National Science Foundation – Nuclear Physics



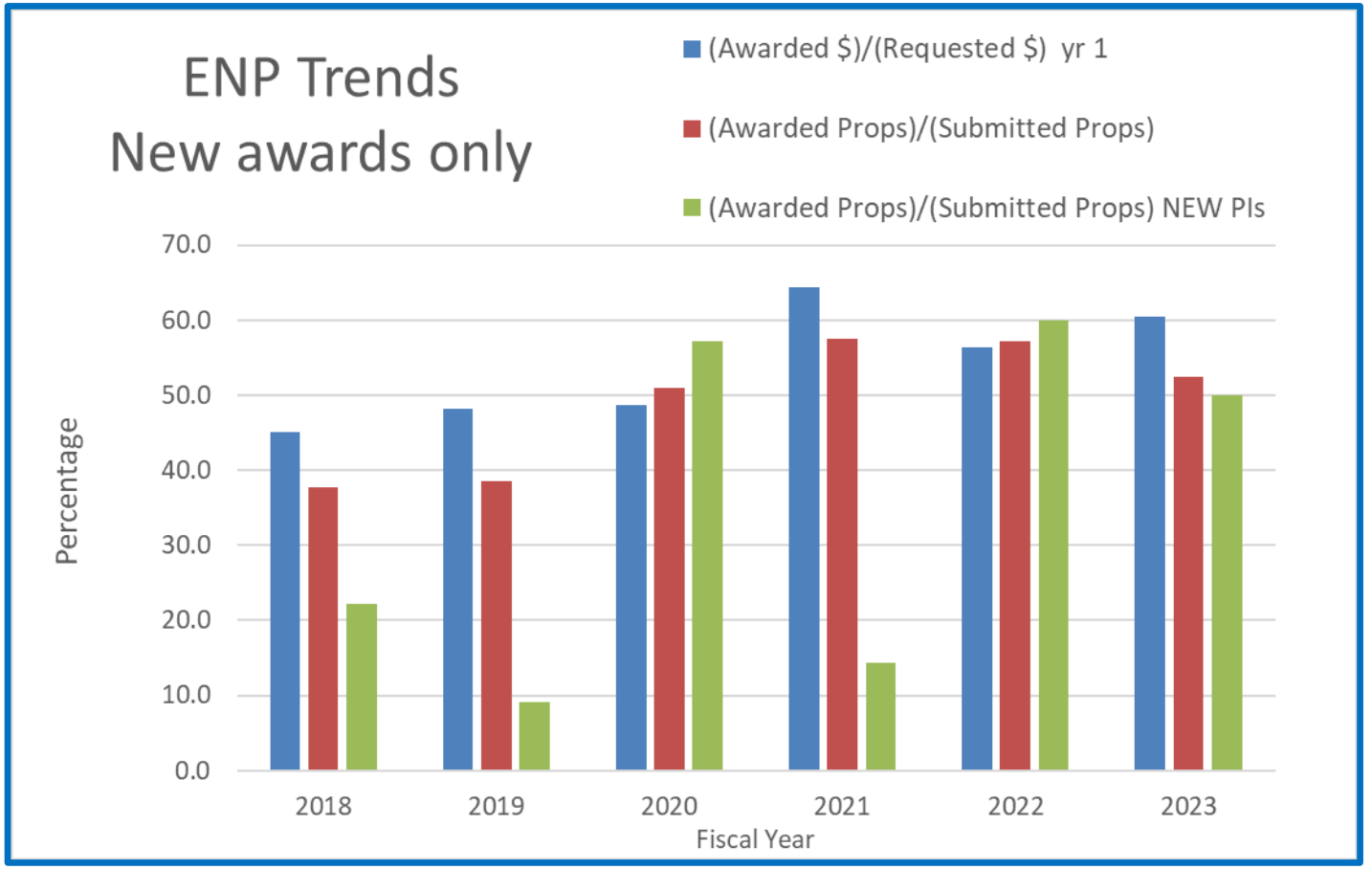
NSF/MPS/PHY Personnel



- Sethuraman Panchanathan – Director
- Sean L. Jones – Assistant Director for MPS
- Denise Caldwell – Physics Division Director
- Jean Cottam Alan – Deputy Division Director
- Bogdan Mihaila – Nuclear Theory Program Director
- Alfredo Galindo-Uribarri – Expt'l Nuclear Physics Program Director
- Allena Opper – Expt'l Nuclear Physics Program Director

https://beta.nsf.gov/careers/openings/mps/phy/phy-21-001
www.nsf.gov/careers/rotator

