E08-007 Part II
Physics & Status

Guy Ron
Hebrew University of Jerusalem
For the E08007 Collaboration

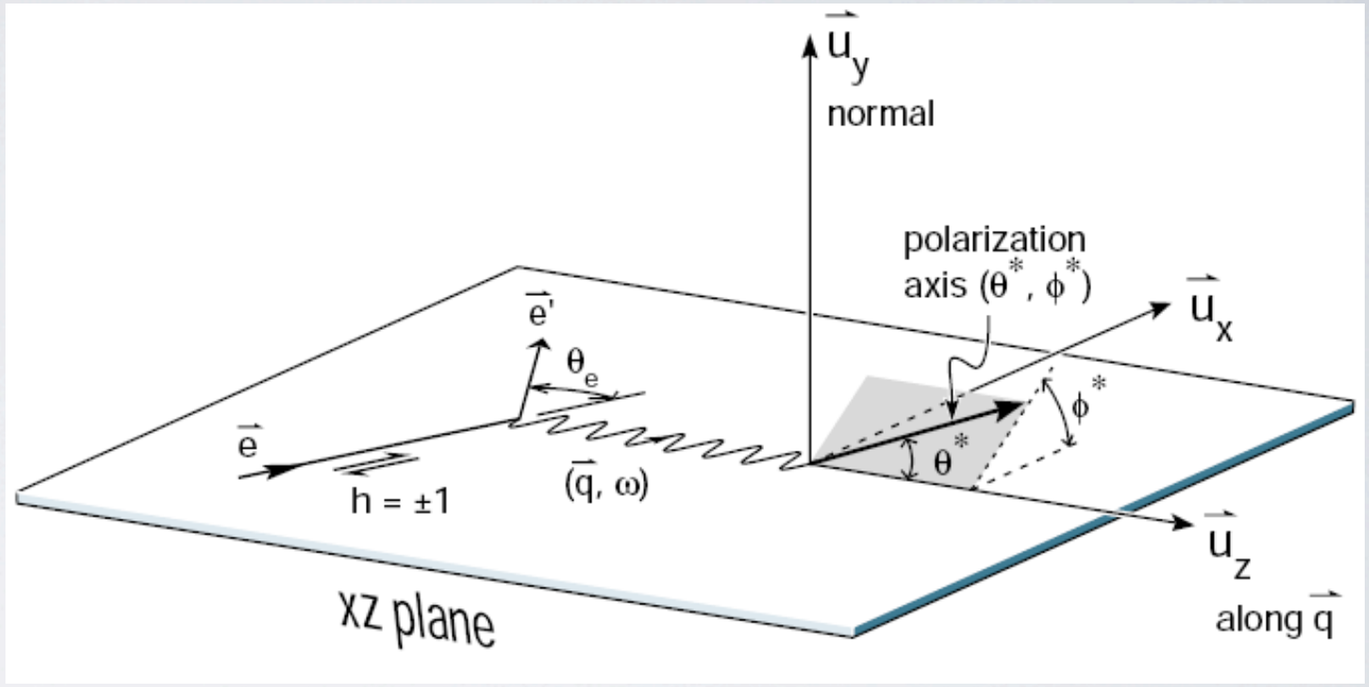
GENERAL

- Part II of a two part experiment to measure the proton form factor ratio at high precision downto $Q^2 \sim 0.015$ GeV^2.
- Part I completed during 2008 using recoil polarization (HRS) and electron tagging (BigBite).

