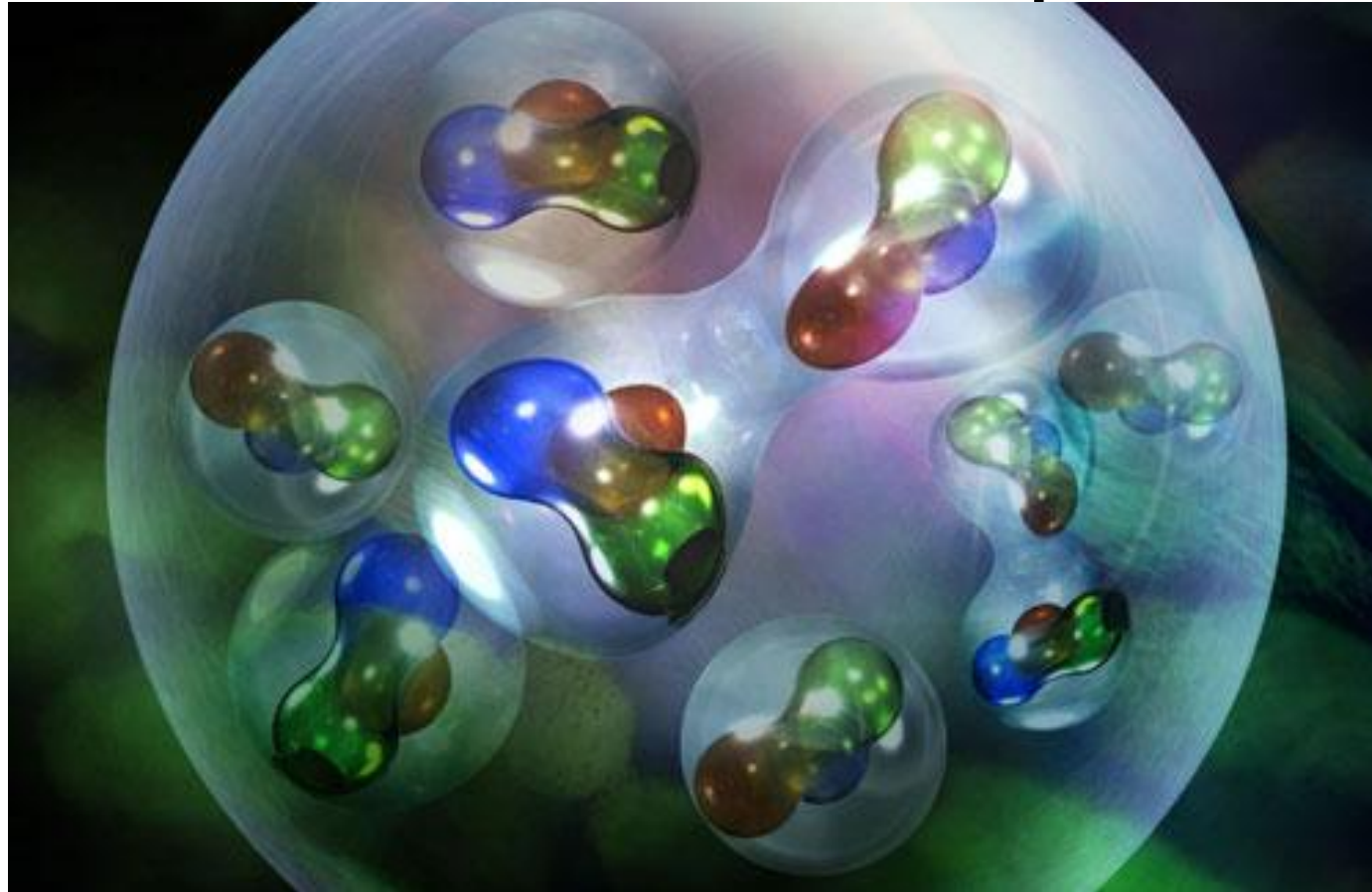
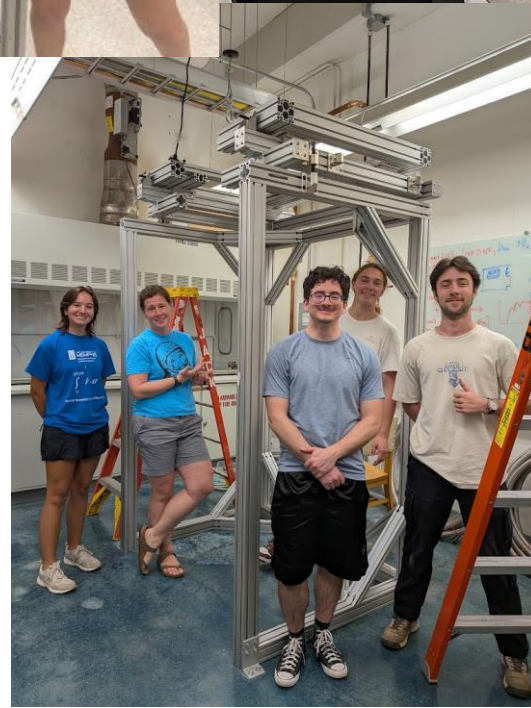


UT MEP Group



Dec 3, 2025

Nadia Fomin and Dien Nguyen





Professor Nadia Fomin

2013 - present

DOE MEP Grant Covers:

- XEM2
- Nuclear R
- TDIS*

UTORII Start Award covers:

- DNP (expires June 2026)

Assistant Professor Dien Nguyen

2024 - present

DOE ECA:

- CLAS program
- 3He Program

UT Startup

- Magic Money



DOE LANL co-PI & CERN

- EIC Silicon detectors/electronics

Graduate Student Funding:

DOE SCGSR

NSF Graduate Fellowship

JSA Fellowship

UTORII magic money*

Undergraduate Student Funding

Departmental Summer Fellowship

FRAF (faculty apply)

AURA (students apply)

