A Measurement of Two-photon Exchange in Unpolarized Elastic e^+ and e^- Scattering

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Two-Photon Exchange

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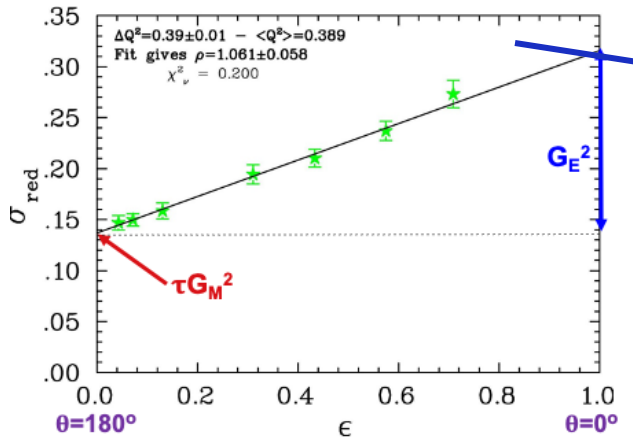
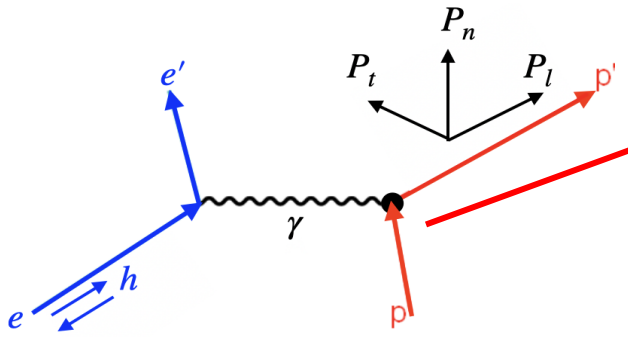
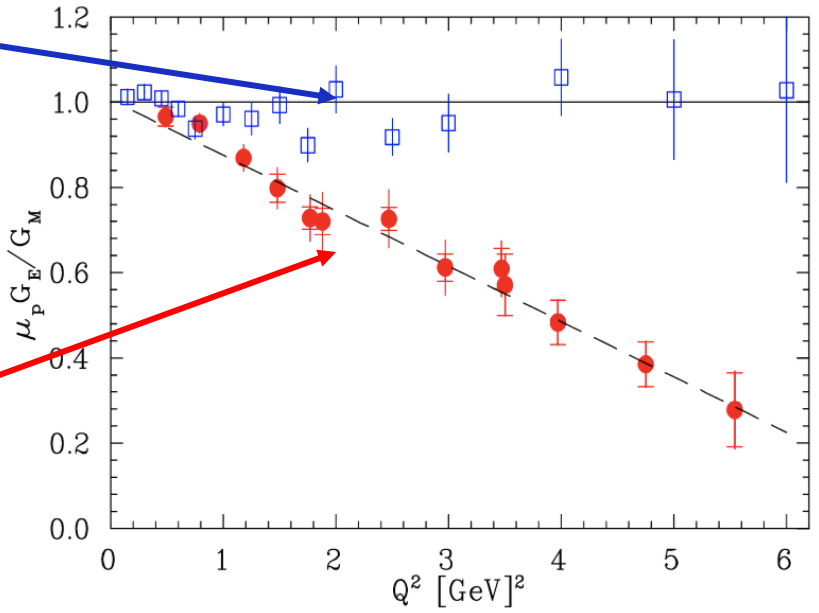
G_{E_p}/G_{M_p} Ratio by Polarization Transfer in $\vec{e}p \rightarrow e\vec{p}$

