National Science Foundation – Nuclear Physics

Outline

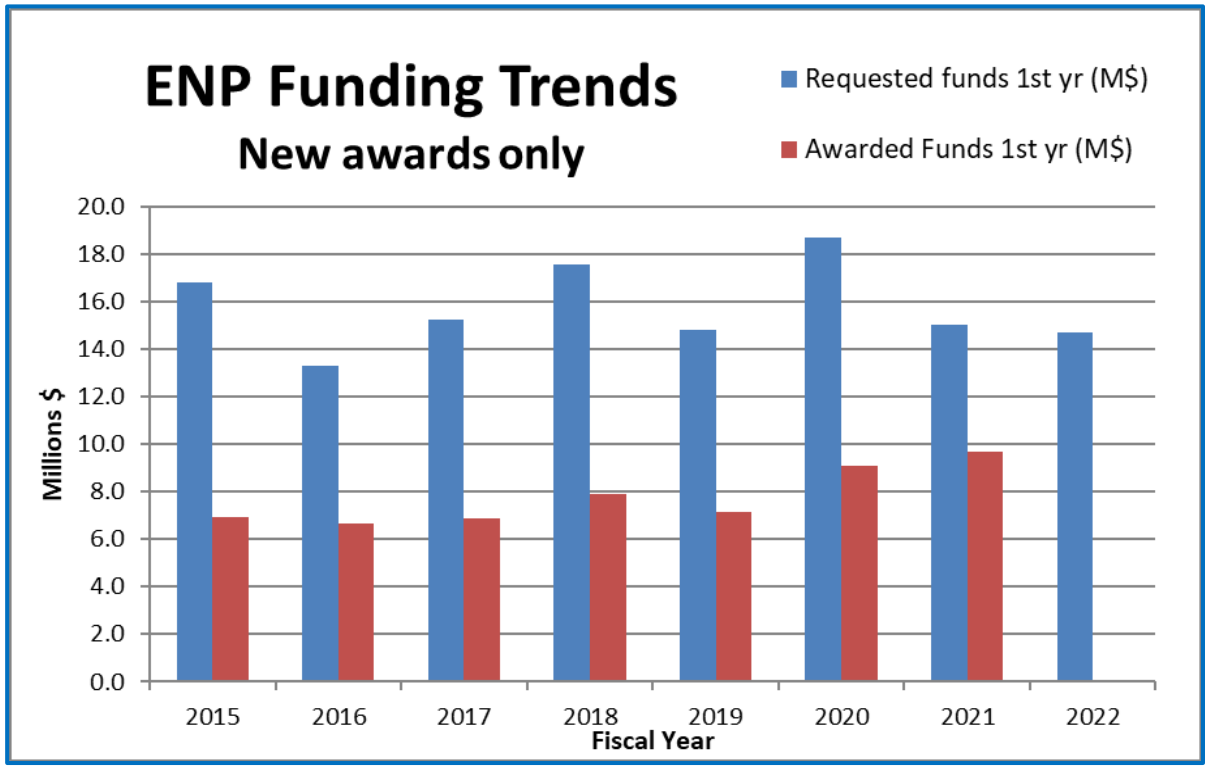
- Nuclear Physics Info
- FY22 & FY23 Budget Info
- Funding Announcements and Successes
- Highlights

