

ARUNA Focus: Ohio University

Andrea Richard

August 15, 2025

Meet the team!



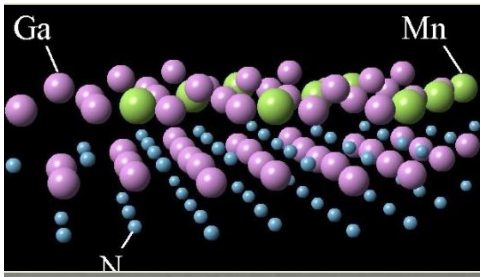
Front Row: Charlotte Elster, Julie Roche, Andrea Richard, Gabriella Popa, Cody Parker, Steven Grimes
Back Row: Alexander Voinov, Gang Chen, Carl Brune, Justin Frantz, Christian Drischler, Paul King, David Ingram, Thomas Massey

Not Present in Picture: Chaden Djalali, Mark Lucas, Daniel Phillips, Madappa Prakash

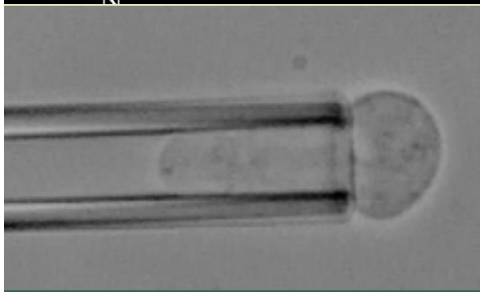
Physics and Astronomy Department



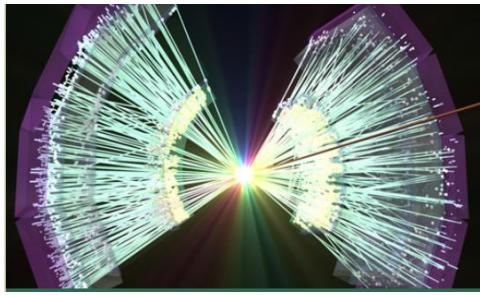
Astrophysics & Cosmology



Nanoscience, Condensed Matter and Surface Science



Biophysics



Nuclear & Particle Physics

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EAL

CMSS

ASTROPHYSICAL INSTITUTE

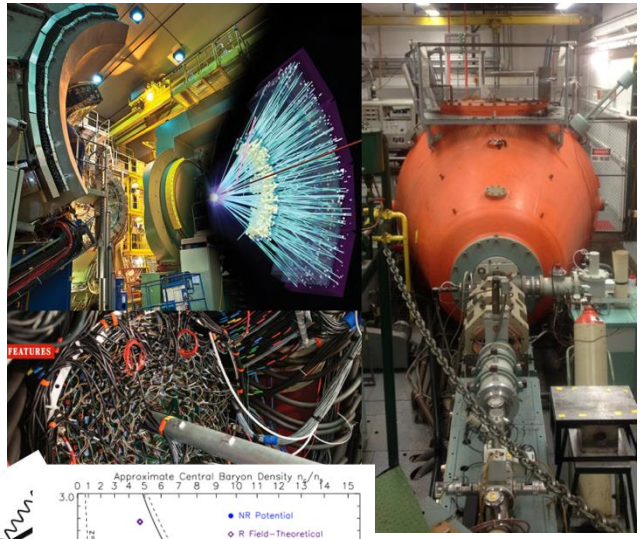
ONQPI OHIO UNIVERSITY Nanoscale | Quantum Phenomena Institute

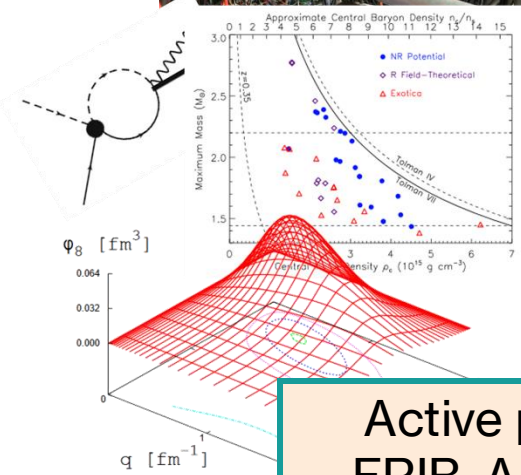
30 faculty
70 graduate students
70 undergraduate students

Institute of Nuclear & Particle Physics

The 2023 Long Range Plan for Nuclear Science had 4 main questions:

- How do quarks and gluons make up protons, neutrons, and, ultimately, atomic nuclei?
- How do the rich patterns observed in the structure and reactions of nuclei emerge from the interactions between neutrons and protons?
- What are the nuclear processes that drive the birth, life, and death of stars?
- How do we use atomic nuclei to uncover physics beyond the Standard Model?