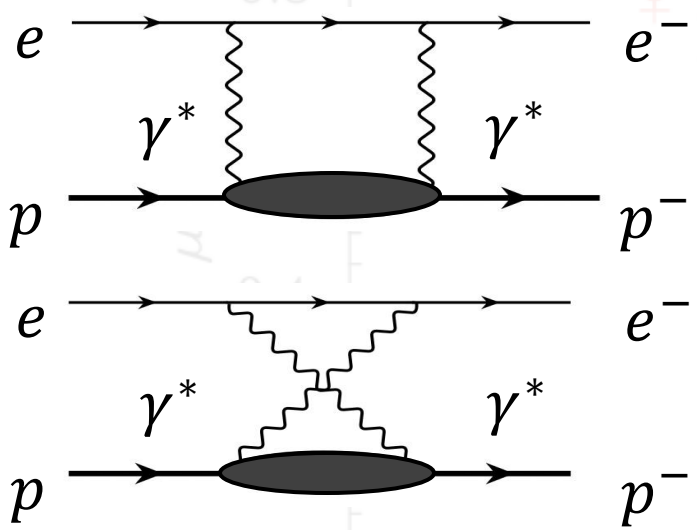






Two-Photon Exchange

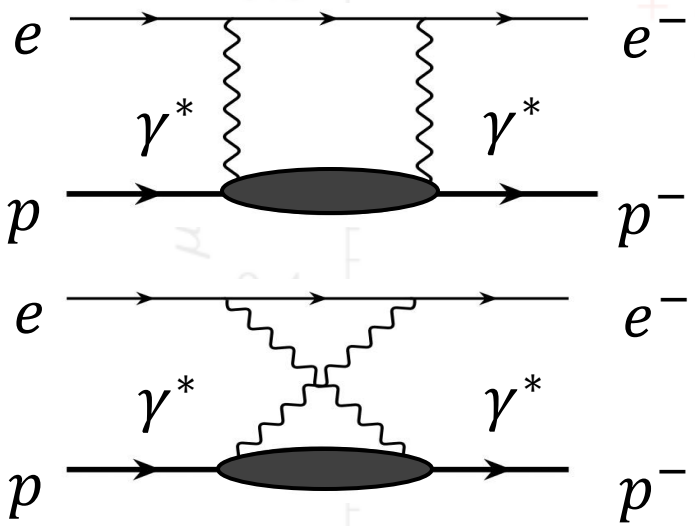
Discrepancy believed to be due to unaccounted TPE terms

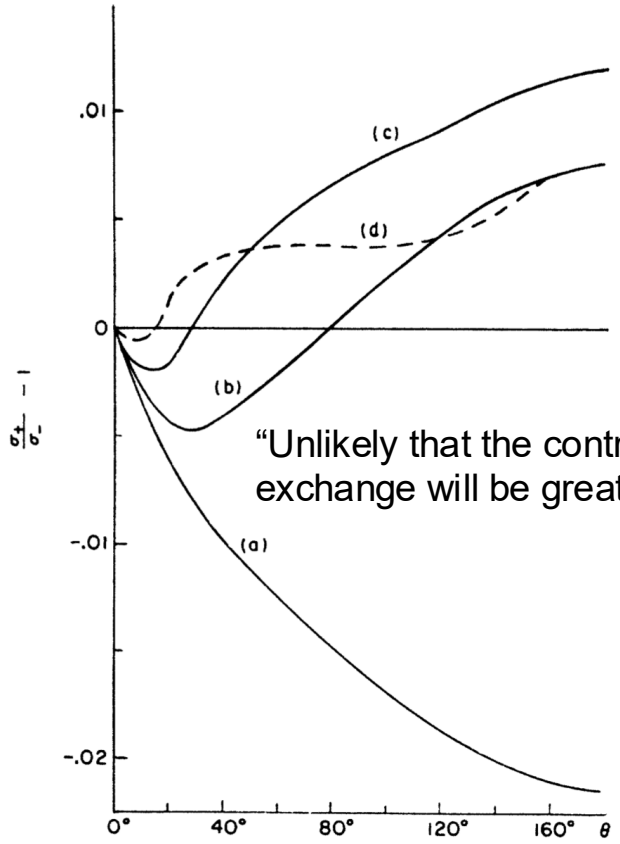


Two-Photon Exchange

Discrepancy believed to be due to unaccounted TPE terms

- Early predictions ➡ small effect & likely would not influence results





"Unlikely that the contribution of two-photon exchange will be greater than 2%"

Gary K. Greenhut Phys. Rev. 184,(1969)

