NSF Nuclear Physics Overview for NSAC

Allena K Opper

- Long Range Plan
- Highlights
- Budget
- Announcements
  - Solicitations
  - Other funding opportunities
- Physics Division Personnel

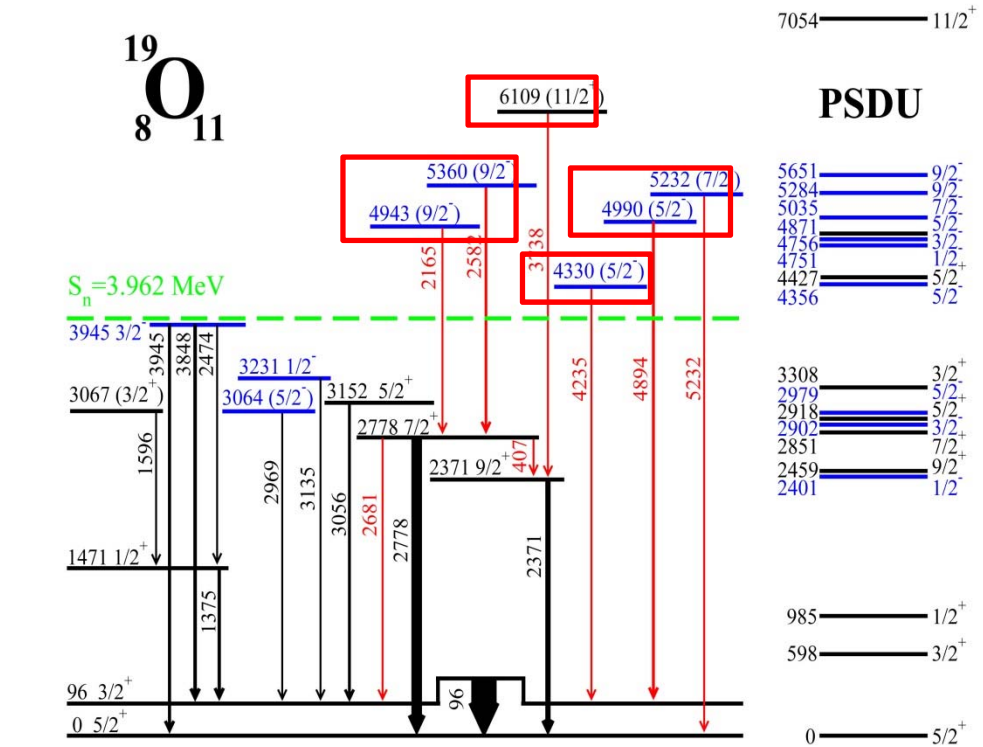
NSAC LRP

- Provides critical advice for review process
  - Crucial questions
  - Landscape

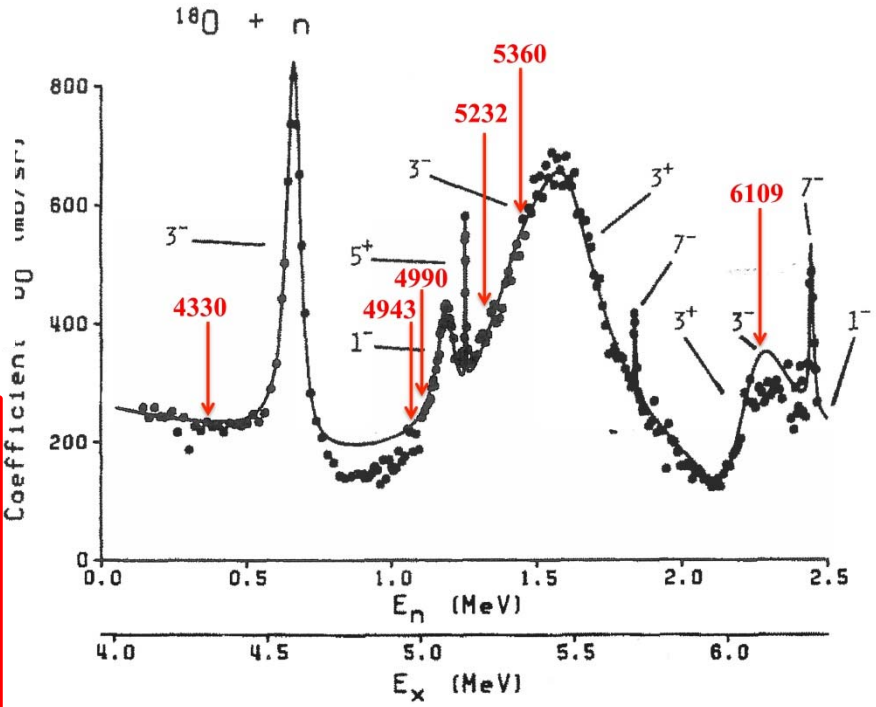
- Excellent cooperation between DNP and NSAC
- Thoughtful and serious work

- *Thank you*
  - DNP as well as to the Town Meeting organizers and conveners
  - The NP community for the input to the LRP-WG

Highlights – new γ states in ^{19}O



These states (shown with red boxes to the left and red arrows in *n* resonance curve below) are interspersed among broader *n* decaying states. The γ-decaying states have somewhat higher spins and more complex intruder configurations leading to very small overlap with ^{18}O + *n*.