Work-study

SULI

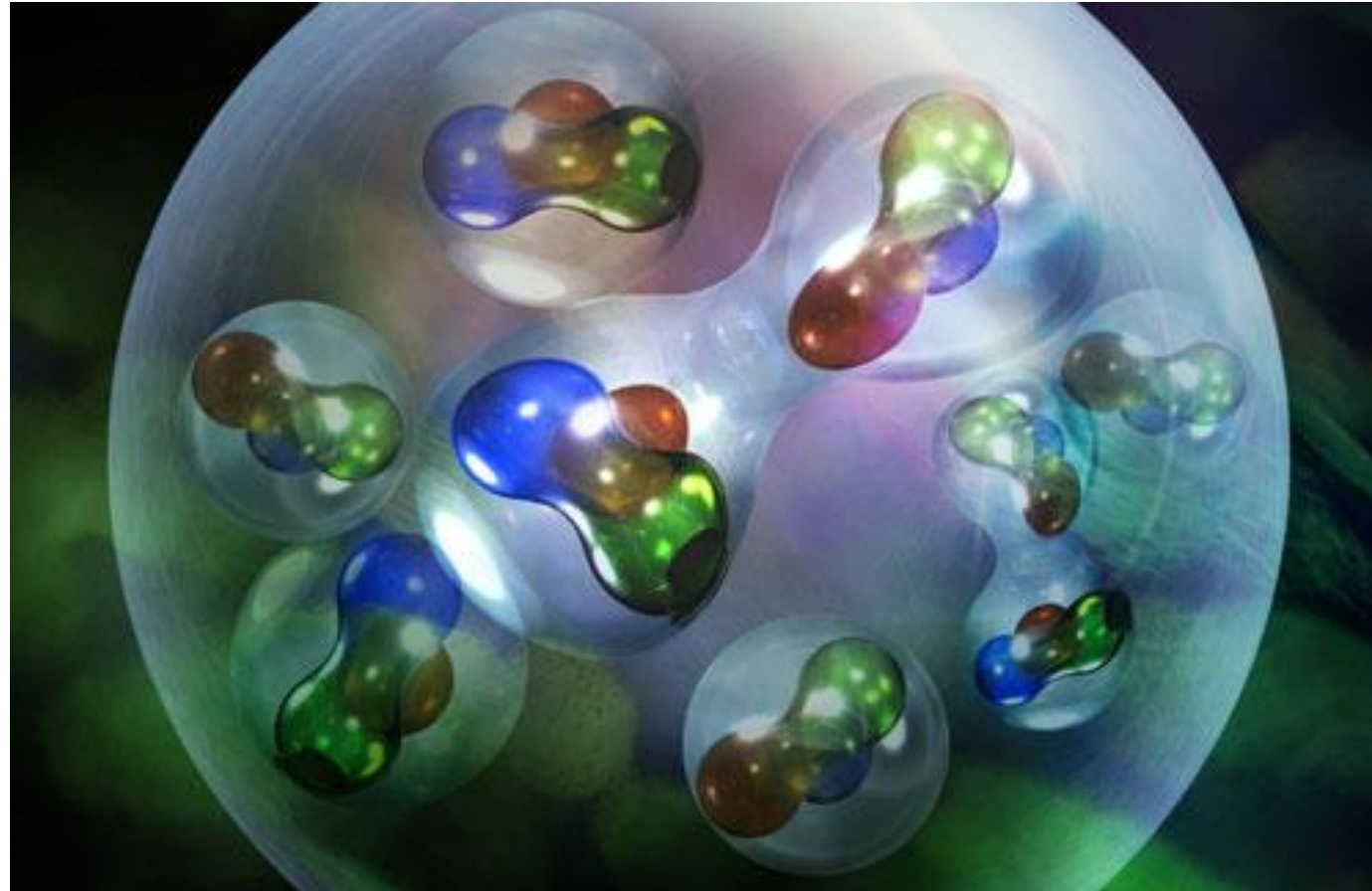
Rough Idea of Current Work

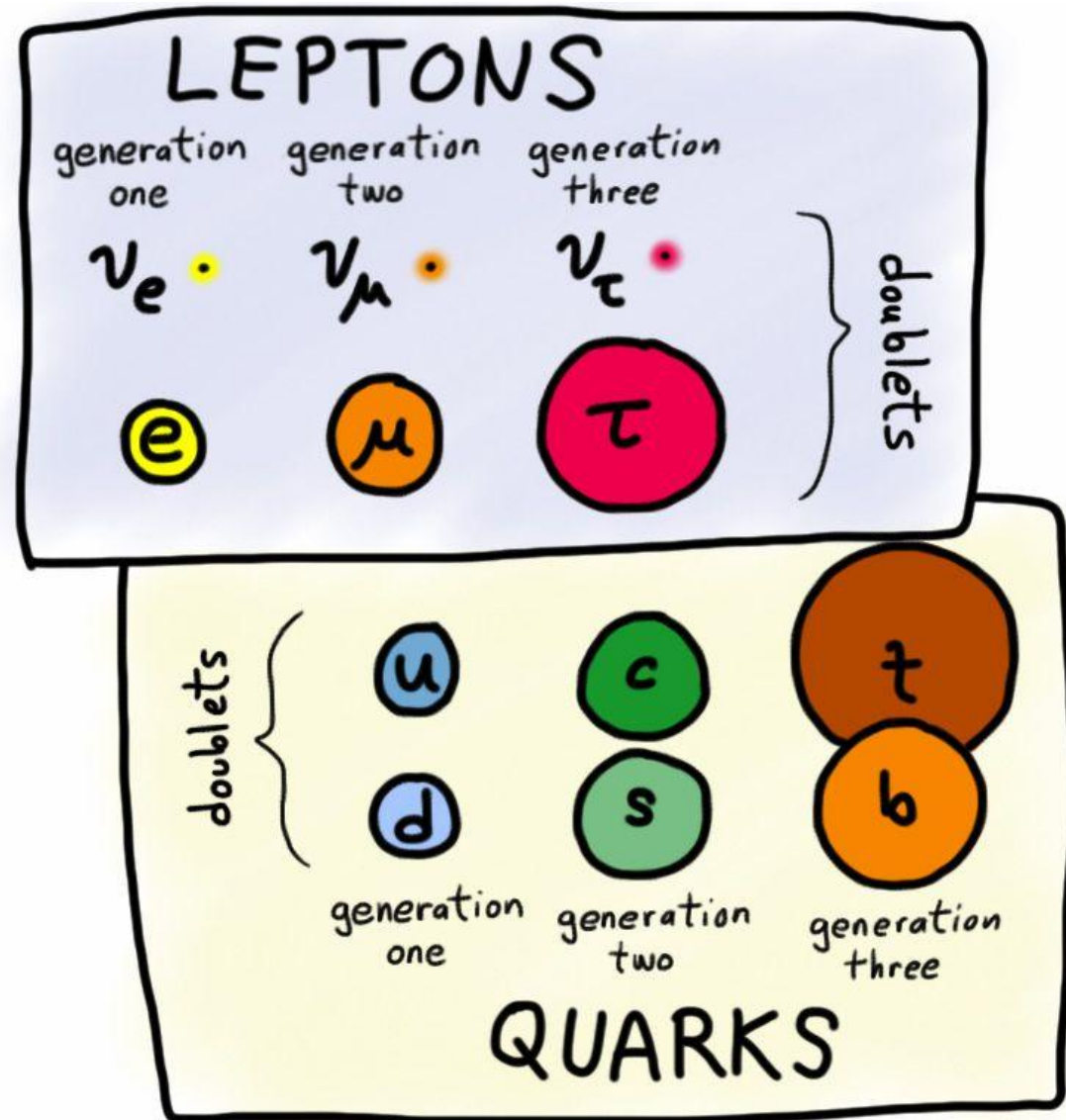
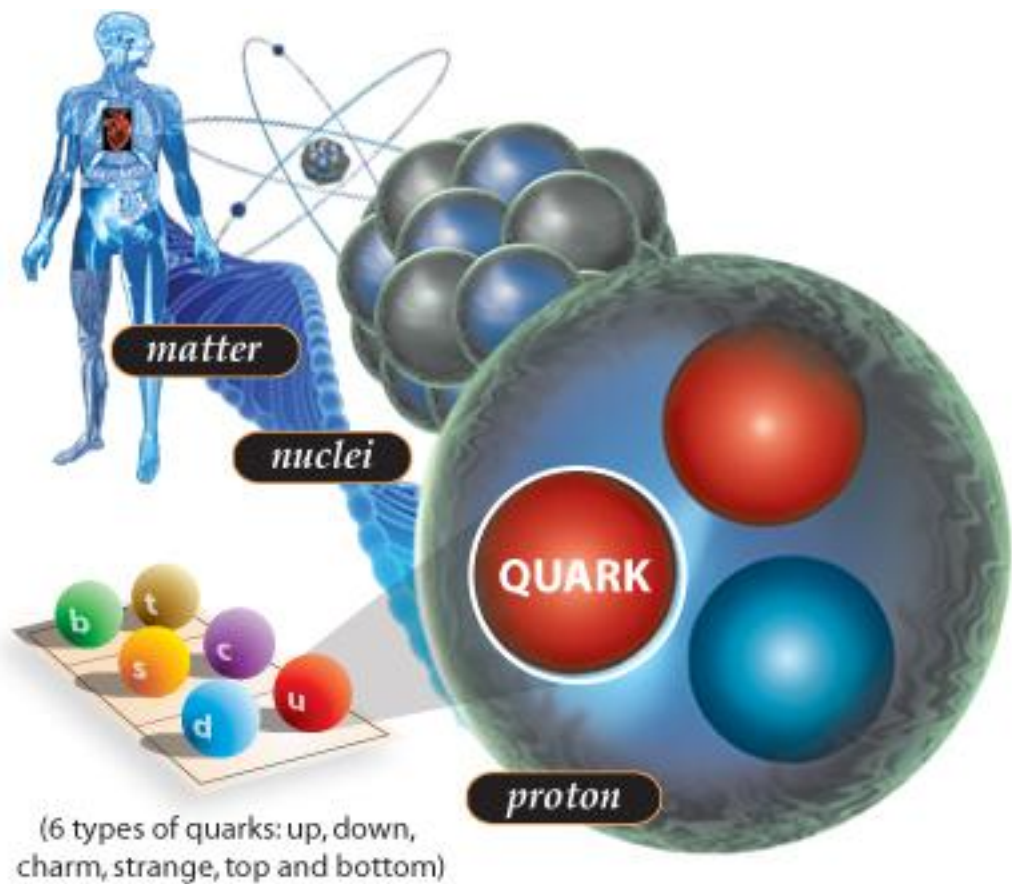
Project/Expt	Note	Time	
E12-06-105	SRCs	Completed 2023	Jordan, Ramon
E12-10-008	EMC effect	Completed 2023	Abhyuday
Nuclear R	Future	2026/2027 (?)	
Nuclear R-SIDIS	Half-done	Fall 2026 (part 2)	Julio, Ryan
CLAS A=3 program	Future	Starts 2027	Abhishek
3He high-B target	For CLAS	Ongoing	Hao, Jordan
3He test lab	At UT	Ongoing	Amelia, Lindsey, Evan, Elle, Kinsley*
Hall D program		Not scheduled	Vicente
DNP development	At UT	Ongoing	Vicente, Evan, Lindsey, Amelia, CJ*
EIC Detectors	Silicon	Starts 2026	Lindsey, Abhishek, Amelia
EIC Polarimeter		Ongoing	Ramon's SCGSR
Side Quest	HYDRA	Ongoing	Jordan



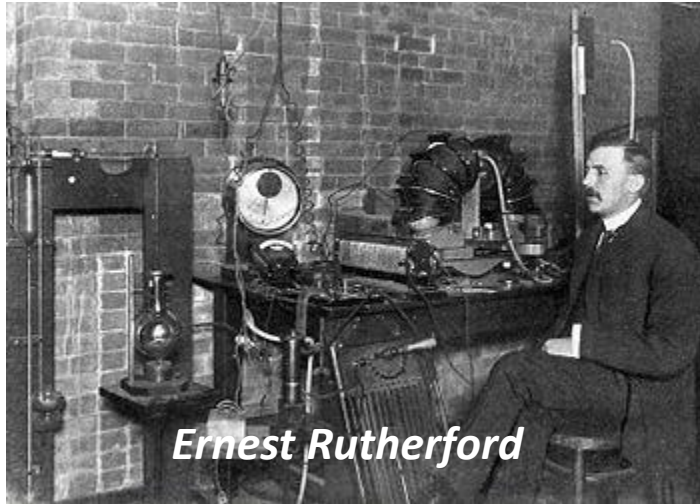
Hang this on your fridge!

On the boundary of nuclear and particle physics





Scattering Experiments – a proven technique



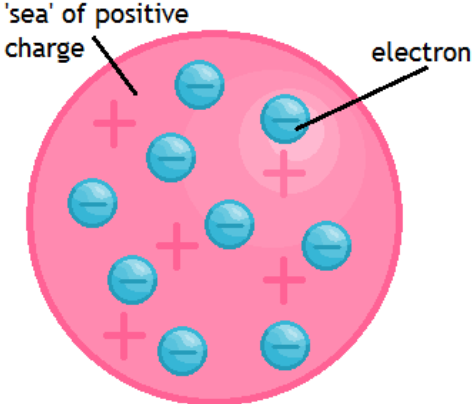
- Make a model of what's inside an atom



Plums – negative charges
Pudding – positive charges

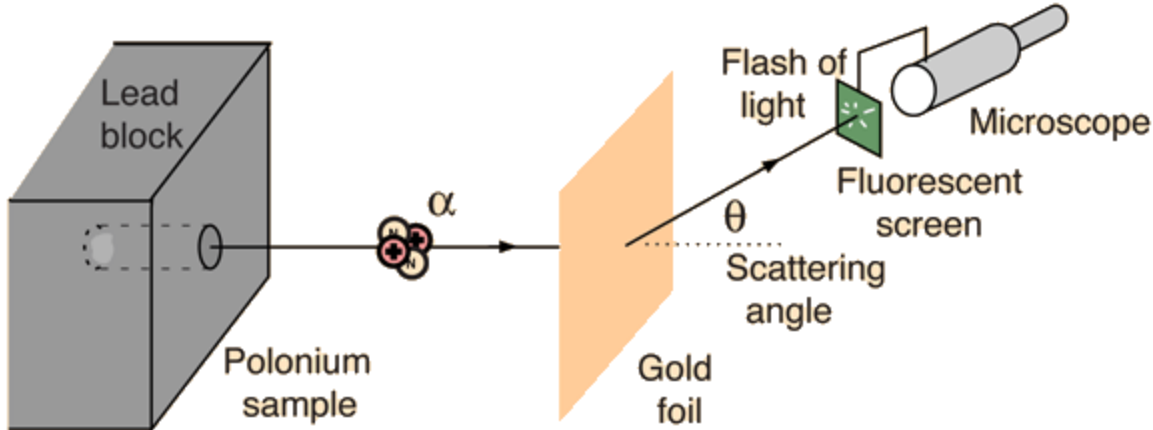
Test it with a scattering experiment

Scattering Experiments

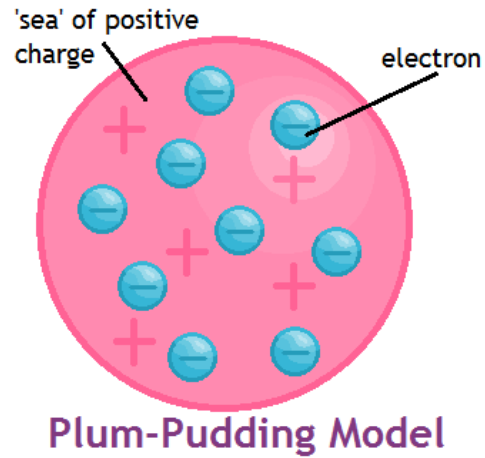


Plum-Pudding Model

Expectation → alpha particles will come out at forward angles (very little deflection)