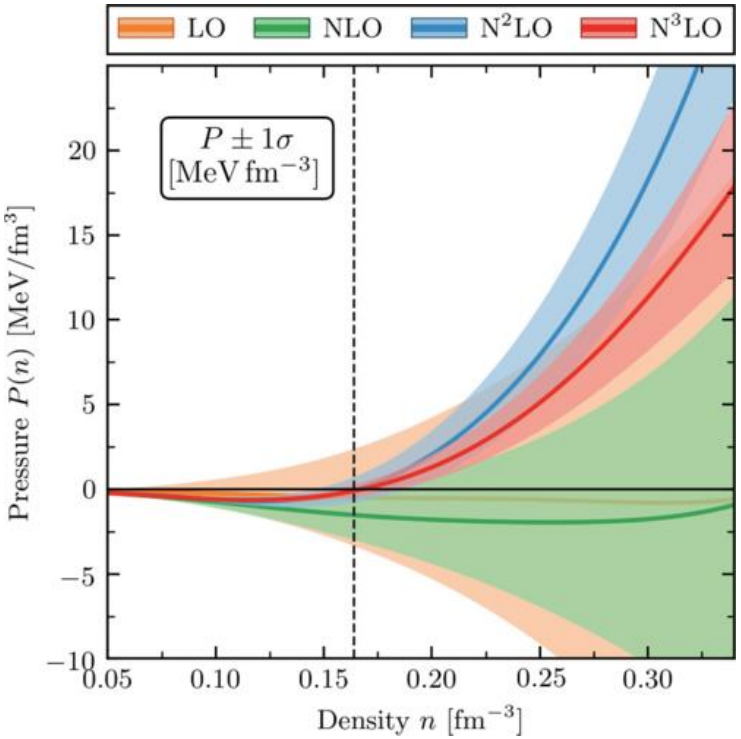




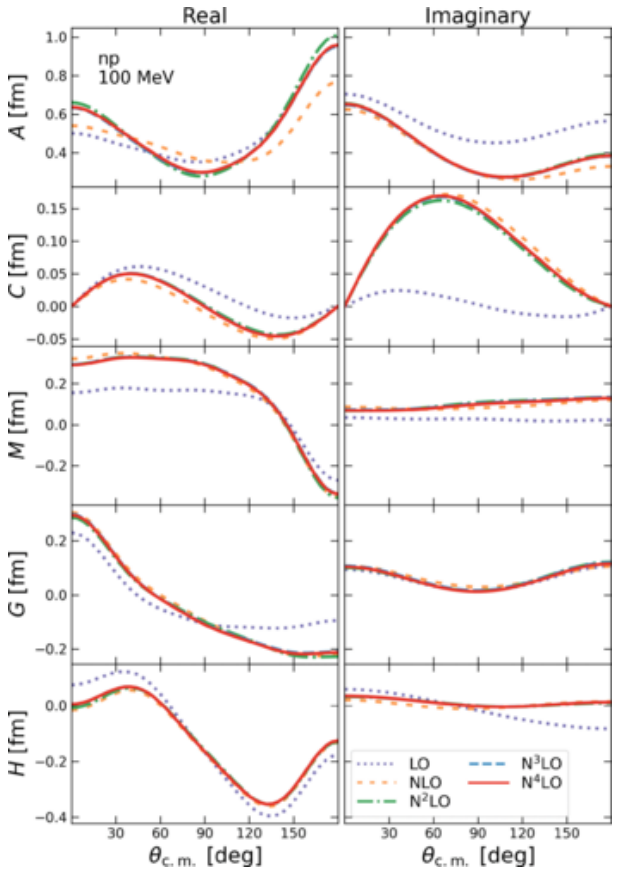
Active programs at FRIB, ANL, TRIUMF, RHIC, JLab, EIC

Recent Results from the Nuclear Theory Group

From chiral effective field theory to perturbative QCD using Bayesian Model Mixing



A. Semposki, C. Drischler, *et al.* Phys. Rev. C **111**, 035804 (2025)

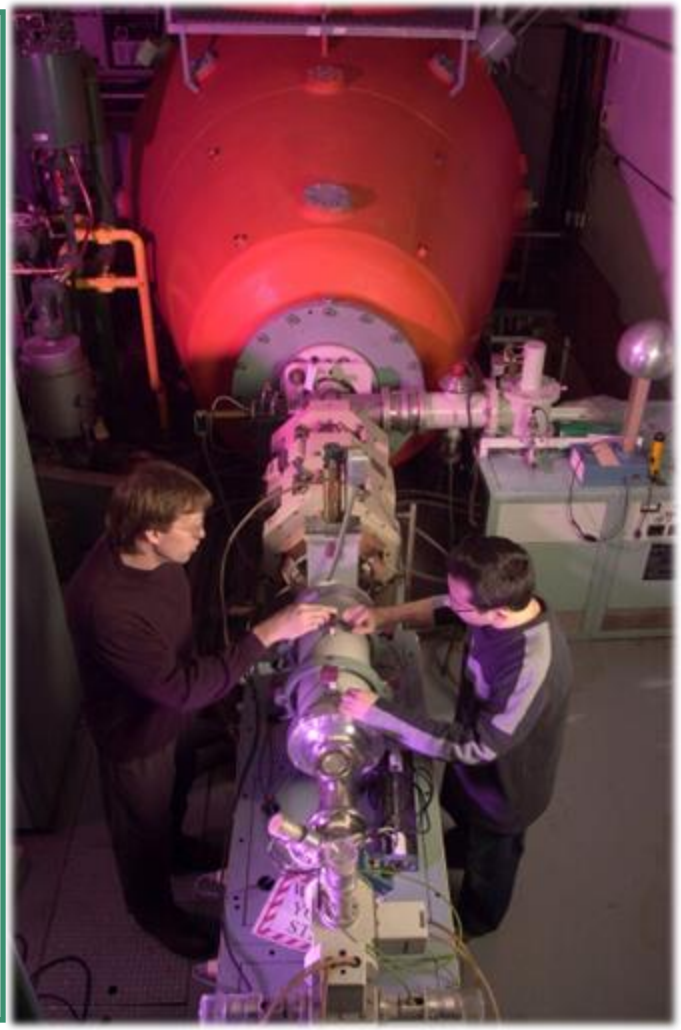


Order-by-order uncertainties of nucleon-nucleon Wolfenstein amplitudes in chiral EFT