Proposal Trends in Experimental Nuclear Physics







Director's vision points to:

- Strengthening Established NSF
  - NSF's central focus = accelerate discovery and enhance state of the art research capabilities
- Bringing the "Missing Millions" into the STEM Workforce
  - There is tremendous untapped STEM potential throughout the nation
- Accelerating Technology and Innovation
  - NSF will foster partnerships with other agencies, private industry, philanthropy, like-minded countries – and thriving partnership environments

FY24 President's Budget Request – NSF ($M)

NSF by Account	FY 2022 Actual[1]	FY 2023 Estimate Base[2]	FY 2023 Estimate Total	FY 2024 Request	FY 2024 Request Compared to FY 2022 Actual Amount	FY 2024 Request Compared to FY 2022 Actual Percent	FY 2024 Request Compared to FY 2023 Base Total[3] Amount	FY 2024 Request Compared to FY 2023 Base Total[3] Percent
Research & Related Activities	**$6,964.66**	**$7,006.136**	**$7,826.80**	**$9,029.90**	**$2,065.24**	**29.7%**	**$1,415.60**	**18.6%**
STEM Education	**$1,146.72**	**$1,154.00**	**$1,371.00**	**$1,444.18**	**$297.46**	**25.9%**	**$198.18**	**15.9%**
Major Res. Equip. & Fac. Construction[1]	**$120.60**	**$187.23**	**$187.23**	**$304.67**	**$184.07**	**152.6%**	**$117.44**	**62.7%**
Agency Operations & Award Mgmt.	**$420.21**	**$463.00**	**$463.00**	**$503.87**	**$83.66**	**19.9%**	**$40.87**	**8.8%**
Office of Inspector General	**$18.89**	**$23.39**	**$23.39**	**$26.81**	**$7.92**	**41.9%**	**$3.42**	**14.6%**
National Science Board	**$4.52**	**$5.09**	**$5.09**	**$5.25**	**$0.73**	**16.2%**	**$0.16**	**3.1%**
Total, NSF Discretionary Funding	**$8,675.61**	**$8,838.85**	**$9,876.51**	**$11,314.68**	**$2,639.07**	**30.4%**	**$1,775.67**	**18.6%**
STEM Education - H-1B Visa	278.48	192.54	192.54	198.84	-79.64	-28.6%	6.30	3.3%
Donations	25.94	40.00	40.00	40.00	14.06	54.2%	-	-
Total, NSF Mandatory Funding	**$304.42**	**$232.54**	**$232.54**	**$238.84**	**-$65.58**	**-21.5%**	**$6.30**	**2.7%**
Total, NSF Budgetary Resources	**$8,980.03**	**$9,071.39**	**$10,109.05**	**$11,553.52**	**$2,573.49**	**28.7%**	**$1,781.97**	**18.2%**

FY24 President's Budget Request – MPS ($M)

