U.S. DEPARTMENT OF ENERGY

Office of Science

Nuclear Physics Program Budget Report

Nuclear Science Advisory Committee

Eugene A. Henry
Acting Associate Director of the Office of Science
for Nuclear Physics
March 2, 2009

Outline of Presentation

- FY 2008 Appropriation
- FY 2009 Budget Request
- Secretary Chu's plans for DOE
- 2009 Stimulus
- Outlook
- Office of Nuclear Physics

DOE SC Nuclear Physics Program

University/National Laboratory Research Program

Researchers (permanent & temporary/postdocs)	~ 1000 Ph.D.s
Students	~ 500 graduates & ~100 undergraduates

National User Facilities

Relativistic Heavy Ion Collider (BNL)	HE heavy ions, polarized protons
Continuous Electron Beam Accelerator Facility (TJNAF)	Polarized electron beams
Holifield Radioactive Ion Beam Facility (ORNL)	LE unstable and stable heavy ions
Argonne Tandem Linac Accelerator Facility (ANL)	LE stable and unstable heavy ions

Laboratory Facilities/Centers

88-Inch Cyclotron (LBNL/UCB)	LE/ME light and heavy ions
Brookhaven Linac Isotope Producer (BNL)	Isotope Production and R&D
Isotope Production Facility (LANL)	Isotope Production and R&D
National Nuclear Data Center (BNL)	Coordinates U.S. ND program

Centers of Excellence

Triangle University Nuclear Laboratory (Duke)	LE light ions, neutrons, photons
Texas A&M Cyclotron Laboratory (TAMU)	LE/ME light and heavy ions
Wright Nuclear Structure Laboratory (Yale)	LE light and heavy ions
Center for Experimental Nuclear and Particle Astrophysics (U. Wash)	R&D and project infrastructure
MIT Research and Engineering Center (MIT)	R&D and project infrastructure
Institute for Nuclear Theory (U. Wash)	DOE Nuclear Theory Center

Experiments

Non-NP Facilities:	HERA/DESY, MAMI, PSI	Photons, electrons, muons
	LANSCE/LANL, Tevatron/FNAL	Cold neutrons, accelerator neutrinos
	LHC/CERN	VHE heavy ions
	SNS/ORNL	Cold and ultra cold neutrons
Non-accelerator:	KamLAND	Solar and reactor neutrinos
	Cryogenic Underground Observatory for Rare Events (CUORE)	Double beta decay
	ATTA (ANL), etc.	Precision measurements

Nation needs a highly trained scientific/technical workforce

Nuclear Physics is attracting and training next-generation of scientists

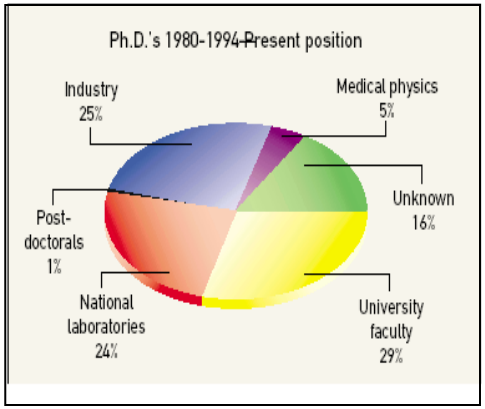
Graduate Student and Postdoctoral Associate Training

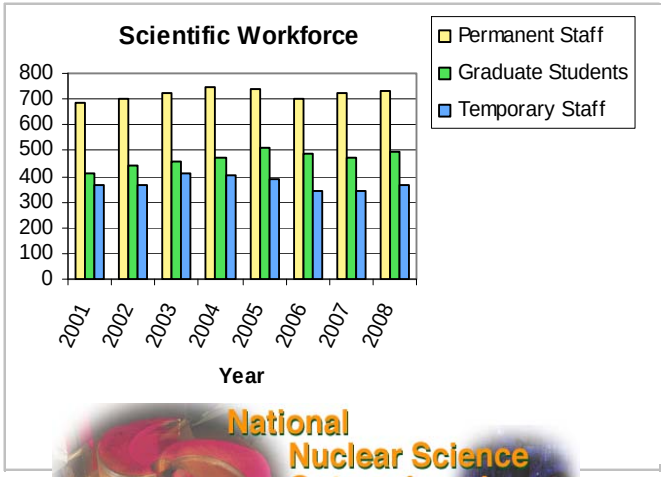
- NP supports ~500 graduate students (~ 80 PhD degrees per year)
  ~ 400 post doctoral appointments (postdocs)
- About two-thirds (2/3) these highly trained scientists go on to careers outside of basic nuclear physics research
- Only about one-half of the graduate students & postdocs are U.S. citizens

Nuclear Science Outreach to Students K-12, Public, Undergraduates

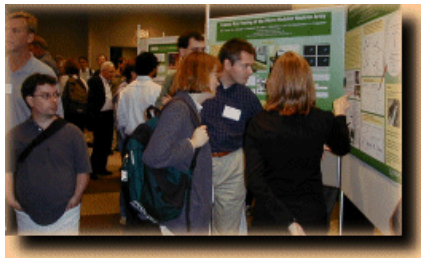
- Dozens of outreach activities are carried out each year by nuclear scientists at laboratories and universities
- Specific activities such as the Conference Experience for Undergraduates are aimed at attracting the brightest students to nuclear science
- Workshops and summer schools enrich the experience of graduate students and postdoctoral associates

