



# NSF Nuclear Physics Overview

Allena K. Opper

- New personnel
- Budget – focus on PHY
- Highlights
- Announcements



# NSF/MPS/Physics Personnel

- **France Córdova** – Director
- **Anne L Kinney** – Assistant Director for MPS
- **Denise Caldwell** – Physics Division Director
- ★ **Jean Cottam Allen** – Acting Deputy Division Director
- **Bogdan Mihaila** – Nuclear Theory Program Director
- ★ **Jim Thomas** – Expt'l Nuclear Physics Program Director
- **Allena Opper** – Expt'l Nuclear Physics Program Director

<http://www.nsf.gov/pubs/2015/phy15001/phy15001.jsp?org=PHY>

<http://www.nsf.gov/careers/rotator/index.jsp>



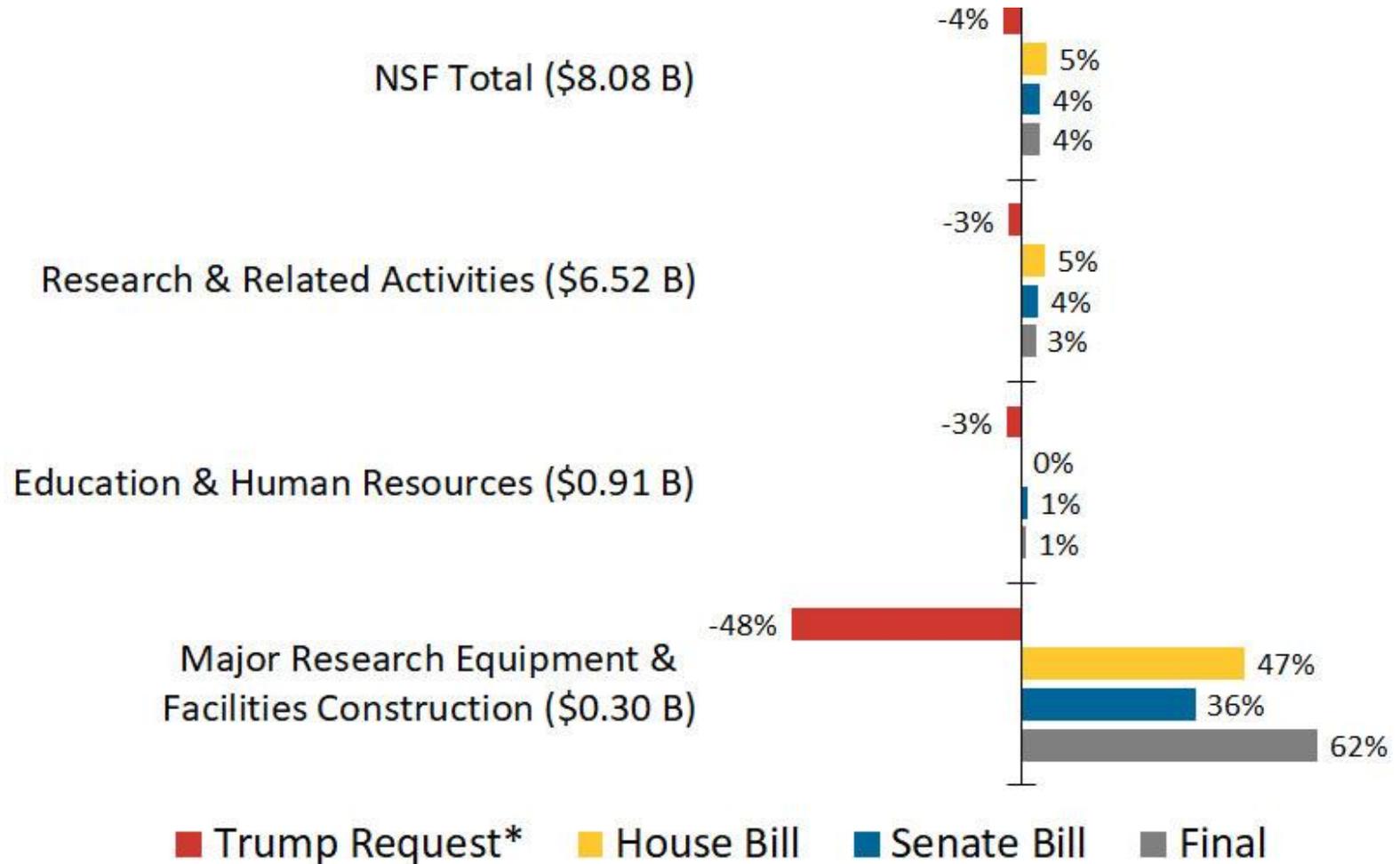
# Interesting Times

- Launched Mid-scale Research Infrastructure -1 (\$6M - \$20M) 21-nov-2018
- Launched Mid-scale Research Infrastructure -2 (\$20M - \$70M) 11-dec-2018
- Lapse in Appropriations:
  - 22-dec-2018 → 25-jan-2019
  - NSF staff not allowed to work even on voluntary basis
  - IPA Rotators (and other essential personnel) ran NSF
  - MRI proposal due date 22-jan-2019
- Onward from January 28<sup>th</sup>
  - Thank you to reviewers and panelists providing service during compressed review cycle

# NSF FY19 Appropriations

## % change from FY18 enacted

### \$ in ( ) = FY19 amounts



\* The administration submitted the budget request to Congress before the final amounts for fiscal year 2018 were set.