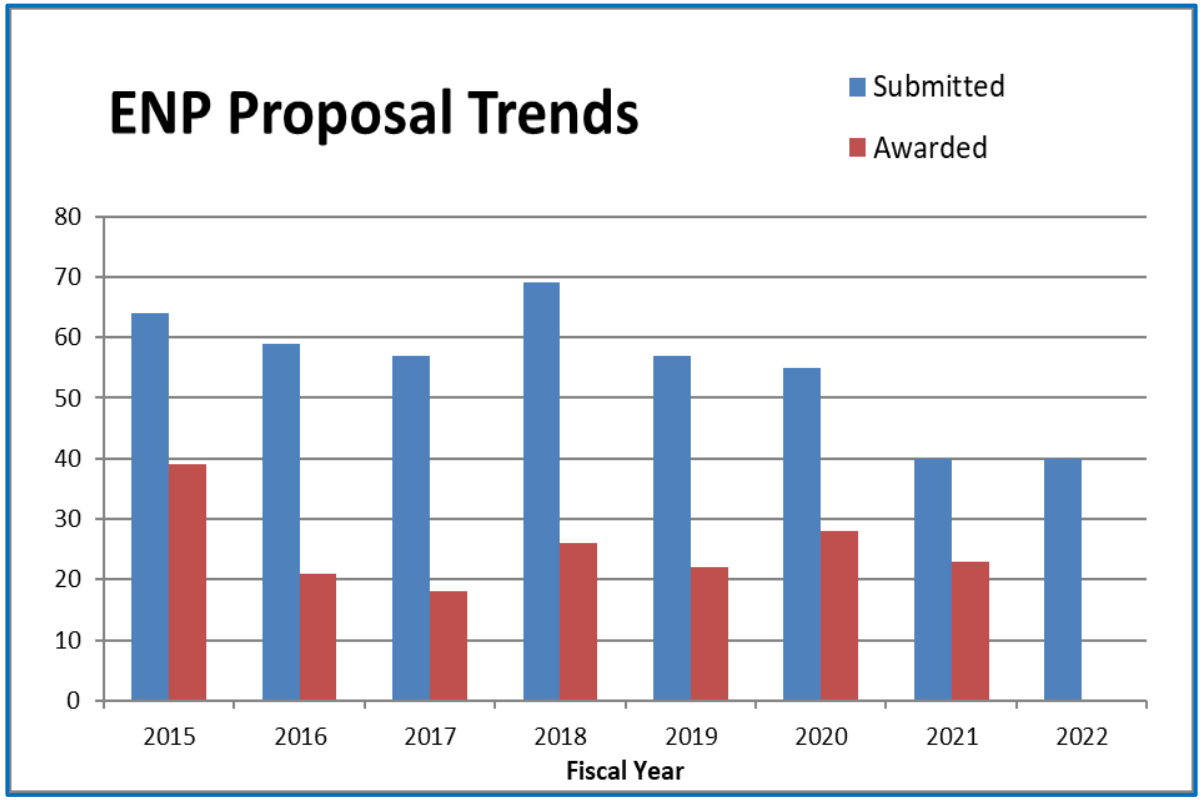
Allena K. Opper
June 2022

NSF/MPS/PHY Personnel

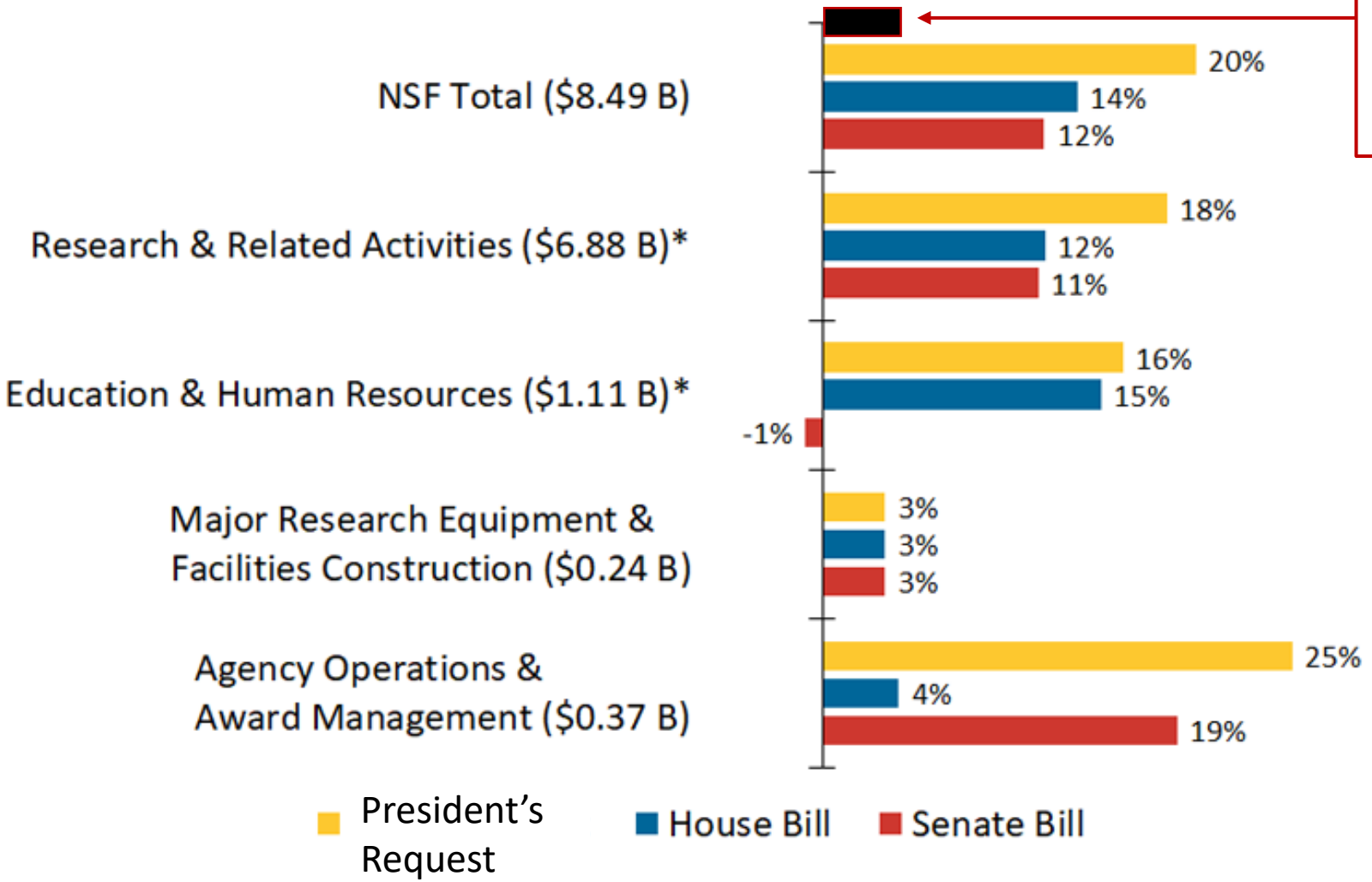
- Sethuraman Panchanathan – Director
- Sean L. Jones – Assistant Director for MPS
- Denise Caldwell – Physics Division Director
- Jean Cottam Alan – Deputy Division Director
- Bogdan Mihaila – Nuclear Theory Program Director
- Alfredo Galindo-Uribarri – Expt'l Nuclear Physics Program Director
- Allena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