B. McClung, Ch. Elster, and D. R. Phillips, Phys. Rev. C **111**, 064002 (2025).

Edwards Accelerator Laboratory

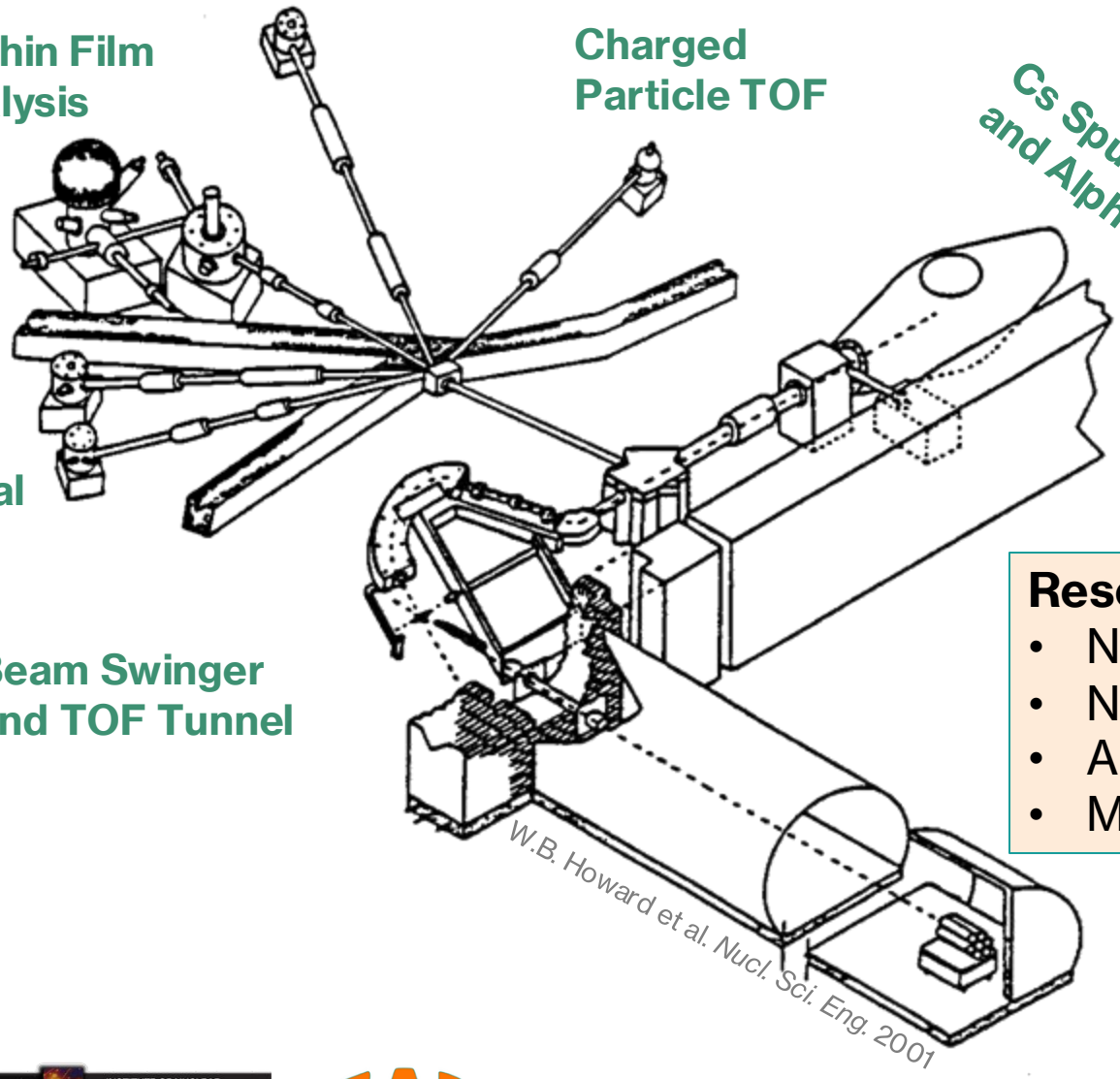
- 4.5-MV tandem accelerator
  - T-style
  - Pelletron charging
- Cs sputter ion source
  - (H, D, Li, C,...)
- Alphatross ion source
  - (^{3}He and ^{4}He)
- Beam pulsing with nanosecond resolution
- Neutron detection
  - (NE213, Li-glass, CLYC, HeBGB, ...)
- Gamma-ray detection
  - (Ge, NaI, BGO, LaBr)
- Neutron production
  - 0.5 – 24 MeV
- 6 instrumented beamlines