# FY19 & FY20 Budget Process

- Agency budget request → OMB ~ end of summer FY20 ✓
- “Pass Back”: OMB provides numbers to agency ~ end of Nov FY20 ✓
  - May also include additional instructions
- President’s Budget Request set ~ end of cal year FY20:  
11-mar-2020
  - Much activity → NSF Budget Book
- ...
- Congress passes appropriation ~ before beginning of FY FY19:  
25-jan-2019
  - NSF: Amounts for 6 high-level accounts, occasionally with additional text
- President signs appropriation; budget → agency via OMB
- NSF generates a new Budget Book (“current plan”) and submits to Congress via OMB
- Congress acts within 30 days: “current plan” → “operating plan”

~ 60 days

# FY20 PHY \$247.50M



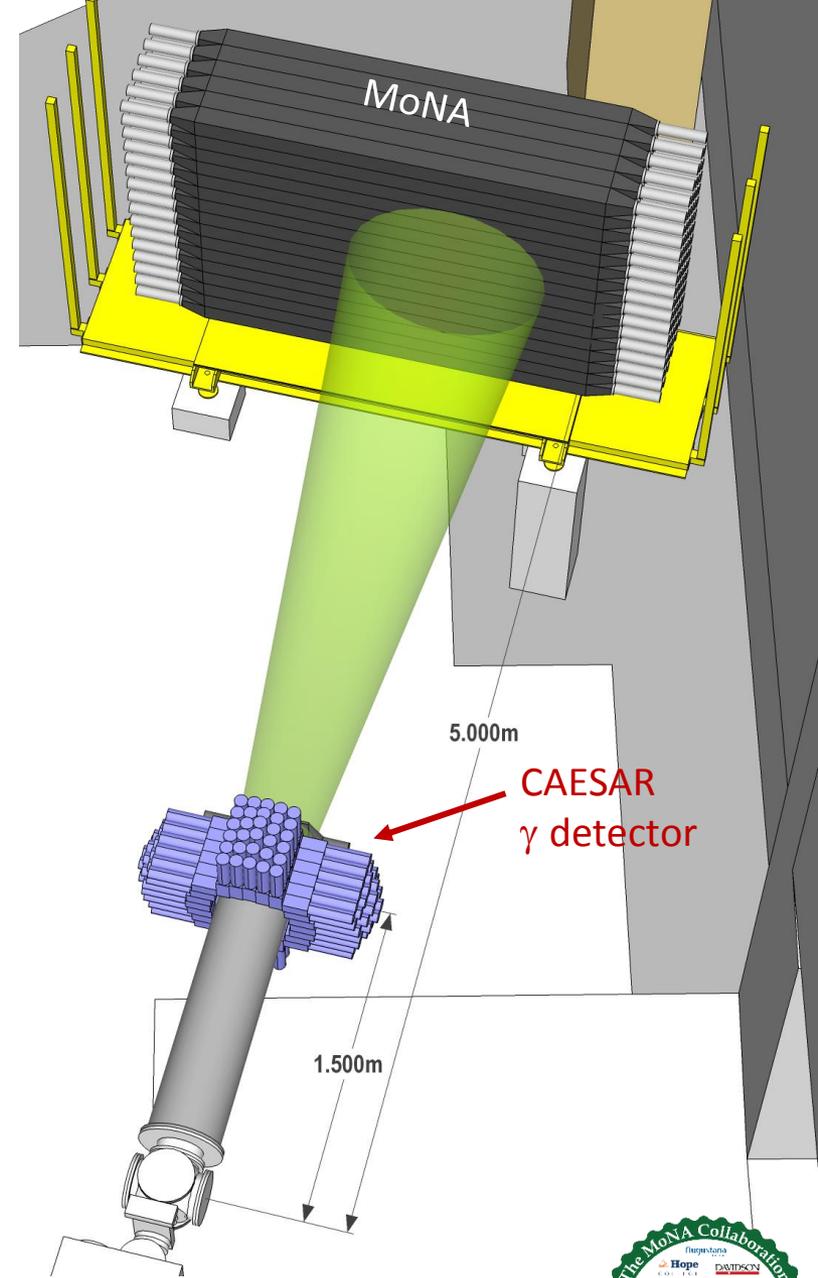
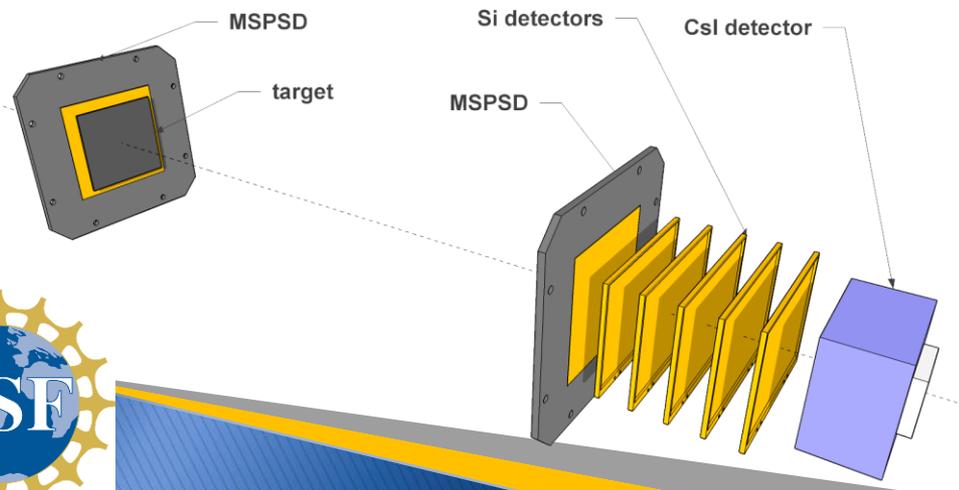
(Dollars in Millions)