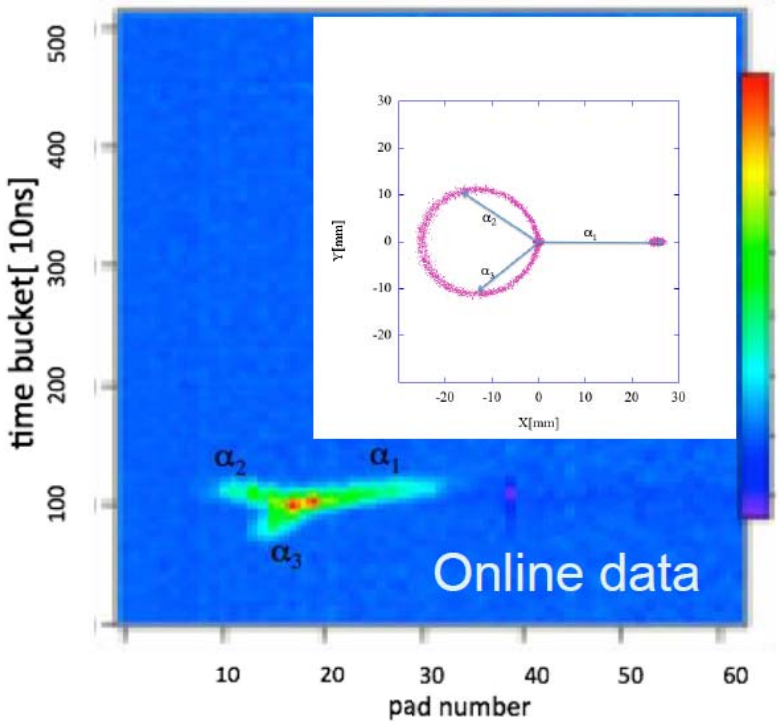


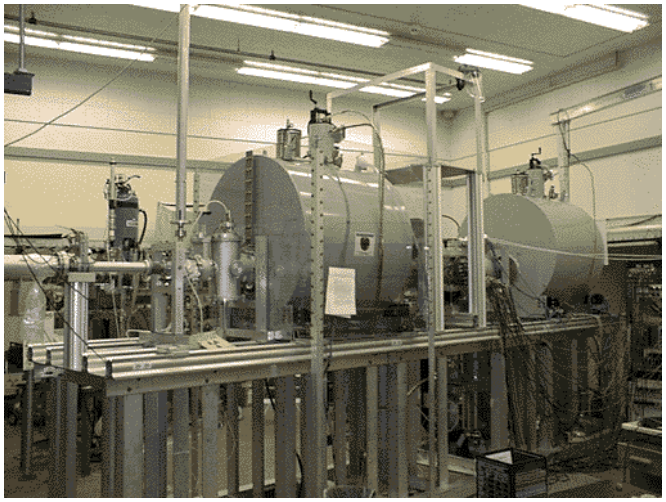
FSU grad student Rutger Dungan discovered 6 γ-decaying states unbound to neutron decay in ^{19}O from the ^{9}Be(^{14}C,αn) reaction

Highlights – ^{12}C Hoyle State Investigations

He-burning red giant stars → C

Requires Hoyle state in ^{12}C but its nature not understood.





The TwinSol separator at the Notre Dame NSL

TwinSol separator → ^{12}B beam

^{12}B → implanted in prototype AT-TPC
→ ^{12}C + e^- + $\overline{\nu_e}$

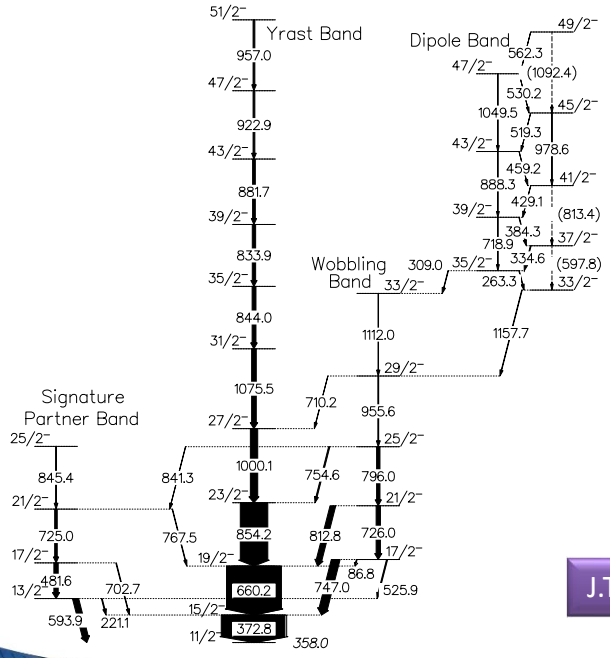
^{12}C → Triple-alpha decays, zero spin Hoyle State
→ further investigations

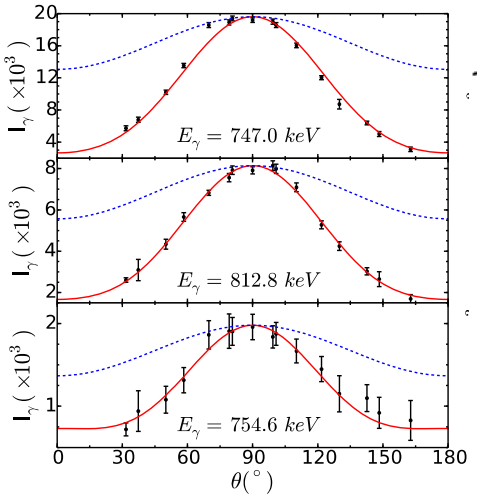
Highlights – Transverse Wobbling: New Collective Motion

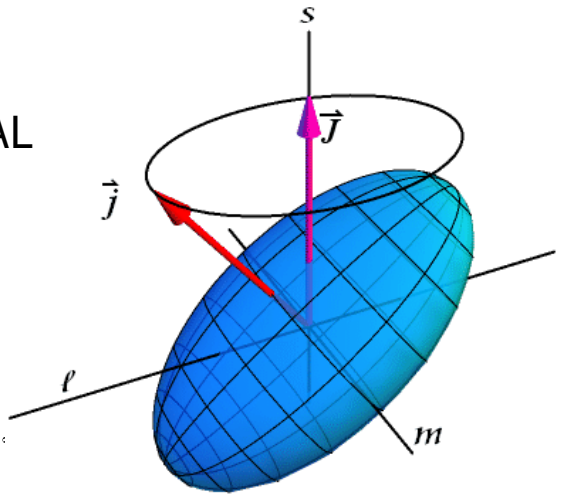
Deformed nuclei – usually axial

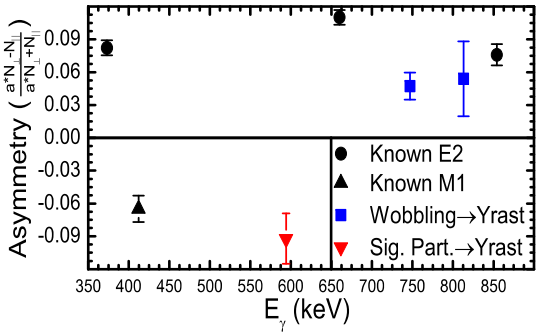
Chirality (fairly common) or Wobbling (rare) → TRIAXIAL