Ph.D. Recipients go on careers in Academia, Medicine, National Laboratories, and Industry





Conference Experience for Undergraduates



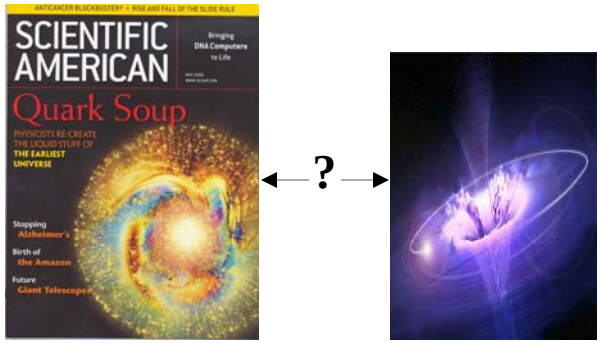
National Nuclear Physics Summer School

Scientific Highlights

Properties of a "Quark Soup":

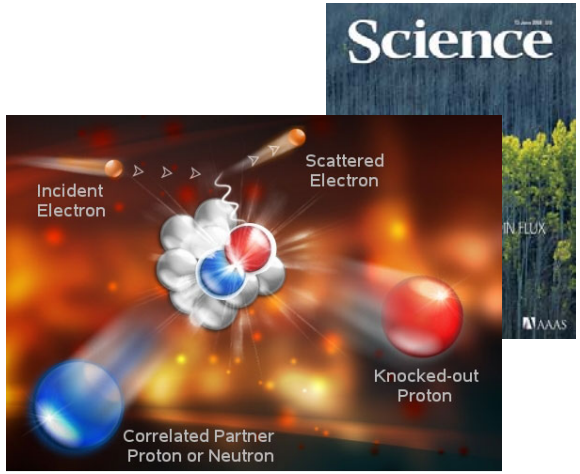
The conditions of the infant universe, replicated in experiments at BNL/ RHIC, continue to be revealed:

- Behavior of the "quenched" far-side jet produced in gold-gold collisions suggest evidence of what appears to be near perfect Quark-Gluon Plasma (QGP) liquid formed at RHIC. Scientists believe the density of this 'new' medium is very high - estimated densities could be as large as 100 times the density of normal nuclear matter.
- Can the mathematical description of a black hole better approximate the QGP? Recently, string theory methods have been found useful in estimating some of the fluid parameters of the QGP, such as viscosity and entropy density.

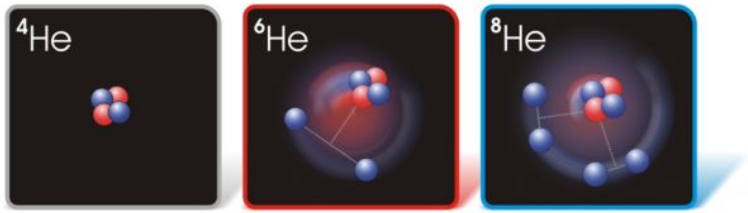


Understanding the coupling of protons and neutrons inside nuclei:

- A JLab experiment recently published in **Science** found that high momentum protons are 20 times more likely to pair up with neutrons than other protons inside a nucleus. The experiment provides a better understanding of the pairing of protons and neutrons inside nuclei. A theoretical calculation that includes this pairing effect inside neutron stars indicates that such pairing could have a significant impact on the structure of neutron stars.



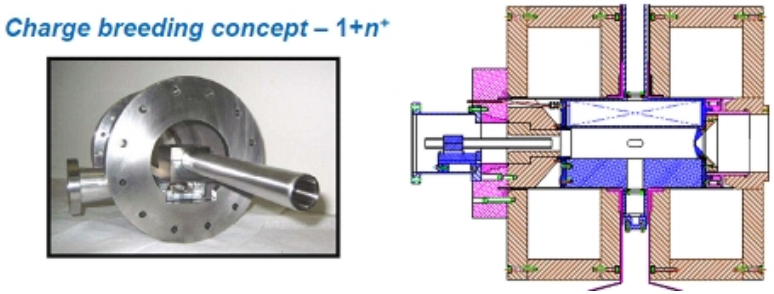
- ANL scientists have recently completed a very difficult precision measurement of the He-8 nuclear charge radius using their state-of-the-art, atom-trapping laser technology. This fundamental measurement, along with their previous He-6 result, is independent of nuclear models, thus providing important information to nuclear theorists on the motion of the two protons as they interact with the neutrons inside the nucleus.



