Preparation of an Electromagnetic Calorimeter for Nucleon Form Factor Measurements at JLab Hall A

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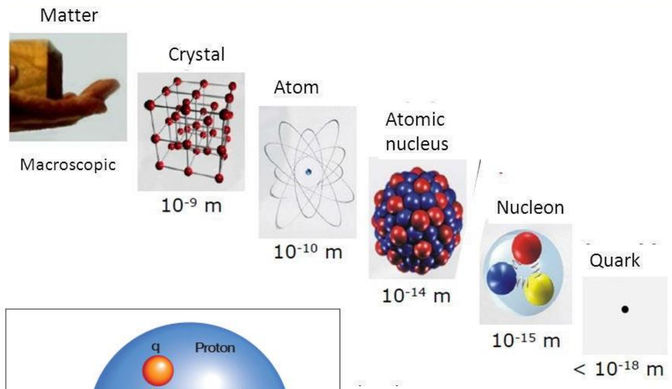
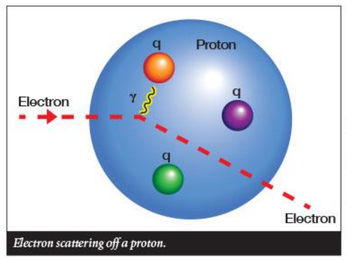
Motivations

Protons and Neutrons (Nucleons) are made of quarks, the "building block", elementary constituent of matter



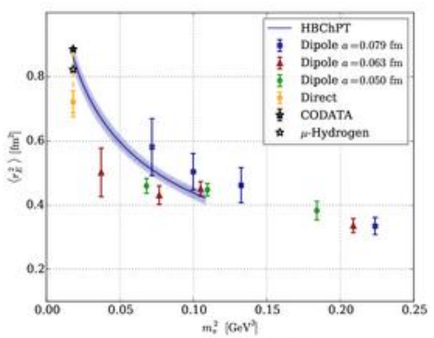


Elastic Scattering is a reaction to probe the quark content of the nucleon (proton or neutron)

Form Factors (FF) parametrize the quark content of the nucleons in elastic reactions, they give access to the nucleon's charge distribution, i.e. the quarks' positions

Form Factors

Example of Form Factors measurement and fits:
(ref: Mark Vanderhaeghen Mainz U. webpage)

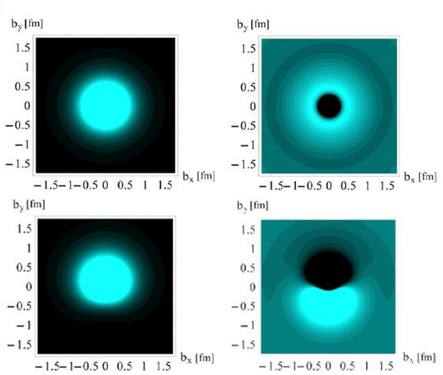


https://www.kernphysik.uni-mainz.de/theorie/forschungs-highlights-2/

Proton imaging:

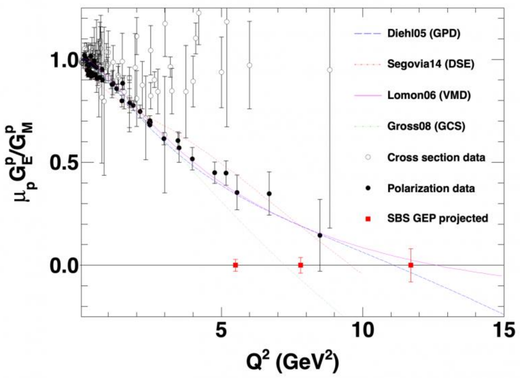
Left: proton
Right: neutron

1st Row: without magnetic field
2nd row: with magnetic field

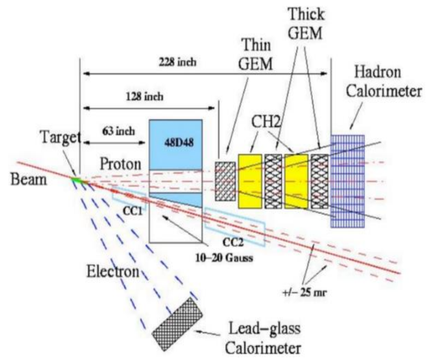


Experiment E12-007-109
Jefferson Lab Hall A, SBS

Projected statistical precision of the upcoming proton form factor ratio measurements from E12-07-109, compared to existing data and selected theoretical models. Data acquisition: spring 2025
(ref: Andrew Puckett, UConn)