Transverse Wobbling observed in ^{135}Pr



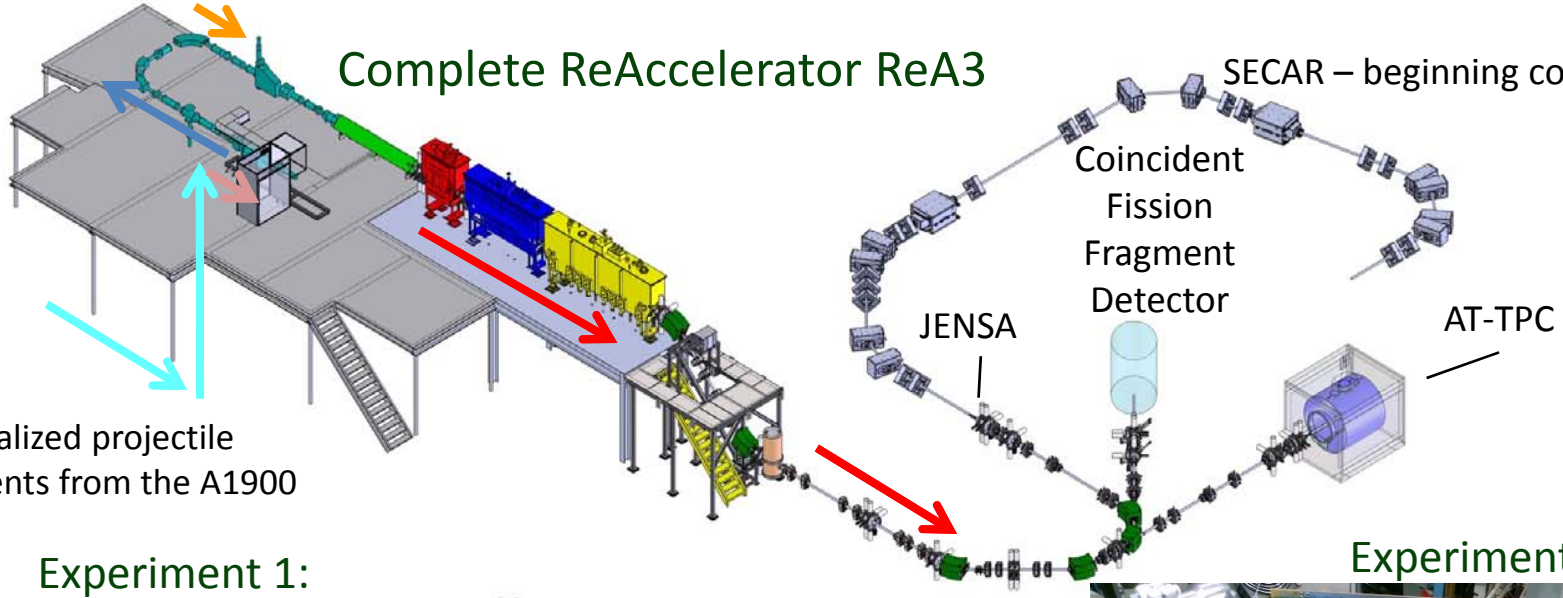




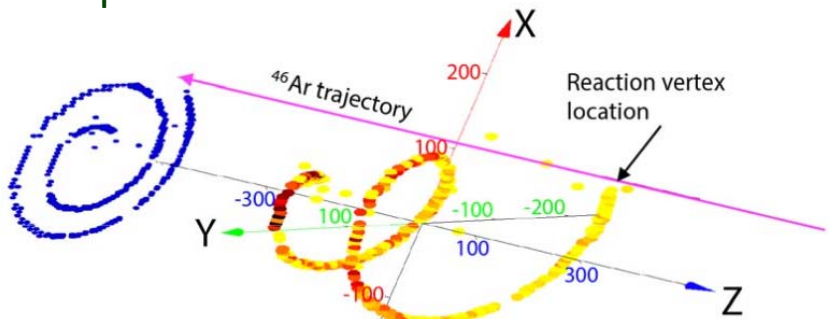


J.T. Matta et al., Phys. Rev. Lett. 114, 082501 (2015)

Highlights – NSCL ReAccelerator Facility Operational

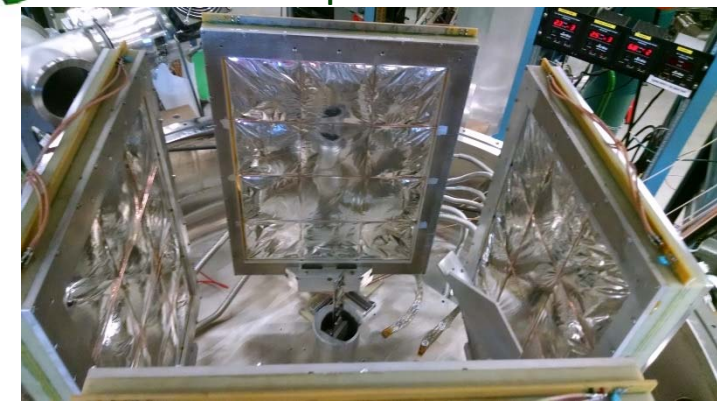


Experiment 1:



^{46}Ar + p scattering in AT-TPC; Bazin, Mittig, et al.

Experiment 2:



^{46}K + ^{181}Ta fusion-fission; Loveland et al.

Highlights – High Precision Penning Trap Mass Measurements with LEBIT

Program Goal

- Measurements for nuclear structure, nuclear astrophysics, fundamental interactions and symmetry tests

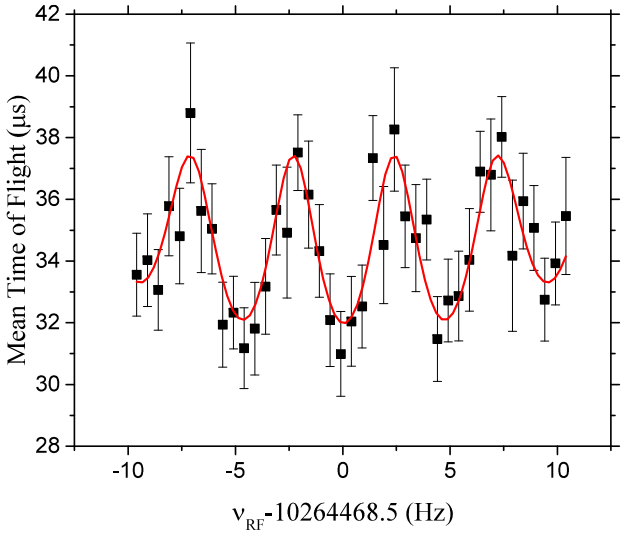
Q-value Measurement of Superallowed β-decay of ^{14}O via Penning Trap

