

Exclusive π^0 Production in the Backward Region

DESY Summer Student Programme 2009

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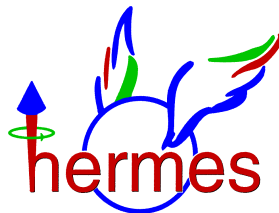
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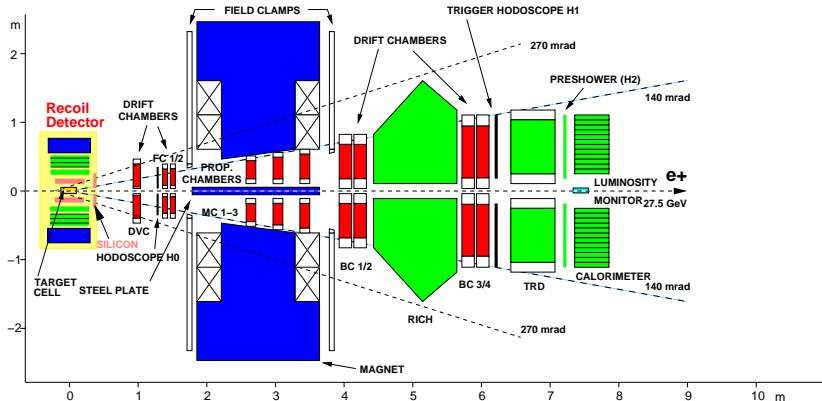
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HERMES

- **HERA Measurement of Nucleon Spin**
- Study of spin structure of proton
- Fixed target experiment using only HERA lepton beam (27.6 GeV)
- Start in 1995: only Forward Spectrometer
- 2006: Recoil Detector added



The HERMES Spectrometer



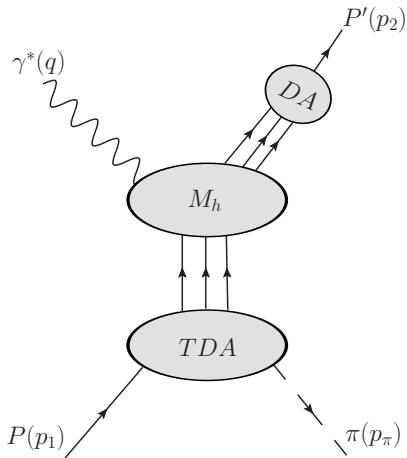
Exclusive π^0 Production

Process

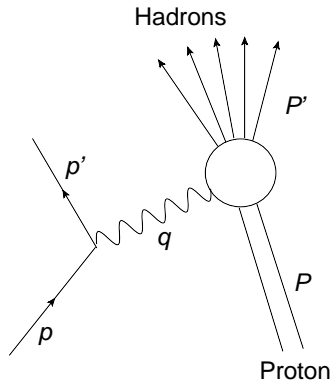
$$ep \rightarrow ep\pi^0$$

$$\hookrightarrow 2\gamma$$

- lepton and proton go in forward direction \rightarrow FS
- π^0 in backward region $\rightarrow 2\gamma \rightarrow$ RD
- unpolarized hydrogen target



Deep Inelastic Scattering (DIS)