Proposal Trends in Experimental Nuclear Physics





FY22 Budget Proposals – NSF
$ in ( ) = FY21 estimates

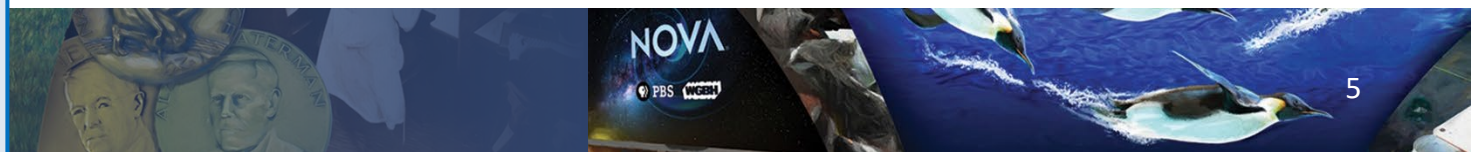


FY22 Appropriation
- $8.8B
- 4% over FY21 est

* Figures account for consolidation of the Graduate Research Fellowship Program budget in the EHR directorate.

Director's vision points to opportunities we must seize:

- 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 Partnerships
  - NSF will foster partnerships with other agencies, private industry, philanthropy, like-minded countries – and thriving partnership environments



FY23 President's Budget Request – NSF ($M)

What Congress appropriates

NSF by Account	FY 2021 Actual	FY 2021 ARP Actual	FY 2022 Enacted[1]	FY 2023 Request	FY 2023 Request change over: FY 2021 Actual Amount	FY 2021 Actual Percent	FY 2022 Enacted Amount	FY 2022 Enacted Percent
BIO	$817.74	$9.18		$970.23	$152.49	18.6%	N/A	N/A
CISE	1,007.13	35.72		1,150.78	143.65	14.3%	N/A	N/A
ENG	764.43	3.00		940.28	175.85	23.0%	N/A	N/A
GEO	1,004.27	71.04		1,239.05	234.78	23.4%	N/A	N/A
MPS	1,593.31	20.33		1,746.847	153.54	9.6%	N/A	N/A
SBE	282.11	18.16		330.21	48.10	17.0%	N/A	N/A
TIP[2]	369.01	19.87		879.87	510.86	138.4%	N/A	N/A
TIP Programs	*136.73*	*2.00*		*596.81*	*460.08*	*336.5%*	*N/A*	*N/A*
SBIR/STTR, including Operations	*232.28*	*17.87*		*283.06*	*50.78*	*21.9%*	*N/A*	*N/A*
OISE	51.29	1.45		74.04	22.75	44.4%	N/A	N/A
OPP	484.04	14.52		547.10	63.06	13.0%	N/A	N/A
IA[3]	386.42	2.28		545.86	159.44	41.3%	N/A	N/A
U.S. Arctic Research Commission	1.60	-		1.72	0.12	7.5%	N/A	N/A
Research & Related Activities	**$6,761.35**	**$195.54**	**$7,159.40**	**$8,425.987**	**$1,664.63**	**24.6%**	**$1,266.59**	**17.7%**
STEM Education[3,4]	**$1,110.85**	**$23.99**	**$1,006.00**	**$1,377.18**	**$266.33**	**24.0%**	**$371.18**	**36.9%**
Major Research Equipment & Facilities	**$161.27**	**$8.95**	**$249.00**	**$187.23**	**$25.96**	**16.1%**	**-$61.77**	**-24.8%**
Agency Operations & Award Management	**$384.52**	**$12.00**	**$400.00**	**$473.20**	**$88.68**	**23.1%**	**$73.20**	**18.3%**
Office of Inspector General	**$17.61**	**-**	**$19.00**	**$23.393**	**$5.78**	**32.8%**	**$4.39**	**23.1%**
Office of the National Science Board	**$4.43**	**-**	**$4.60**	**$5.09**	**$0.66**	**14.9%**	**$0.49**	**10.7%**
Total, NSF Discretionary Funding	**$8,440.03**	**$240.48**	**$8,838.00**	**$10,492.08**	**$2,052.05**	**24.3%**	**1654.08**	**18.7%**
STEM Education - H-1B Visa	146.51	-	162.47	158.86	12.35	8.4%	-3.61	-2.2%
Donations	25.94	-	10.00	10.00	-15.94	-61.4%	-	-
Total, NSF Mandatory Funding	**$172.45**	**-**	**$172.47**	**$168.86**	**-$3.59**	**-2.1%**	**-$3.61**	**-2.1%**
Total, NSF Budgetary Resources	**$8,612.48**	**$240.48**	**$9,010.47**	**$10,660.94**	**$2,048.46**	**23.8%**	**$1,650.47**	**18.3%**

