.
- World data for $G_M^P/\mu_P G_D$ and red data points are our regions of interest.



$$G_D = \frac{1}{\left(1+\frac{Q^2}{0.71}\right)^2}$$

HRS Acceptance

- HRS is a magnetic spectrometer consisting of a dipole and four quadrapole magnets in the configuration Q1Q2DQ3.
- Q1 and Q2 are used to achieve the desire angular acceptance and maximize the resolving power and Q3 enhance the position and and angular resolutions whereas, dipole bended the charge particles by 45°.
- The acceptance limits for HRS for in-plane and out-plane angles are ± 28mr and ± 60mr respectively, where as momentum acceptance is ± 6%.



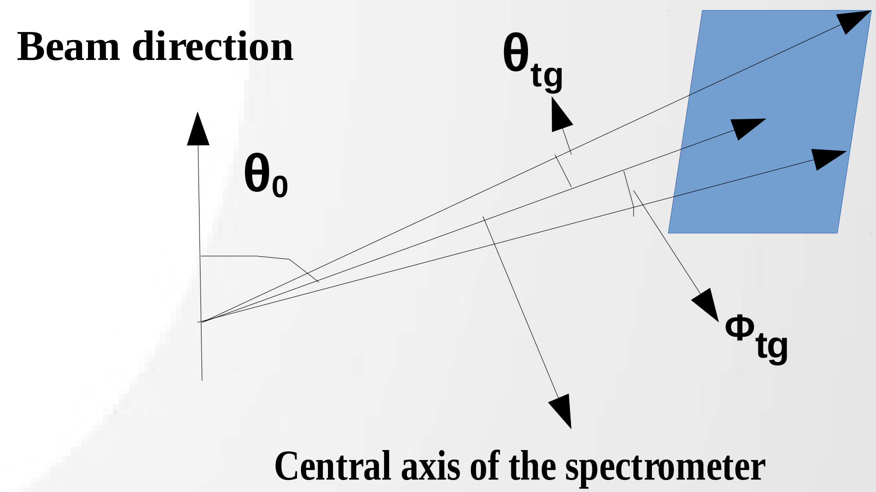


Fig: schematic of HallA high resolution spectrometer

- Generally the acceptance is a function of three target coordinates X,Y,Z and three spectrometer coordinates $\delta, \theta_{tg}, \Phi_{tg}$. However, physics depends only upon the momentum and full scattering angle, the acceptance can be written as a function of two variables δ and θ. Where,