THE GENERAL IDEA

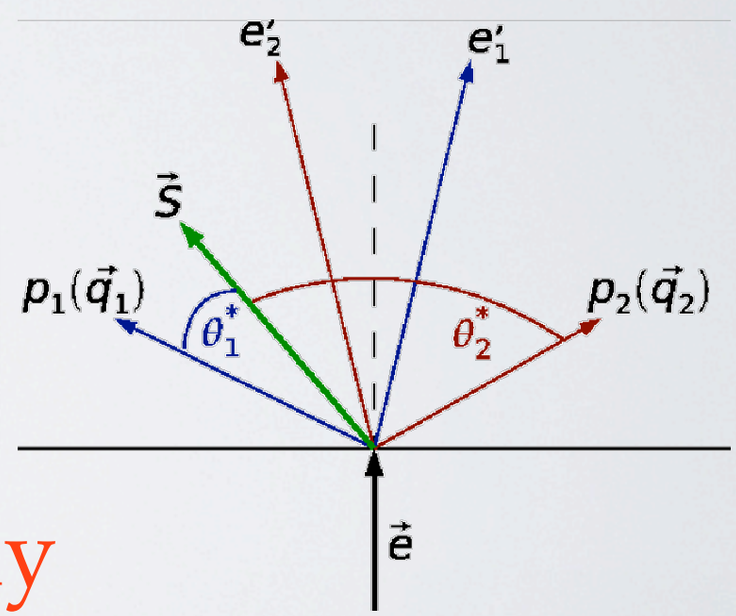
- Polarized electron - polarized target.

- Measure asymmetry in both HRSs at the same time (equal acceptance).



- Ratio of asymmetries gives:

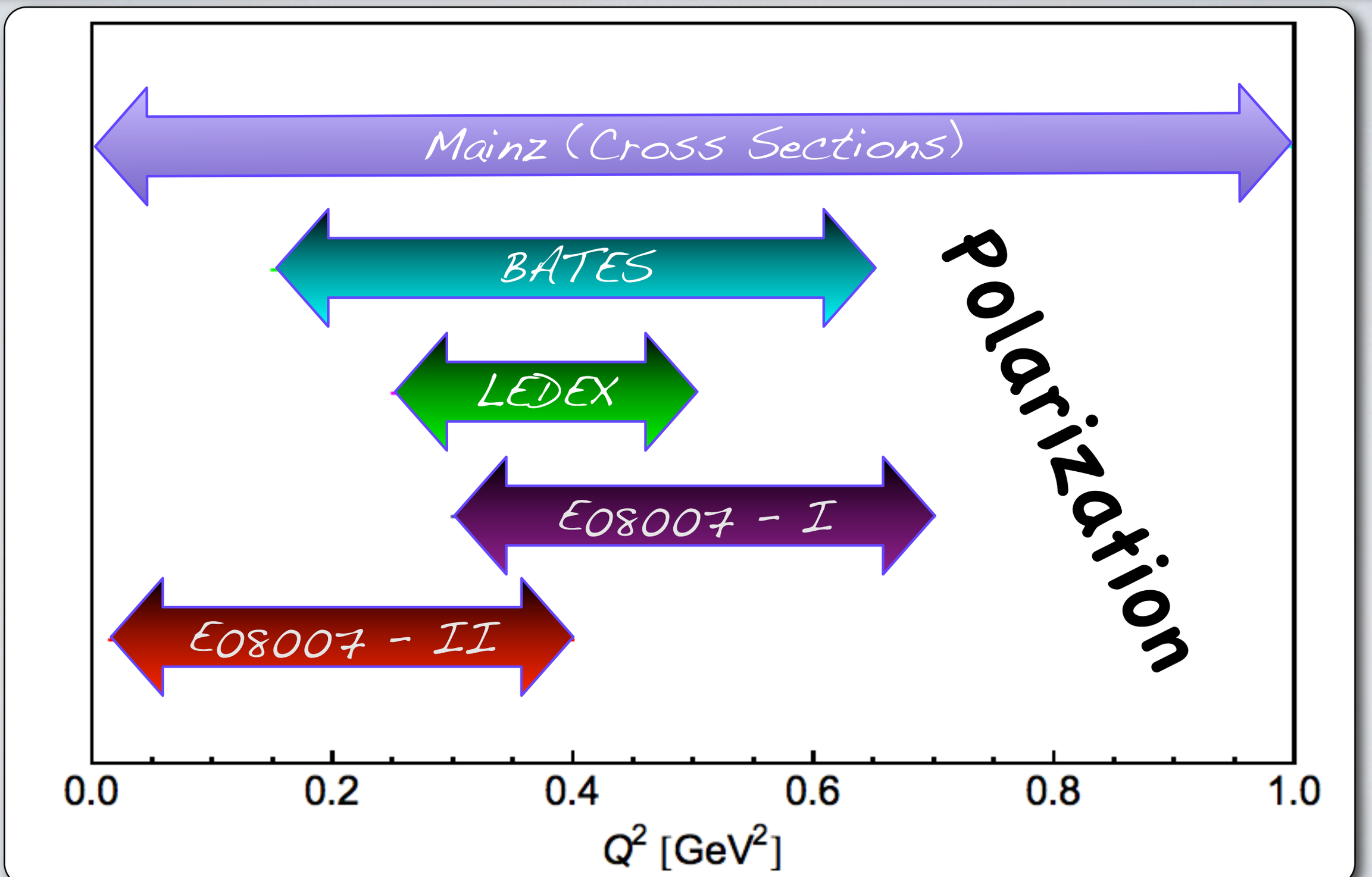
$$\mu_p \frac{G_E}{G_M} = -\mu_p \frac{a(\tau,\theta)\cos\theta_1^* - \frac{f_2}{f_1}\frac{A_1}{A_2}a(\tau,\theta)\cos\theta_2^*}{\cos\phi_1^*\sin\theta_1^* - \frac{f_2}{f_1}\frac{A_1}{A_2}\cos\phi_2^*\sin\theta_2^*}$$