$$-Q^2 = q^2 = (p - p')^2$$

$$\approx \frac{-4EE'}{c^2} \sin^2 \frac{\theta}{2}$$

$$\nu = \frac{Pq}{M} \stackrel{\text{lab}}{=} E - E'$$

$$y = \frac{\nu}{E}$$

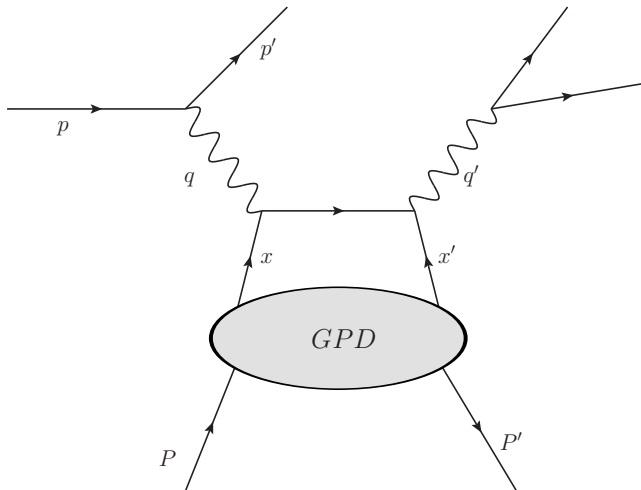
$$W^2 c^2 = P'^2 = (P + q)^2$$

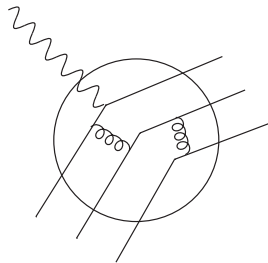
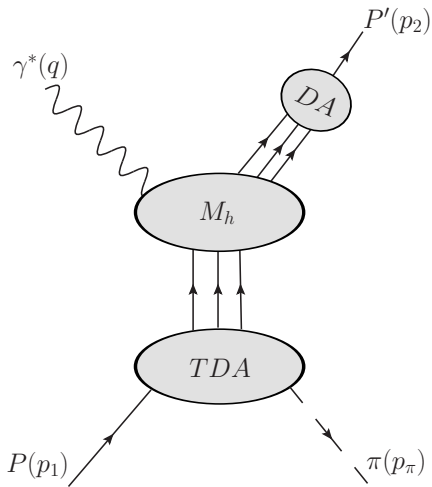
$$= M^2 c^2 + 2Pq + q^2$$

$$= M^2 c^2 + 2M\nu - Q^2$$

PDF \rightarrow GPD \rightarrow TDA

$$\langle P | \hat{O} | P' \rangle$$



PDF \rightarrow GPD \rightarrow TDA

- $\langle P | \hat{O} | \pi \rangle$
- structure proton \leftrightarrow pion

Basic cuts

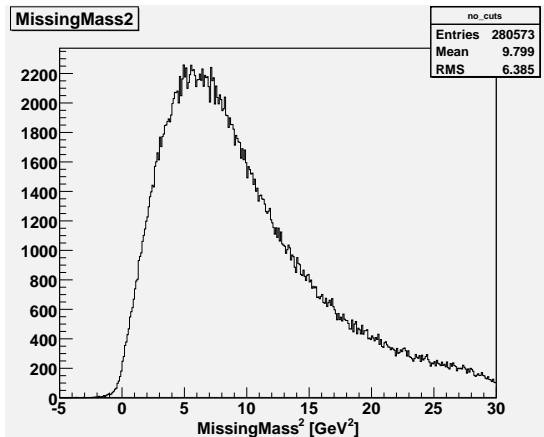
- DIS cuts
 - $Q^2 > 1 \text{ GeV}^2$
 - $W^2 > 4 \text{ GeV}^2$
 - $y < 0.85$
- Fiducial volume cuts
- Target geometry cut
- NG1Tracks = 2, NSMClusters = 0
- PID to identify lepton
- PID and RICH to identify proton