Technical and Facility Highlights

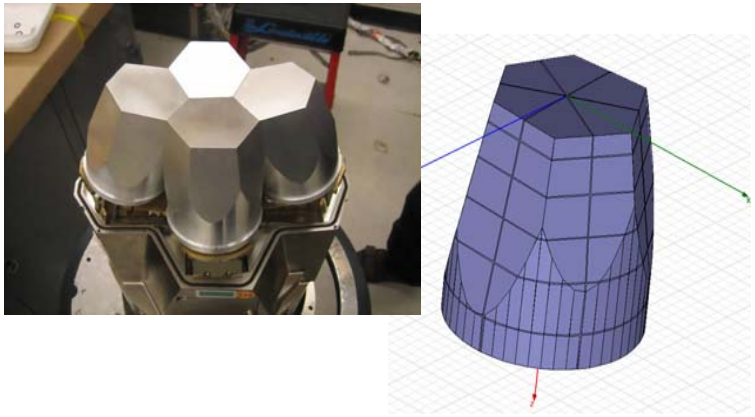
ANL accelerates charge-bred beam for first time:

- CARIBU uses californium-252 to produce rare, exotic isotopes at limit of stability to study formation of elements
- Fission products need to be reaccelerated to high velocities
- For first time in western hemisphere successfully tested charge breeding using electron cyclotron ion source; 1+ rubidium beam charge-bred to 13+ and accelerated to 123 MeV



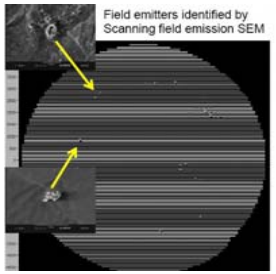
Tracking of low-energy gamma rays in highly-segmented, high-resolution Germanium crystals:

- First four-crystal detector module of the Gamma-Ray-Energy-Tracking-In-Beam-Nuclear-Array (GRETINA)
- Each encapsulated crystal segmented 36 ways (6 longitudinal, 6 transverse)
- Measure in 3 dimensions interaction points inside the crystal of individual gamma rays from a cesium-137 pencil beam

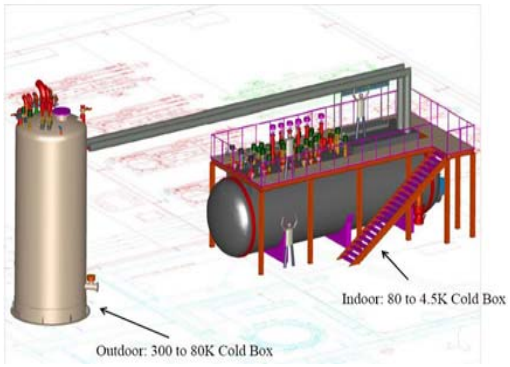


TJNAF remains a world-leader in superconducting radio frequency (SRF) technology, cryogenics, instrumentation. SRF accomplishments in FY 2008 include:

- Using advanced diagnostic tools TJNAF developed an understanding of the root cause of gradient limitation in SRF cavities
- Developed a very effective DOE laboratory/ industrial collaboration to transfer latest cryogenic technology based on Ganni cycle to industry



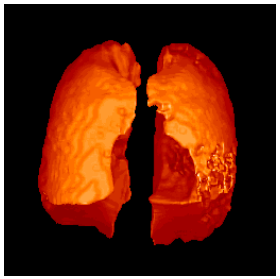
Understanding Field Emission in srf cavity



"Split Cold Box Design

Nuclear techniques and instrumentation are widely used

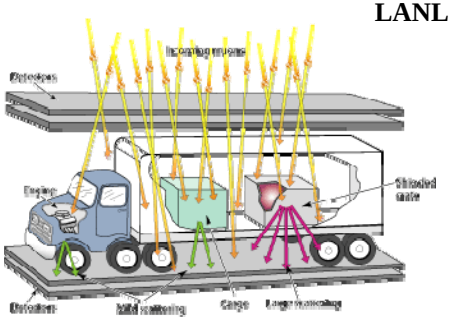
Nuclear Physics develops advanced instrumentation and techniques



U of VA
TJNAF

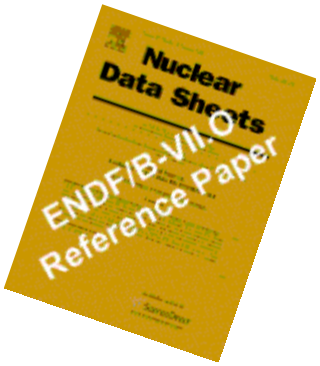
Imaging lungs with polarized Xe

LANL



Searching for SNM with cosmic rays

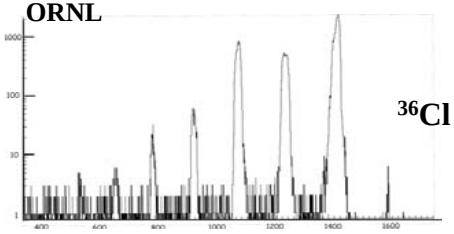
BNL



Nuclear Data for next next generation reactors

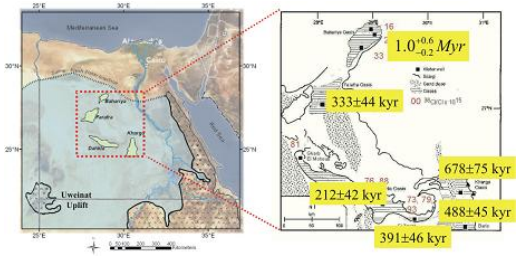
Medical Diagnostics and Therapy Radiography Computerized tomography Positron emission tomography MRI (regular) MRI (with polarized noble gases) Photon therapy Particle-beam therapies Isotope Production and Development	**Material Analysis** Activation analysis Accelerator mass spectrometry Atom-trap trace analysis Forensic dosimetry Proton-induced x-ray emission Rutherfold backgrounding Ion-induced secondary-ion emission Muon spin rotation
Safety and National Security Airport safety and security Large-scale x-ray scanners Nuclear materials detection Arms control and nonproliferation Stockpile stewardship Tritium production Space-radiation health effects Semi-conductors in radiation environments Food sterilization	**Environmental Applications** Climate-change monitoring Pollution control Groundwater monitoring Ocean-current monitoring Radioactive-waste burning
Energy Production and Exploration Nuclear reactors Oil-well logging R&D for next generation nuclear reactors **Art and Archaeology** Authentication Nuclear dating	**Materials Testing and Modification** Trace-isotope analysis Ion implantation Surface modifications Flux-pinning in high-Tc superconductors Free-electron lasers Cold and ultracold neutrons Single-event efforts Microphone filters