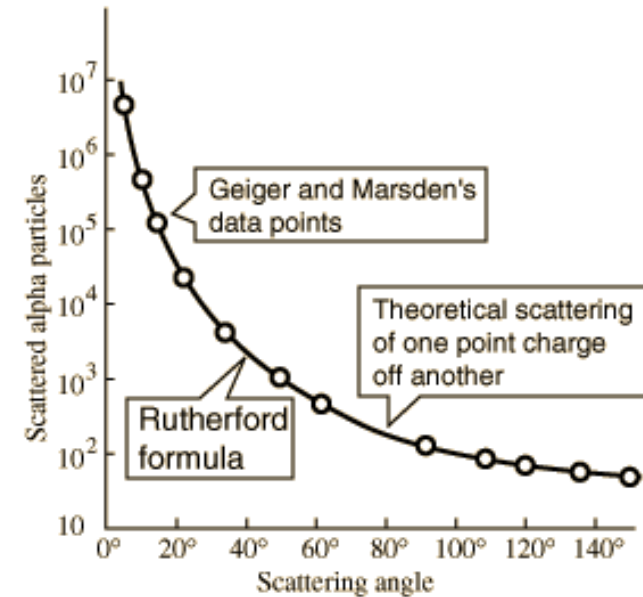
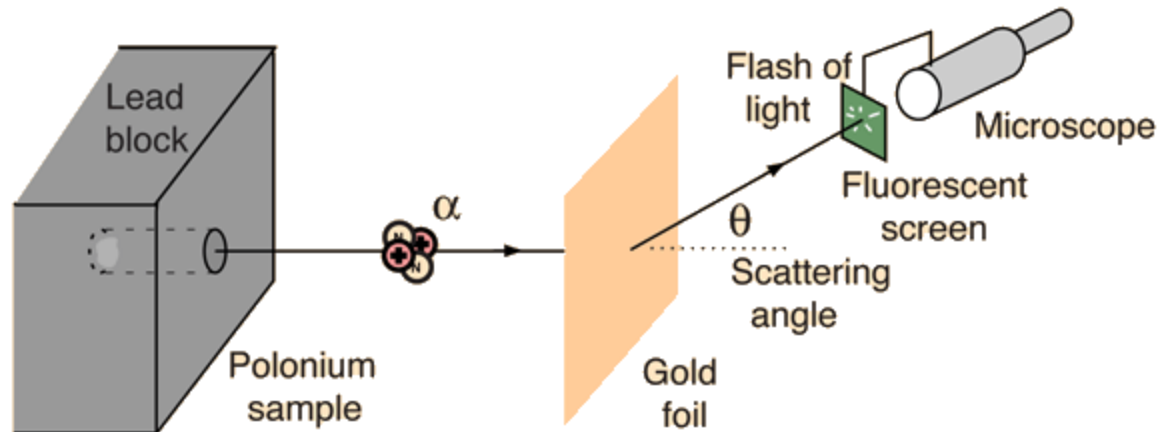


Scattering Experiments

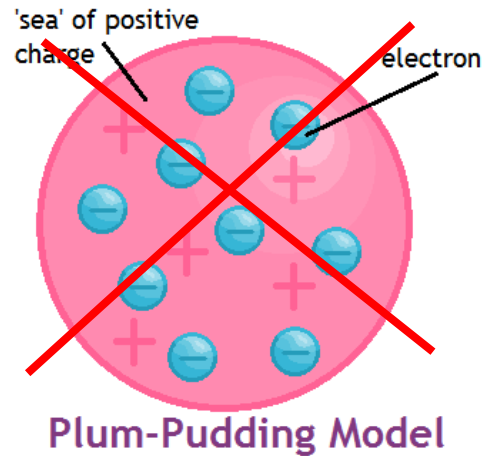


Expectation → alpha particles will come out at forward angles (very little deflection)

Reality → Particles scatter through a large range of angles



Scattering Experiments

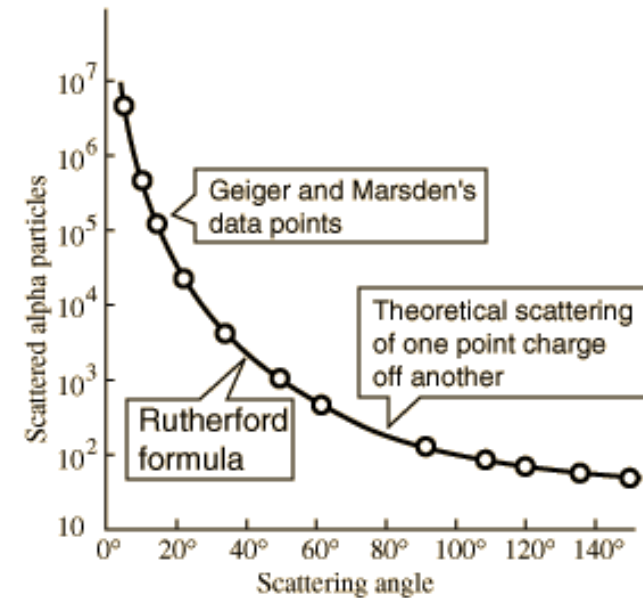


NOT a plum pudding

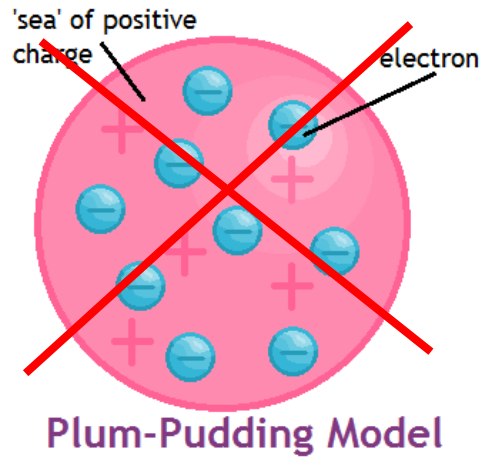
What can explain such high deflection angles?

Expectation → alpha particles will come out at forward angles (very little deflection)

Reality → Particles scatter through a large range of angles



Scattering Experiments



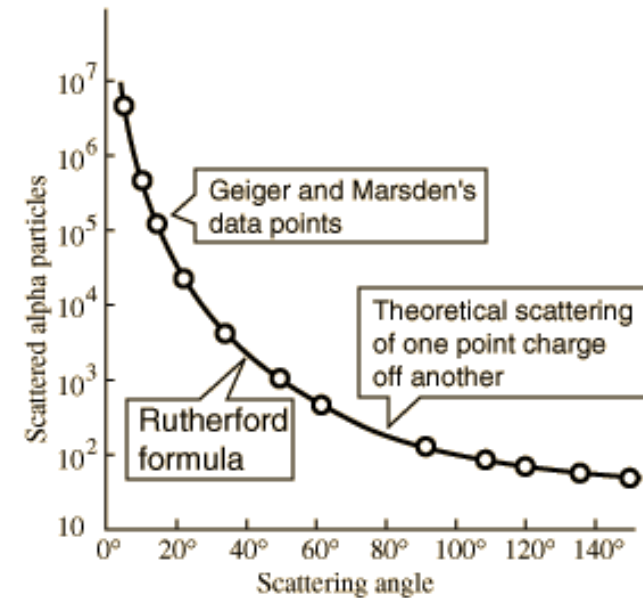
NOT a plum pudding

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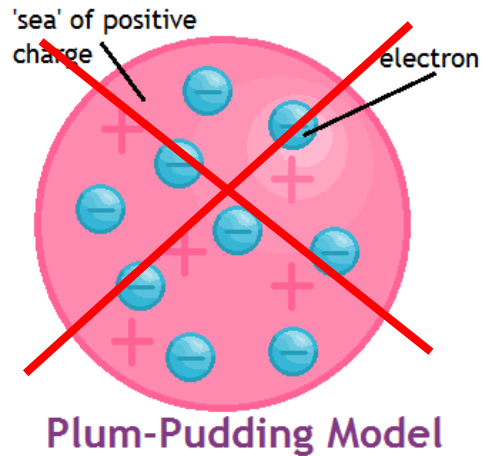
Let's think: the alpha is positively charged, what would repel it through a large angle?