	FY 2022 Actual[1]	FY 2023 Estimate Base	Disaster Relief Supplemental Base	Disaster Relief Supplemental RI Damage Mitigation	FY 2023 Estimate Total	FY 2024 Request	Change over FY 2023 Base Total[2] Amount	Change over FY 2023 Base Total[2] Percent
Astronomical Sciences (AST)	$283.61	$283.57	$8.76	-	$292.33	$303.33	$11.00	3.8%
Chemistry (CHE)	265.19	264.46	4.37	-	268.83	279.83	11.00	4.1%
Materials Research (DMR)	338.75	338.78	0.63	-	339.41	350.41	11.00	3.2%
Mathematical Sciences (DMS)	248.32	247.99	4.00	-	251.99	262.99	11.00	4.4%
Physics (PHY)	309.89	308.90	4.23	-	313.13	324.13	11.00	3.5%
Office of Strategic Initiatives (OSI)[3]	169.50	169.20	48.45	2.50	220.15	315.10	97.45	44.8%
Total	**$1,615.26**	**$1,612.90**	**$70.44**	**$2.50**	**$1,685.84**	**$1,835.79**	**$152.45**	**9.1%**

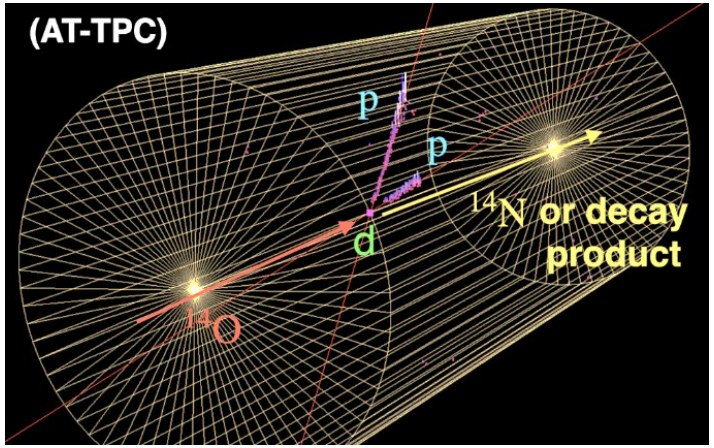
Major Research Instrumentation (MRI) NSF 23-519

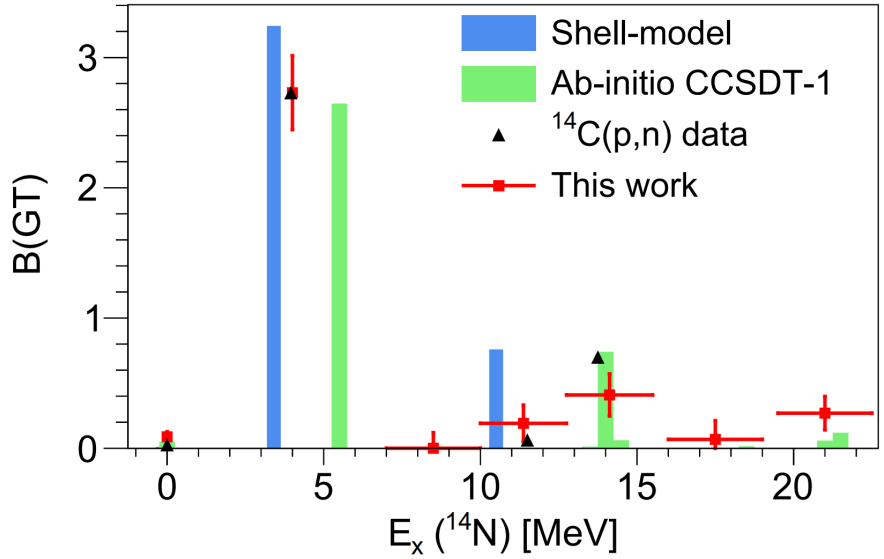
- Two tracks:
  - Track 1 $100 k < $ from NSF < $1.4 M; up to 2/university
  - Track 2 $1.4 M < $ from NSF < $4 M; 1/university
  - Track 3 acquisition, development, installation, operation, and maintenance of equipment and instrumentation to reduce consumption of helium; 1/university
- Two types: development and acquisition; both need to be “shovel ready”
- Deadlines & details
  - October 16 – November 15, 2023, (a window of opportunity)
  - https://www.nsf.gov/od/oia/programs/mri/
  - https://www.nsf.gov/pubs/2023/nsf23519/nsf23519.htm
  - *Contact your program directors well ahead of time to discuss & avoid pitfalls*
  - Awards above $1M compete across the entire Foundation
  - ~~30% cost share req’d for PhD granting institutions~~