Missing Mass

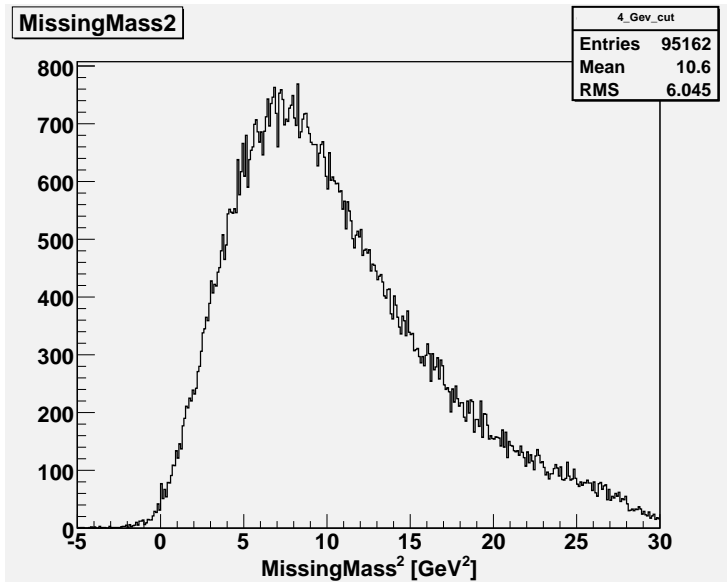
$$MM^2 = (p + P - p' - P')^2$$

Missing Mass

$$MM^2 = (p + P - p' - P')^2$$

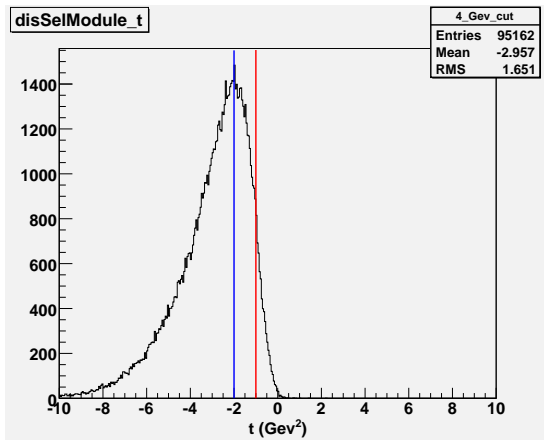


4 GeV momentum cut on proton

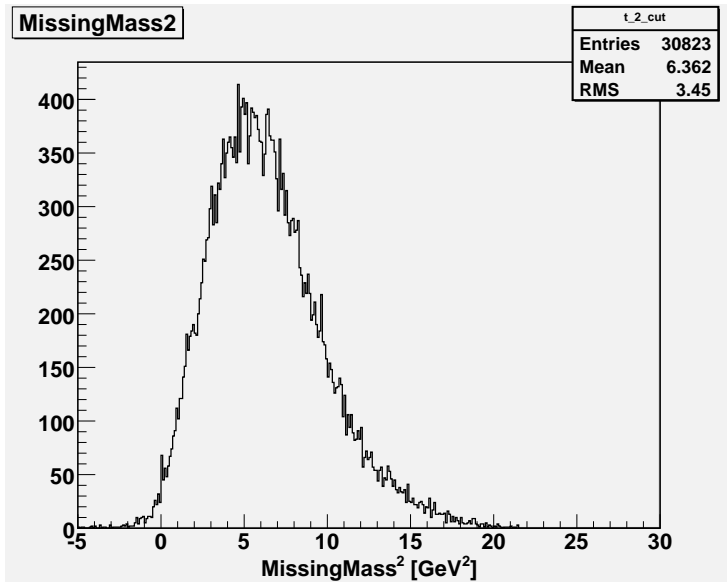


t -distribution

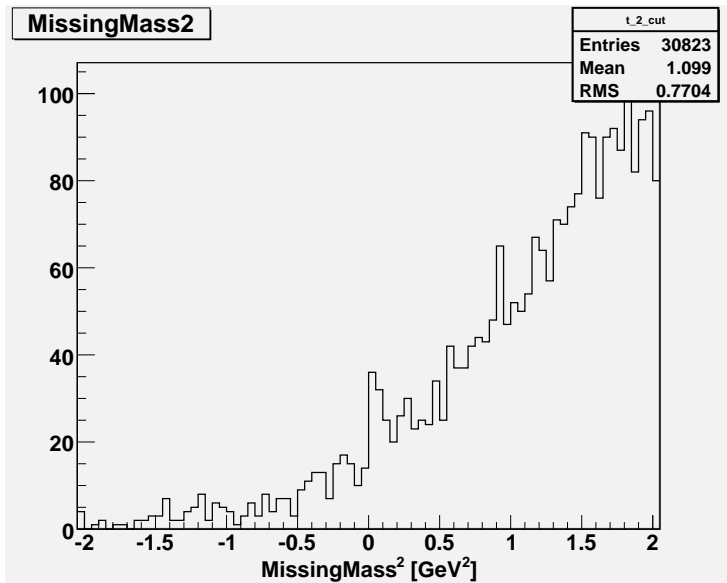
$$t = (P' - q)^2$$



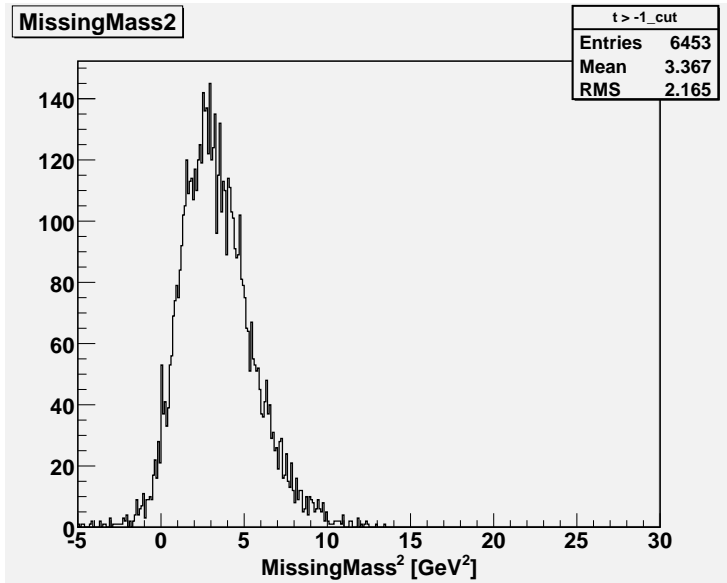
$$t > -2 \text{ GeV}^2$$



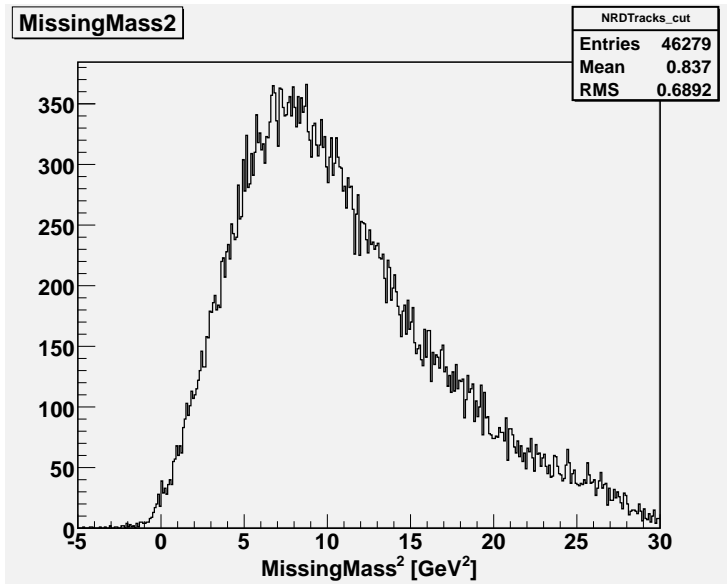