- Contributes to tests of Conserved Vector Current (CVC) hypothesis
- One of 14 best-known decays, and the only one that had not been previously measured in a Penning trap
- Attempted multiple times at other facilities – now successfully measured at LEBIT in 2015

Precision:

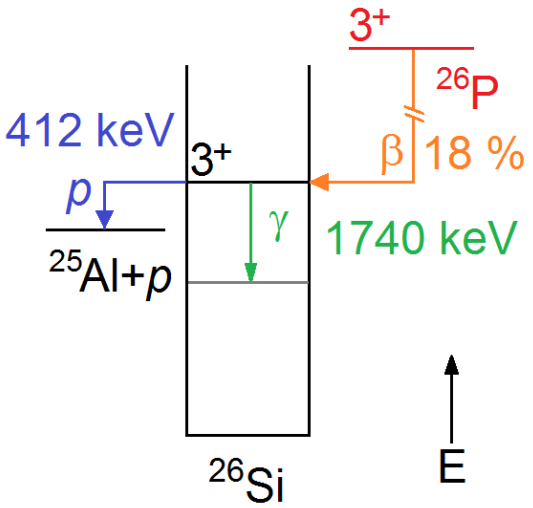
$\delta m = 25$ eV

$\delta m/m = 2 \cdot 10^{-9}$



Highlights – Production of ^{26}Al in Novae

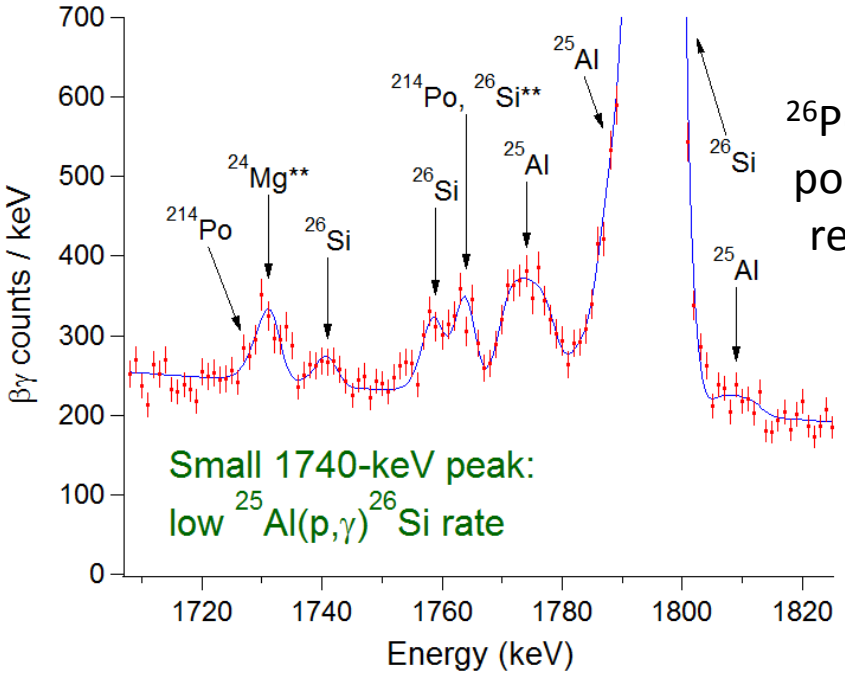
^{25}Al(p,γ)^{26}Si – dominant uncertainty in ^{26}Al production in Milky Way



- Measured γ branch for first time to determine strength of 3+ resonance
- Allowed the production rate of ^{26}Al in novae to be accurately determined for th first time
- **Up to 30% of Galactic ^{26}Al produced i novae**