Edwards Accelerator Laboratory

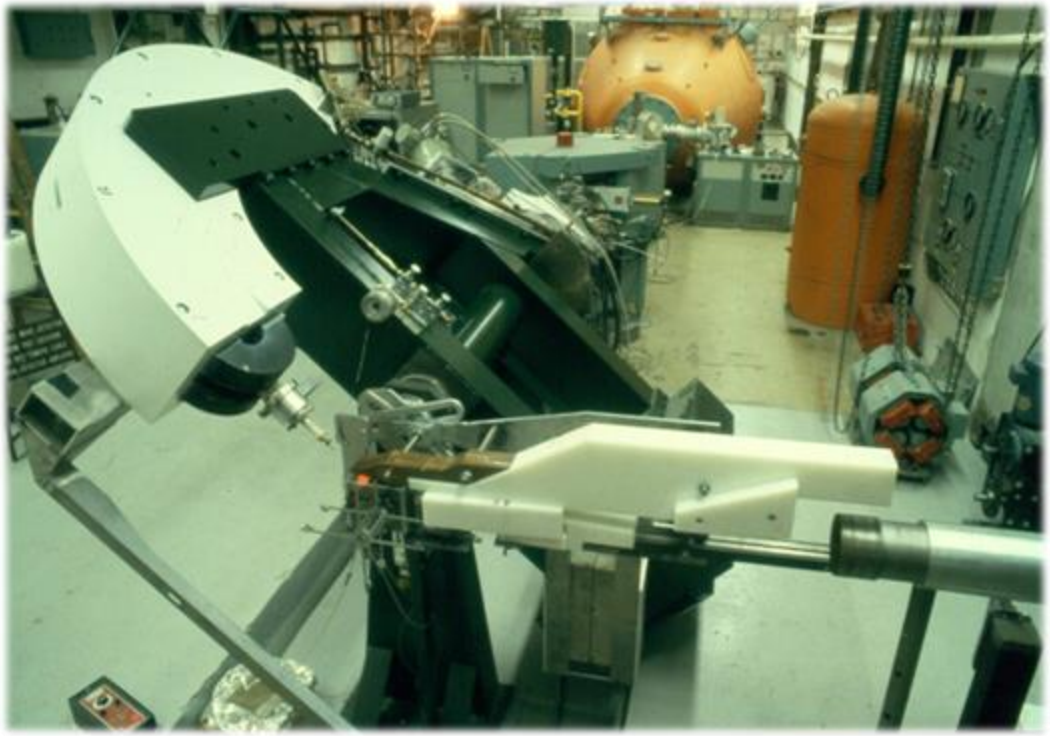


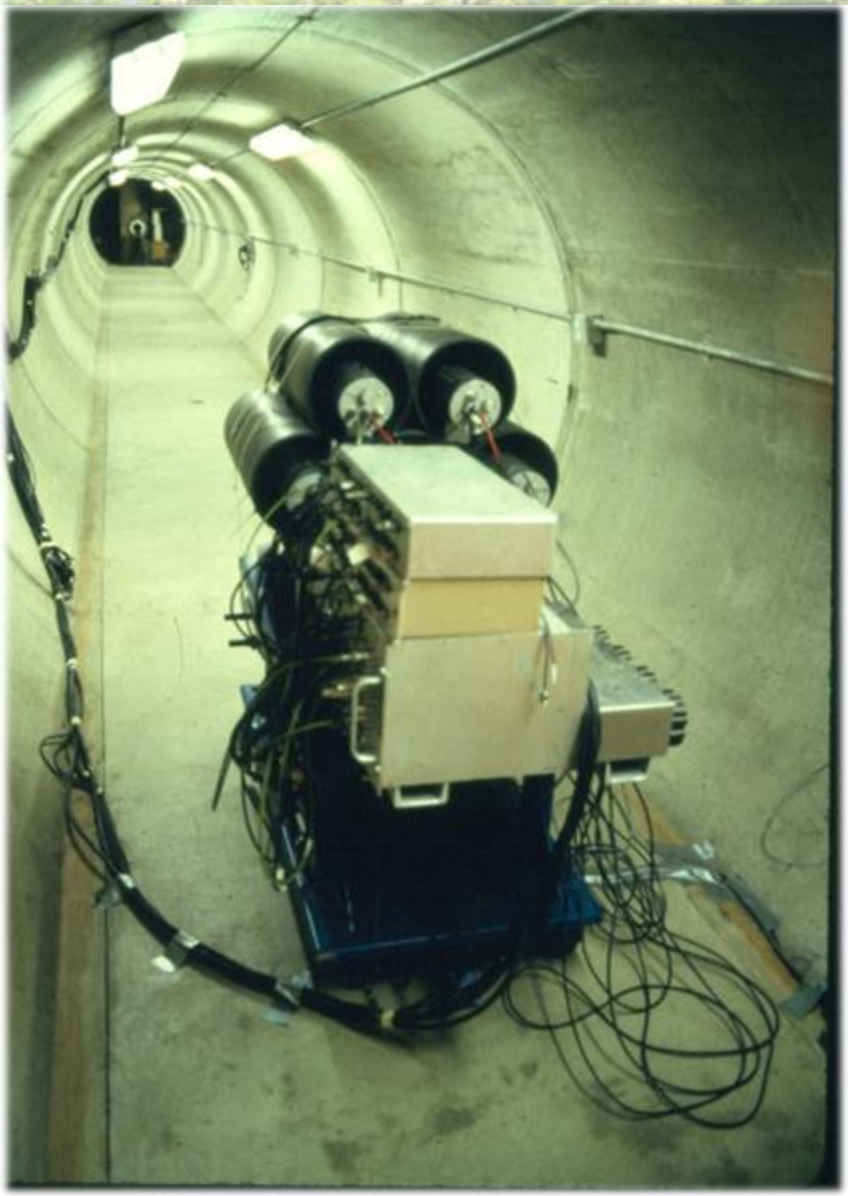
Research Areas:

- Nuclear Astrophysics
- Nuclear Structure
- Applications
- Material Science

Beam Swinger Facility

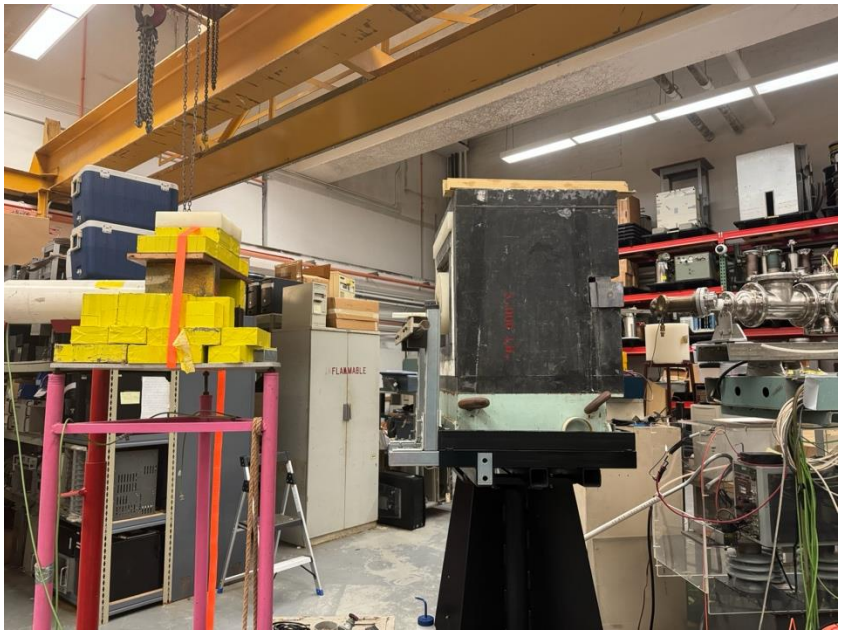
- Swinger range: $-4° \leq \theta_{lab} \leq 158°$
- 30 m neutron TOF flight-path
- Polyethylene collimation & lead shielding for tunnel entrance
- Solid & gaseous targets