ORNL



Accelerator mass spectrometry of sea water to monitor deep currents

ANL



Determination of ages of Egyptian aquifers with ATTA

LBNL

Tests of micro-electronics for space applications

Accelerators are Important for Other Scientific Fields and Society

Nuclear Physics is a leader in developing advanced accelerator capabilities

- Nuclear Physics is playing a strong role in both short-term and long-term advanced accelerator R&D important to the NP mission

- World leader in several areas

Ion sources

- Electron Cyclotron Resonance Sources (LBNL)
- Electron Beam Ion Source (BNL)
- Polarized Proton source (BNL) polarization > 65%
- Rare Isotope Beams (HRIBF, ATLAS)

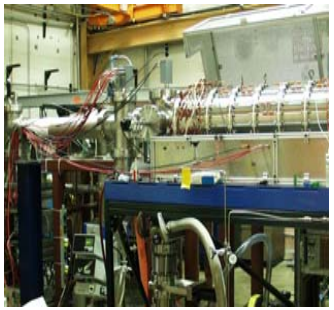
Polarized Electron Sources

- Polarization > 85% (TJNAF)

Superconducting RF Accelerators

- Low energy SRF cavities (ANL)
- Higher energy SRF cavities (TJNAF SRF Institute)
  - World-leadership expertise
  - Provided DOD FEL an advanced SRF energy-recovering linac (ERL)
  - Supports future SRF projects (12 GeV, FRIB, ILC, etc)

Ion Catcher at ANL

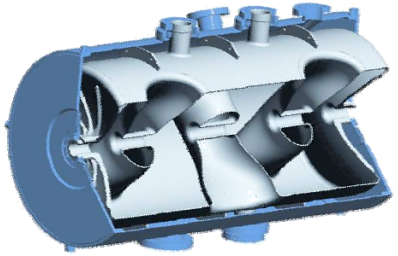


EBIS at BNL

Polarized Test Facility at TJNAF

VENUS ECR at LBNL

Triple spoke SC RF cavity at ANL

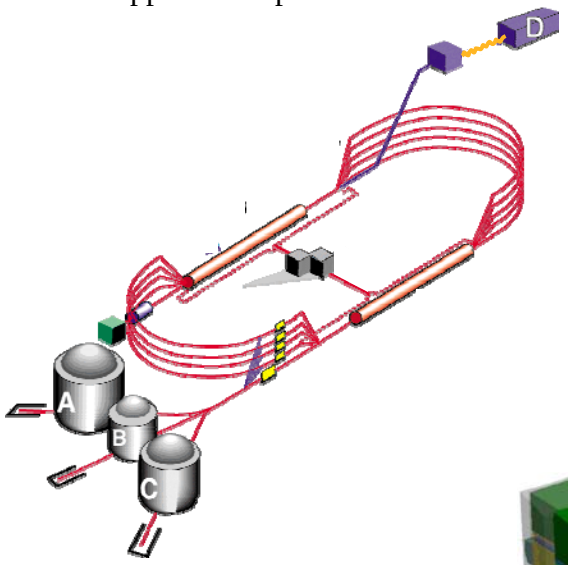


SNS SC RF cavities at TJNAF

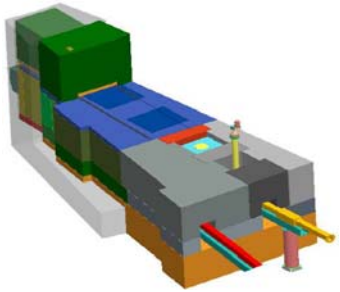
Nuclear Physics is Implementing Recommendations
of the Long Range Plan

The program has taken significant steps during the past year to implement the Long Range Plan

- The 12 GeV CEBAF Upgrade project CD-3 was approved September 2008

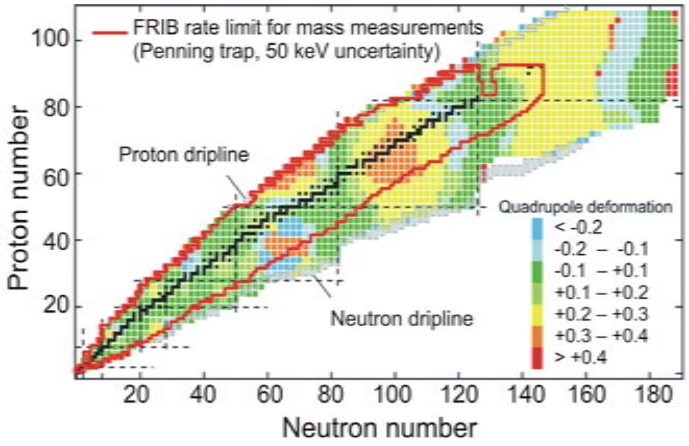


- The Fundamental Neutron Physics Beamline project CD-4A was approved September 2008