	FY 2018 Actual	FY 2019 (TBD)	FY 2020 Request	Change over FY 2018 Actual Amount	Percent
<b>Total</b>	<b>\$310.75</b>	-	<b>\$247.50</b>	<b>-\$63.25</b>	<b>-20.4%</b>
<b>Research</b>	<b>182.35</b>	-	<b>145.63</b>	<b>-36.72</b>	<b>-20.1%</b>
CAREER	10.14	-	6.78	-3.36	-33.1%
Centers Funding (total)	4.81	-	5.00	0.19	4.0%
STC: Center for Bright Beams	4.81	-	5.00	0.19	4.0%
<b>Education</b>	<b>4.50</b>	-	<b>4.70</b>	<b>0.20</b>	<b>4.4%</b>
<b>Infrastructure</b>	<b>123.90</b>	-	<b>97.17</b>	<b>-26.73</b>	<b>-21.6%</b>
IceCube	3.50	-	3.50	-	-
LHC	15.86	-	20.00	4.14	26.1%
LIGO	39.43	-	44.60	5.17	13.1%
Midscale Research Infrastructure	14.42	-	6.67	-7.75	-53.7%
NSCL	24.00	-	22.00	-2.00	-8.3%
Research Resources	0.09	-	-	-0.09	-100.0%
Facilities Design Stage Activities (total)	26.60	-	0.40	-26.20	-98.5%
High Luminosity-LHC <sup>1</sup>	16.60	-	-	-16.60	-100.0%
Advanced LIGO Plus (LIGO A+)	10.00	-	0.40	-9.60	-96.0%

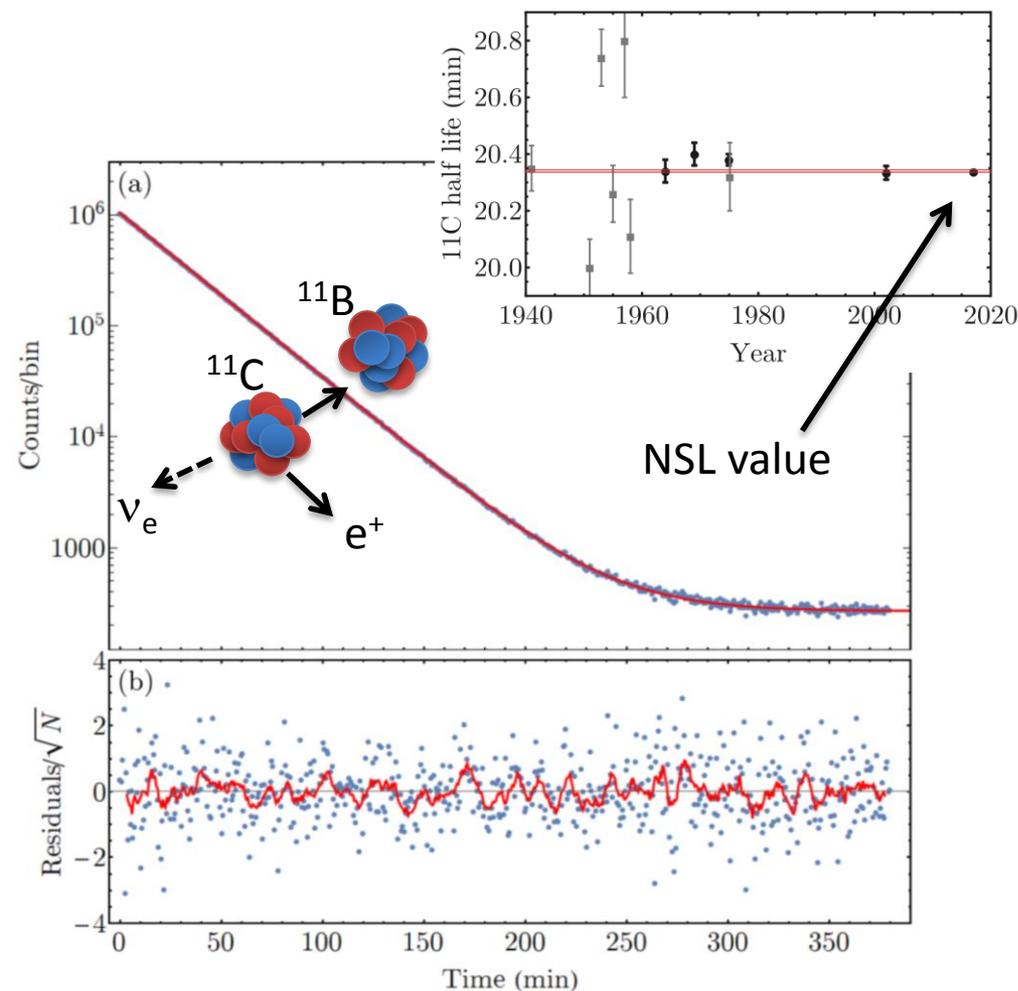
<sup>1</sup> FY 2018 Actual reflects \$7.50 million of funding for FY 2019 and FY 2020 development and design. No additional funds are expected in these years.