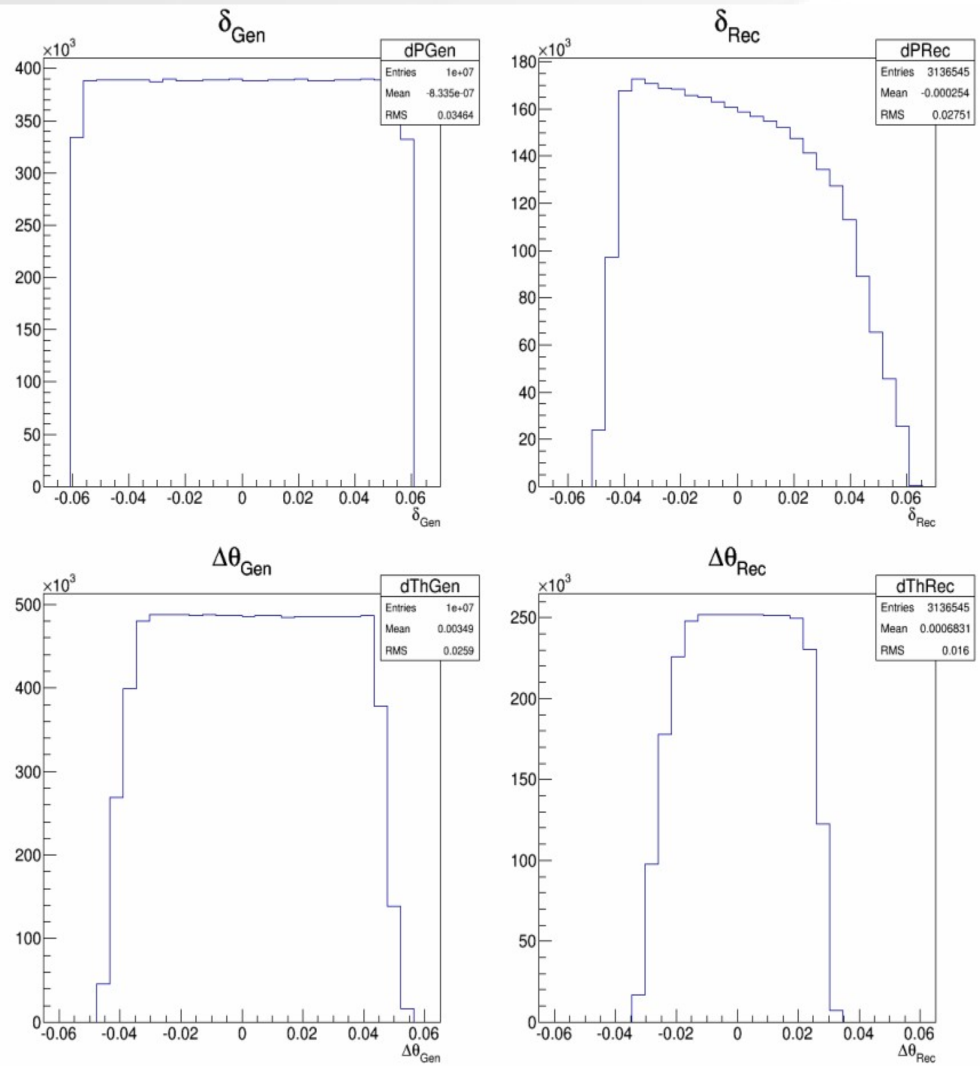
$$\delta = \frac{P - p_0}{P_0} \qquad \text{and}$$