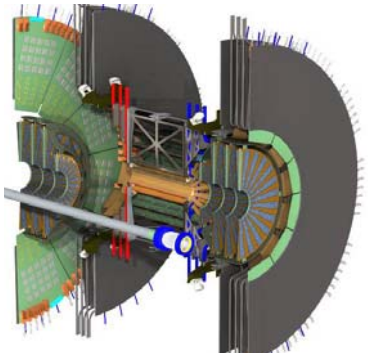
The CUORE Double Beta Decay Neutrino Experiment MIE is preparing for CD-2

- Michigan State University was announced as the site and operating institution for the Facility for Rare Isotope Beams in December 2008



- Luminosity and detector upgrades are underway for RHIC

PHENIX Barrel and Forward Vertex Detector



DOE SC Nuclear Physics
Strategic Plan

The DOE SC Nuclear Physics Strategic Plan:

- Addresses the scientific opportunities identified and priorities recommended by community
- Builds on existing strengths and infrastructure
- Exploits opportunities elsewhere in which the U.S. can play leadership roles
- Positions the U.S. to deliver outstanding science, remain among the leaders, and maintain core competency

The major elements of DOE's plan are to:

- Operate and upgrade RHIC and CEBAF to achieve their scientific goals
- Implement a plan to become a world leader in nuclear structure/astrophysics studies
- Address compelling high-impact scientific opportunities in neutrinos/fundamental symmetries
- Nurture a strong U.S. nuclear physics research community
- Produces isotopes in short supply for basic research and applications

- Funding above COL is required for investments in new research capabilities

FY 2008 Appropriations

Nuclear Physics	FY 2005 Approp.	FY 2006 Approp.	FY 2007 Approp.	FY 2008 Pres. Req.	delta	FY2008 Approp.	versus FY 2008
Medium Energy Nuclear Physics	123,463	107,605	113,754	123,379	-11,389	111,990	-9.2%
Heavy Ion Nuclear Physics	174,280	160,230	184,290	203,188	-16,525	186,663	-8.1%
Low Energy Nuclear Physics	76,169	68,367	79,397	90,647	-7,024	83,623	-7.7%
Nuclear Theory	30,865	28,352	33,205	36,405	-1,994	34,411	-5.5%
Isotope Production and Applications	0	0	0	0	0	0	0.0%
Subtotal, Nuclear Physics	404,777	364,554	410,646	453,619	-36,932	416,687	-8.1%
Construction	0	2,480	12,120	17,700	-161	17,539	-0.9%
Total, Nuclear Physics	404,777	367,034	422,766	471,319	-37,093	434,226	-7.9%

* Includes SBIR/STTR in FY 2005-2008 for comparability

• Stretch out of EBIS construction project, RHIC MIE's, GRETINA and nEDM (DOE/NSF), Accelerator Improvement Projects, facility capital equipment projects; able to partially restore GRETINA later in FY2008.

• NP research programs nearly flat funded with FY 2007. Planned increases in research efforts that support ongoing initiatives, such as FNPB and LHC, are reduced. Still able to meet our LHC commitments.

• Generic R&D related to rare isotope beam capabilities reduced; 16 out of 29 proposals supported.

• Operations at all four National User Facilities reduced. RHIC operated 19 weeks; CEBAF 24 weeks. All four facilities operated reliably.

• Increased support for the Advanced Fuel Cycle initiative and theoretical topical collaboration is deferred. Not able to identify funds throughout FY. AFCI proposals declined.

• Efforts throughout the year to mitigate RIFS throughout the program.

FY 2008 Supplemental Funds

FY 2008 Supplemental funding:

- Allocation of $62,500,000 FY 2008 Emergency Supplemental Funding to DOE Office of Science

- $1,500,000 over a prior FY 2008 appropriation of $432,726,000, for a revised total of $434,226,000) to Nuclear Physics

- Support directed towards RHIC to mitigate potential of any RIF's and ensure minimum 19 week run in FY 2009

Office of Science
FY 2009 Congressional Budget Request

Office of Science
FY 2009 Budget Request to Congress
(dollars in thousands)

	FY 2007 Approp.	FY 2008 Request	FY 2008 Approp.	FY 2009 Request to Congress	FY 2009 Request to Congress vs. FY 2008 Approp.	
Basic Energy Sciences	1,221,380	1,498,497	1,269,902	1,568,160	+298,258	+23.5%
Advanced Scientific Computing Research	275,734	340,198	351,173	368,820	+17,647	+5.0%
Biological and Environmental Research	480,104	531,897	544,397	568,540	+24,143	+4.4%
High Energy Physics	732,434	782,238	689,331	804,960	+115,629	+16.8%
Nuclear Physics	412,330	471,319	432,726	510,080	+77,354	+17.9%
Fusion Energy Sciences	311,664	427,850	286,548	493,050	+206,502	+72.1%
Science Laboratories Infrastructure	41,986	78,956	66,861	110,260	+43,399	+64.9%
Science Program Direction	166,469	184,934	177,779	203,913	+26,134	+14.7%
Workforce Dev. for Teachers & Scientists	7,952	11,000	8,044	13,583	+5,539	+68.9%
Safeguards and Security (gross)	75,830	76,592	75,946	80,603	+4,657	+6.1%
SBIR/STTR (SC funding)	86,936	——	——	——	——	——
Subtotal, Office of Science	3,812,819	4,403,481	3,902,707	4,721,969	+819,262	+21.0%
Adjustments*	23,794	-5,605	70,435	——	-70,435	——
Total, Office of Science	3,836,613	4,397,876	3,973,142	4,721,969	+748,827	+18.8%