# MoNA Collaboration

- 11 (RUI) institutions
- 2 recent PAC approved:
  - Measurements of relative neutron decay energies of  $^{28}\text{F}$  → insight into doubly-magic  $^{28}\text{O}$ .
  - The first simultaneous measurement of the  $^{13}\text{Be}$  decay energy and decay of its isomer.
- New charged ptcl detector → coincident n,  $\gamma$ , charged ptcl



# $^{11}\text{C}$ half-life measurement at the NSL

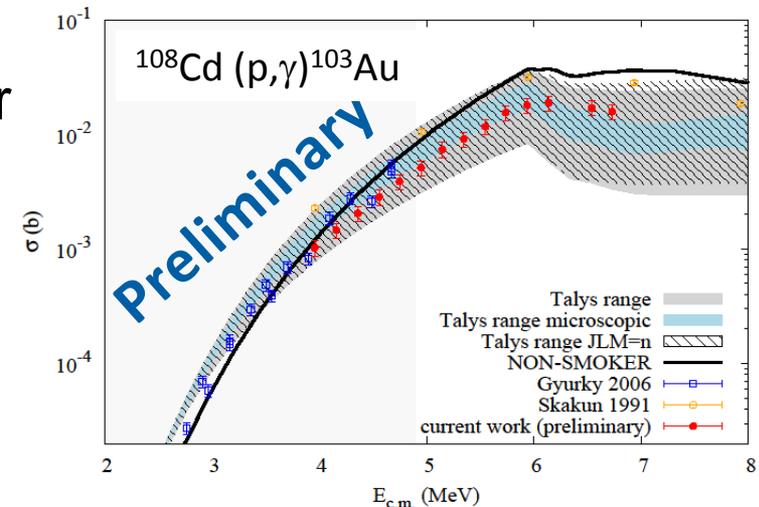
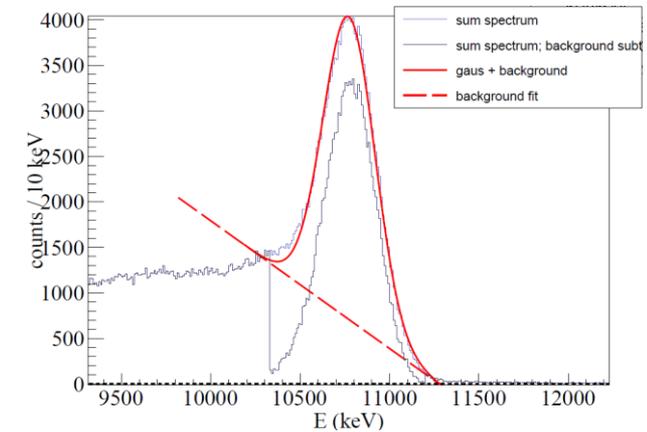


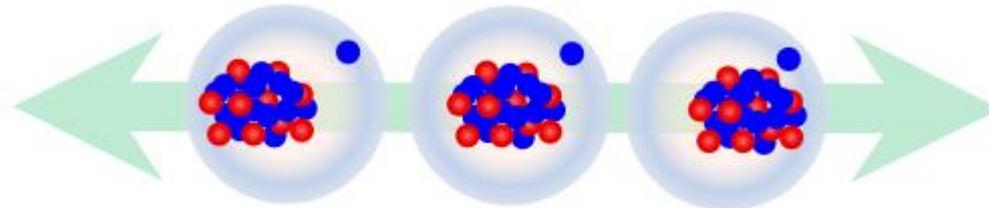
- Superaligned mixed mirror decays  $\rightarrow$  precision tests of SM through  $V_{ud}$
- Measurement of  $^{11}\text{C}$   $t_{1/2}$  @ UND  $\rightarrow$  most precise of all SA mixed decays
- Lightest of all mirror transitions to test CVC
- Measurement of mixing ratio using the future NSLtrap is planned to extract  $V_{ud}$ .

# First measurement of proton capture reactions using HECTOR



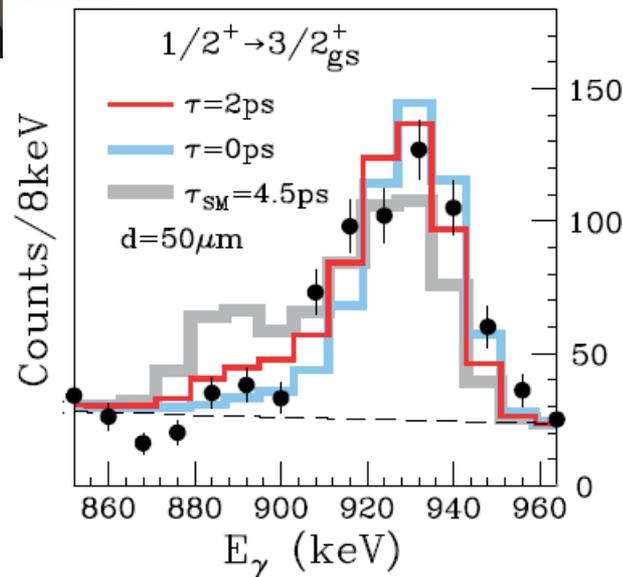
- HECTOR uses  $\gamma$ -summing technique  $\rightarrow$  cross section meas'ts
- Focused on identifying branching points in p-process flow.
- These nuclei determine the flow of the p-process and have impact on final abundances of the p-nuclei.
- Measurements on p-nuclei in mass region of  $A \sim 100-110$ .
- Results will constrain reaction rates for the p-process in this mass region.
- First result compared with NON-SMOKER and TALYS calculations





