Proton form factor measurement using electron proton scattering with the gas jet target at MAMI A1

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Losinj, September 2019
Remember this?

\begin{figure}
\centering
\includegraphics[width=\textwidth]{plot.png}
\caption{Relative precision on the cross section on $G_E$ on $G_M$}
\end{figure}
New A1/MAGIX measurement for $G_E$ AND $G_M$

» Validate Mainz data set with equal or better data
» Get a better handle on $G_M$
» Opens up another comparison point with spectroscopy: Zemach radius, sensitive to $r_M$ (see talks this week)
What can we do better?

» Avoid all the mistakes we made before
  » Keep B and C apart
  » Don’t use C if you can
  » Fewer normalization groups
What can we do better?

» Avoid all the mistakes we made before
  » Keep B and C apart
  » Don’t use C if you can
  » Fewer normalization groups
» MESA: smaller beam energies, better $G_M$
» Better target
Old target
Cluster jet target

» Windowless, ideally no background
» Density $10^{19}$ cm$^{-2}$
» Collaboration with U. Münster
Commissioning run 2018

» April 11 to 23
» Multiple jet profile measurements
» $I = 20\mu A$, 15h of data in $2^\circ$ steps from $20^\circ$ to $32^\circ$
» 25h of data for $21^\circ$
» Vacuum not optimal
» Spec A: Luminosity
» Spec B: Cross section
» Spec C: not used
Luminosity stability

Lumi stable to 10%
Elastic Scattering ($\rho_{\text{target}} = 3.15 \cdot 10^{18}/\text{cm}^2$)

J. C. Bernauer et al., PRL107 (2011)
Background

» Not gone
» Not by a long shot
» :( 
Background

on April 13
Beam halo hitting nozzle/catcher → build an active veto

on April 21
Active Veto design
It is alive!
Veto test

» Immediately saw hits at much too high rate
Veto test

» Immediately saw hits at much too high rate
» In coincidence on both sides
Veto test

» Immediately saw hits at much too high rate
» In coincidence on both sides
» Periodic, correlated with power grid!

Marco Dehn (accelerator expert): Probably dead power supply somewhere in the accelerator. Was found after beam time. Could not retest yet.
Veto test

» Immediately saw hits at much too high rate
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» Periodic, correlated with power grid!
» Marco Dehn (accelerator expert): Probably dead power supply somewhere in the accelerator
» Was found after beam time. Could not retest yet.
Collimator

» To reduce veto rate
» Movable for optimization
» Produced by MIT, will ship to A1 soon
» Test in December
Collimator design
It’s also alive
MESA + MAGIX

» Delayed for the best reason: more money
MESA + MAGIX

» Delayed for the best reason: more money

» Mainz Energy recovering Superconducting Accelerator

» Maximum beam energy of 155 MeV

» Beam current of >1mA
MAGIX: Little brother of A1

» MAGIX: MESA Gas Internal target eXperiment
» Ground up designed for cluster jet
» Two high resolution spectrometers, FP-TPC with GEM readout
What can we do?

» Cluster jet target to kill major contributions to systematic errors

» Repeat ISR with new target (mainly $G_E$)

» Use new target also for classical approach