* Adjustments include SBIR/STTR funding transferred from other DOE offices (FY 2007 only), a charge to reimbursable customers for their share of safeguards and security costs (FY 2007 and FY 2008), Congressionally-directed projects and a rescission of a prior year Congressionally-directed project (FY 2008 only), and offsets for the use of prior year balances to fund current year activities (FY 2007 and FY 2008).

Nuclear Physics Program in FY 2009

Nuclear Physics	FY 2005 Approp.	FY 2006 Approp.	FY 2007 Approp.	FY 2008 Approp.	delta	FY 2009 Pres. Req.	versus FY 2008
Medium Energy Nuclear Physics	123,463	107,605	113,754	111,990	9,056	121,046	8.1%
Heavy Ion Nuclear Physics	174,280	160,230	184,290	186,663	14,894	201,557	8.0%
Low Energy Nuclear Physics	76,169	68,367	79,397	83,623	12,939	96,562	15.5%
Nuclear Theory	30,865	28,352	33,205	34,411	5,543	39,954	16.1%
Isotope Production and Applications	0	0	0	0	19,900	19,900	100.0%
Subtotal, Nuclear Physics	404,777	364,554	410,646	416,687	62,332	479,019	15.0%
Construction	0	2,480	12,120	17,539	13,522	31,061	77.1%
Total, Nuclear Physics	404,777	367,034	422,766	434,226	75,854	510,080	17.5%

FY 2009 Budget Request for NP ($510.0M) allows for effective utilization of the program's scientific facilities and makes important investments for the future.

- University and Laboratory research efforts are strengthened to effectively support and implement the nuclear physics program.
- User Facilities (RHIC, CEBAF, ATLAS and HRIBF) operations are increased.
  - RHIC is at 25 weeks
  - CEBAF is at 34 weeks
- Important instrumentation projects are continued.
- The 12 GeV CEBAF Upgrade Project initiates construction.
- Conceptual design and R&D for a facility for a facility for rare isotope beams is initiated in FY 2009.
- Support is provided for advanced fuel cycle initiatives and theoretical topical collaborations.
- Isotope Production Program is transferred to Office of Nuclear Physics.
- Continuing Resolution has impacted all of the above.

Office of Nuclear Physics
FY 2009 Congressional Budget Request

	(millions)			
	FY07	FY08	Request FY09	vs FY08
Research Operating	138.7	142.6	161.5	+ *13%*
Research Cap. Equip.	13.1	14.1	18.0	+ *28%*
<Research>	151.8	156.7	179.5	***+ 15%***
RHIC	135.5	137.0	148.6	+ *8%*
CEBAF	70.4	70.8	77.8	+ *11%*
HRIBF	12.9	13.1	14.6	+ *12%*
ATLAS	11.7	12.4	13.7	+ *15%*
88-Inch Cyclotron	3.1	3.2	3.7	+ *16%*
MIT/Bates	2.0	2.0	0	
<Facility Operations>	235.6	238.5	258.4	***+ 8%***
12 GeV Upgrade R&D/PED	9.5	14.4	28.6	
EBIS (RHIC)	5.1	4.1	2.7	
FRIB R&D/CDR	0	0	7.0	
<Construction (TPE)>	14.6	18.5	38.3	***+107%***
Other (GPP/SBIR/etc)	21.0*	20.5*	33.8**	
<Stewardship>	21.0	20.5	33.8	+ *65%*
Nuclear Physics Total	422.8	434.2	510.0	***+ 18%***