Expectation → alpha particles will come out at forward angles (very little deflection)

Reality → Particles scatter through a large range of angles



Scattering Experiments



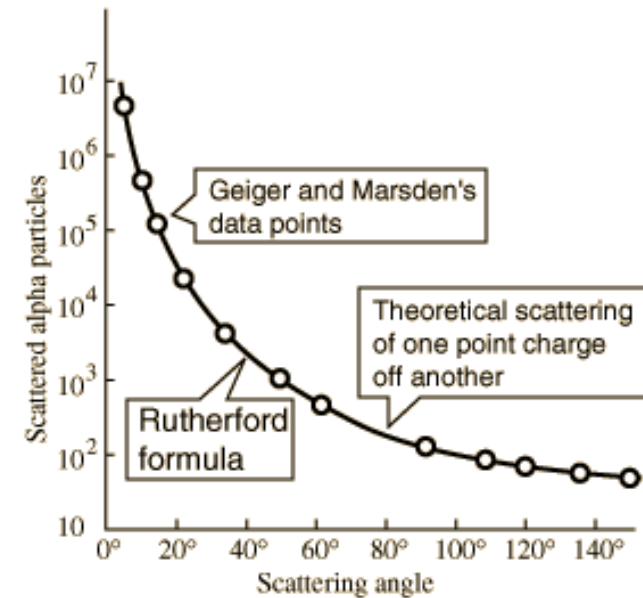
NOT a plum pudding

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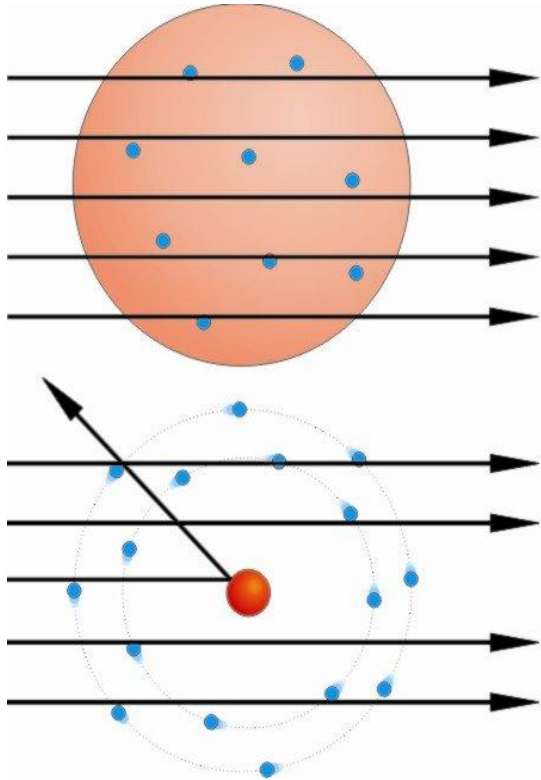
Expectation → alpha particles will come out at forward angles (very little deflection)

Reality → Particles scatter through a large range of angles

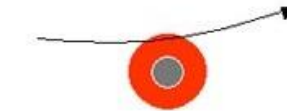


Would work if charge of the nucleus was concentrated in a small space

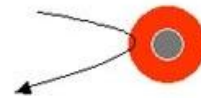
Scattering Experiments



Most alpha particles are undeflected



A few alpha particles are slightly deflected



A few alpha particles bounce off Nucleus

$$\text{Scattering into a small area} \propto \left(\frac{1}{4\pi\epsilon_0} \frac{Ze^2}{mv^2} \right)^2 \frac{1}{\sin^4 \frac{\theta}{2}}$$

From Rutherford to today

Rutherford cross section

$$\frac{d\sigma}{d\Omega} = \frac{\alpha^2}{4E^2 \sin^4(\theta/2)}$$

Scattering from an infinitely massive target

Mott Cross section

$$\frac{d\sigma}{d\Omega} = \frac{\alpha^2}{4E^2 \sin^4(\theta/2)} \cos^2(\theta/2)$$

Account for electron spin

Add recoil of the target

$$\frac{1}{1 + (2E/M) \sin^2(\theta/2)} \longrightarrow \left(\frac{d\sigma}{d\Omega} \right)_{NS}$$

**Rosenbluth
Cross section**

$$\frac{d\sigma}{d\Omega} = \left(\frac{d\sigma}{d\Omega} \right)_{NS} \left[\frac{G_E^2 + \frac{Q^2}{4M^2} G_M^2}{1 + \frac{Q^2}{4M^2}} + \frac{Q^2}{2M^2} G_M^2 \tan^2\left(\frac{\theta}{2}\right) \right]$$

Scattering from a nucleon with internal structure

Inelastic Scattering from a nucleon

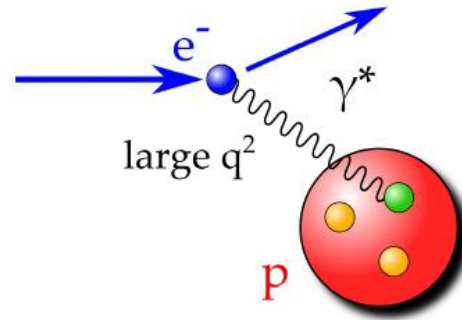
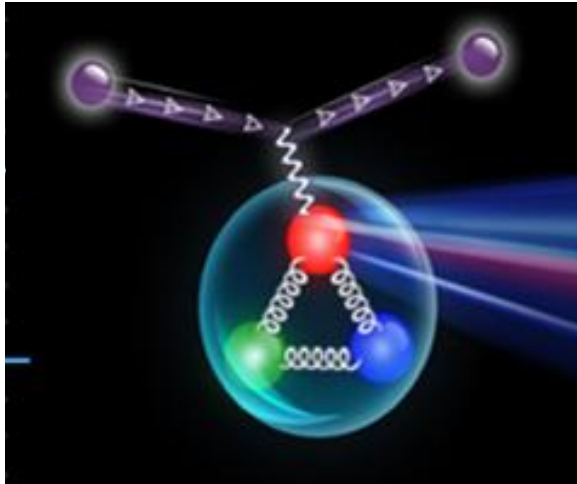
$$\frac{d\sigma}{dE' d\Omega} = \frac{\alpha^2 \cos^2(\theta/2)}{4E^2 \sin^2(\theta/2)} [2F_1(\nu, Q^2) \tan^2(\theta/2) + F_2(\nu, Q^2)]$$

Structure functions

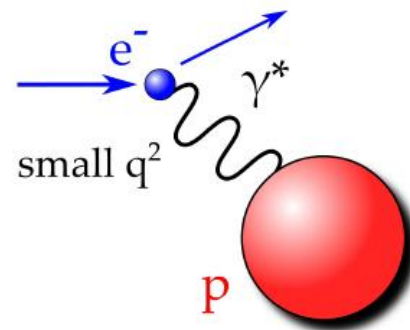
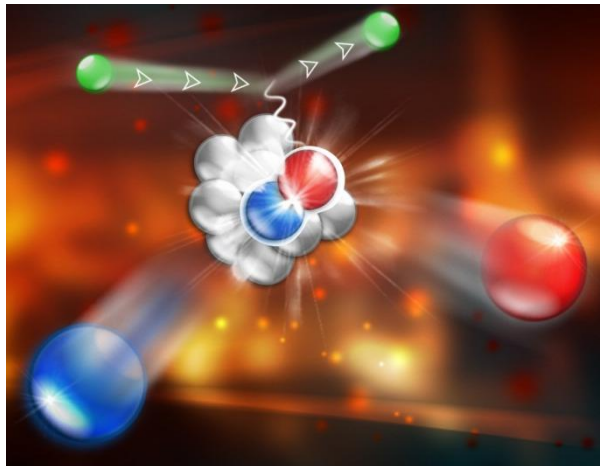
Similar form for scattering from nuclei

END

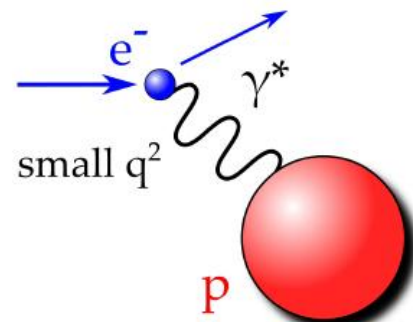
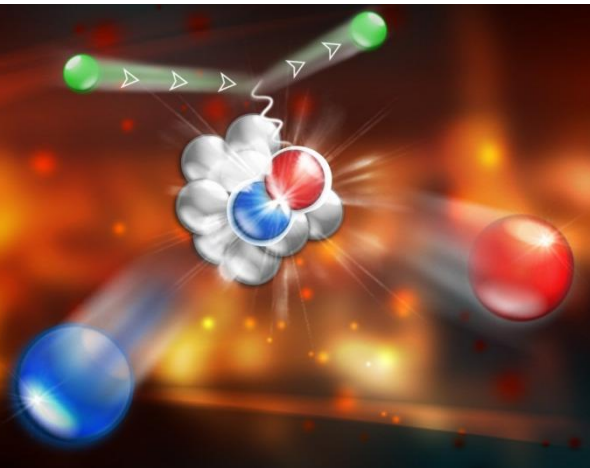
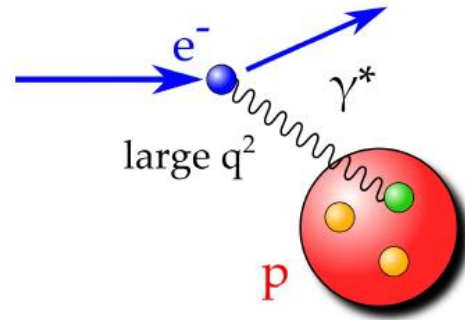
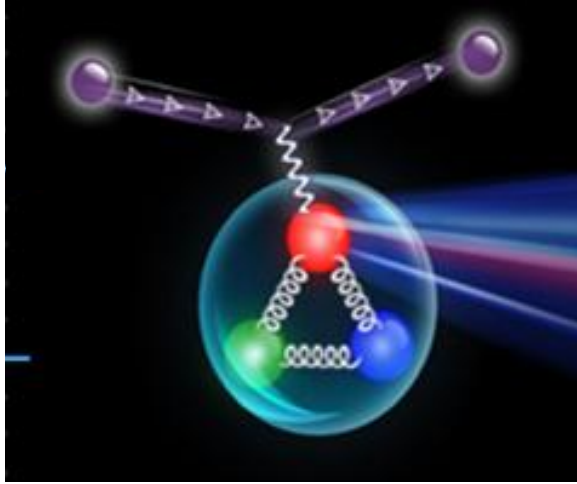
Electron Scattering is our microscope



$$\lambda \approx \frac{1}{q}$$
$$|\vec{q}| = \sqrt{Q^2 + (E - E')^2}$$
$$Q^2 = 4EE' \sin^2 \frac{\theta}{2}$$