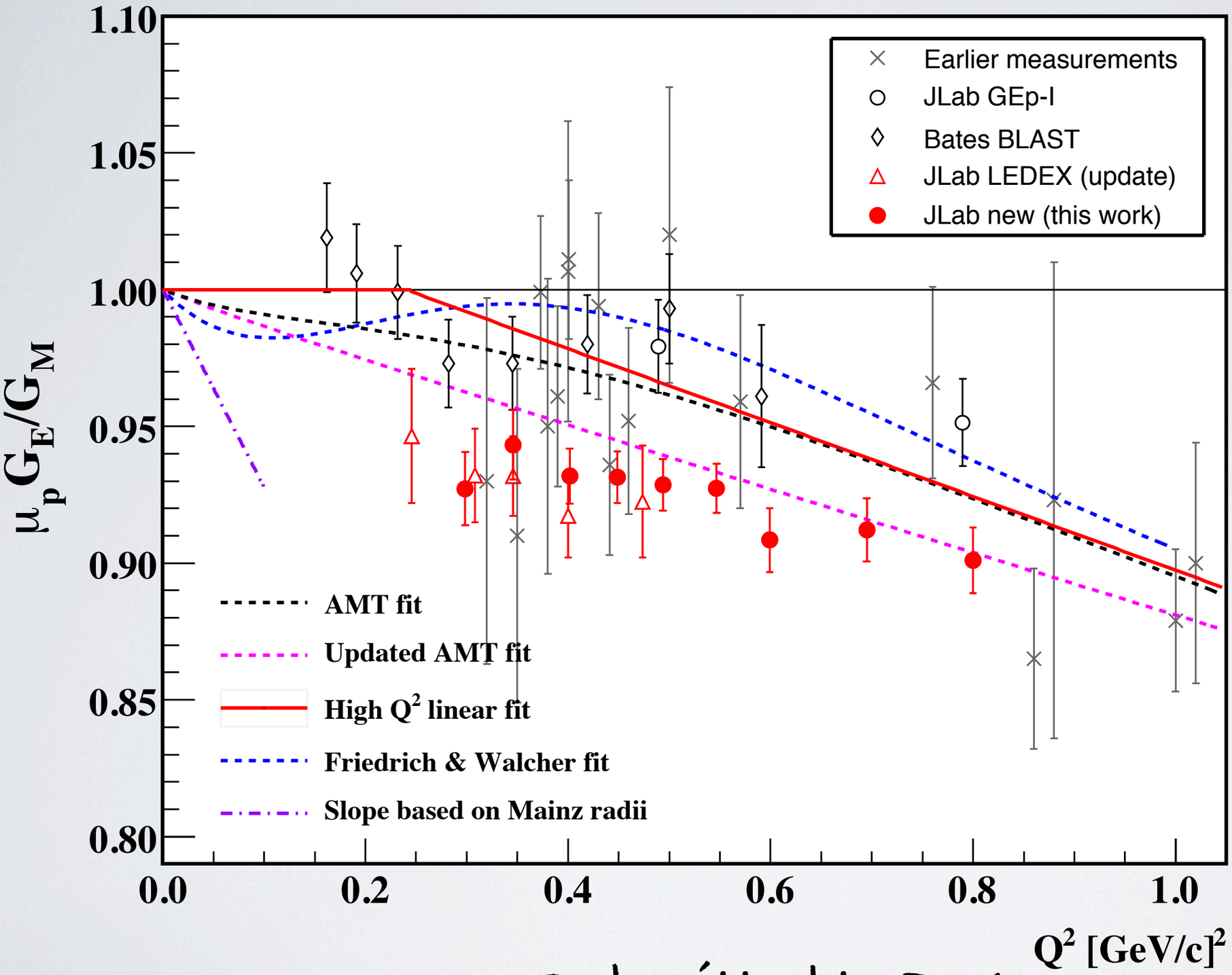
- Except asymmetries, everything is purely kinematical factors.