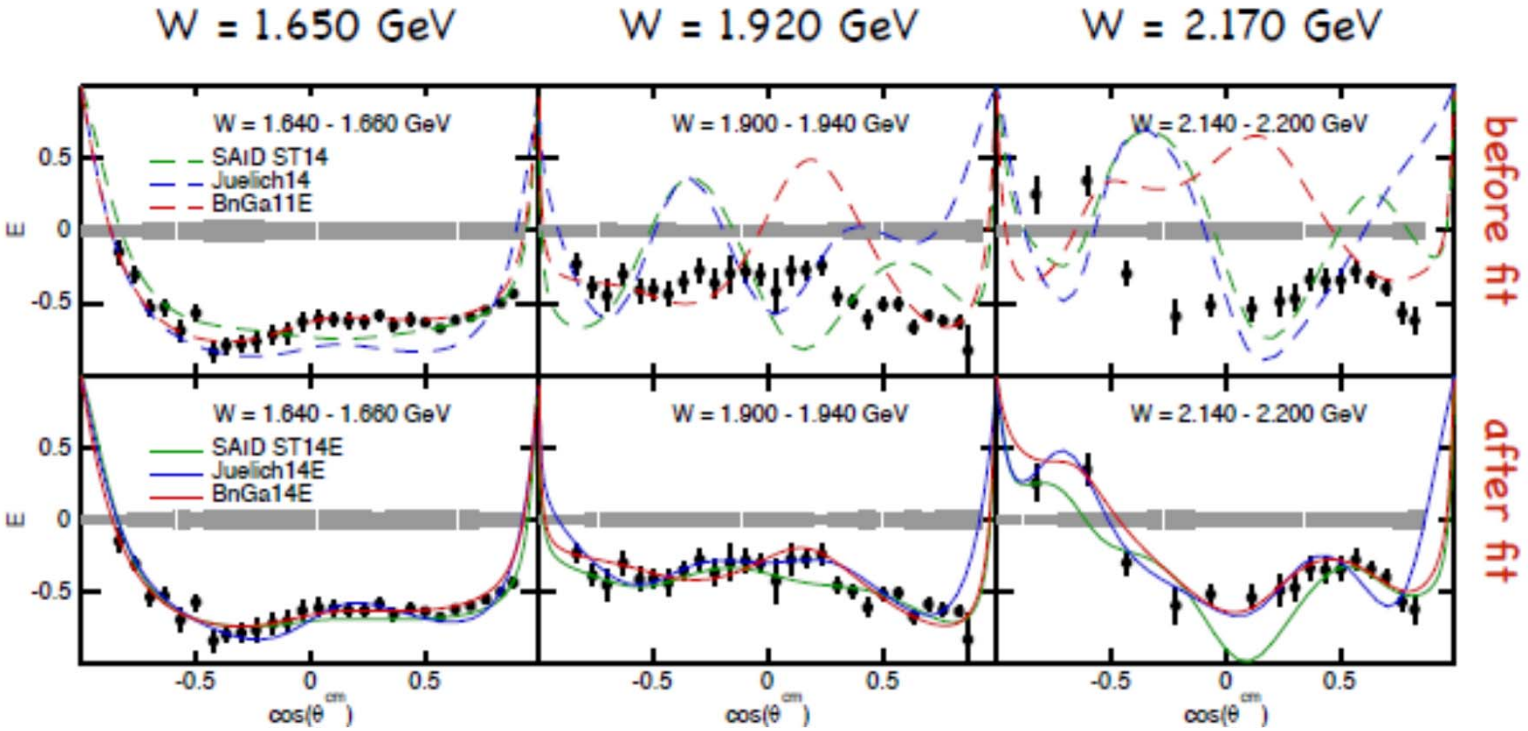
^{26}P decay ID

Gamma detection



^{26}P(β+γ)^{26}Si – populate 3+ resonance

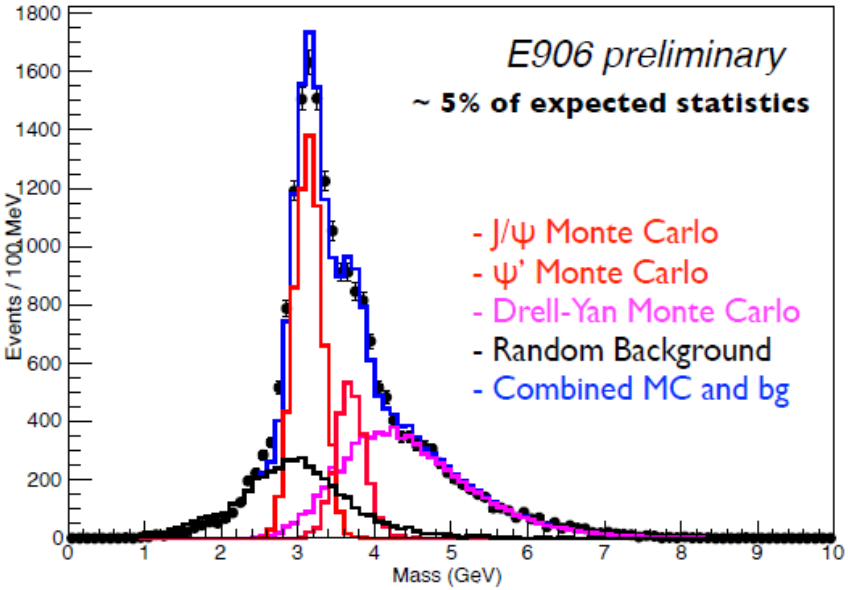
Highlights – Selected Results from FROST Experiment @ JLab $\gamma p \rightarrow \pi^+ n$

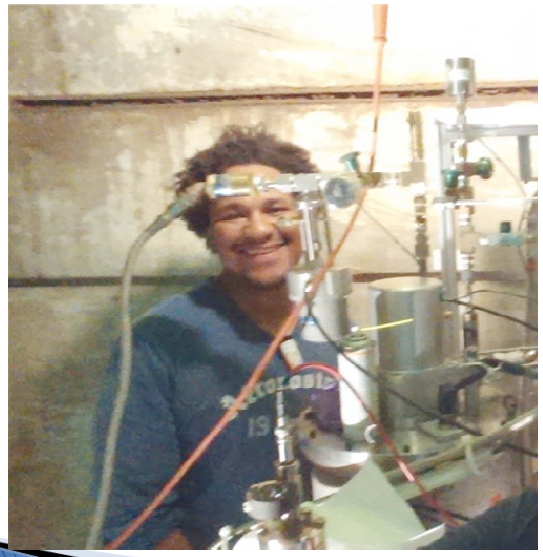


- FROST → 900 data points of **double-polarization observable E** in π+ photoproduction (circularly polarized beam on longitudinally polarized protons) for W = 1240 – 2260 MeV.
- Significant improvements of the description of the data in SAID, Jülich, and BnGa partial-wave analyses after fitting.
- New evidence found in this data for a Δ(2200)7/2- resonance (BnGa analysis).

Highlights – E906/SeaQuest

- Invariant mass distribution of $\mu^+\mu^-$ pairs coming from the target shows mass resolution of ~180 MeV/c^2 — better than expected!
- Data agree well with simulation
- Physics results on d_bar/u_bar ratio in the proton coming soon!