Two-Photon Exchange

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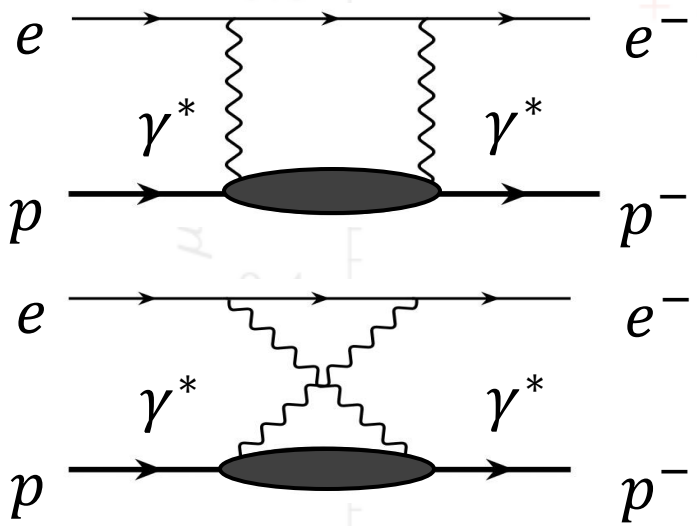
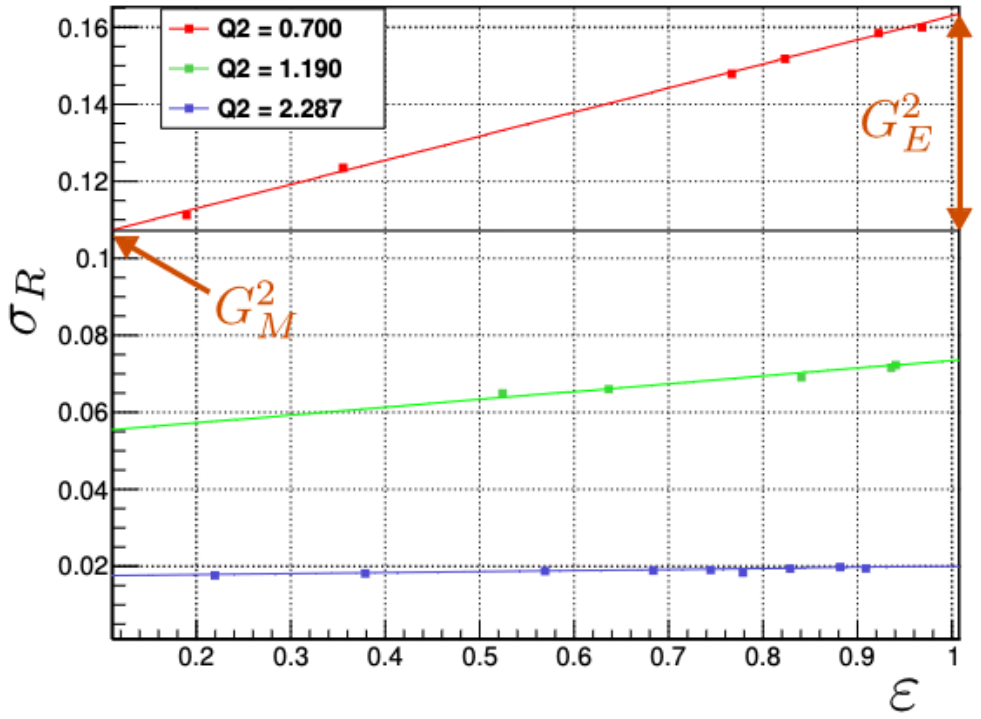
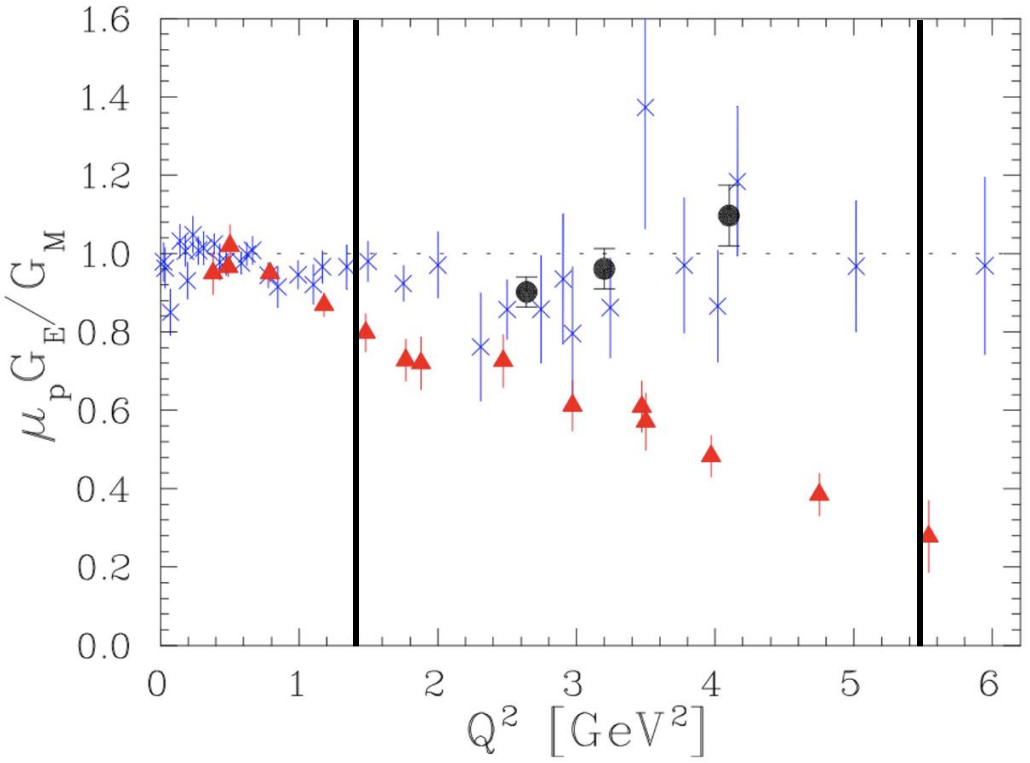