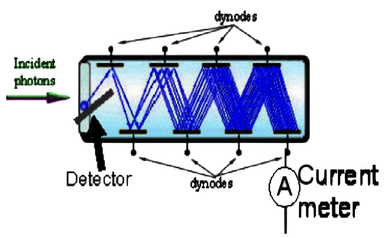
https://puckett.physics.uconn.edu/2019/08/22/sbs-gep-experiment-e12-07-109-re-approved-by-jlab-pac47/-milestone



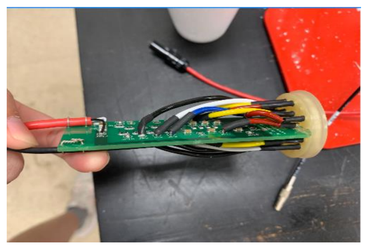
Super Bigbite (SBS) experiment layout, Jlab Hall A

Preparation of the new calorimeter: PMTs

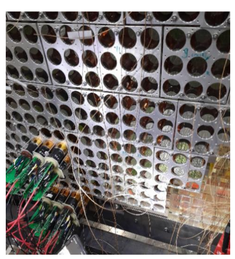
PhotoMultiplier Tubes (PMTs) multiply the electron signal to be interpretated by the electronic, then converted to a format we can analyze: this allows for tracking and reconstructing the interaction



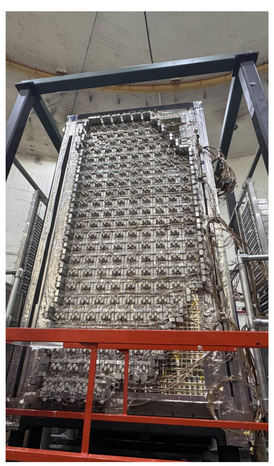
https://www.chegg.com/homework-help/questions-and-answers/photomultiplier-tubes-pmts-used-many-instruments-need-measure-small-amounts-light-pmts-use-q157815170



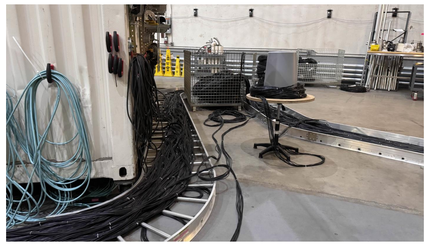
Soldering of PMT elements at Virginia Tech



We are currently installing and testing the PMTs at JLab and preparing the detector prior to the experiment



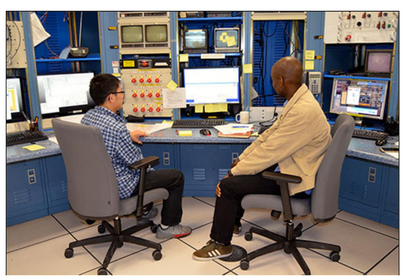
Cabling work in the Hall A



We are also running cables into the Hall to connect various detectors and data acquisition system. The experiment will start next January

(personal pictures)

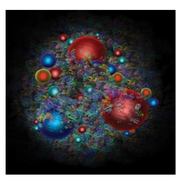
Next step: running the experiment and data analysis



Two persons "on shift": monitoring the experiment during the run, from the "counting house". Next, graduate students will analyze the data (pic: JLab)

https://www.jlab.org/news/releases/beam-target-cebaf-accelerator-achieves-12-gev-commissioning

Summary and Acknowledgments



This experiment will improve knowledge of the proton and neutron structure, with better views of the quarks' distributions

We extend our sincere gratitude to Mahmoud for working with us this whole time. Additionally, we acknowledge the invaluable guidance, support, and insights provided by Professor Marie Boer in shaping the experimental process and enriching our understanding of the subject matter.