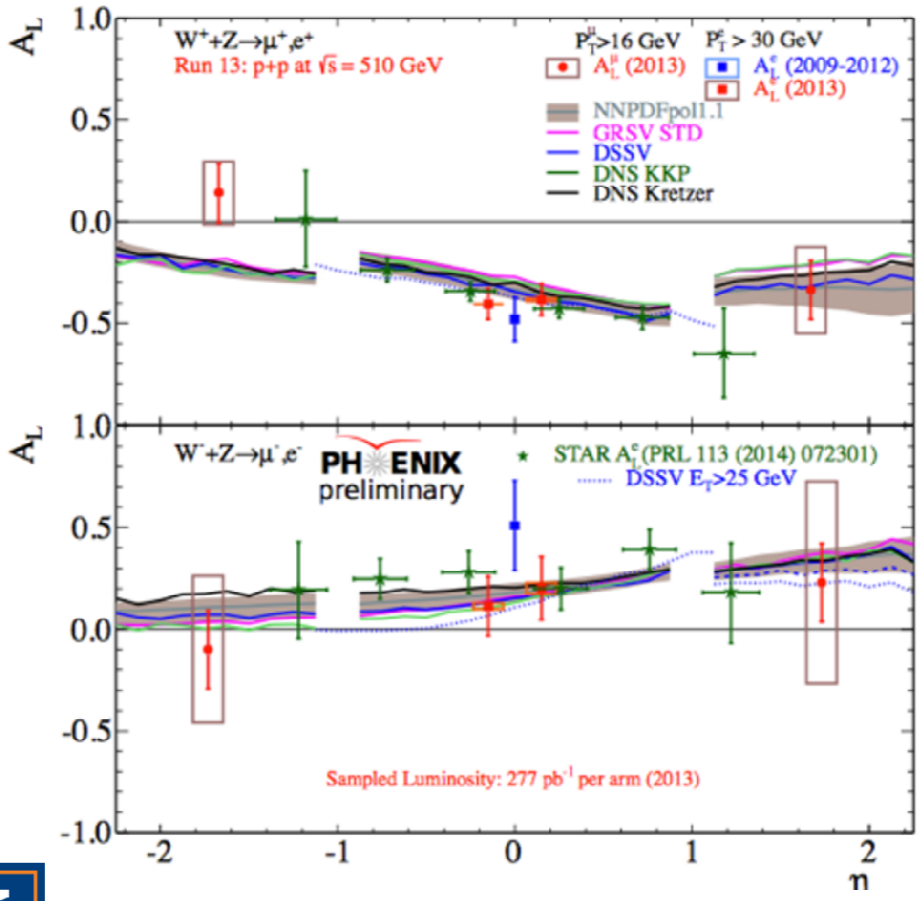




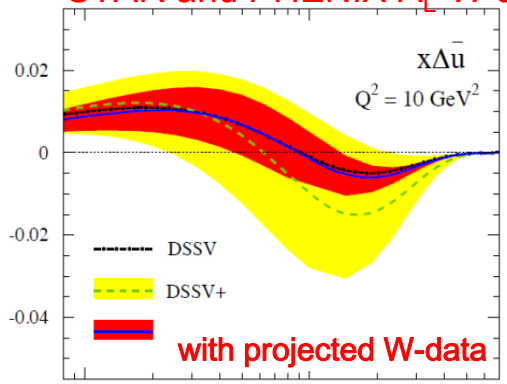
Liquid hydrogen and deuterium targets built and maintained by University of Michigan

Highlights – Parity Violating A_L in W-Production Observed in pol p-p @ RHIC Constrains $\Delta q(x)$ and $\Delta\bar{q}(x)$

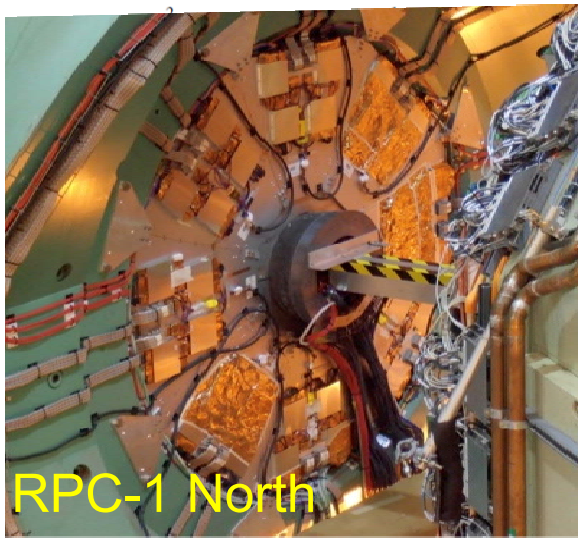
PHENIX and STAR A_L for W-bosons



DSSV: projected impact of STAR and PHENIX A_L-W data

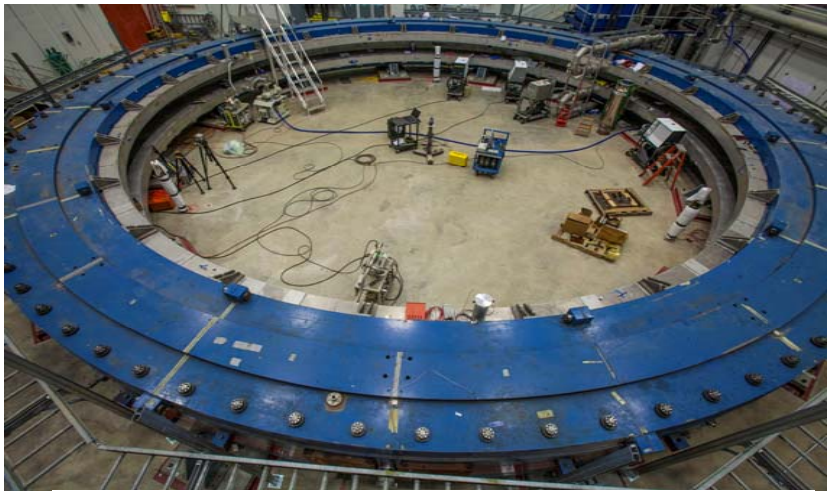


DSSV from "The RHIC Spin Program" Aschenauer et al. arXic:1501.01220

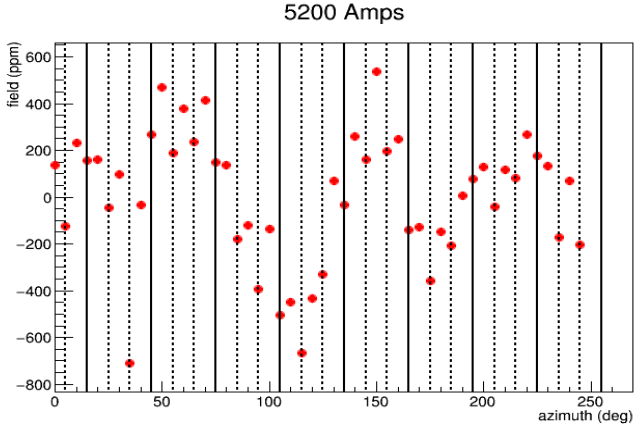


Highlights – New Muon g-2 @ FNAL

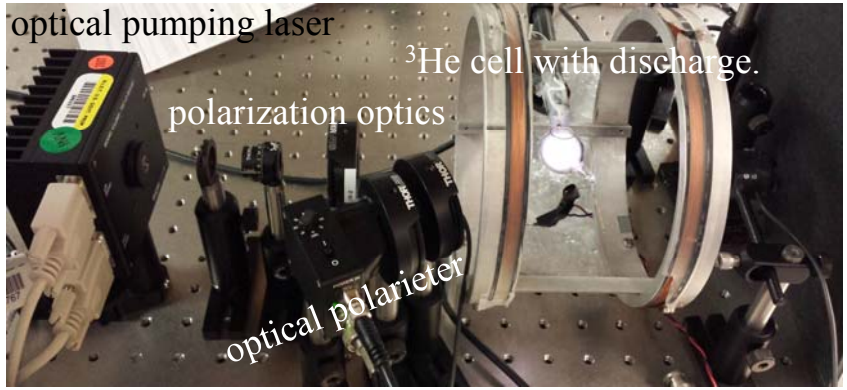
Superconducting coils transported from Brookhaven arriving at Fermilab