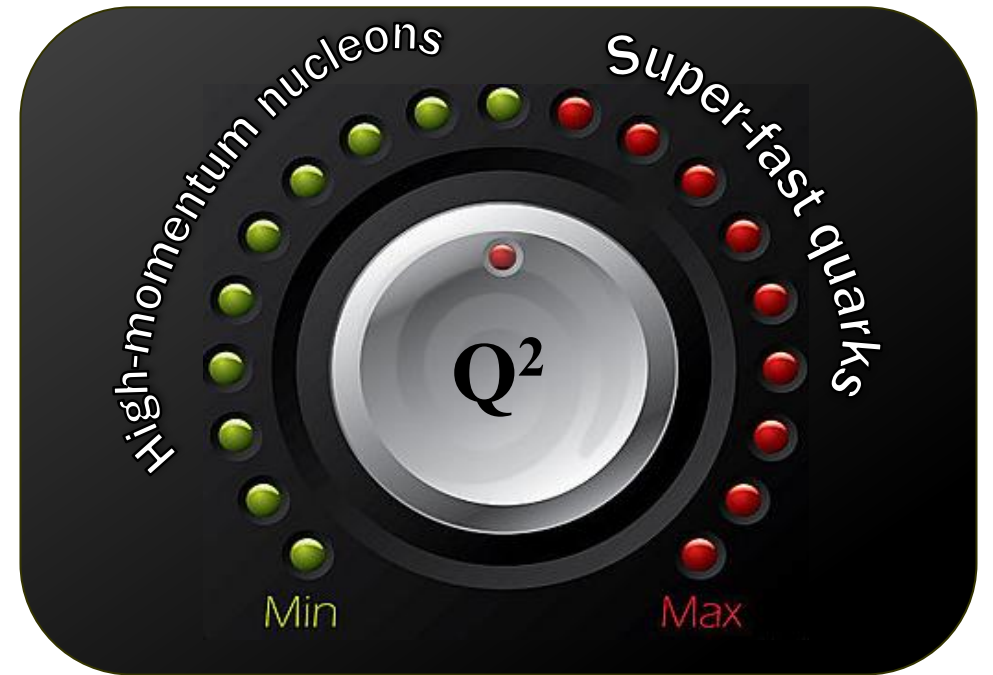
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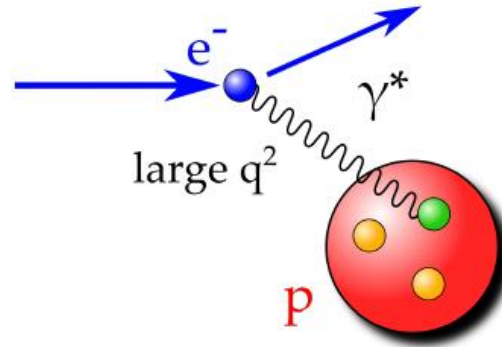
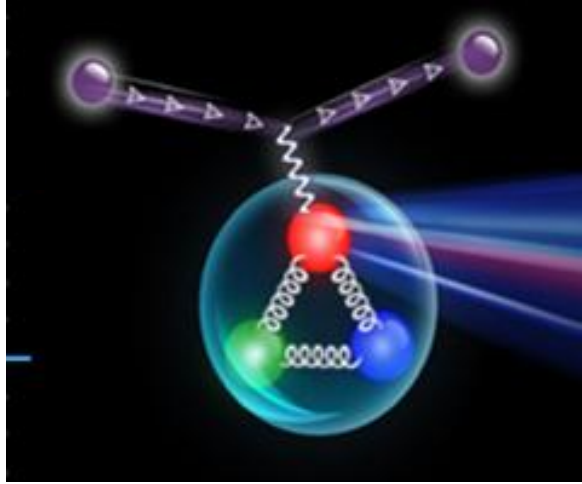
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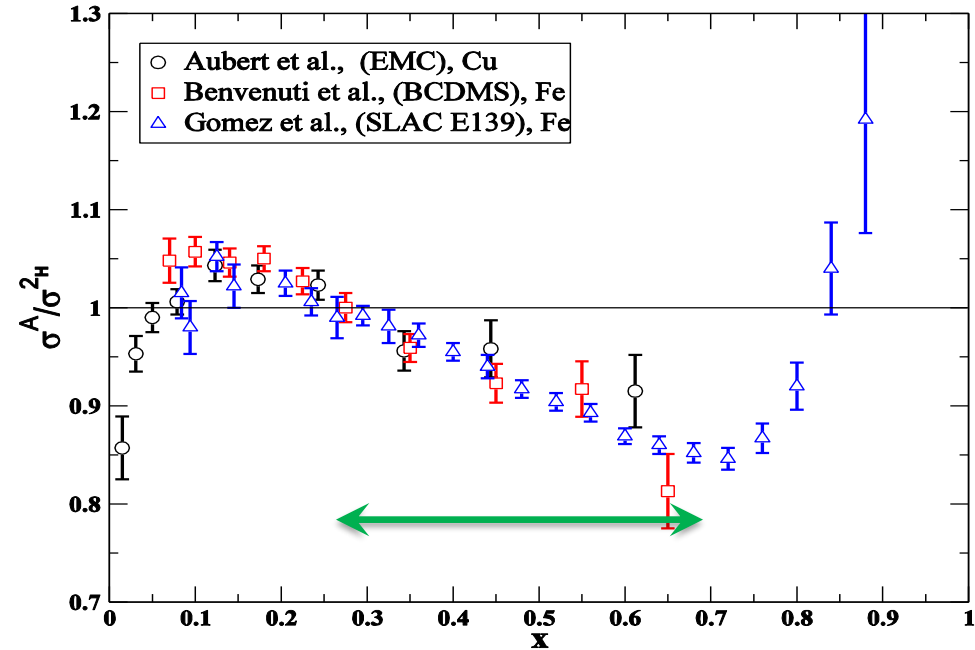
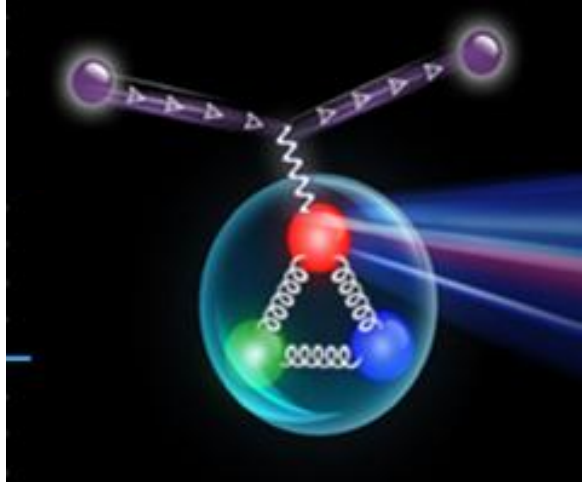
Electron Scattering is our microscope



Callan-Gross relation:
 $2xF_1(x) = F_2(x)$

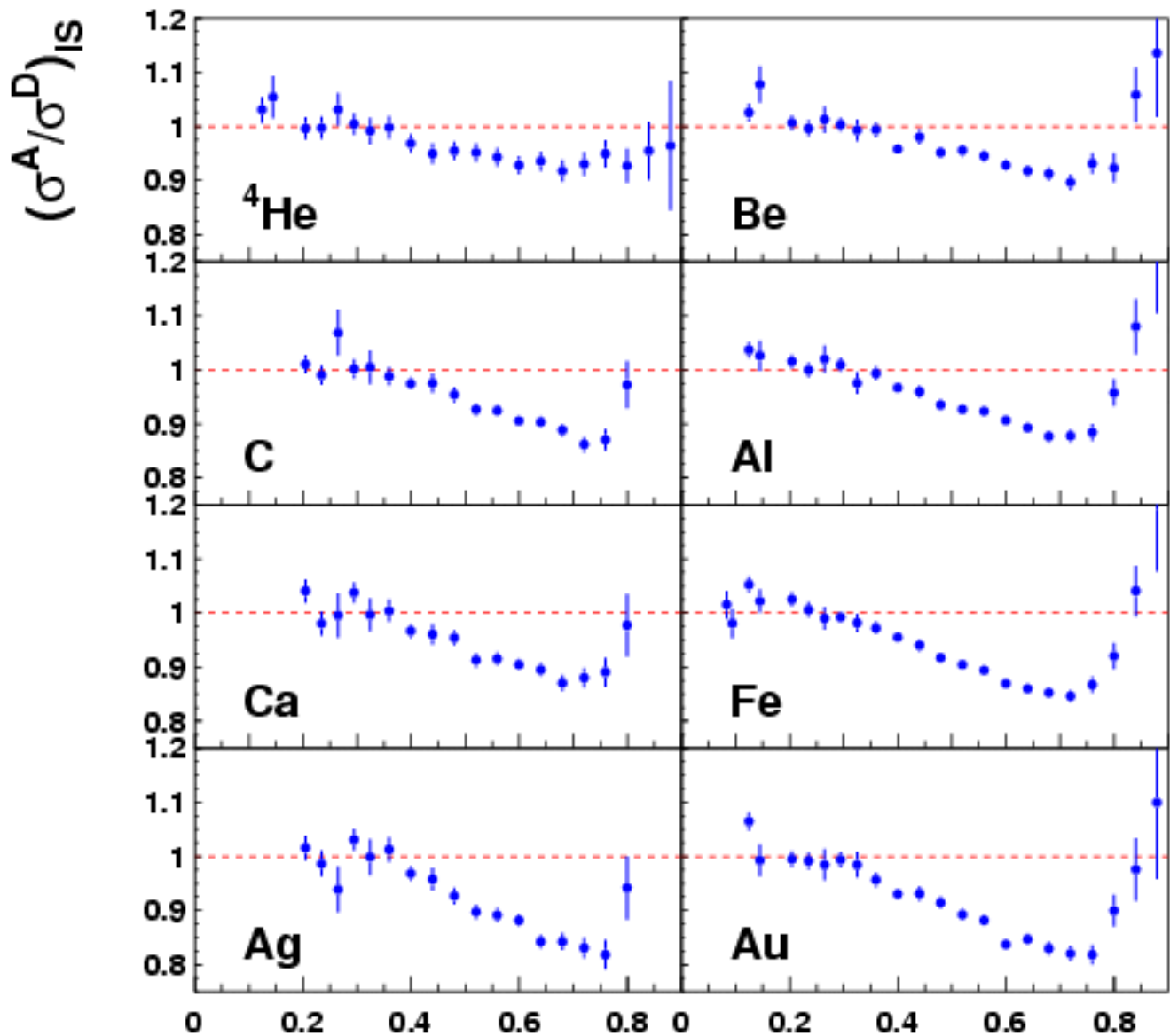
$$2F_1(x) = \frac{F_2(x)}{x} = \sum_i e_i^2 q_i(x) = \frac{4}{9} [u(x) + \bar{u}(x)] + \frac{1}{9} [d(x) + \bar{d}(x)] + \frac{1}{9} [s(x) + \bar{s}(x)]$$

