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 $\gamma$ 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 $\gamma$-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 $\gamma$-decaying states unbound to neutron decay in $^{19}$O from the $^9$Be($^{14}$C,$\alpha$n) reaction.
He-burning red giant stars

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

TwinSol separator $\rightarrow$ $^{12}$B beam

$^{12}$B $\rightarrow$ implanted in prototype AT-TPC
$\rightarrow$ $^{12}$C + $e^{-} + \bar{\nu}_{e}$

$^{12}$C $\rightarrow$ Triple-alpha decays, zero spin
Hoyle State
$\rightarrow$ 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

Highlights – NSCL ReAccelerator Facility Operational

Complete ReAccelerator ReA3

Thermalized projectile fragments from the A1900

Experiment 1:

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

Experiment 2:

\[ ^{46}\text{K} + ^{181}\text{Ta fusion-fission; Loveland et al.} \]
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 $\beta$-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:
$$\delta m = 25 \text{ eV}$$
$$\frac{\delta m}{m} = 2 \cdot 10^{-9}$$
Highlights –
Production of $^{26}\text{Al}$ in Novae

$^{25}\text{Al}(p,\gamma)^{26}\text{Si}$ – dominant uncertainty in $^{26}\text{Al}$ production in Milky Way

- Measured $\gamma$ branch for first time to determine strength of $3^+$ resonance
- Allowed the production rate of $^{26}\text{Al}$ in novae to be accurately determined for the first time
- Up to 30% of Galactic $^{26}\text{Al}$ produced in novae
Highlights – Selected Results from FROST Experiment @ JLab $\gamma p \rightarrow \pi^+ n$

- FROST $\rightarrow$ 900 data points of double-polarization observable $E$ in $\pi^+$ 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 $\Delta(2200)7/2^-$ resonance (BnGa analysis).
Highlights – E906/SeaQuest

• Invariant mass distribution of $\mu^+\mu^-$ pairs coming from the target shows mass resolution of $\sim 180$ MeV/$c^2$ — better than expected!
• Data agree well with simulation
• Physics results on $d_{\text{bar}}/u_{\text{bar}}$ 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. arXiv:1501.01220
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 \( \nu \) Interaction Results

Charged and neutral-current quasielastic interactions on C

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

\[ \frac{\bar{\nu}}{\nu} \text{ NC quasielastic cross section ratio} \]

\[ \bar{\nu} \text{ NC/CC quasielastic cross section ratio} \]

\( Q^2_{QE} = \text{measured 4-momentum transfer} \)
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

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

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
  – **November 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)**

• Follow the GPG checklist

• Follow instructions that are specific to this solicitation …
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
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)
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

For the latest updates, check out


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