*E1* soft mode in halo nuclei

- GREINA measurements at NSCL see strong *E1* in  $^{27}\text{Ne}$  from short ( $<2\text{ps}$ )  $\tau$  of  $1/2^+$  state
- Calculations with normal assumptions cannot account for a strong transition
- A difference in deformation between the core and halo  $n$  (weakly bound, extended wf) might explain this - new and unexpected



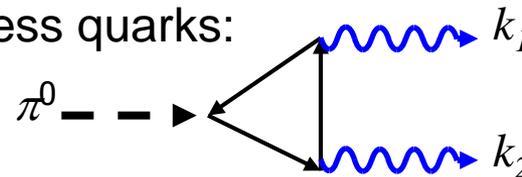
GREINA  
@ NSCL



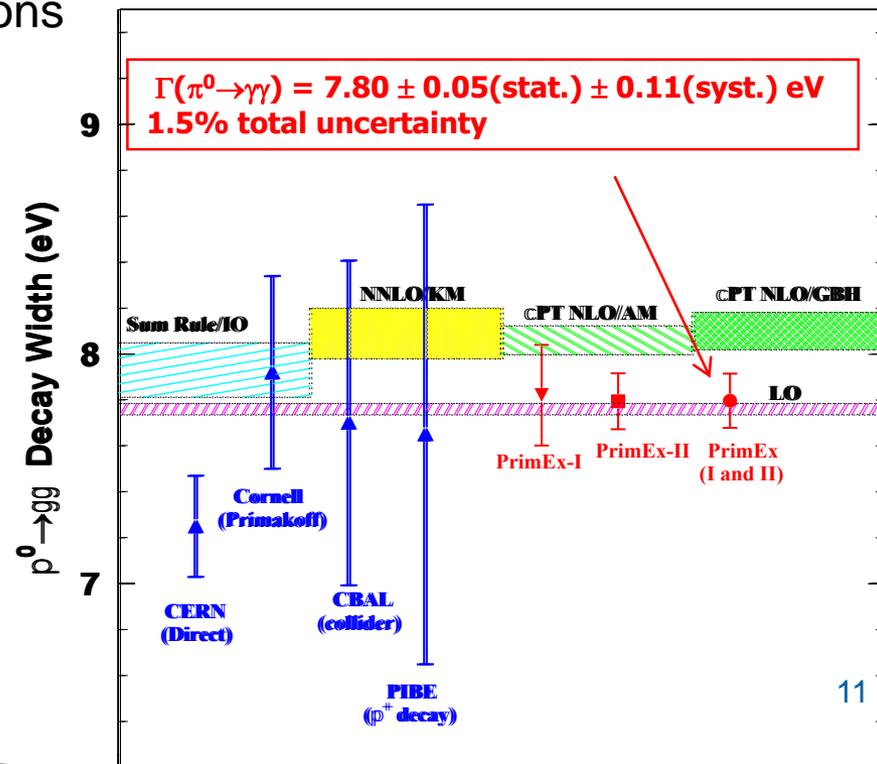
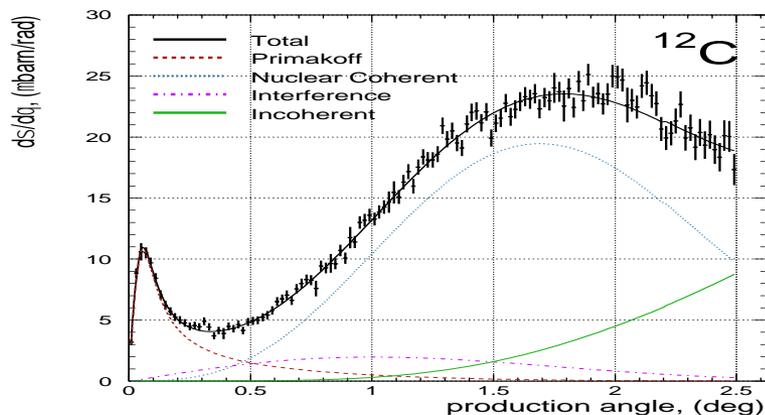
# PrimEx Final Result: the $\pi^0$ Lifetime

- $\pi^0 \rightarrow \gamma\gamma$  proceeds primarily via the **chiral anomaly** in QCD.
- The anomaly prediction **is exact** for massless quarks:

$$\Gamma(\pi^0 \rightarrow \gamma\gamma) = \frac{\alpha^2 N_c^2 m_\pi^3}{576 \pi^3 F_\pi^2} = 7.725 \text{ eV}$$

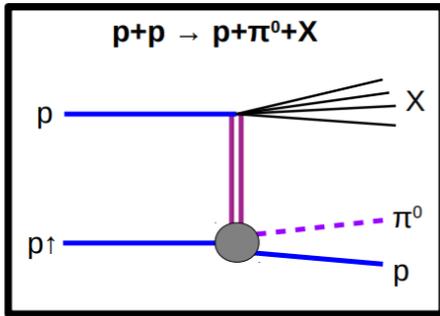


- $\Gamma(\pi^0 \rightarrow \gamma\gamma)$  is one of the few quantities in confinement QCD calculated by independent theoretical groups to  $\sim 1\%$  precision up to NNLO.
- PrimEx final result agrees to the leading order and is  $2\sigma$  lower than the higher order low-energy QCD predictions