Electron Scattering is our microscope

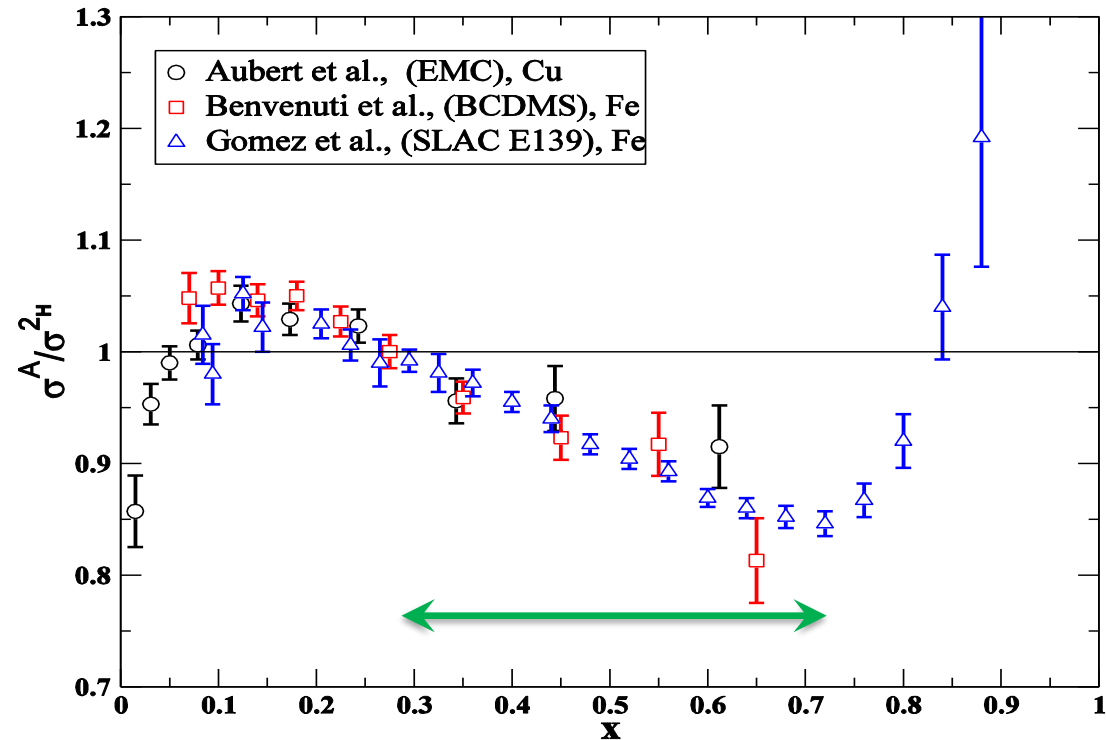


$$2F_1(x) = \frac{F_2(x)}{x} = \sum_i e_i^2 q_i(x) = \frac{4}{9} [u(x) + \bar{u}(x)] + \frac{1}{9} [d(x) + \bar{d}(x)] + \frac{1}{9} [s(x) + \bar{s}(x)]$$

$$F_2^A(x) \neq ZF_2^p(x) + NF_2^n(x)$$



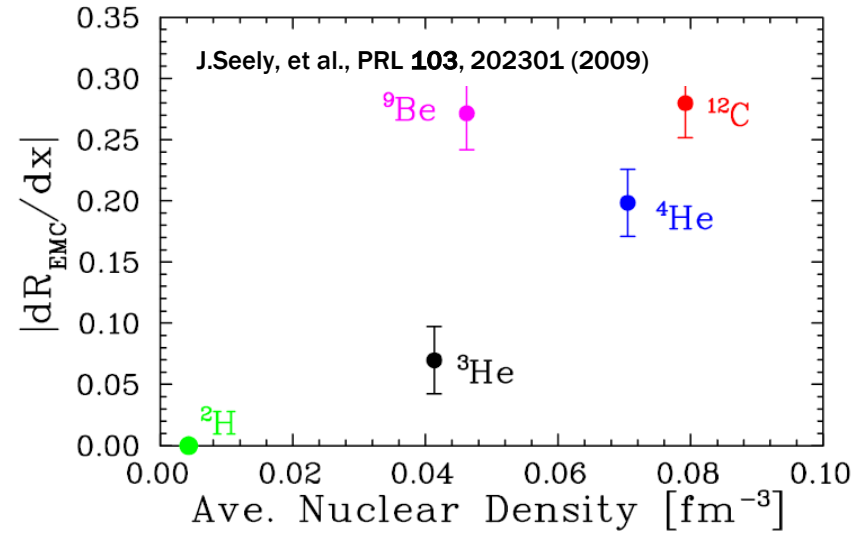
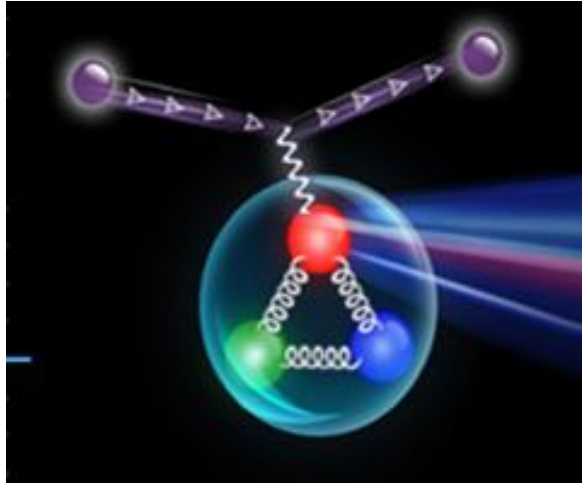
The EMC effect



$$F_2^A(x) \neq ZF_2^p(x) + NF_2^n(x)$$

Gomez et al, SLAC E139

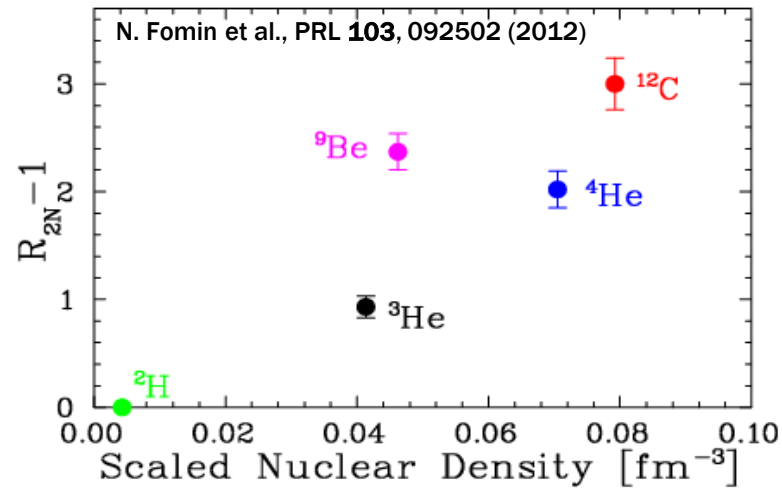
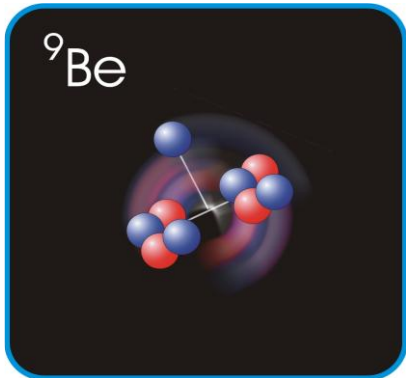
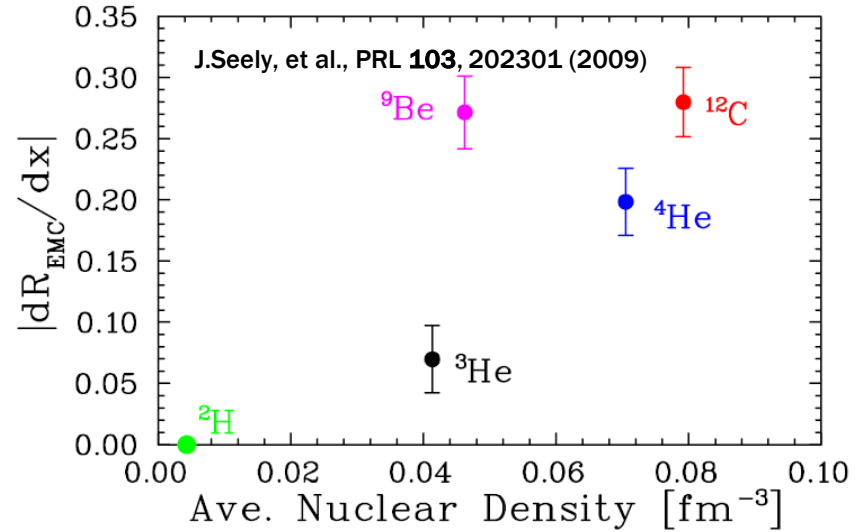
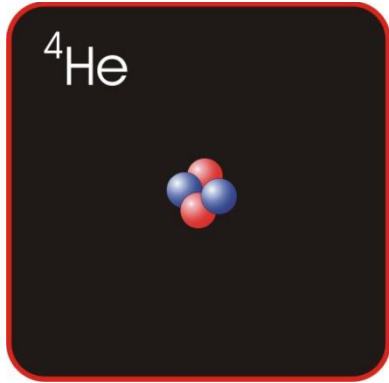
Electron Scattering is our microscope