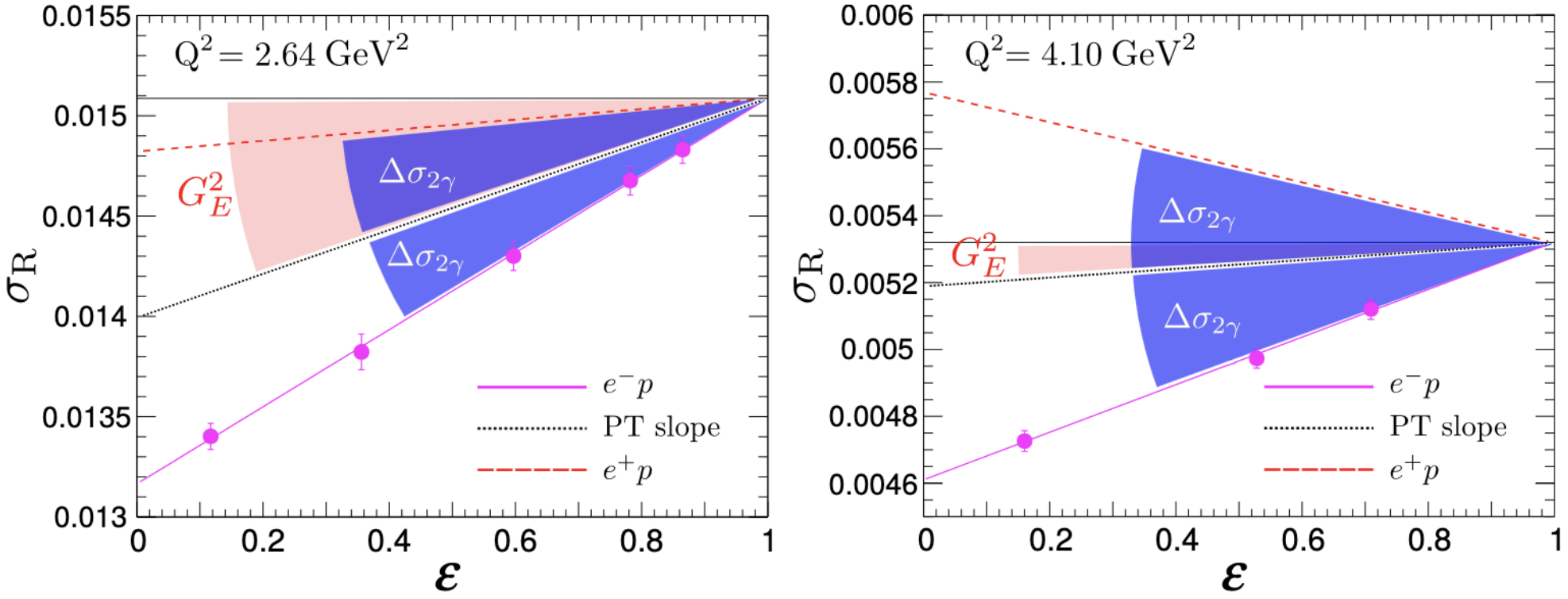


PR12+23-012

- Modified method Rosenbluth separation using e^- & e^+
  - Proton detection
- Will allow for precision in extracting the ε dependence of the cross section
  - Precision extraction of $\frac{G_E}{G_M}$
- Make direct comparison of e^- & e^+ S-R data
  - Test the TPE assumption at high Q^2