Complements MAINZ

Overlaps LEDEX, E08007-I - Different technique (systematics)



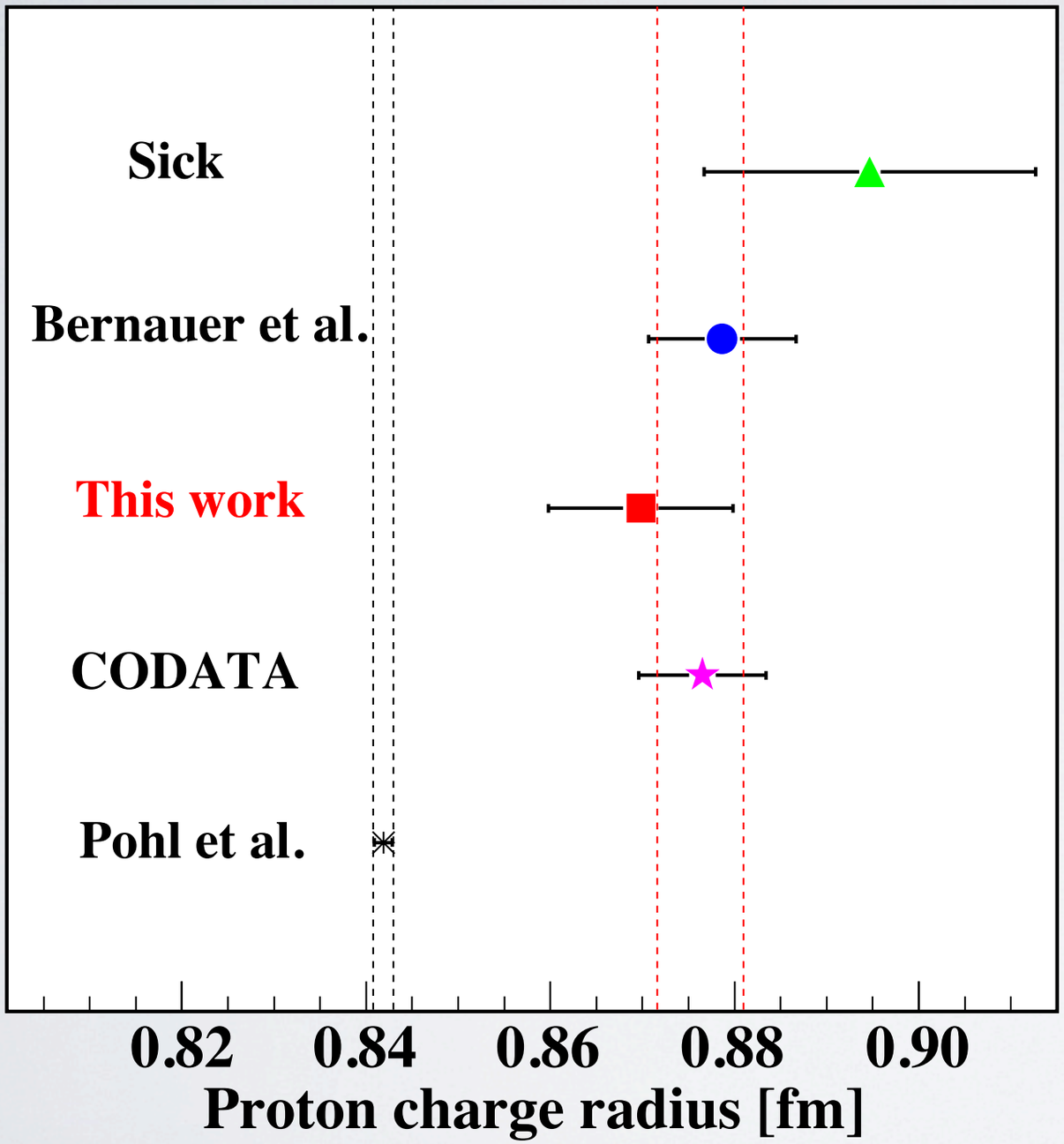
Results from E08007 (X. Zhan)