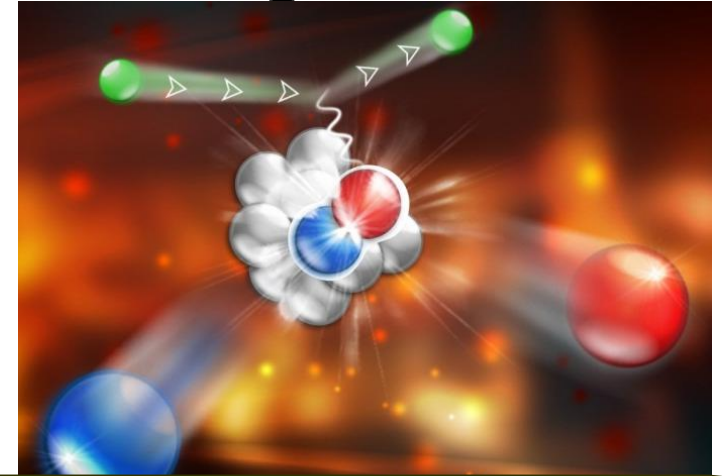
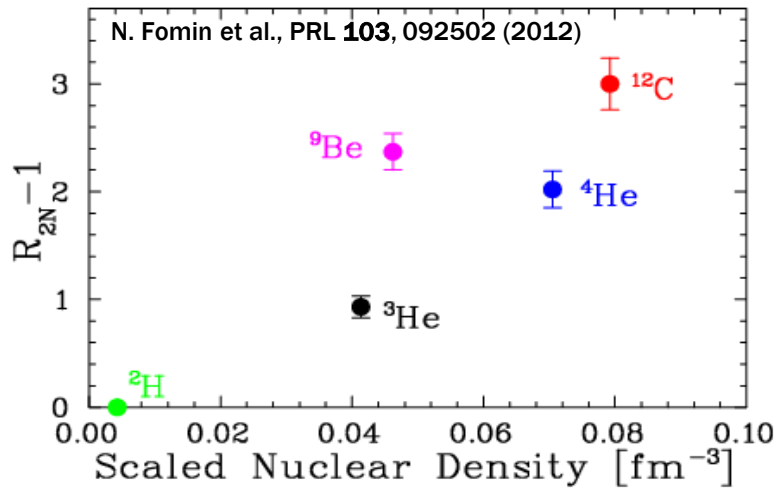
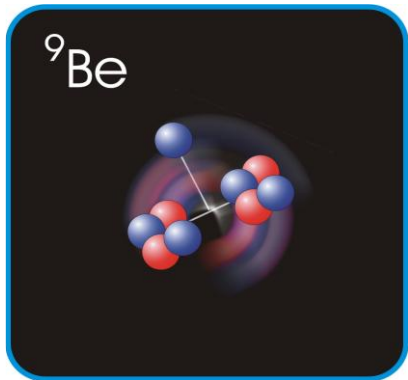
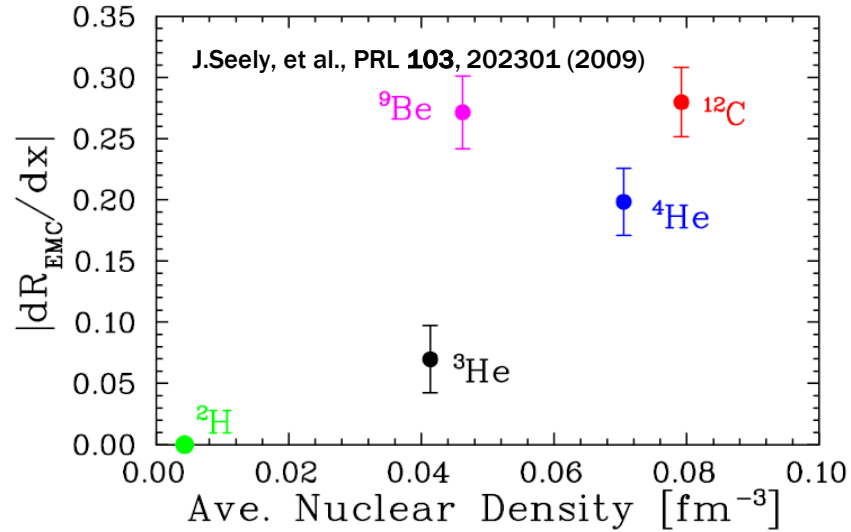
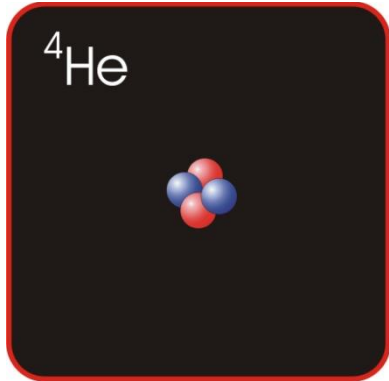
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Electron Scattering is our microscope

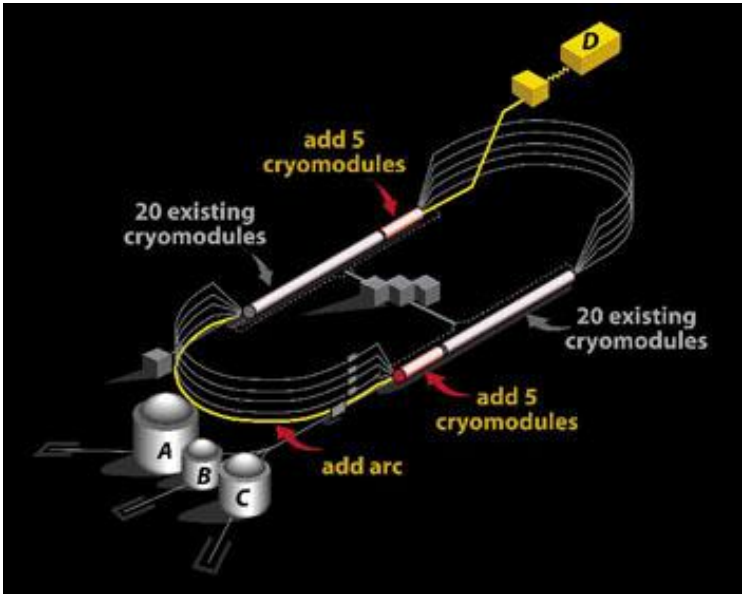
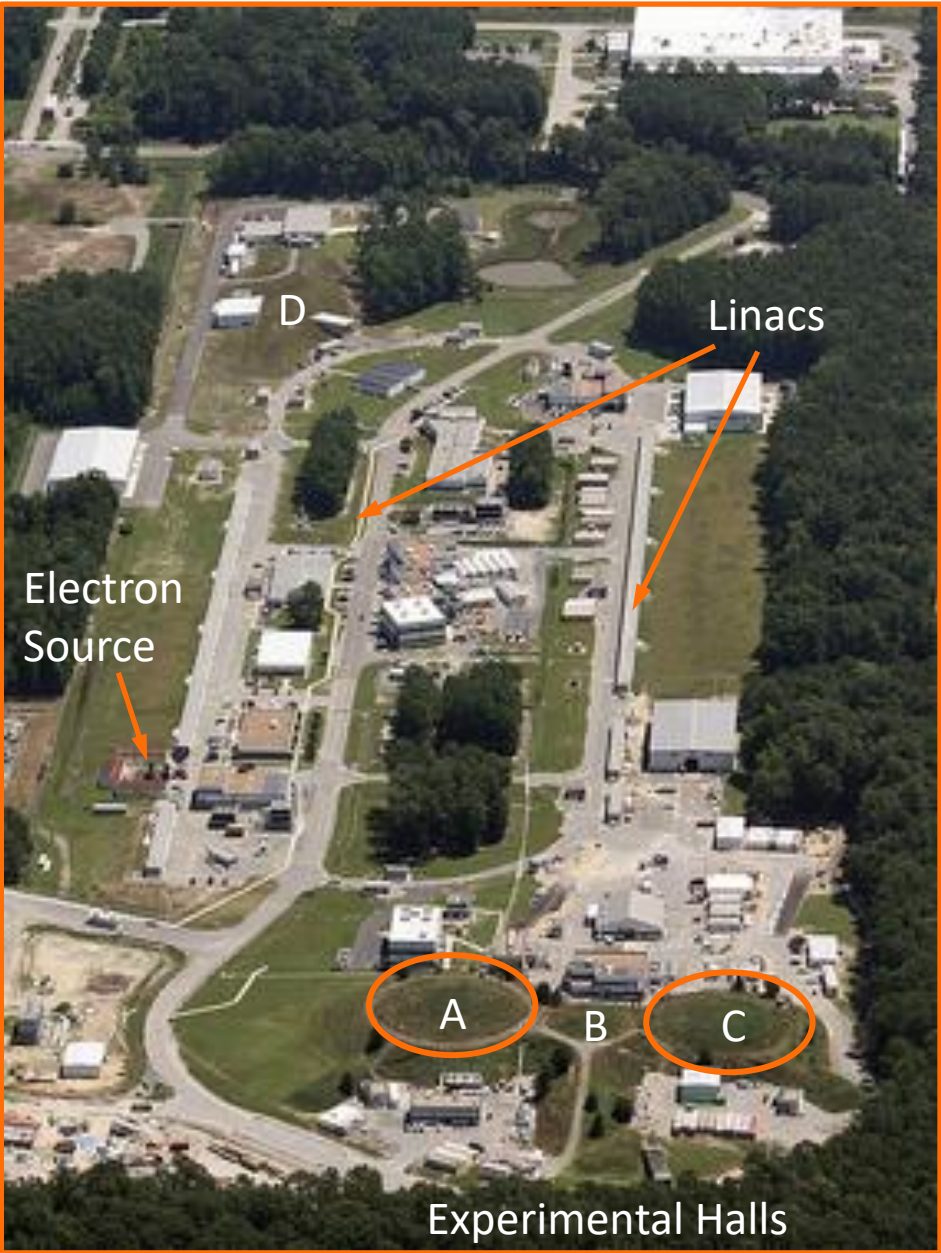