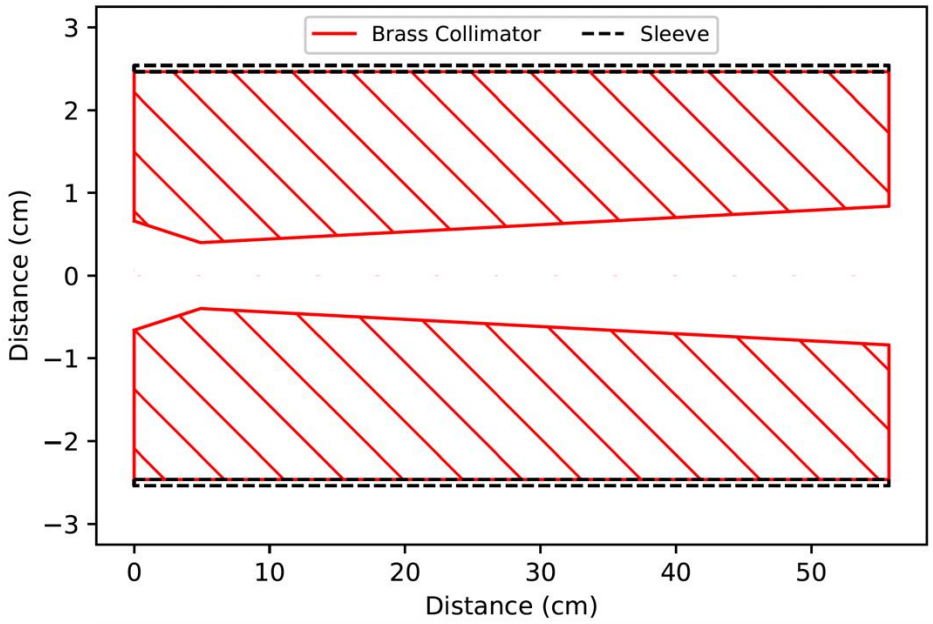




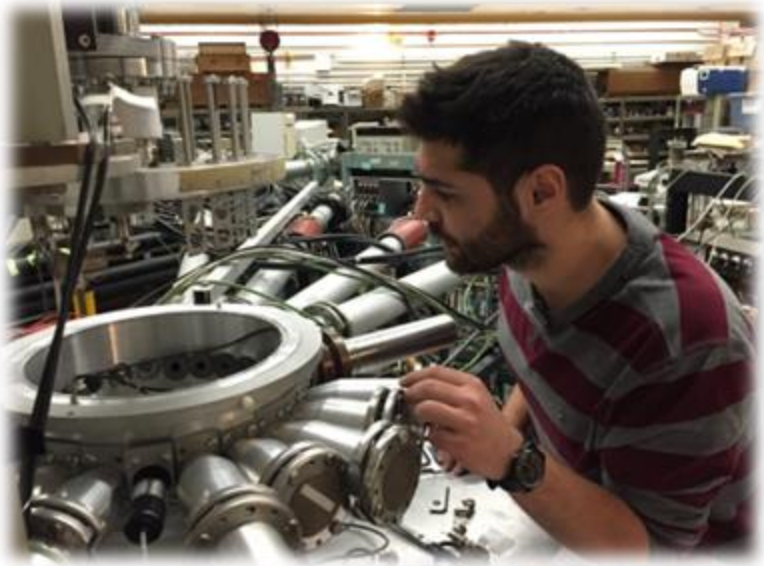
FAST Neutron Source

- Swinger measurements don't allow for sample distances between 0.14 and 3.8 m
- **F**ixed **A**ngle **S**hort **T**rajectory neutron source: FAST
- Angle fixed at 0° and source distances down to 0.6m possible
- Initial physics goal: $^{16}O(n,n)$ resonances for $^{13}C(\alpha,n)^{16}O$
- Ph.D. project of Dr. Joseph Derkin

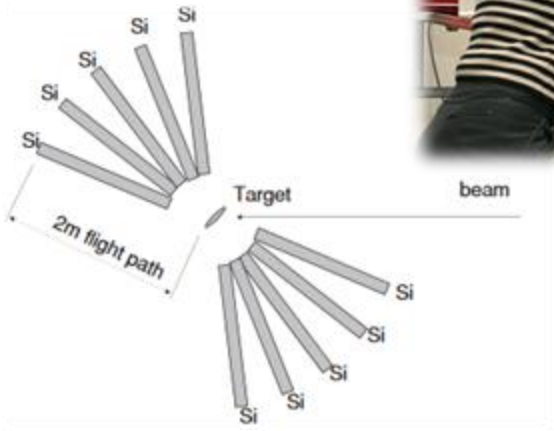




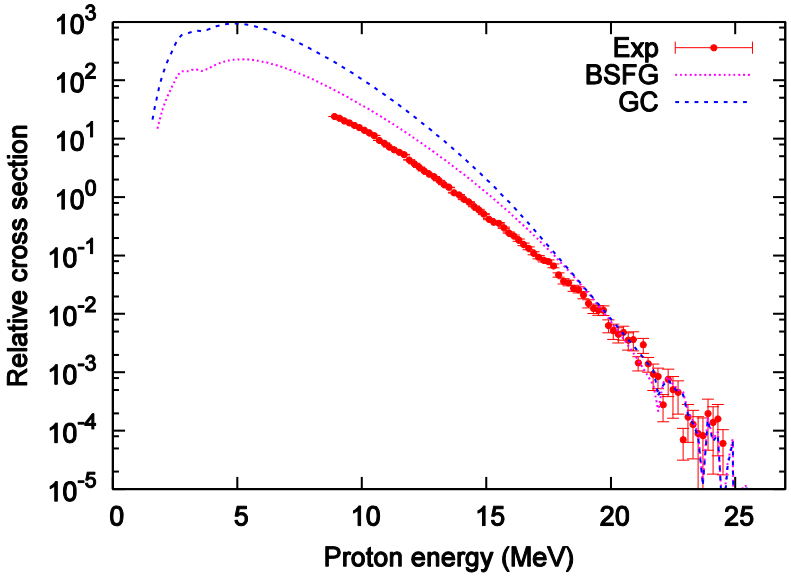
Charged Particle TOF Chamber







Example:
^{76}Ge level density via ^{70}Zn(^{7}Li,p)



Critical to benchmark for β-Oslo technique

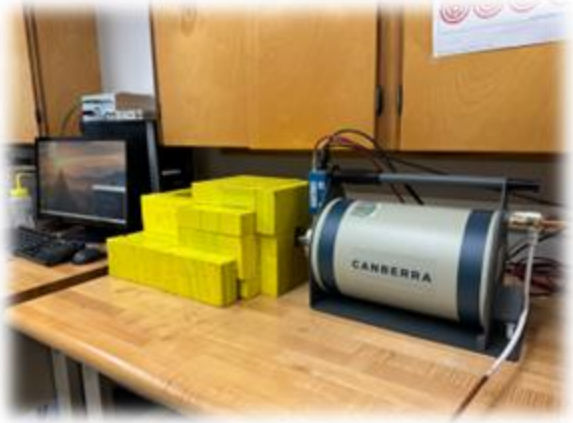
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New Detector Systems