FY23 President's Budget Request – MPS ($M)

	FY 2021 Actual	FY 2021 ARP Actual	FY 2022 (TBD)	FY 2023 Request	Change over FY 2021 Actual Amount	Change over FY 2021 Actual Percent
Astronomical Sciences (AST)[1]	$289.27	-	-	$294.05	$4.78	1.7%
Chemistry (CHE)	259.60	-	-	284.14	24.54	9.5%
Materials Research (DMR)	330.07	-	-	349.92	19.85	6.0%
Mathematical Sciences (DMS)	243.66	-	-	259.47	15.81	6.5%
Physics (PHY)	304.42	-	-	316.59	12.17	4.0%
Office of Multidiscplinary Activities (OMA)	166.29	20.33	-	242.677	76.39	45.9%
Total	**$1,593.31**	**$20.33**	**-**	**$1,746.847**	**$153.54**	**9.6%**

Faculty Career Development Program (CAREER)

- CAREER - Awards in support of early-career faculty who have the potential to serve as academic role models in research and education, and to lead advances in the mission of their department or organization.
  - Integration of Research and Education - CAREER proposals should describe an integrated path that will lead to a career as a researcher and educator
- PECASE - Presidential Early Career Awards for Scientists and Engineers from among the most meritorious recent CAREER awardees
- Eligibility – must be untenured assistant professor in position that is at least 50% tenure-track
- Five year award

New Solicitation! → NSF 22-586

Faculty Career Development Program (CAREER)

NSF 22-586

- Deadline: Fourth Wednesday in July ⇒ July 27, 2022
- Required department chair may not be a letter of support; should
  - Affirm PI's pre-tenure status
  - Indicate that the proposed research and education objectives of the proposal are supported by and advance department's goals
  - Describe how proposed goals are related to mission of department and how dept will provide appropriate mentoring
- PECASE text: additional requirement for the PI to reflect commitment to STEM DEI & accessibility
- Single copy document: states PI's eligibility for PECASE (optional)
- Submission through Research.gov or Grants.gov (not FastLane ☹)

PHY DCL: Growing a Strong, Diverse Workforce NSF 21-065

PHY-GR Supplements – emphasis on URMs in STEM fields

- Graduate Student Eligibility
  - Not currently supported by federal government (NSF, DOE, NIH, …)
  - US Citizen, US National, or US Permanent Resident
- Stipend, tuition, benefits, and IDC (~$60k)
- Renewable up to two times, no deadline for submission however, early submission suggested

REU Supplements – emphasis on URMs in STEM fields

- US Citizen, US National, or US Permanent Resident

MPS – ASCEND

ASCEND - Postdoctoral Research Fellowships NSF 22-501

- Goal: to support Postdoctoral Fellows who will broaden the participation of groups who are underrepresented in Mathematical and Physical Sciences (MPS) fields in the U.S.
- Prepare PD Fellows to transition from a postdoctoral position into the first few years of an academic faculty position
- Fellowships are awards to individuals, not institutions, and are administered by the Fellows
- $100k/year for up to 3 years

MPS – ASCEND

ASCEND - Postdoctoral Research Fellowships

FY21: 33 MPS ASCEND Fellows (7 in PHY)

FY22: 31 MPS ASCEND Fellows (6 in PHY)

Including Brandon Sumner:

Determine properties of excited cascade states, search for new states using data from GlueX at JLab, & develop in-person K – 12 outreach

Arizona State University with Michael Dugger

MPS – LEAPS

LEAPS: Launching Early-Career Academic Pathways in MPS NSF 22-503

- Designed to launch research careers of pre-tenure faculty in MPS fields, emphasis on *minority-serving institutions (MSIs), predominantly undergraduate institutions (PUIs), and Carnegie Research 2 (R2) universities* while promoting the participation of the entire MPS scientific community
- Awards = 24 months, up to $250k