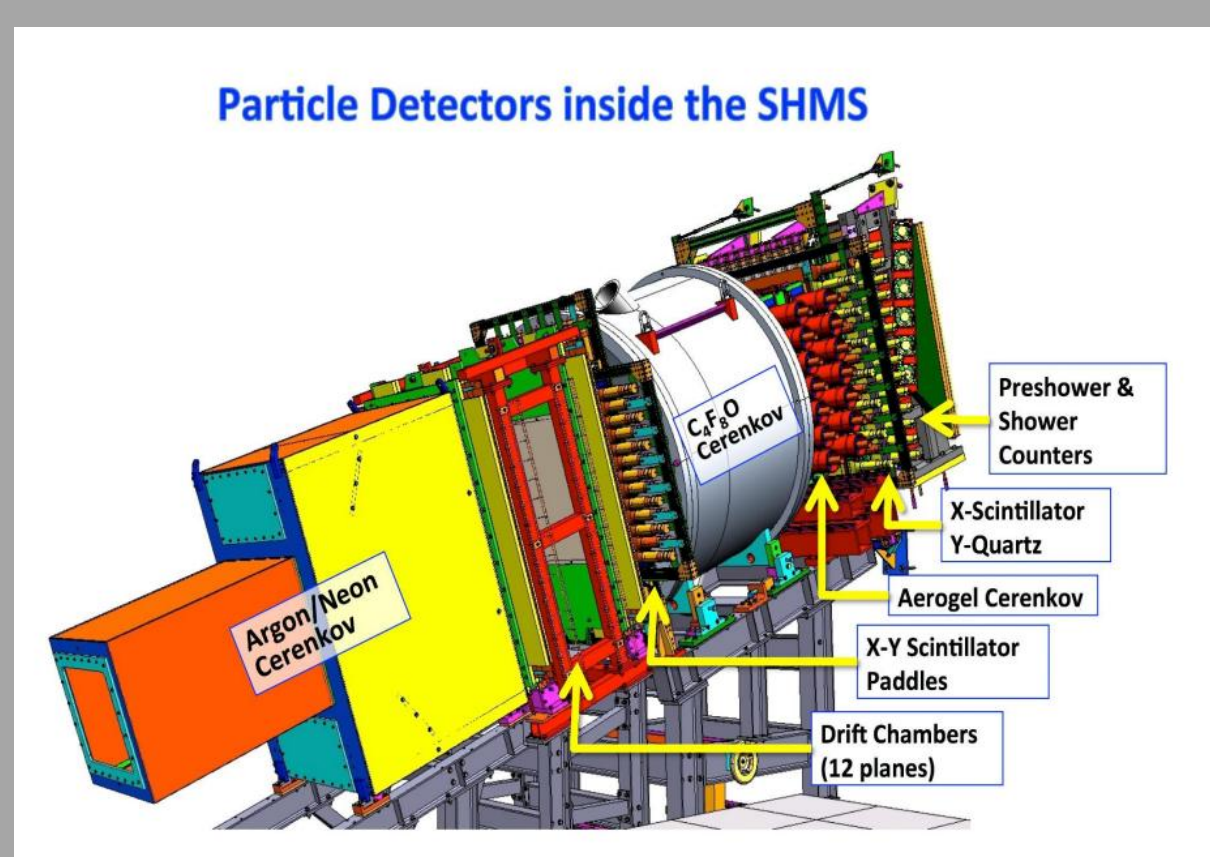
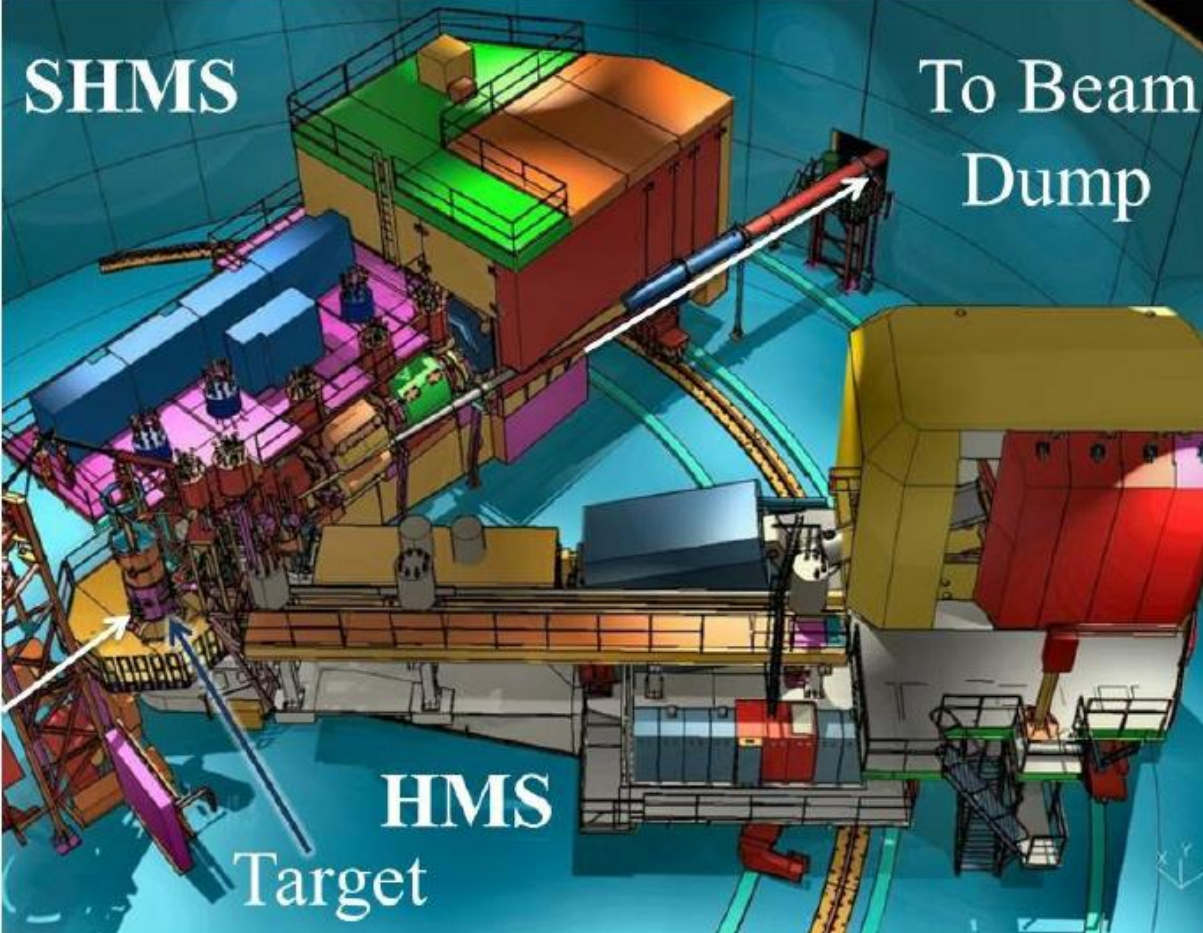
Electron Scattering is our microscope



Thomas Jefferson National Accelerator Facility

now with an 11 GeV electron beam!!!





Casey Morean Wins SCGSR Award from the US Department of Energy

May 27, 2020



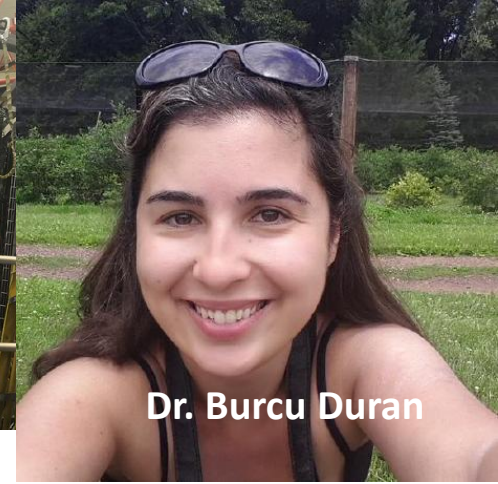
Physics Graduate Student **Casey Morean** is among 62 graduate students nationwide recently selected for the US Department of Energy Office of Science Graduate Student Research (SCGSR) Program. This award will help support his research at the Thomas Jefferson National Accelerator Facility (TJNAF), under the supervision of **Associate Physics Professor Nadia Fomin**. The



Jason Bane



The Kids in the Hall



Dr. Burcu Duran



Ryan Goodman and Abhyuday Sharda

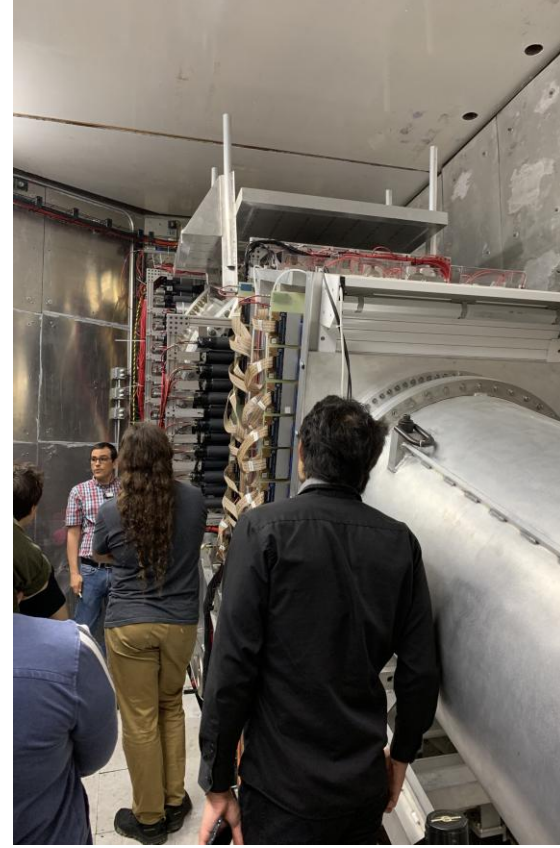
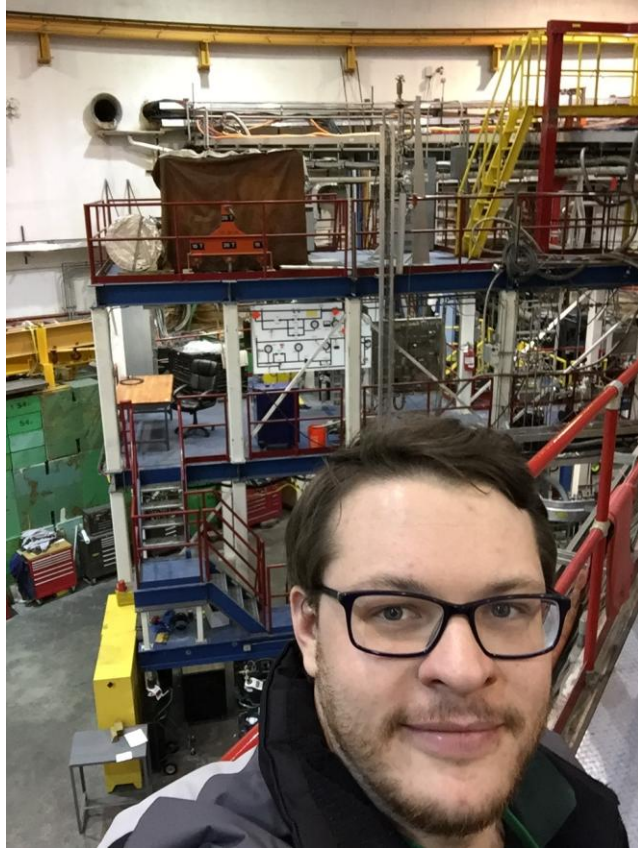


Not shiftless

UT Medium Energy Group - 2024



Travel To Virginia



TRAVEL THE WORLD