(d,2He) Inverse Kinematics → novel probe to constrain e-capture rates in astrophysical phenomena

- EC & β decay on medium mass nuclei → stellar evolution
  - Core-collapse SN, thermonuclear SN, neutron star crust
- *B*(GT) ($\Delta L = 0$, $\Delta S = 1$, $\Delta T_z = +/- 1$) needed to extract EC rates
- 2011: *B*(GT) from (p,n) inverse kinematics on ^{56}Ni → EC rates
- 2023: *B*(GT) from (n,p) inverse kinematics

  ^{14}O (d, ^{2}He)^{14}N
- AT-TPC (filled with d) + S800

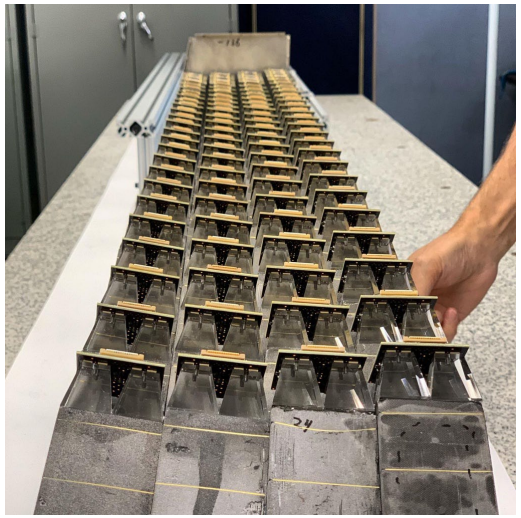




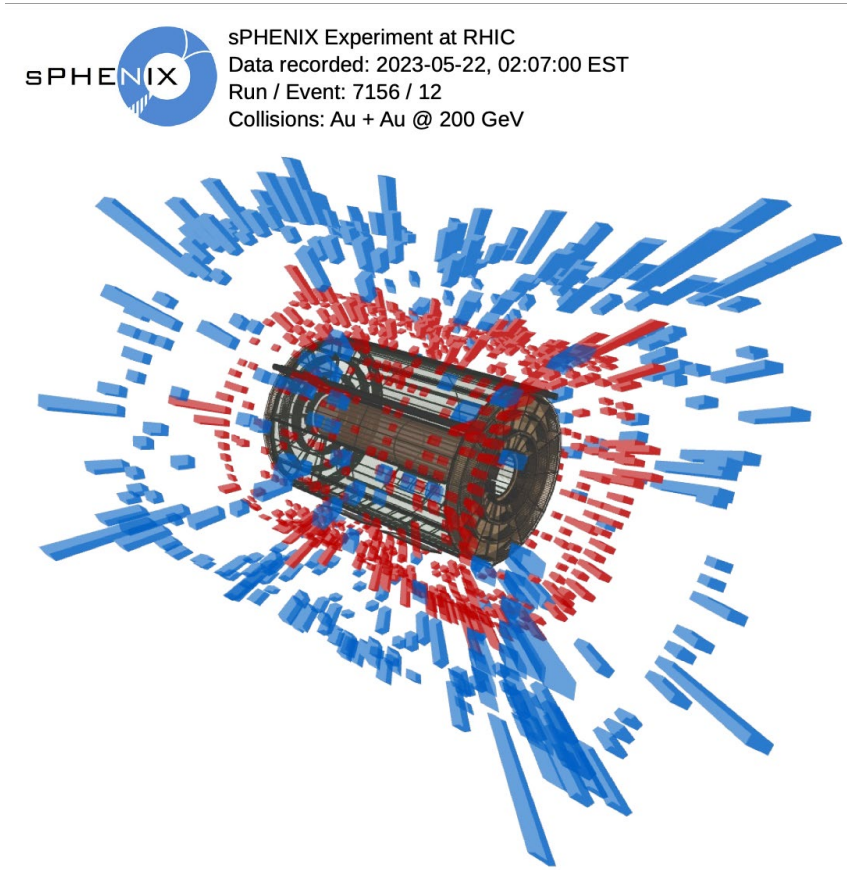
S. Giraud, J. Zamora, et al., PRL **130**, 232301 (2023)