MPS – LEAPS

LEAPS: Launching Early-Career Academic Pathways in MPS NSF 22-503

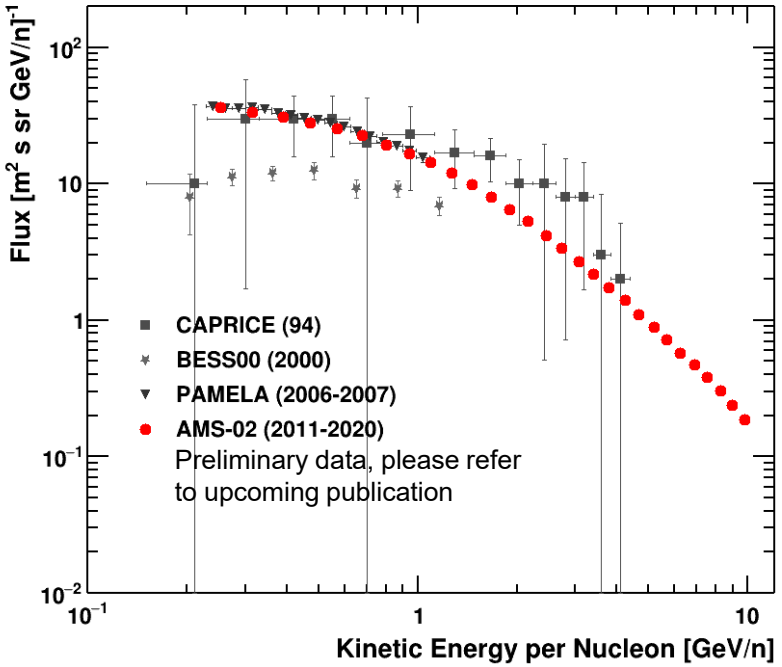
FY21: 45 LEAPS-MPS Ascend Awardees (4 in PHY)

FY22: 54 LEAPS-MPS Awardees (5 in PHY)

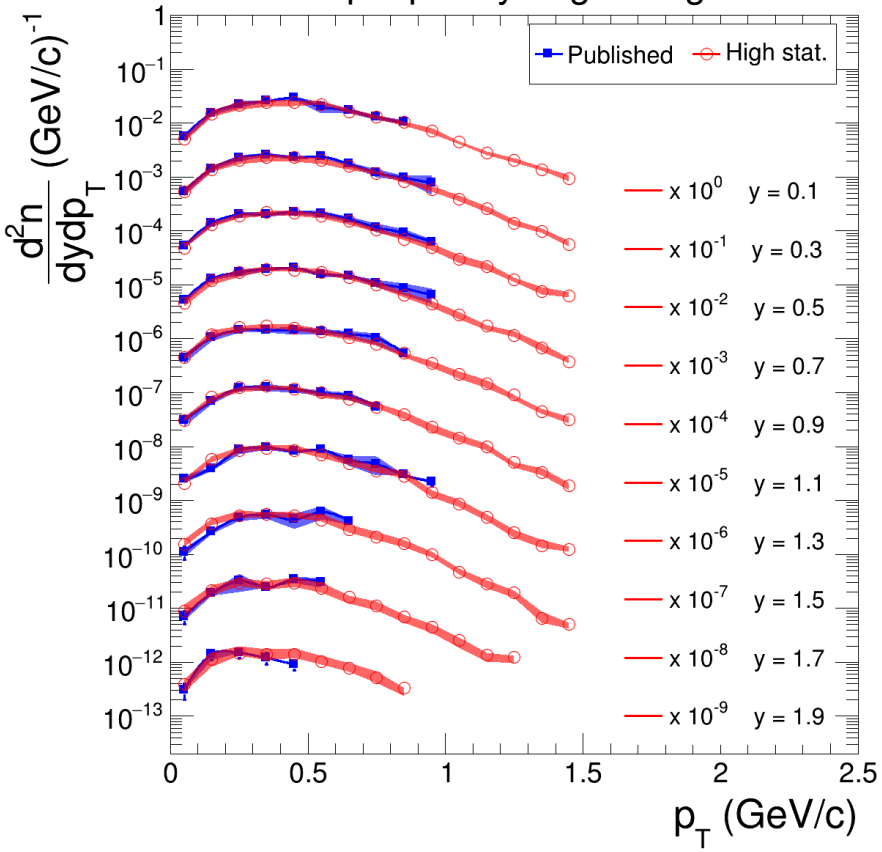
Including Jason Fry Eastern KY Univ:
Precise measurements of neutron beta decay parameters (Nab) and the free neutron lifetime (BL3) & mentoring 1st gen college students

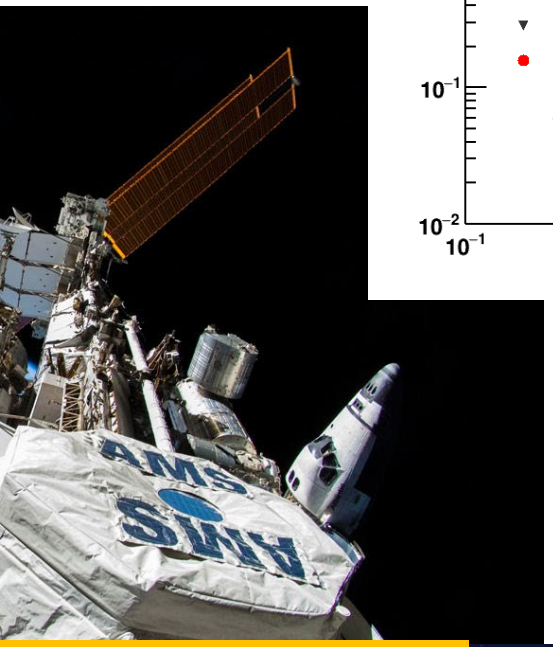
Cosmic-ray Antinuclei as Messengers of New Physics