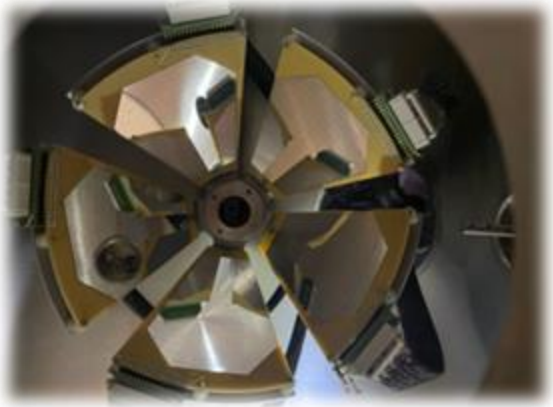
HeBGB Long Counter



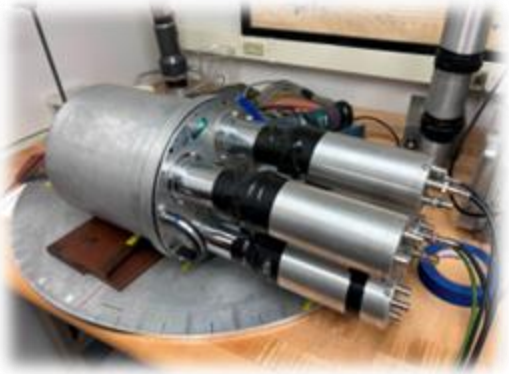
Low Background HPGe



ASLAN Lampshade Array

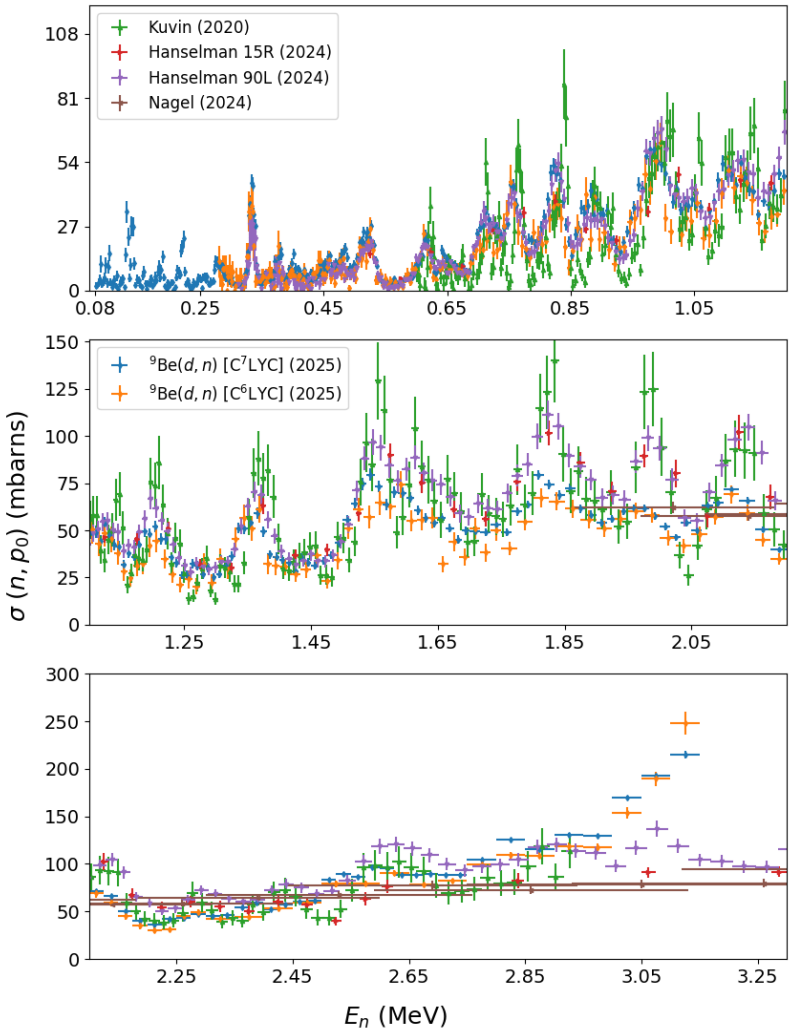


Split Annulus NaI



Plans for (n,Z) chamber and TAS detector

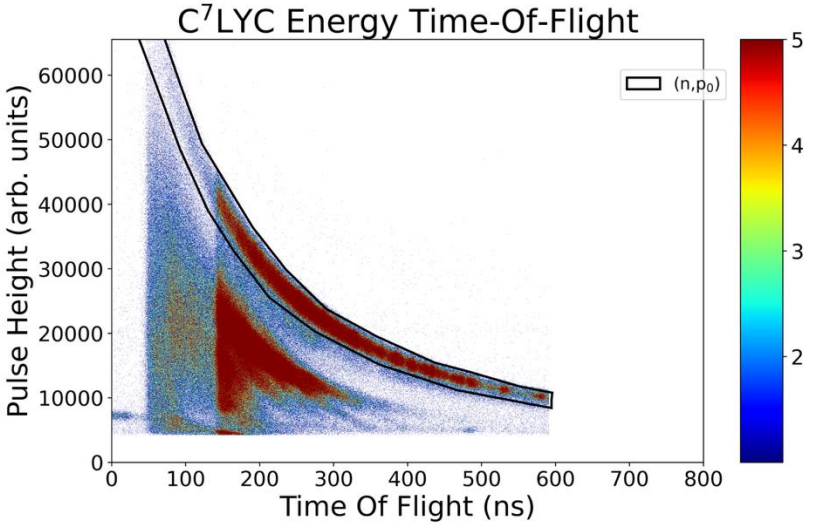
Selected Student Results: Neutron-Induced Reactions on ^{35}Cl





Ph.D of
Dr. Justin
Warren

- ^{35}Cl(n,p) and ^{35}Cl(n,α) for Molten chloride salt reactors
  - Neutrons from ^{9}Be(d,n) and ^{9}Be(p,n) reactions



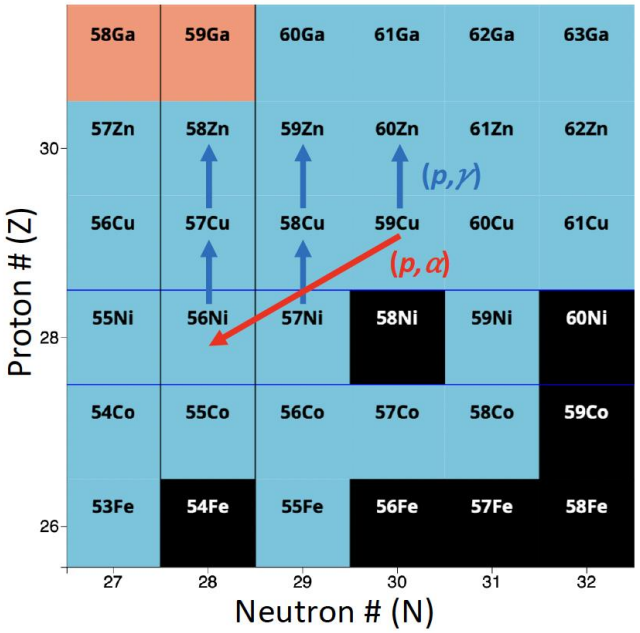
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Selected Student Results: Level Density of Doubly Magic ^{56}Ni