Submitted to PRL

LEDEX update paper submitted to PRC

But Also....



PSI Lamb shift in muonic Hydrogen. Inconsistent with other measurements.

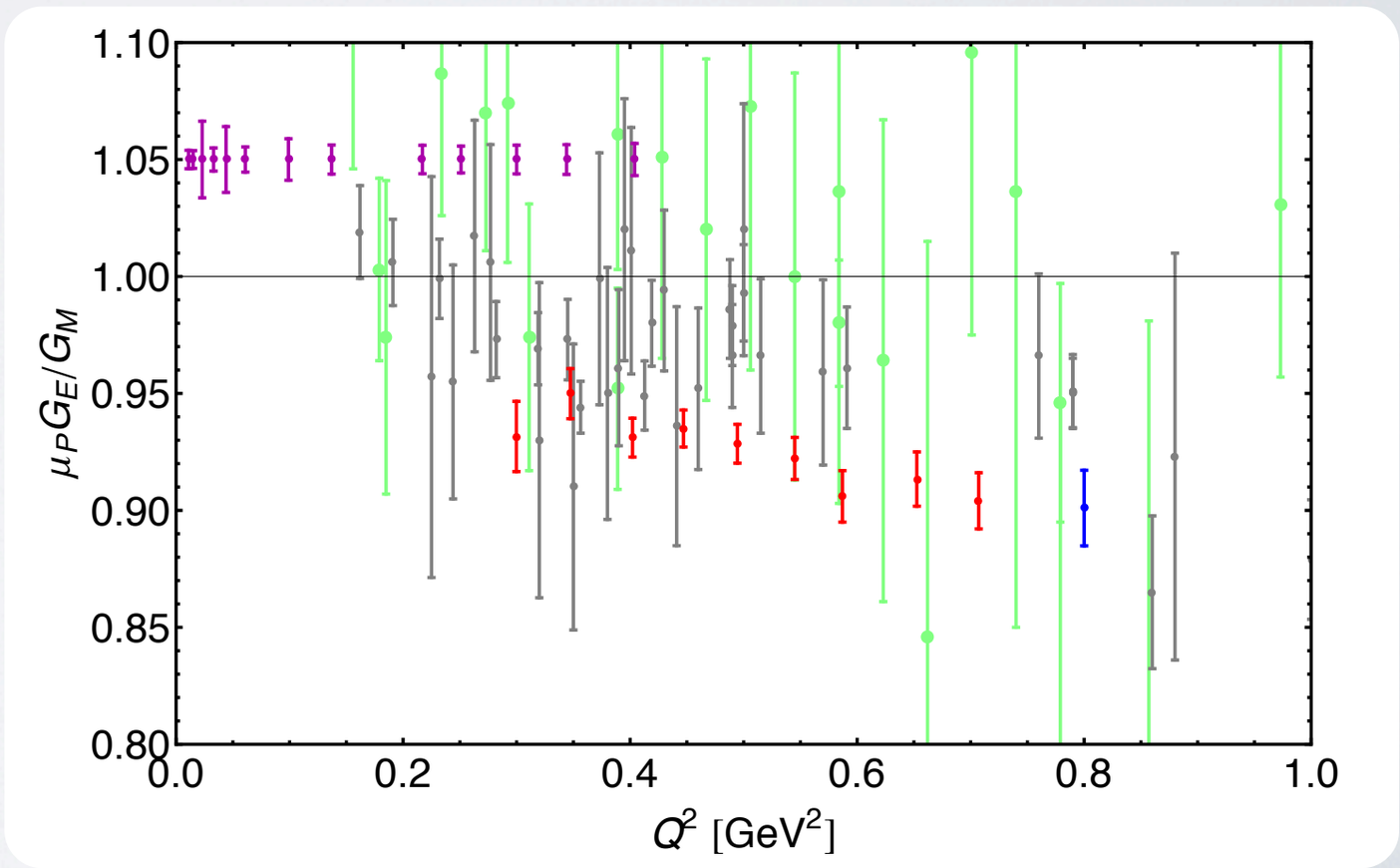
Hot Topic....