Precision deuteron spectrum (crucial analysis step for antideuteron search)



High-precision antiproton spectrum from 2010 p-liquid hydrogen target data





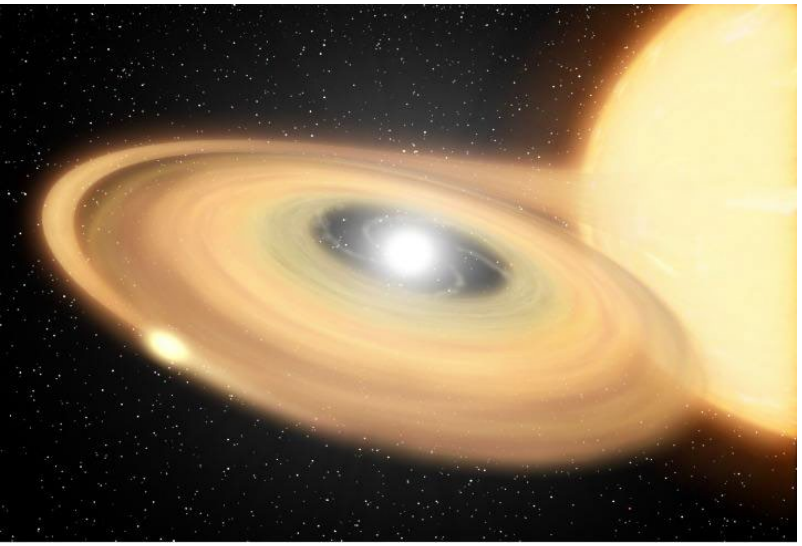
Goals:

- Search for cosmic antinuclei
- Improve (anti)nuclei formation models
- Use cosmic antinuclei as messengers for new physics

PI: von Doetinchem
U of Hawaii

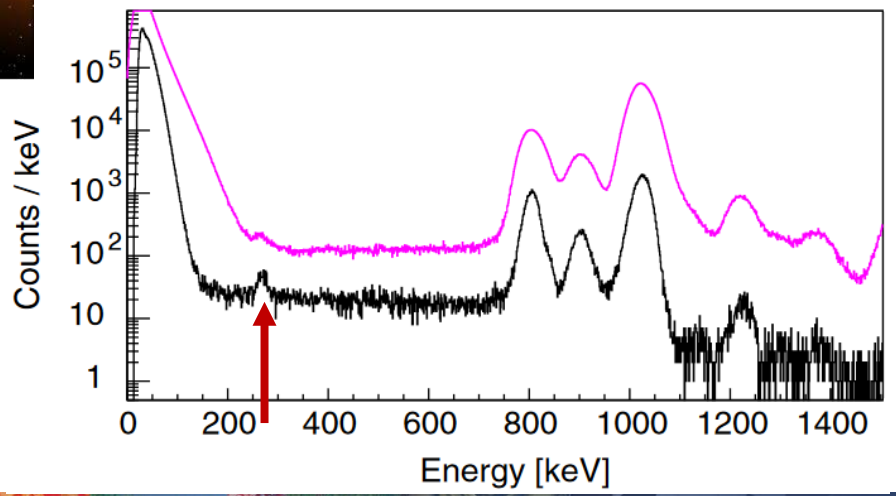
Classical Novae and Nuclear Thermometers

Compact WD accretes matter from companion → nova → new nuclei ejected

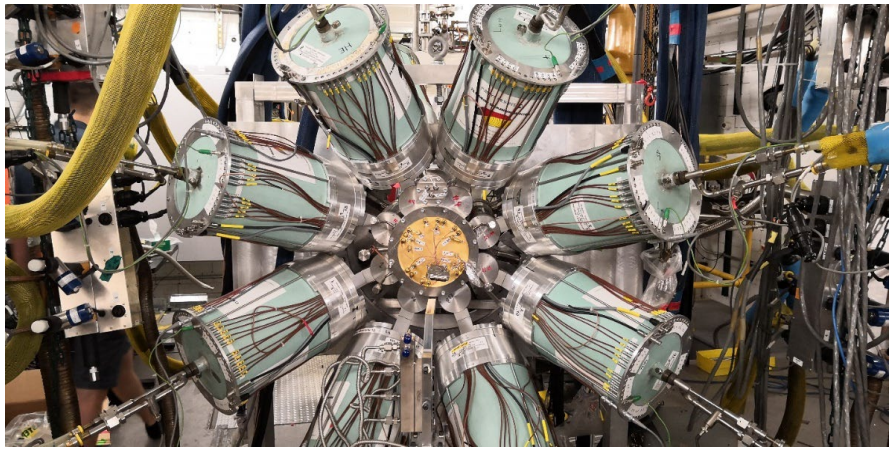


$^{30}P(p,\gamma)^{31}S$ = bottleneck for A> 30
dominated by p-capture on g.s.
but many low-lying resonances →
significant uncertainty