$$\theta = \arccos\left[\cos(\theta_{tg})\cos(\theta_0 - \Phi_{tg})\right]$$

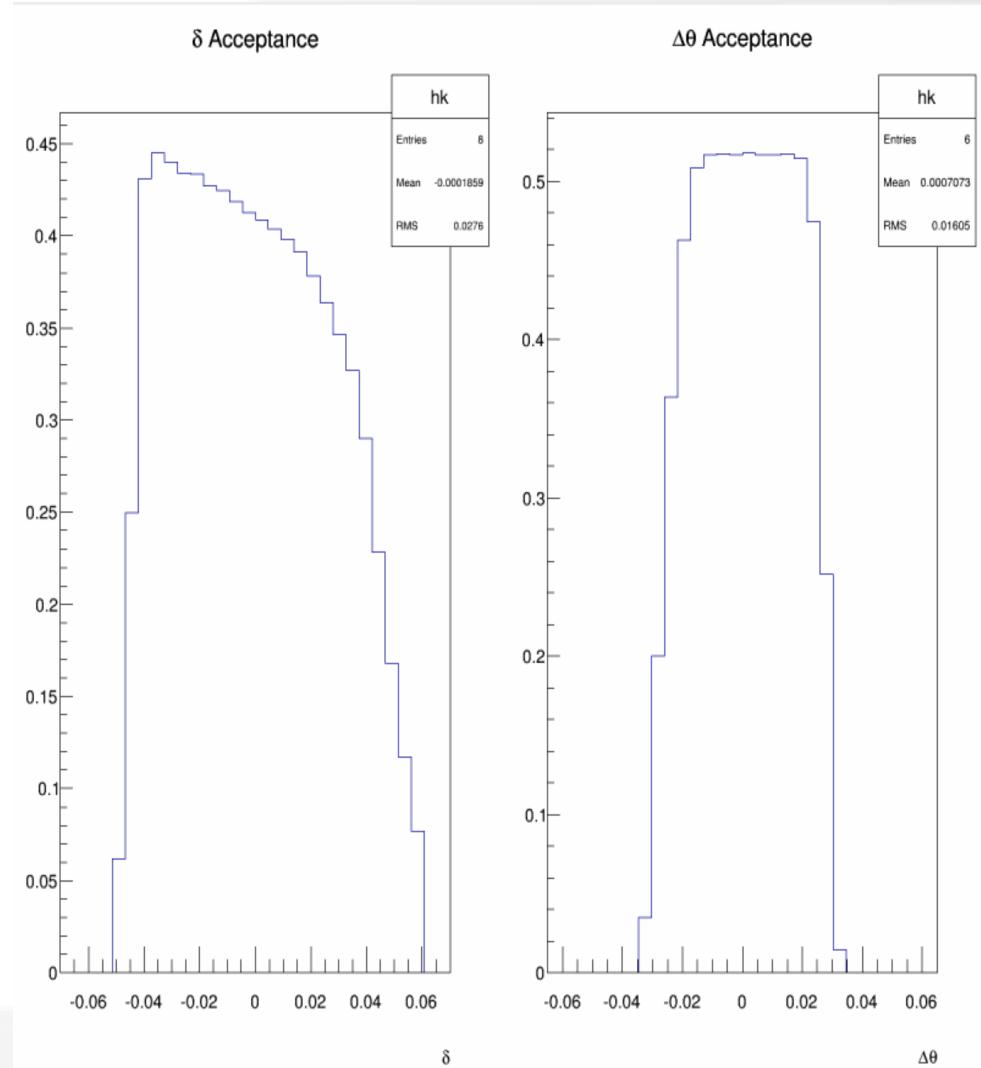
- The acceptance function is calculated generating Monte Carlo events and taking the ratio of the number of detected to the number of generated in each bin in phase space. That is,