E08007-11 will help resolve it.

Relation to Part I

- **Phase-I (polarization transfer)**
  - High precision (mostly sub-%) extraction of $R = \mu_p G_{Ep}/G_{Mp}$
  - Suggests $R < 1$ even for very low Q^2
  - Global fit with TPE: $\langle r_p^2 \rangle$ = 0.873(14) fm
  - 3% below previous value (Sick): 0.897(18) fm; CODATA (2006) value: 0.877(7) fm
  - If R=1 as Q^2 approaches zero, yields 0.015 fm change in charge radius

- **Phase-II (pol. Target - 2012)**
  - Extract R down to Q^2=0.015
  - Good overlap with Phase-I
  - First precise extraction of magnetic radius
  - Linear approach to Q^2=0 ?
    - ~3% smaller magnetic radius
    - No region where magnetization, charge are simply sum of quarks.



Changes since the proposal

- Septa no longer movable.
- Target rotation angle changed several times (now settled on 20deg - like the proposal).
- Target polarization could be lower (2.5T field).
- None of these is a show stopper:
  - Bin in Q^2 over septa acceptance.
  - Add 1.6GeV beam energy.
  - Add no-septa runs.
  - New target angles actually work somewhat in our favor (higher Q^2 settings may use 90deg rotation).
  - Interleave (in energy, not target rotation) with E08-027.
  - Need to increase beam time to compensate for lower polarization.

E08007 - Part II

Commitments / Status

- Active collaboration - building up for the run.
- Lots of interest from theorists.
- 2 potential PhD students (HUJI + TAU) - but no commitments yet.
- Potential MsC student (HUJI).
- Funding for students exists.
- Can potentially commit techs for installation if needed - according to Ed Folts, probably not useful.
- Equipment:
  - Function generator purchased - awaiting delivery (will ship/FedEx to JLab when delivered).
  - Machining BPM stands at HUJI (estimate shipping early June).
  - Additional machining possible at TAU if needed (but not much).
  - HU500 Pump bought by Rutgers.
  - ~6K$ of machining in the Rutgers machine shop queue.

E08007 - Part II

Institute Commitments

- HUJI:
  - Guy Ron.
  - Tech if needed.
  - Joint student with TAU?
  - Machine shop work - cheap.
- TAU:
  - Eli Piasetzky.
  - Joint student with HUJI?
  - Some material costs for HUJI machine shop.
  - Postdoc?
- ANL:
  - John Arrington.
  - Postdoc - Xiaohui Zhan.
- Rutgers:
  - Ron Gilman.
  - Gerhard Kumbartzki.
  - Ron Ransom.
  - Postdocs - Lamia El Fassi + new postdoc.
  - Machine shop work.
- UVA (including g2p):
  - Donal Day.
  - Oscar Rondon.
  - Don Crabb.
  - 2 postdocs.
  - 2 students.
- JLab:
  - Doug Higinbotham.

- Total (including some g2p people):
  - 10 Faculty / Staff.
  - 4/5 postdocs.
  - 2/3 students (at least one student dedicated to E08007).
  - Machine shop work.
  - We also expect shift crews from the different institutes.