To the rescue:
^{31}Cl β-delayed p-decay thru ^{31}S resonance



GADGET: designed to measure p-branching ratio of $^{30}P(p,\gamma)^{31}S$ 260 keV res using ^{31}Cl β-delayed p-decay



New $^{30}P(p,\gamma)^{31}S$ rate + 1D hydrodynamic nova model →

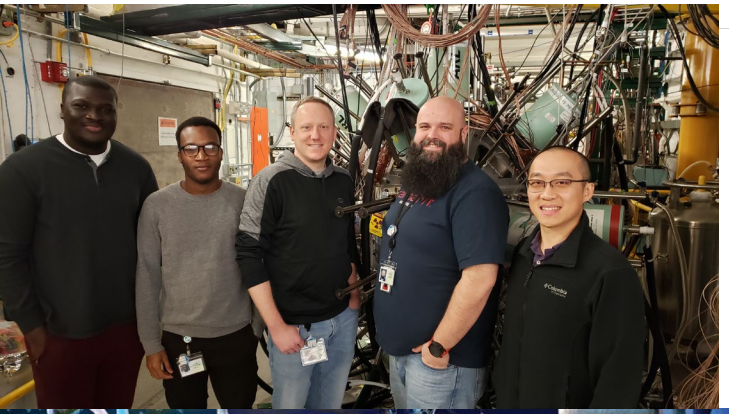
- factor of 2 – 4 improvement in accuracy of 4 nova thermometers
- ^{30}Si:^{28}Si from WD novae greater than solar ratio.

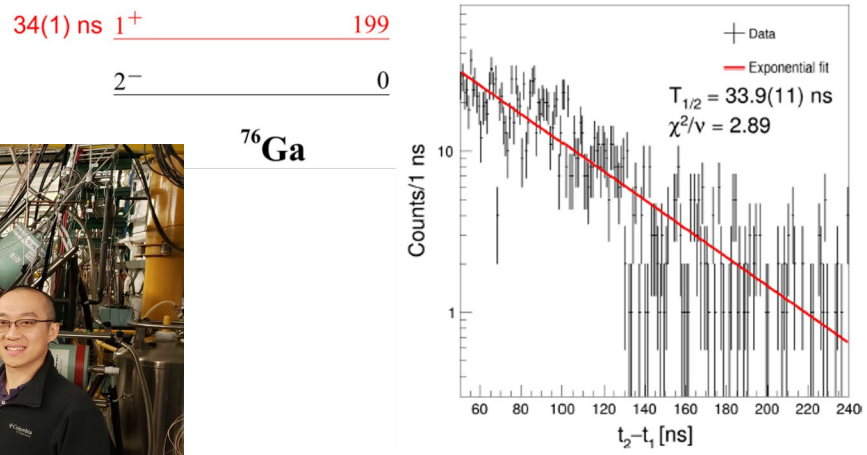
MICHIGAN STATE UNIVERSITY

T. Budner, et al., PRL 128, 182701 (2022)

DEI Activities Within Research Awards

- Ben Crider @ Mississippi State University
  - Determine properties of exotic, neutron-rich nuclear systems predicted to exhibit multiple shapes
  - Training and mentoring a diverse group of undergrad and grad students → prepared for STEM careers
  - Physics summer school experience for students with Autism Spectrum Disorder in Mississippi → new generation of highly capable scholars