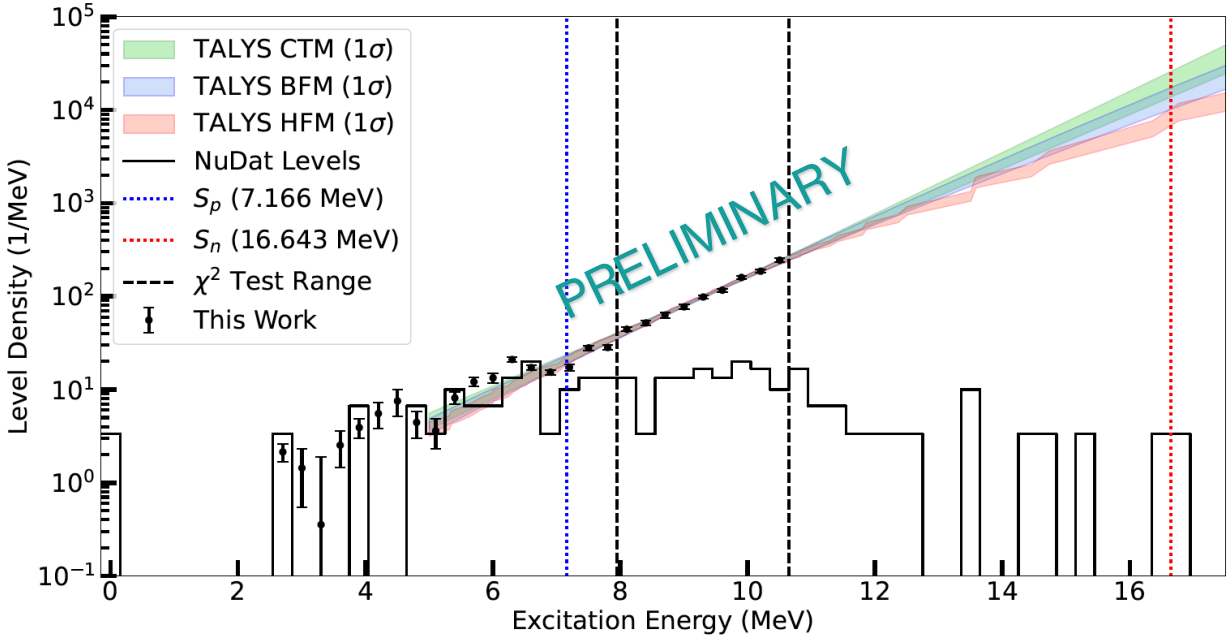
Ni-Cu cycle in the *rp* process





Austin Rambo

Particle-Evaporation level density technique to constrain ^{56}Ni using ^{54}Fe(^{3}He,n)^{56}Ni

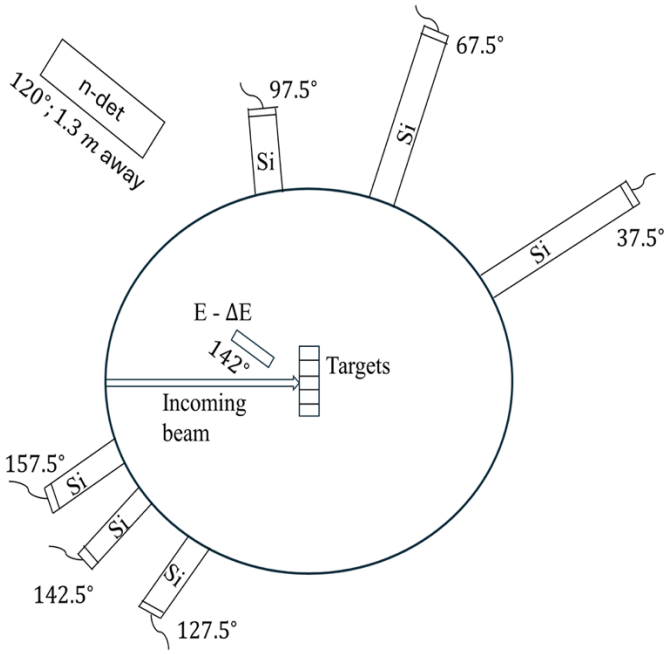


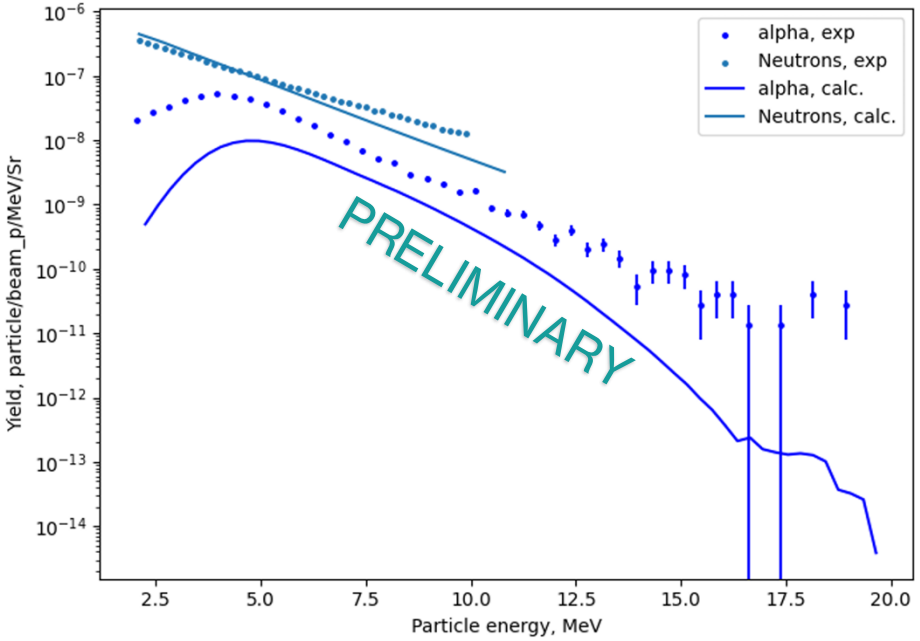
Selected Student Results: Optical Model Potential Studies

- Incident ^{7}Li beams on ^{48}Ca
  - Measure n, p, and α spectra to probe OMP for multiple exit channels



Chirag Rathi





Selected Student Results: Optical Model Potential Studies

- Incident ^{7}Li beams on ^{48}Ca
  - Measure n, p, and α spectra to probe OMP for multiple exit channels



The Level Density Project

https://nld.ascsn.net

Search Criteria:

Enter Proton Number

Enter Mass Number

Filter by method:

Evaporation Oslo Ericson
Inverse Oslo Beta Oslo
Beta-n Beta-p

Select or type a reaction

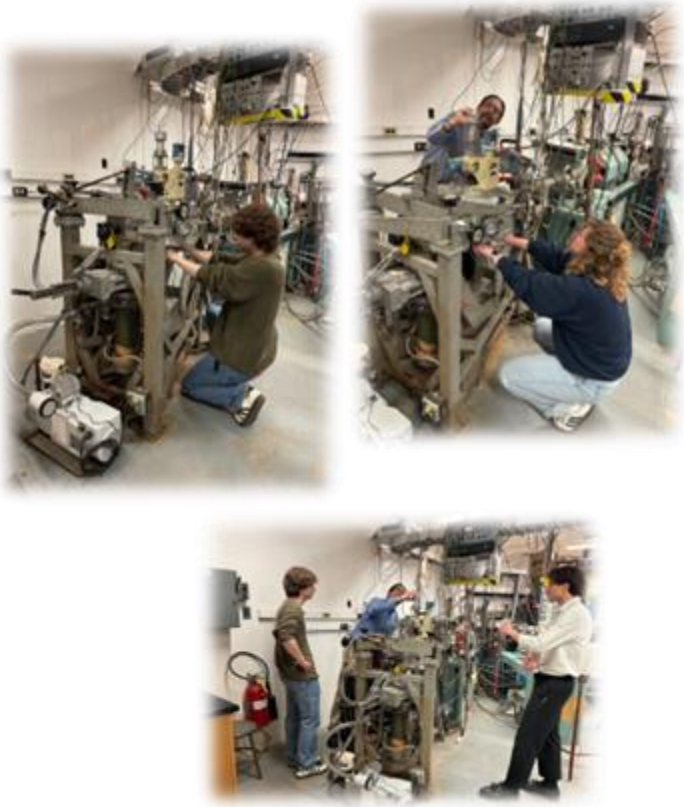
Select all

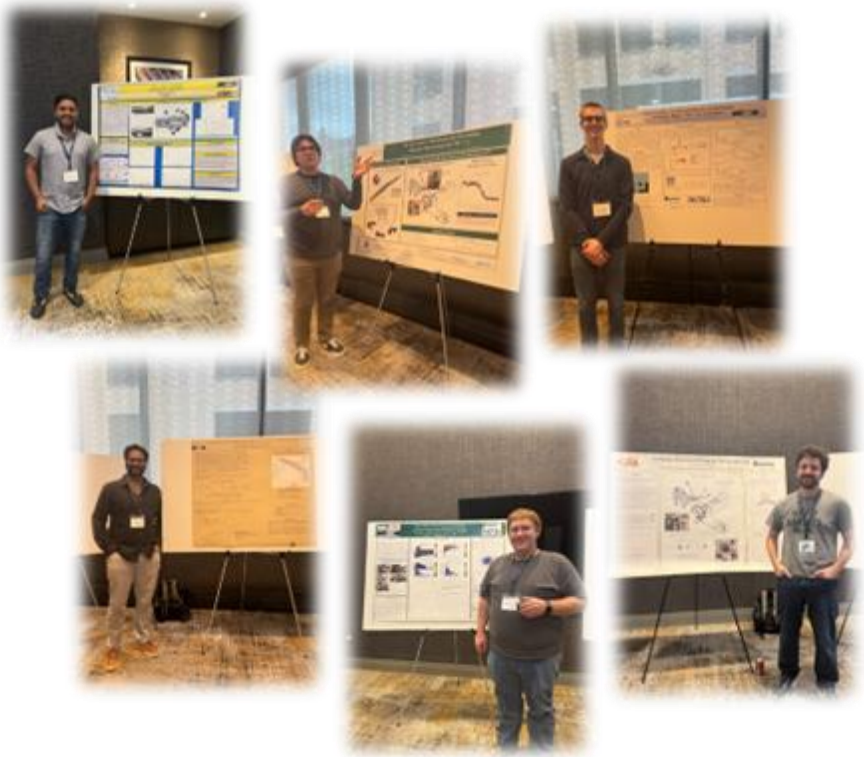
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☐	0	25Mg	12	25	14	20	Ericson	p,t; d,d	Carlson and Barschall, Phys. Rev. 158, 1967
☐	2	28Al	13	28	13	16	Ericson	p,t; d,d	Carlson and Barschall, Phys. Rev. 158, 1967
☐	3	28Al	13	28	12	18	Ericson	n,g	DOI:10.1103/PhysRevC.47.1033.
☐	4	28Si	14	28	0	21	Ericson	p,n	Phys. Rev. C 70, 024311 (2004)
☐	5	29Si	14	29	15	20	Ericson	p,t; d,d	Carlson and Barschall, Phys. Rev. 158, 1967
☐	6	29Si	14	29	3	22	Ericson	n,p; n,a; d,n	F.B. Bateman et al. PRC 55, 133 (1997)
☐	7	29Si	14	29	12.5	21	Ericson	n,g	DOI:10.1103/PhysRevC.47.1033.
☐	8	32P	15	32	9.5	17	Ericson	n,g	Phys. Rev. C 62, 064312 (2000)
☐	9	33S	16	33	15	19	Ericson	p,t; d,d	Carlson and Barschall, Phys. Rev. 158, 1967
☐	10	33S	16	33	9	17.5	Ericson	n,g	Phys. Rev. C 62, 064312 (2000)

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Student Engagement and Workforce Development

All undergraduate physics majors perform experiments at EAL as part of the curriculum

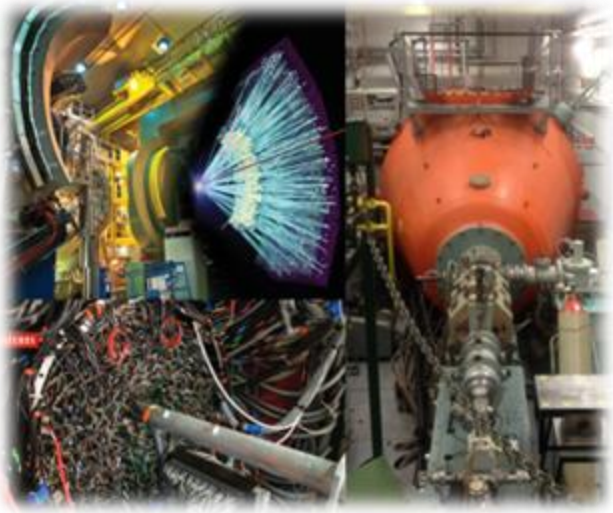




Graduate students at the Frontiers Meeting in 2024

Summary and Outlook

- Strong nuclear theory and nuclear experiment program at OU
- EAL provides intense beams of p, d, ^{3,4}He, and heavier ions
  - Neutron production from 0.5 – 24 MeV (Swinger, FAST)
- EAL funding from DOE Office of Science, NNSA, NDIAWG, LLNL, PNNL
- Future plans to build up (n,Z) and particle+gamma coincidence capabilities
- Visitors welcome!
  - Recent guests: AFIT, ND, LLNL, LANL, PNNL, FRIB, CMU





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Thank you!
Questions?