$$t > -2 \text{ GeV}^2$$



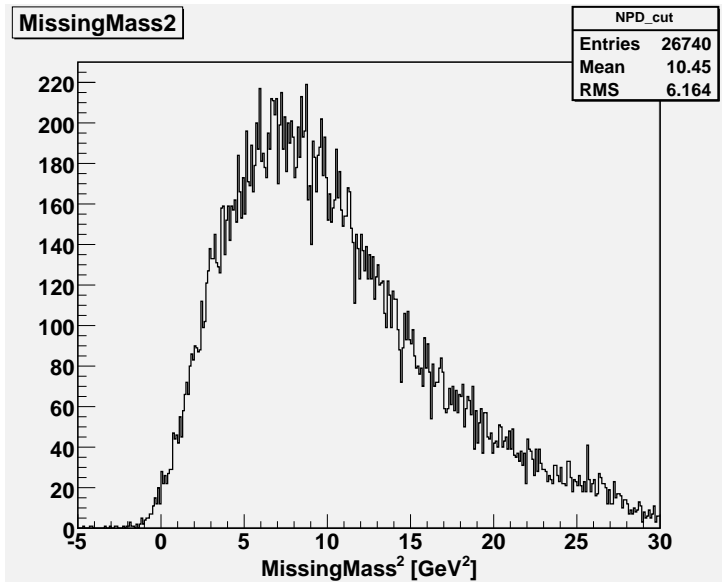
$$t > -1 \text{ GeV}^2$$



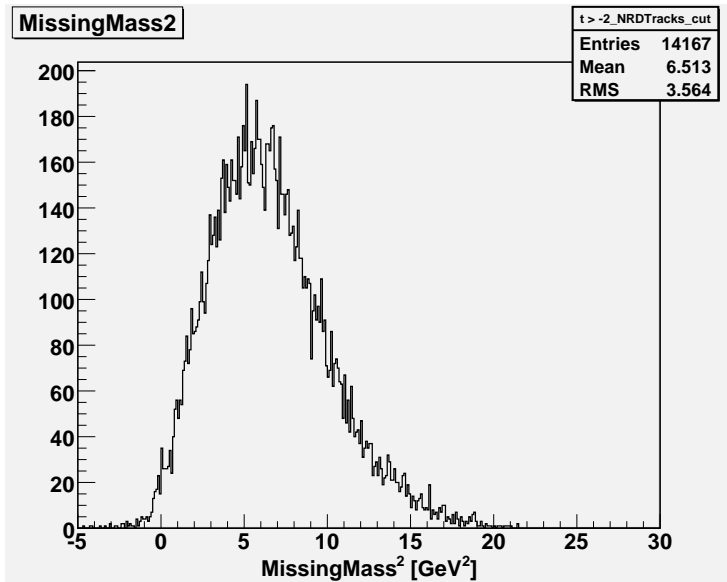
NG1RDTracks = 0



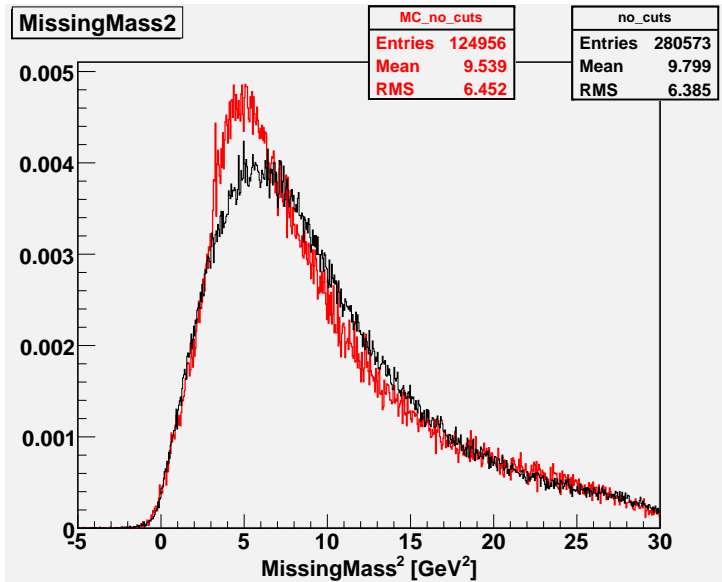
NG1PD > 0

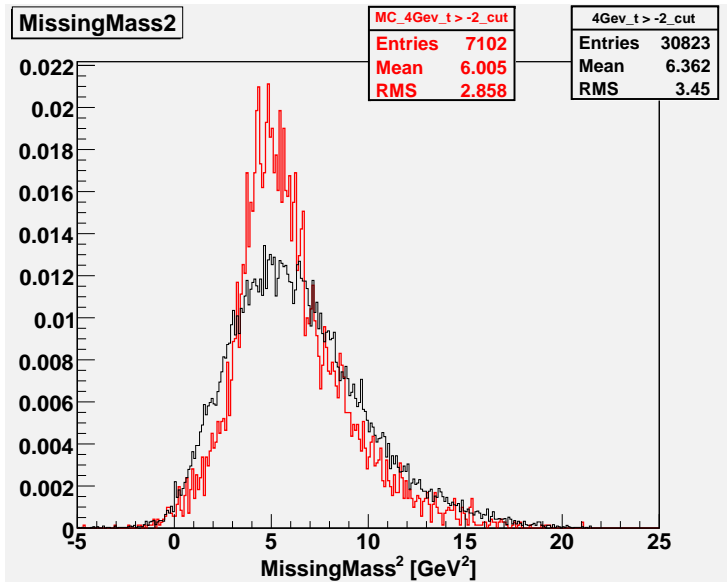


$$t > -2 \text{ GeV}^2, \text{NG1RDTracks} = 0$$



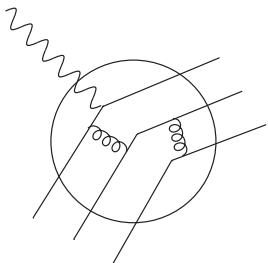
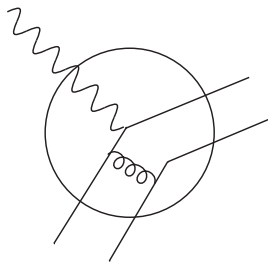
Only basic cuts



4 GeV momentum cut on proton, $t > -2 \text{ GeV}^2$ 

Conclusion

- No signal found
- Detector resolution
- Process suppressed due to hard scattering matrix element
- Cross section $\sim \frac{1}{Q^6}$



An aerial photograph of a valley with a large lake in the background and mountains in the distance. A red oval is drawn over the foreground, containing the text. The text is white and centered within the oval.

Any questions?

Thank you for your attention