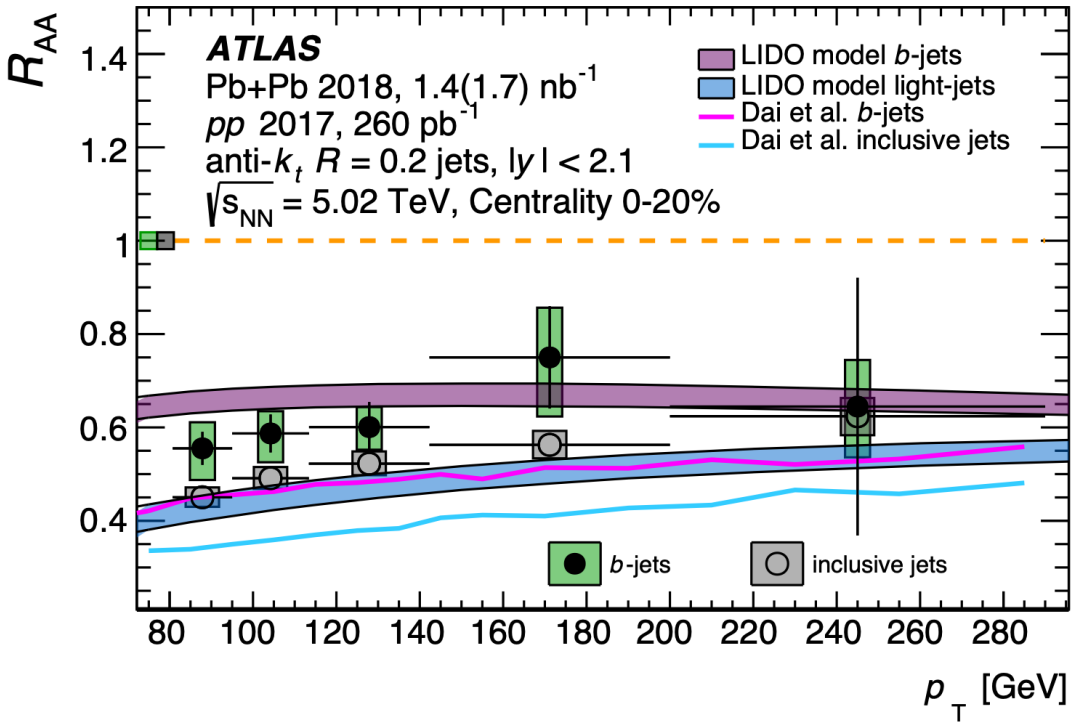
Comparison of b- & Inclusive-jet Suppression

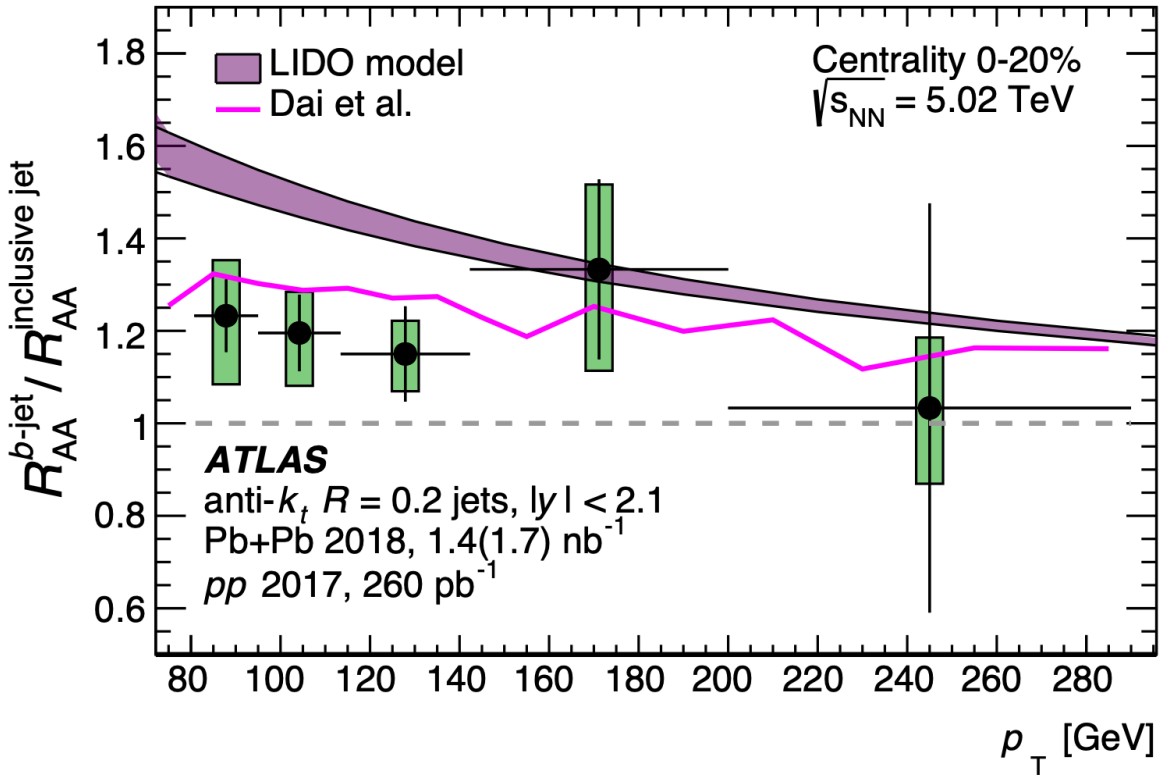
first observation of a difference between b- & inclusive-jet R_{AA} values

R_{AA}: nuclear modification factor, quantifies jet quenching due to interactions with the QGP

larger R_{AA} → less quenching

~20% higher R_{AA} for b-jets than inclusive jets





https://arxiv.org/abs/2204.13530

For the latest updates:

https://www.nsf.gov/physics

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