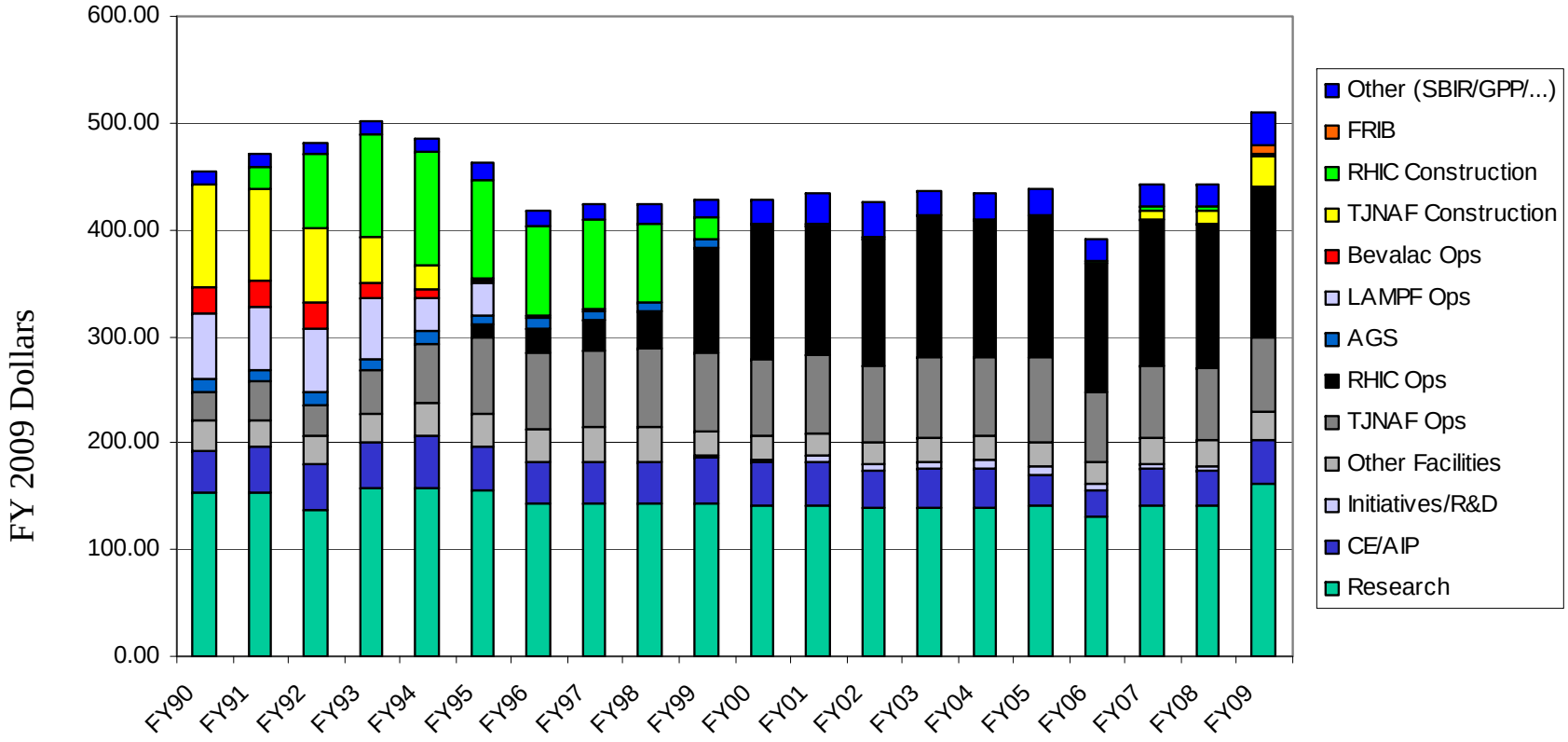
** Includes SBIR/STTR **Includes Isotope Program*

FY 2009 Budget Request
Research

	millions			
			Request	
Research	FY07	FY08	FY09	vs FY08
Universities	62.3	63.2	67.7	+ *7%*
Laboratories	69.9	72.9	84.0	+ *15%*
SciDAC & LQCD	2.7	2.8	3.2	+ *14%*
Rare Isotope R&D	3.8	3.8	0	
R&D for AFCI	-	-	6.6	
Operating Subtotal	138.7	142.5	161.5	+ *13%*
Research Capital Equipment (TEC)				
GRETINA	3.9	4.2	2.0	
FNPB	1.5	1.5	1.5	
STAR TOF	2.4	0	0	
PHENIX Silicon VTX	1.6	2.0	0.9	
PHENIX Forward Vertex Detector	0	0.7	2.2	
PHENIX Nose Cone Calorimeter	0	0.2	0	
HI LHC	1.0	2.0	4.0	
nEDM	0.8	2.2	1.1	
CUORE	-	0.4	2.0	
University CE	0.9	0.5	1.0	
Laboratory CE	1.0	0.5	3.3	
Capital Equip Subtotal	13.1	14.2	18.0	+ *27%*
Research Subtotal	151.8	156.7	179.5	+ *15%*

Funding in Recent Years has been about OMB COL
FY 2009 may be an exception

However, the FY 2009 President's Request includes the transfer of the Isotopes Program to NP, and an increase in construction. Research and operations increase by about 9%.



FY 2009 Continuing Resolution

- Continuing Resolution funding essentially ~ flat funding from FY 2008.
  - Have mitigated impacts of reduction-in-force. (6-10 FTE across program estimated)
  - Operations of National User Facilities decreased. (RHIC 21 weeks; CEBAF 26 weeks)
  - JLab received $1.5 million additional funds in FY 2009 initial financial plan to mitigate potential RIFS due to unanticipated power rate increases.
  - Attempt to optimize MIE funding within available funds.
  - Throughout the program, there are hiring freezes, lack of promotions, restrictions on salary increases, and an inability to support new postdocs and graduate students. Researchers experience restrictions on travel, including travel to support experimental programs at user facilities.
  - New research programs that had been identified to start or increase in FY 2009 are on hold. This includes increases in research relevant to the design of next generation nuclear reactors, the establishment of theoretical topical centers that will target advances necessary to interpret experimental results, and the initiation of a program to develop and produce research isotopes.

- Isotope Program will not transfer from NE to NP until there is an Appropriation
  - Essentially managing the program.
  - Most significant accomplishment in FY 2009 is resolution of Cf-252.