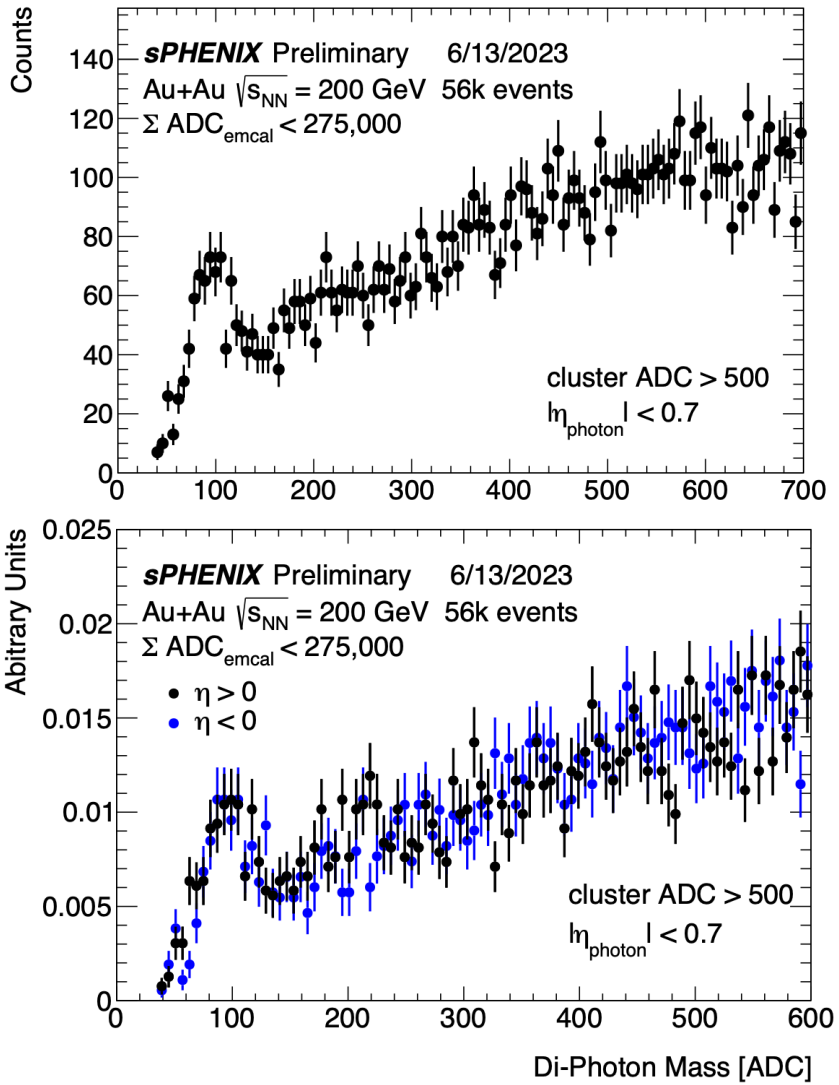
π^0 candidates in Au-Au collisions at sPHENIX