$$A(\delta, \theta) = \frac{N_{Acc}(\delta, \theta)}{N_{Gen}(\delta, \theta)}$$

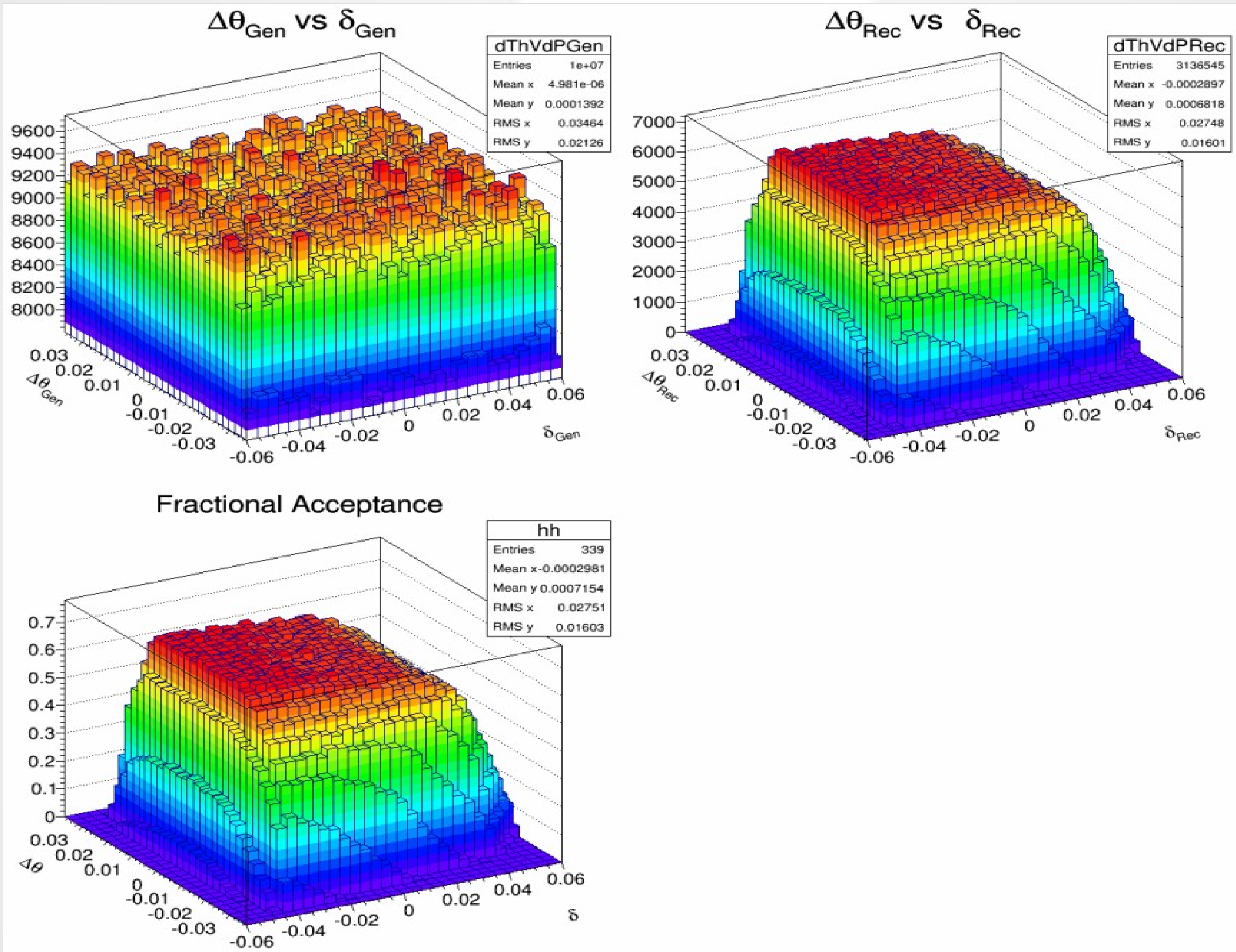
- Both generated and reconstructed data were binned in small δ and θ bins. For HRS, a δ range of ±6% was used and binned in 30 bins and θ is of (-37,37) mrad was binned in 30 bins. The acceptance correction is applied in bin by bin basis in (δ,θ).
- We also applied $\Delta\theta=\theta-\theta_0$ cut on the both generated and reconstructed MC events the correction coming from additional multiple scattering can be estimated



δGen
dPGen
Entries 1e+07
Mean -8.335e-07
RMS 0.03464
δRec
dPRec
Entries 3136545
Mean -0.000254
RMS 0.02751
ΔθGen
dThGen
Entries 1e+07
Mean 0.00349
RMS 0.0259
ΔθRec
dThRec
Entries 3136545
Mean 0.0006831
RMS 0.016



δ Acceptance
hk
Entries 8
Mean -0.0001859
RMS 0.0276
δ
Δθ Acceptance
hk
Entries 6
Mean 0.0007073
RMS 0.01605
Δθ



Δθ_Gen vs δ_Gen
dThVdPGen
Entries 1e+07
Mean x 4.981e-06
Mean y 0.0001392
RMS x 0.03464
RMS y 0.02126
Δθ_Gen
δ_Gen
Δθ_Rec vs δ_Rec
dThVdPRec
Entries 3136545
Mean x -0.0002897
Mean y 0.0006818
RMS x 0.02748
RMS y 0.01601
Δθ_Rec
δ_Rec
Fractional Acceptance
hh
Entries 339
Mean x -0.0002981
Mean y 0.0007154
RMS x 0.02751
RMS y 0.01603
Δθ
δ

Conclusion

- Measured acceptance from this analysis is 60%, which is less than the expected for point target. We are working at present to improve this mismatch.
- Also we are going to calculate acceptance for 15cm target and will compare it with the point target.
- Our next step is to calculate effective solid angle for cross-section analysis.