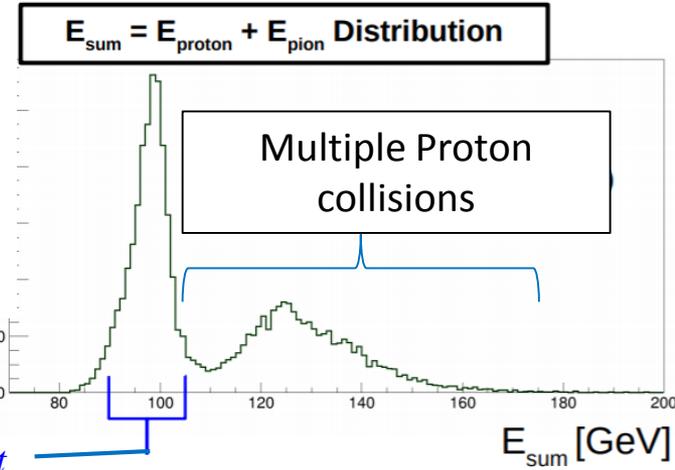




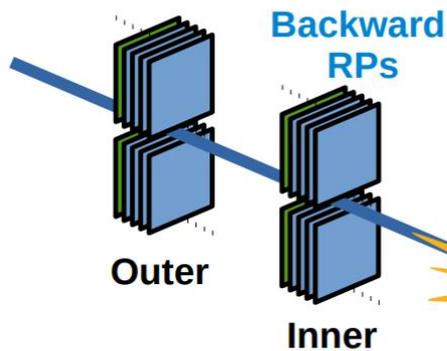
# Observing $p \uparrow p \rightarrow p \pi^0 X$ at STAR



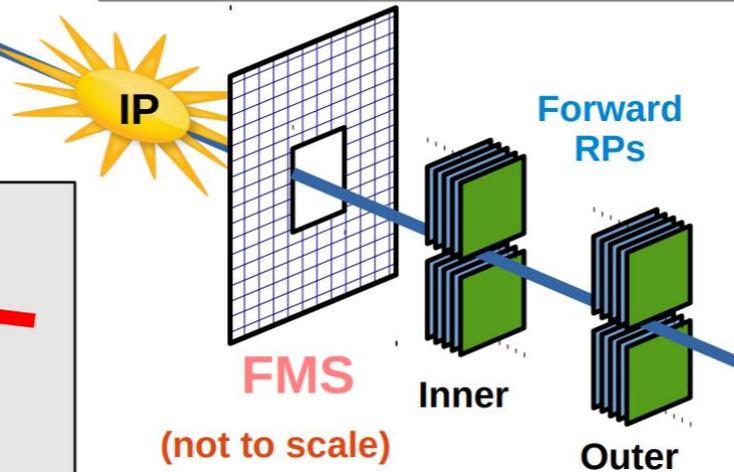
- $E(\text{scattered proton}) + E(\text{pion}) = E(\text{initial proton}) = 100 \text{ GeV}$
- $p_T(\text{proton}) \sim 0.2 \text{ GeV}/c$
- $p_T(\text{pion}) \sim 2 \text{ GeV}/c$
- Evidence of recoil proton breakup



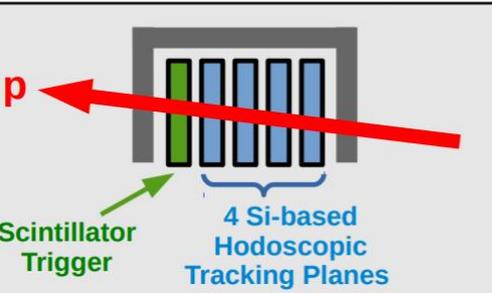
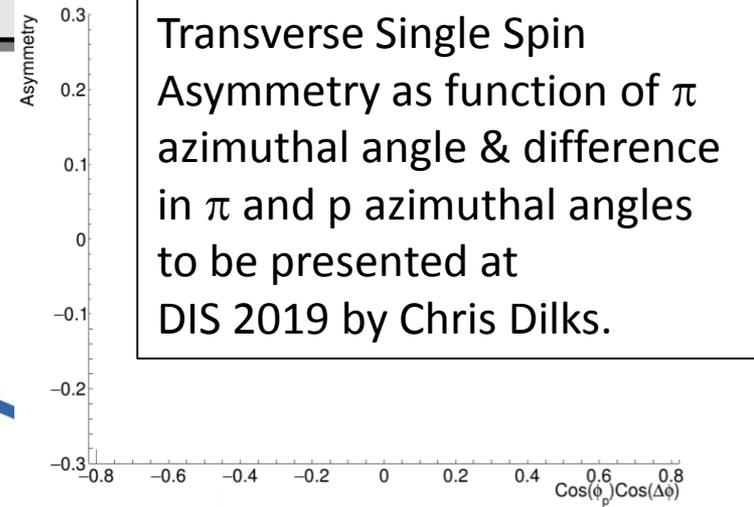
$$p_{West}^{\uparrow} + p_{East} \rightarrow (p + \pi^0)_{West} + X_{East}$$



- RPs are vessels which house Silicon trackers within beam-pipe vacuum, and are moved close to the beam during optimal running conditions
- They are designed to track protons which were slightly deflected after a collision



Transverse Single Spin Asymmetry as function of  $\pi$  azimuthal angle & difference in  $\pi$  and  $p$  azimuthal angles to be presented at DIS 2019 by Chris Dilks.