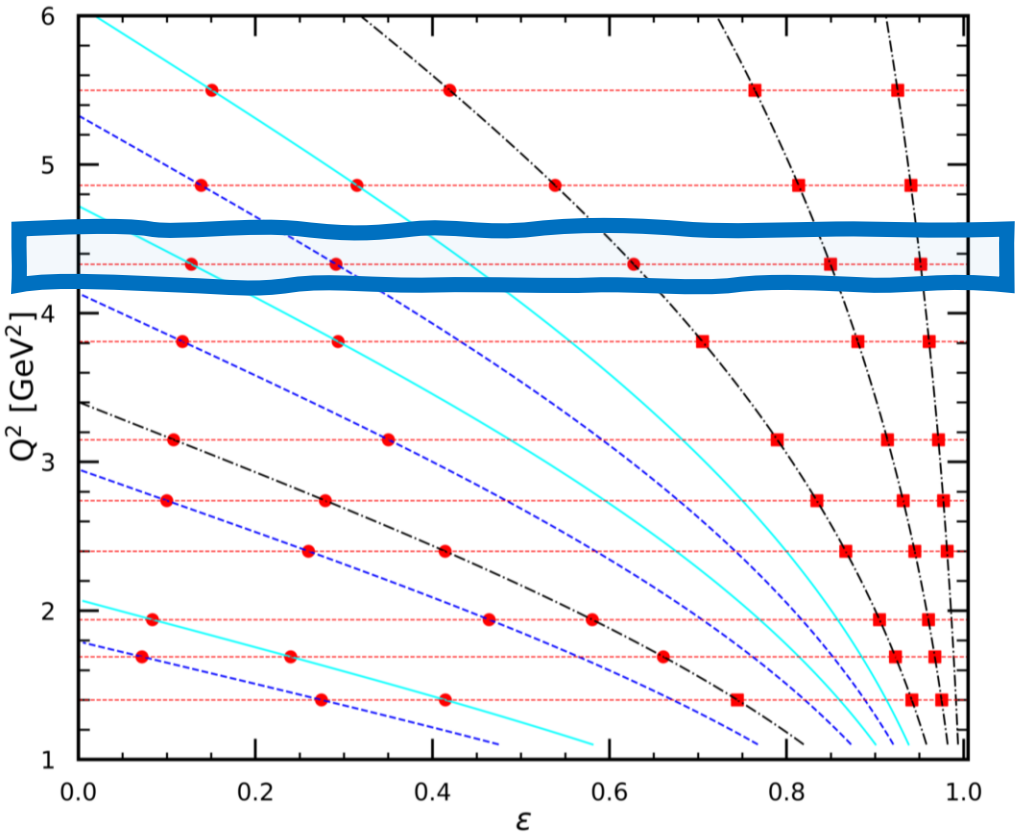
Projected Results



- Approved at PAC 51 with A- scientific rating
- Beam Time Request
  - 41 days (e^+)
  - 15 days (e^+)