sPHENIX EMCal:
WSciFi blocks built at UIUC & China, assembled at BNL



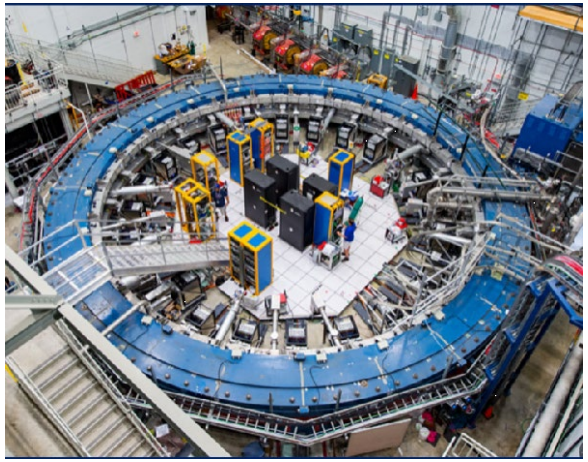
1 of 64 sectors of 96 blocks





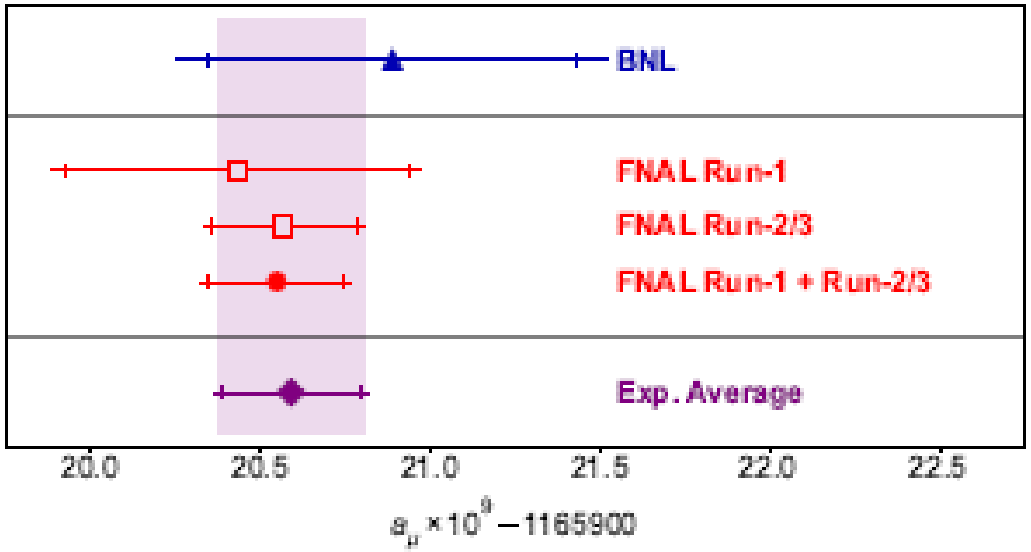
New results from FNAL μ (g-2)

https://indico.fnal.gov/event/60738/



- Precision test of Standard Model and BSM
- BNL result ~ 2000
- FNAL expt approved in 2012 (CD0)
  - Move magnet from BNL to FNAL
  - Lots of redesign and rebuilding
- Six data runs

$$a_\mu^{SM} = a_\mu^{QED} + a_\mu^{EW} + a_\mu^{Hadron}$$



*Theory: g = 2.00233183620(86) a = 0.00116591810(43)

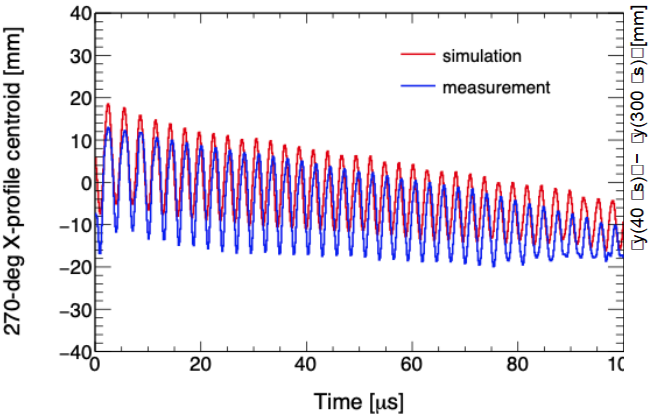
Exp avg: g = 2.00233184110(43) a = 0.00116592059(22) Δ = 5.0 σ