For the latest updates, check out  
<https://www.nsf.gov/div/index.jsp?div=PHY>

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The screenshot shows the NSF website for the Physics (PHY) division. The top navigation bar includes links for HOME, FUNDING, AWARDS, DISCOVERIES, NEWS, PUBLICATIONS, STATISTICS, ABOUT NSF, and FASTLANE. The main header features the NSF logo and the text "National Science Foundation Directorate for Mathematical & Physical Sciences (MPS)". A search bar and a "QUICK LINKS" button are also present. Below the header, there is a secondary navigation bar with links for MPS HOME, MPS FUNDING, MPS AWARDS, MPS DISCOVERIES, MPS NEWS, and ABOUT MPS. The main content area is titled "Physics (PHY)" and includes a sub-header "PHY Home" with a list of links: About PHY, Funding Opportunities, Awards, News, Events, Discoveries, Publications, Career Opportunities, Facilities and Centers, PHY Program Director Jobs, See Additional PHY Resources, and View PHY Staff. There is also a search bar for PHY Staff. The main text area contains two sections: "PHY Replaces DCL with Solicitation NSF 14-576" and "PHY Int'l Activities - Potential Co-Review". The "PHY Replaces DCL" section states: "The Physics Division has issued a solicitation (NSF 14-576) for FY2015 that replaces its prior annual Dear Colleague Letter. The solicitation follows most of the requirements in the Grant Proposal Guide, but has additional requirements that relate primarily to proposers who anticipate having multiple sources of support, and proposals involving significant instrumentation development. The solicitation also has deadlines instead of target dates. All proposals submitted to the Physics Division that are not governed by another solicitation (such as CAREER) should be submitted to this solicitation; otherwise they will be returned without review." The "PHY Int'l Activities" section states: "The Physics Division has issued a Dear Colleague Letter (NSF 14-009) to announce the guidelines for 'International Activities within the Physics Division - Potential International Co-Review'. The DCL outlines a possible coordinated review of projects involving international colleagues and counterpart funding organizations where a mutual review and funding process is beneficial to the advancement of Physics research. Contact with the appropriate NSF Program Officer is a necessary first step and additional time for this coordination must be allowed. Proposals requesting co-review will be competing with all other proposals in that area and must succeed on the strengths of their intellectual merit and broader impact." There is also a "Special Announcements" section with links for "MPS Alliances for Graduate Education and the Professoriate - Graduate Research Supplements (AGEP-GRS) Dear Colleague Letter (NSF 13-071)" and "Dear Colleague Letter - Announcement of Instrumentation Fund to Provide Mid-Scale Instrumentation for FY2014 Awards in Physics Division (NSF 13-118)".



# Backup Slides



# Budget Trends – NSF Nuclear Physics



Includes co-funding and other leveraged funds

~ 25% = Research

~ 75% = Operations



FY	Nucleon & Hadron QCD (k\$)	Nuclear Astroph, Reactions, Structure (k\$)	Prec Meas'ts & Fund. Symm. (k\$)	Total Exp't Nuclear Physics (k\$)	Nuclear Theory (k\$)	Nuclear Program Total (k\$)	NSCL (k\$)	JINA & JINA -CEE (k\$)	MRI (k\$)	Mid-Scale (k\$)	Total Nuclear Physics (k\$)
2012	7,969	4,185	6,343	18,497	3,829	22,326	21,500	2,150	2,744		48,720
2013	6,183	4,693	5,653	16,509	3,474	20,008	21,500	2,150	2,996	490	47,144
2014	5,826	5,189	5,999	17,014	3,514	20,528	22,500	2,280	1,038	1,188	47,533
2015	6,769	4,702	7,304	18,774	4,183	22,957	23,000	2,280	1,801	1,367	51,406
2016	7,141	5,046	7,391	19,579	4,223	23,802	24,000	2,280	1,869	3,238	55,189
2017	6,955	6,273	6,692	19,920	4,344	24,264	24,000	2,280	530	2,990	54,064
2018	7,160	5,058	7,700	19,908 base = 17,800	4,384	24,291	24,000	2,280	3,970	5,249	59,791

FY15 Fundamental Symmetries: + \$1.32M for  $0\nu\beta\beta$

MRI: competes each year; one-time acquisition/development funds

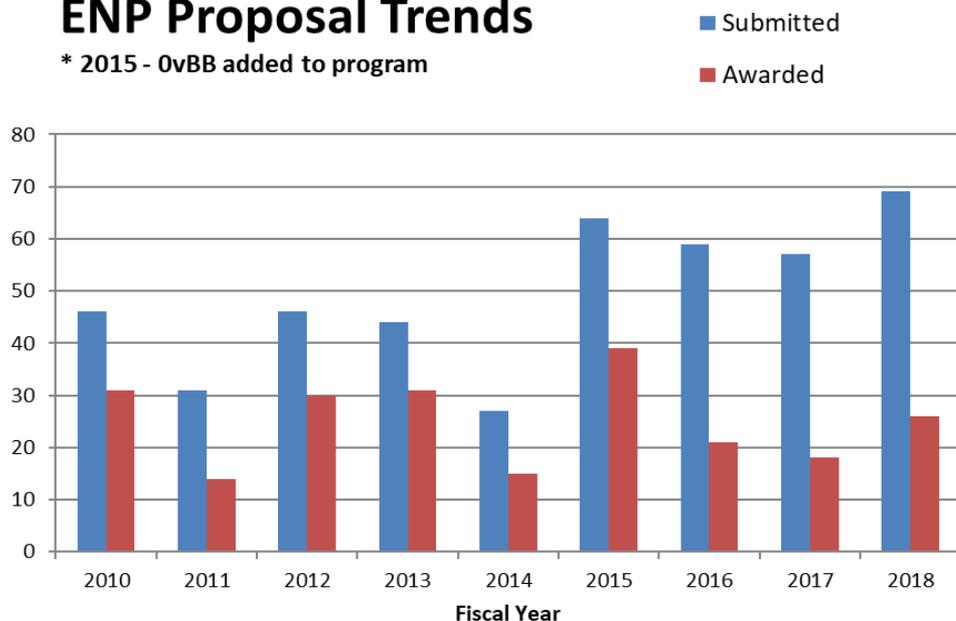
Mid-scale: ad hoc competition; design and construction funds (L-200, MUSE, nEDM)