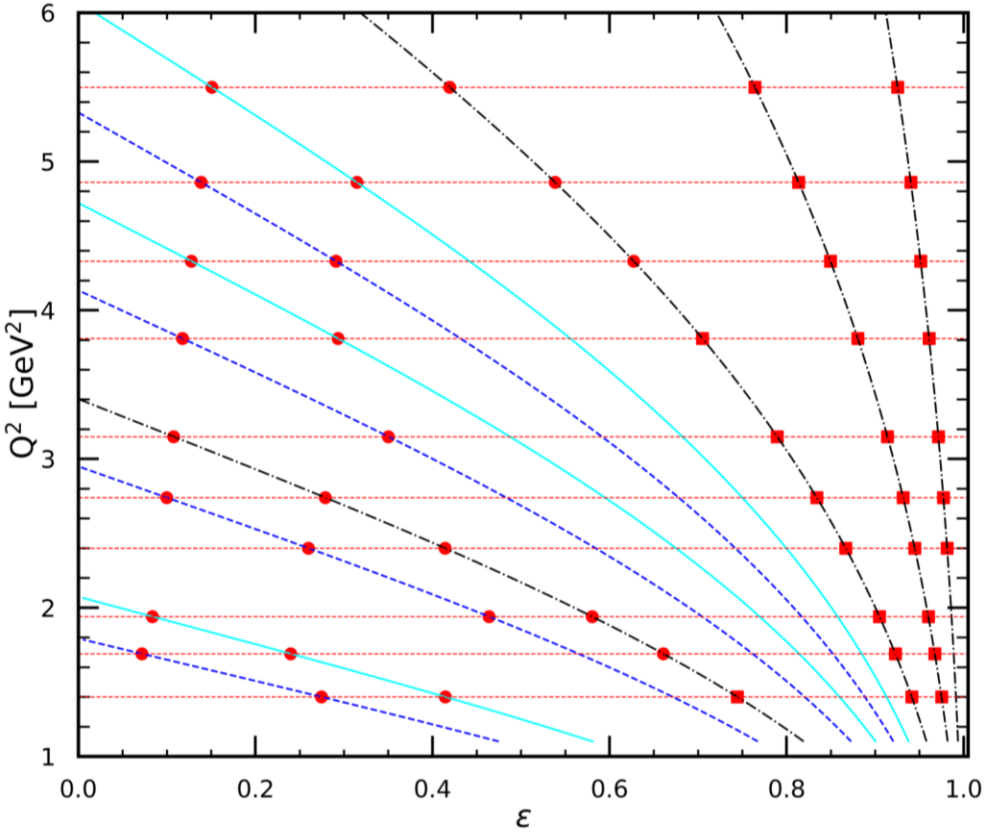
Kinematics

- Will make S-R measurements at 10 Q^2 points
  - Q^2: 1.4 -5.5 GeV^2
  - 4-5 ε points at each Q^2



Kinematics

- Will make S-R measurements at 10 Q^2 points
  - Q^2: 1.4 -5.5 GeV^2
  - 4-5 ε points at each Q^2
- Requires **11** beam energies
- Original configuration of energies used different linac settings
  - Example - 650 MeV/c per pass
  - Injection energy ~36.6 MeV(too low for injector)
- Yves Roblin illustrated the beam energies are achievable using alternative linac settings

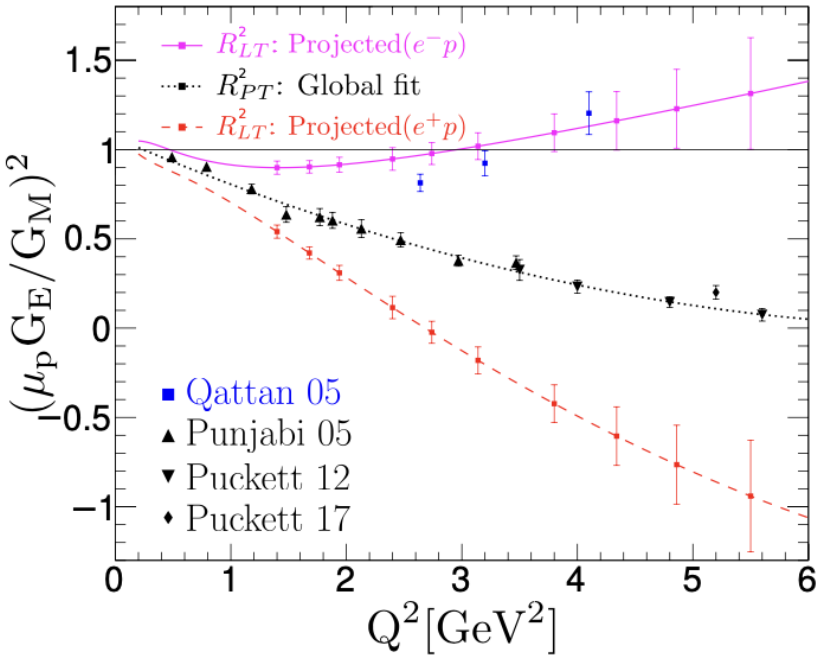


Beam Energies

Beam Energy [MeV]	Injector [MeV]	Linac [MeV]	Pass
1300	69.51	616.0	1
1950	104.14	923.0	1
2600	71.35	632.2	2
3250	89.17	790.2	2
1460	77.98	691.1	1
2920	80.11	710.0	2
3650	100.14	887.5	2
2200	120.68	1069.5	1
4400	120.68	1069.5	2
6600	121.82	1079.6	3
1100	122.77	1088.0	5

Summary and Outlook

- Beam energies achievable
- Hadron 2030
  - Discussions with Yannick Ulrich about using McMule for radiative corrections



Thank You

Standard Hall C Configuration

- 10 cm liquid hydrogen target
- HMS (proton arm): 11°-54°
- SHMS (lepton arm): 10°-39°
- Positron beam current: 1 μA
- Electron beam current: 20 μA