* from 2020

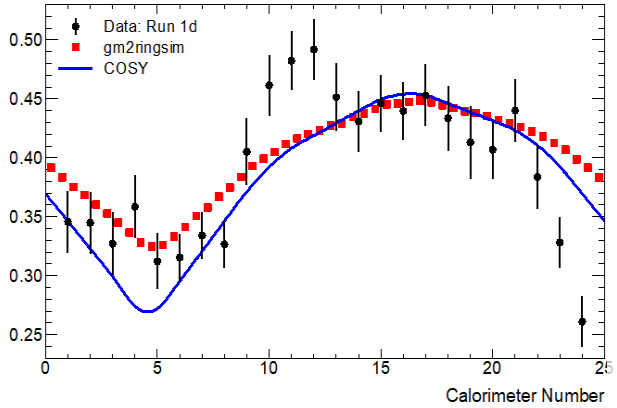
New results from FNAL μ (g-2)

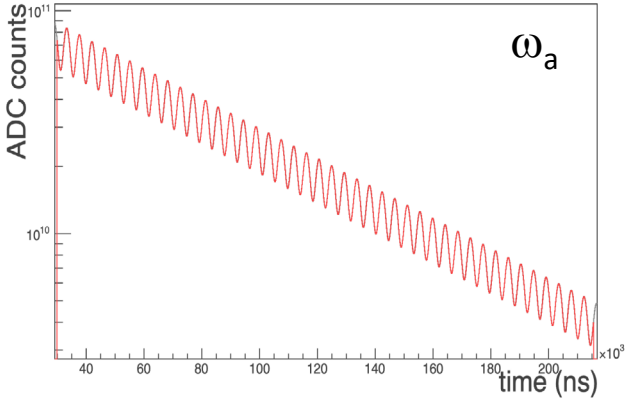
https://indico.fnal.gov/event/60738/

Fiber harps (**RU**)

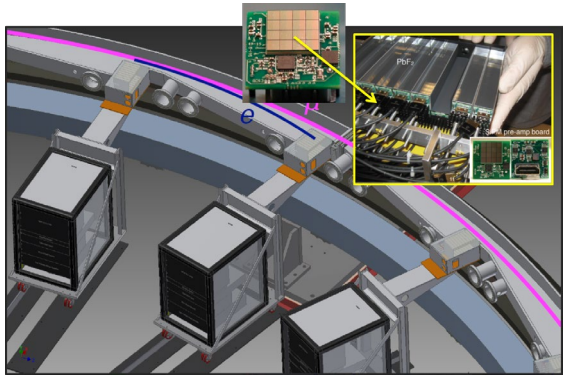


Simulations and Integrated energy analysis(UKy)

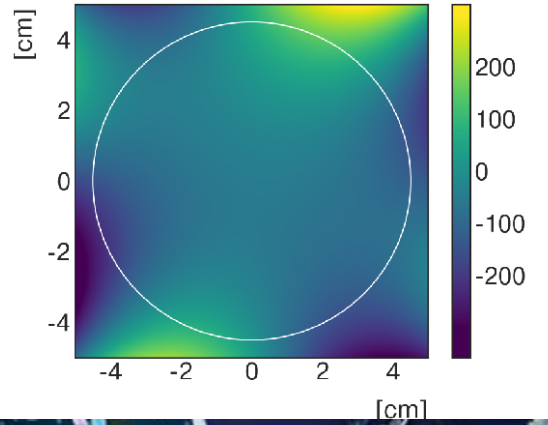


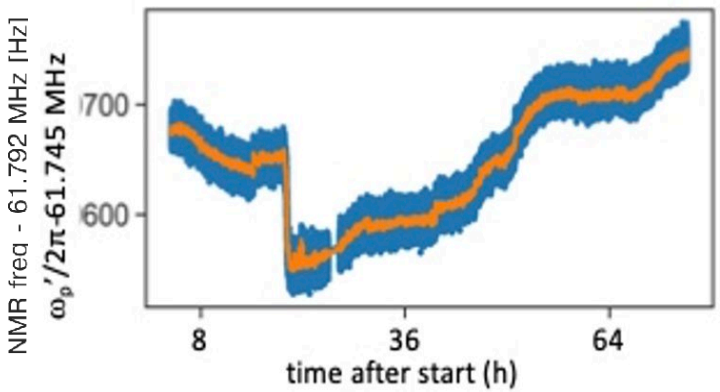


MRI (UW and Cornell)