# Experimental Nuclear Physics

## ENP Proposal Trends

\* 2015 - 0vBB added to program



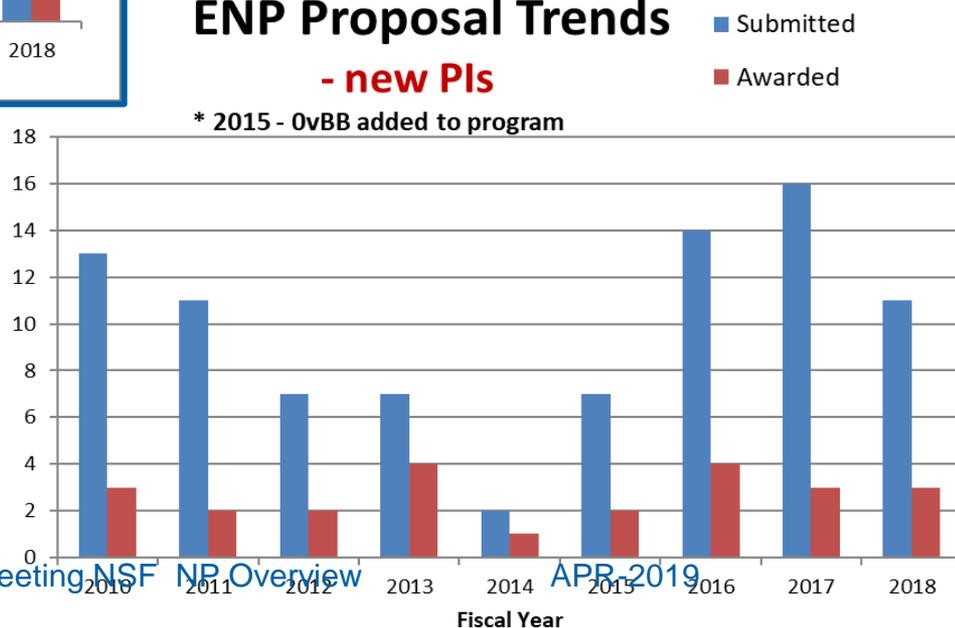
Proposal pressure

Funding pressure  
for new PIs

## ENP Proposal Trends

- new PIs

\* 2015 - 0vBB added to program





# PHY Midscale Instrumentation

- Design and Construction *or* Acquisition of Instrumentation
  - R & early D, operations *funded by research programs*
- ~ \$4M < TPC < ~ \$15M; over multiple years
- Selection based on
  - merit review
  - exceptional opportunity
  - research community priorities.
- Currently 6 Midscale projects (3 Nuclear Physics: MUSE ,nEDM, LEGEND-200)
- For more info, see PHY Solicitation

# Career Program



- Solicitation: 17-537
- Must include excellent research proposal as well as excellent educational plan
- There are eligibility requirements: e.g., must be assistant professor, untenured
- 5 year awards, \$400,000 minimum
- Proposal deadline: **July 19, 2019 →**  
PECASE nominees are chosen from CAREER winners
- Contact program officer for information/advice ahead of time (budget, scope)

# Alliances for Graduate Education and the Professoriate (AGEP)



The AGEP program goal is to increase the number of historically underrepresented minority faculty, in specific STEM disciplines and STEM education research fields, by advancing knowledge about pathways to career success. **See NSF 16-662 for details.**

## AGEP GR Supplements to MPS awards

- Available to PIs at AGEP or AGEP Legacy Institutions  
[https://www.nsf.gov/mps/broadening\\_participation/index.jsp](https://www.nsf.gov/mps/broadening_participation/index.jsp)
- Graduate Student Eligibility
  - Emphasis placed on under-represented groups
  - *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

**See us and DCL 16-125 for more information**

# Writing proposals: Mentoring program



GOAL: make the proposal writing expertise of senior researchers available to junior investigators

How does it work?

- The Mentee requests a Mentor (email us at [aopper@nsf.gov](mailto:aopper@nsf.gov) or [jhthomas@nsf.gov](mailto:jhthomas@nsf.gov) ).
- We will send a list of Mentor Volunteers to Mentee, who contacts Mentors without identifying them to NSF.
- **The Mentor will read the Mentee's proposal and provide feedback once. Send the proposal early – Mentors are busy people!**
- NSF accepts no responsibility on the interaction/outcome of the program!

**Needed: Mentors!**

email us at [aopper@nsf.gov](mailto:aopper@nsf.gov) or [jhthomas@nsf.gov](mailto:jhthomas@nsf.gov)