The storage-ring magnet installed in MC1



First azimuthal field map at 1.45 T September 2015

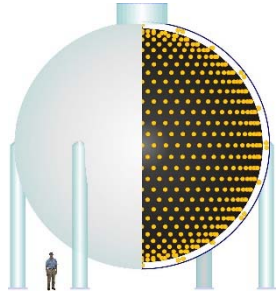


Michigan setup for ^{3}He magnetometry development

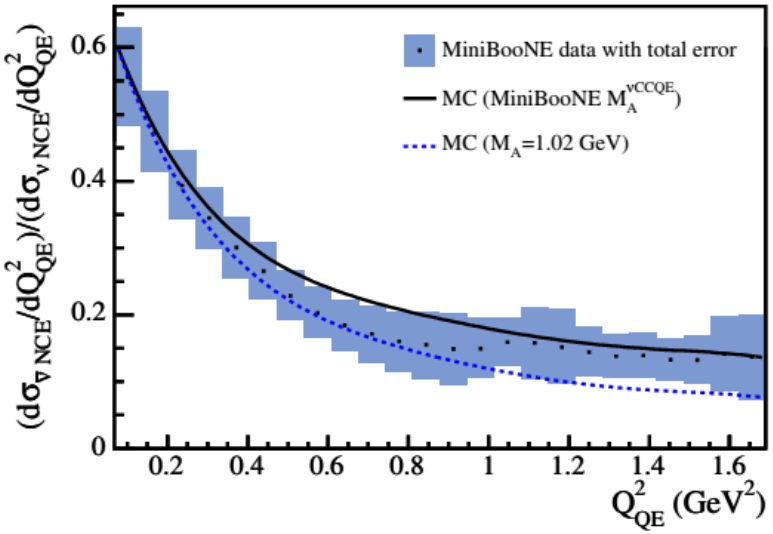
Highlights – Final MiniBooNE ν Interaction Results

Charged and neutral-current quasielastic interactions on C (Phys. Rev. D**91**,012004, 2015, arXiv:1309.7257) →

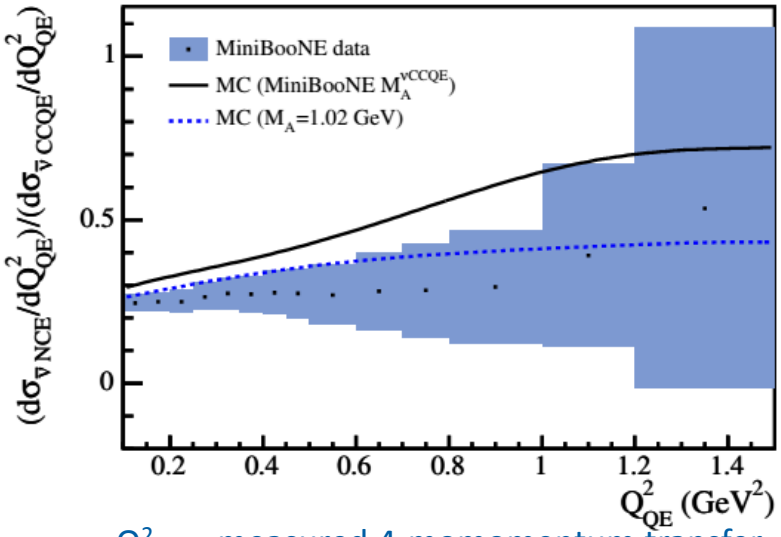
- Multinucleon effects important for ν interactions in nuclei at GeV energies
- Data constrain interaction models for many neutrino oscillation experiments (NoVA, microBooNE, and DUNE)