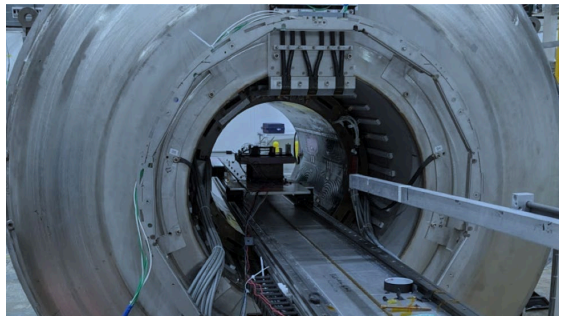


Field maps and tracking (**JMU**, UM, UVa)





^{3}He Calibration (UM)



Calorimeter XLs, SiPMs, electronics, …

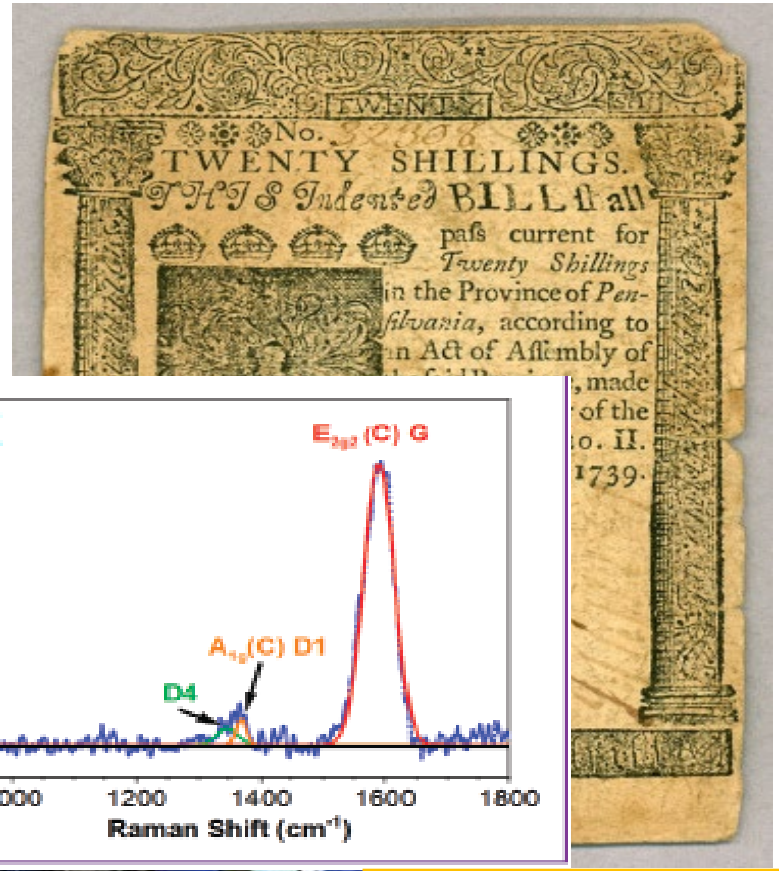


Something completely different

1700's colonies lack of Ag & Au coins → paper currency → counterfeits

Nondistructive & microdistructive imaging and spectroscopy on >600 notes:

- Benjamin Franklin built network to produce legitimate currency and developed techniques identify fakes
- Legitimate notes: specks of mica in the paper
  - BF developed "money paper" with Anthony Newhouse; used exclusively by BF's network of printers
- Legitimate notes: graphite based black ink
  - Visually similar to lampblack based ink …
  - James Green, emeritus librarian in Philadelphia: suggests that BF may have used funds from printing contracts to explore new printing techniques



For the latest updates:

https://www.nsf.gov/physics

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