$\bar{\nu}/\nu$ NC quasielastic cross section ratio

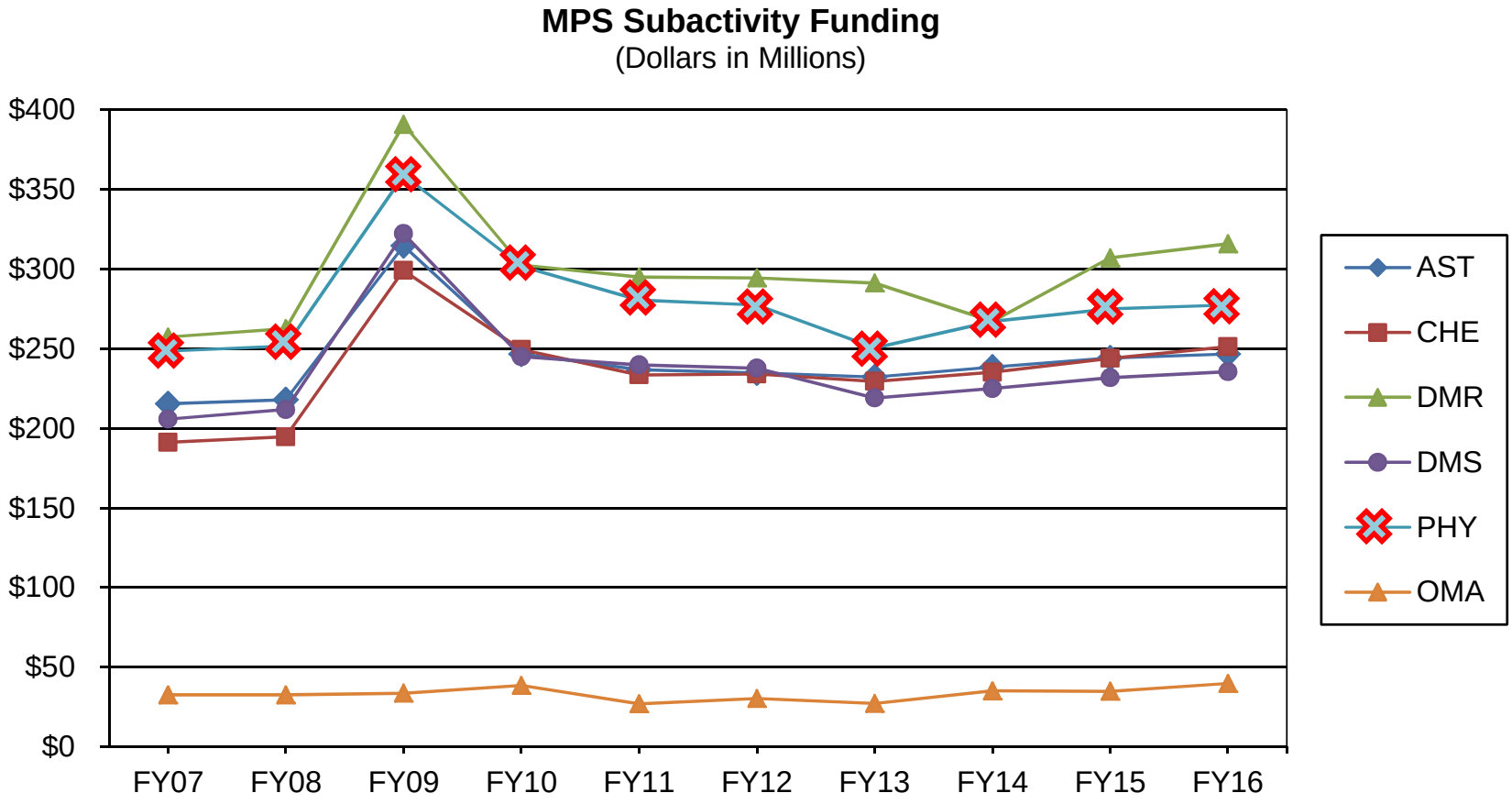


$\bar{\nu}$ NC/CC quasielastic cross section ratio



Q^2_{QE} = measured 4-momomentum transfer

NSF MPS Funding Trends



FY 2009 funding reflects both the FY 2009 omnibus appropriation and funding provided through the American Recovery and Reinvestment Act of 2009 (P.L. 111-5).

Budget Trends – NSF Nuclear Physics

FY	Hadrons & Light Nuclei (k$)	Structure & Heavy Ions (k$)	Fund. Sym. (k$)	Nucl. Astro. (k$)	Theory (k$)	Program Total (k$)	NSCL (k$)	JINA JINA -CEE (k$)	MRI (K$)	Mid-Scale (K$)	Total Nuclear Physics (k$)
2009	7,663	4,734	5,572	N/A	5,825	23,794	22,500	2,000	8,058	9,524	65,877
2010	6,421	6,863	5,532	1,078	3,855	22,672	21,000	2,150	1,134		46,956
2011	5,349	6,485	5,336	1,994	3,719	22,883	21,500	2,150	729		47,262
2012	7,657	3,375	5,855	1,610	3,829	22,326	21,500	2,150	2,744		48,720
2013	5,218	4,259	5,304	1,754	3,474	20,008	21,500	2,150	2,996	490	47,144
2014	5,275	4,215	5,250	2,475	3,514	20,728	22,500	2,280	1,038	1,188	47,733
2015	5,941	3,722	6,818 includes 1,320 for $0\nu\beta\beta$	2,245	4,183	22,908	23,000	2,280	1,801	1,367	51,357

MRI: competes each year; supplemental one-time acquisition/development funds
Mid-scale: ad hoc competition; supplemental construction funds

FY15 PHY Allocation was $275 M

- Approximately 2% for Operations
  - Panels, IPA Appointments and Travel, M&S
- Approximately 30% for M&O for Facilities
  - ATLAS and CMS, IceCube, LIGO, NSCL
- Approximately 8% for Physics Frontiers Centers
  - Currently Ten (one of which is JINA-CEE)
- Approximately 4% for Education and Broadening Participation
  - REU Sites, LIGO Education Center, QuarkNet, …
- Remaining 56% ($154 M) for Six Major Areas of Physics (AMO, PP, GP, NP, PA, PoLS)
  - Experimental and Theoretical

Solicitation for NSF Physics Division Investigator-Initiated Research Projects 15-579

All proposals submitted to the Division of Physics programs must go through this solicitation.

- **Deadlines:**
  - October 28, 2015 for Particle Astrophysics
  - **N*ovember 13, 2015 for Experimental Nuclear Physics & Theoretical Nuclear Physics***
  - December 3, 2015 Computational Physics
  - February 3, 2016 for Accelerator Science
- Follow Grant Proposal Guide (GPG) http://www.nsf.gov/pubs/policydocs/pappguide/nsf15001/gpg_index.jsp
- Follow the GPG checklist
- Follow instructions that are specific to this solicitation …

Focused Research Hubs in Theoretical Physics (FRHTP) 16-501

New!

One of the two focused research hub will support theoretical work in the area of **Fundamental Symmetries, Neutrinos, and their applications to Nuclear Astrophysics** relevant to research within the purview of the Division of Physics

Number of awards: 1 Duration: 5 years

Anticipated funding: $250k-$500k/year, pending availability of funds

The scientific goals of the hub should be achieved in the first five years of the project.

Provide support for:

* Postdoctoral Researchers
* Hub related activities

Does NOT provide *additional* support for:

* Senior Personnel
* Graduate or Undergraduate Students

Deadline: January 22, 2016

Follow Grant Proposal Guide (GPG)
http://www.nsf.gov/pubs/policydocs/pappguide/nsf15001/gpg_index.jsp

Follow instructions that are specific to this solicitation …

Contact Bogdan Mihaila for more information

Major Research Instrumentation (MRI) NSF 15-504

FY15

- *Physics received 24 proposals, NP received 8 proposals, 3 funded*
- *Development of a Helium-Jet Ion-Guide System for Harvesting Rare Isotopes and Commensal Operation at NSCL*, MSU, PI = R Zegers, $1,200k
- *Development of a Neutral Particle Spectrometer to Investigate Quark Structure of the Proton at JLab 12 Gev*, Consortium, PI = T Horn, $526k
- *Gamma Spectroscopy System for Research and Research Training in Nuclear Physics*, Wittenberg Univ, PI = P Voytas, $75k

FY16

- Due date = 13-jan-2016
- Your university probably has an earlier internal deadline

Career Awards

- Solicitation: 15-555
- 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 23, 2015**
- PECASE nominees are chosen from CAREER winners
- Contact program officer for information/advice ahead of time (budget, scope)

Under Review!

NSF/MPS/Physics Personnel

- France Cordova – Director
- Fleming Crim – Associate Director for MPS
- Denise Caldwell – Physics Division Director
- Brad Keister – Deputy Division Director
- Bogdan Mihaila – Nuclear Theory Program Director
- Ken Hicks – Expt'l Nuclear Physics Program Director
- Allena Opper – Expt'l Nuclear Physics Program Director

Ken plans to return to Ohio University August 2016

Search underway for a "rotator" Program Director in Experimental Nuclear Physics

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

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

For the latest updates, check out

http://www.nsf.gov/div/index.jsp?div=PHY

Contact us:

- bmihaila@nsf.gov
  or call (703)292-8235
- khicks@nsf.gov
  or call (703)292-8095
- aopper@nsf.gov
  or call (703)292-8958