Status of NP Projects

Project	TPC	Start	Completion	Status
GRETINA MIE	$18.8 million	FY 2004	FY 2011	CD-2b/3b
FNPB MIE	$9.3 million	FY 2004	FY 2010	CD-4a
STAR TOF	$4.8 million	FY 2006	FY 2009	N/A
nEDM MIE (NSF)	$17-19 million	FY 2007	FY 2015	CD-1
PHENIX SVT MIE	$4.7 million	FY 2007	FY 2010	N/A
HI LHC ALICE MIE	$13.5 million	FY 2007	FY 2011	CD-2/3
PHENIX FVTX	$4.9 million	FY 2008	FY 2011	N/A
CUORE (NSF)	$8-10 million	FY 2008	FY 2013	CD-1
EBIS (NASA)	$14.8 million	FY 2006	FY 2010	CD-2/3
12 GeV Upgrade	$310 million	FY 2004	FY 2015	CD-3

All projects are reviewed monthly, quarterly, annually

12 GeV CEBAF Upgrade

Unique, world-class facility and scientific program

- New insight into the structure of the nucleon
- Investigate transition between hadronic and quark/gluon description
- Address one of great questions of modern physics: the mechanism that "confines" quarks together

Scope of the project

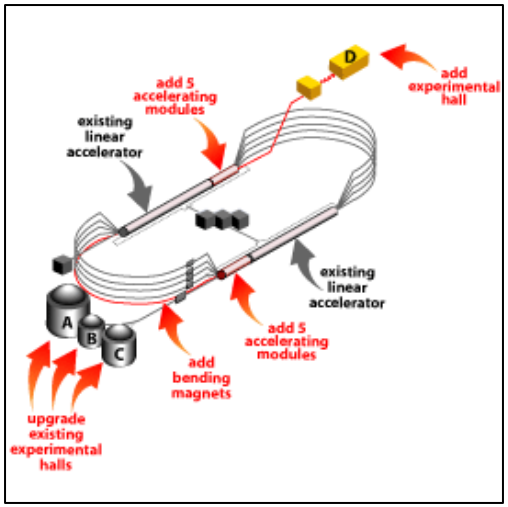
- Doubling the accelerator beam energy
- New experimental Hall and associated beamline
- Upgrades to the existing three experimental Halls.

TPC: $310 Million

Funds redirected from CEBAF Operations

Successful CD-2, CD-3 in FY08

Stimulus funding could advance project , to be reduc in outyears



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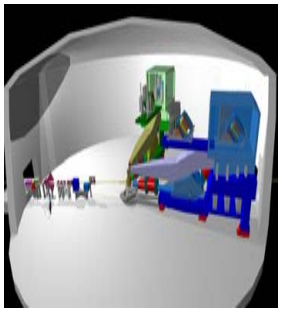
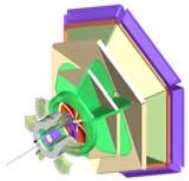


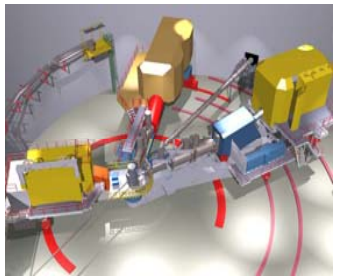
High Resolution Spectrometer (HRS) Pair, and specialized large installation experiments

B



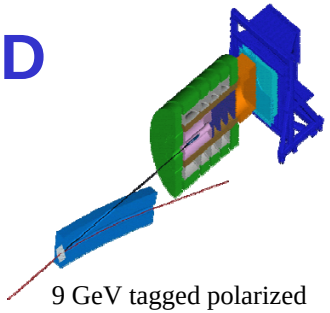
CLAS upgraded to higher (10^{35}) luminosity and coverage

C



Super High Momentum Spectrometer (SHMS) at high luminosity and forward angles

D

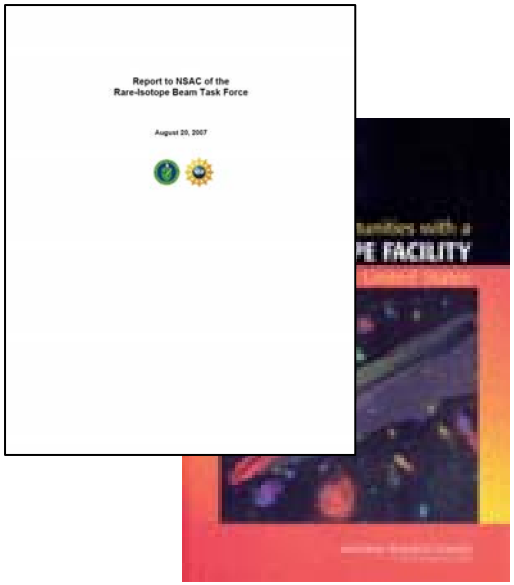


9 GeV tagged polarized photons and a 4π hermetic detector

	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	future
TPC $ in millions	0.7	2.3	4.5	9.5	14.4	28.6	59.0	62.0	66.0	43.0	20.0

Facility for Rare Isotope Beams (FRIB)

- Funding Opportunity Announcement called for proposals due July 21, 2008. Can access from the NP website.
- Followed overall approach of the successful FOA for the GTL BioCenters tailored to the needs of the scope associated with the establishment of a facility.
- Identifies a site that can proceed with facility establishment. Future funding depends on Appropriation. FY 2009 Budget requests Conceptual Design support and R&D.
- Conducted peer review with Merit Review Panel.
- December 2008 - made a single award for the establishment of an FRIB not to exceed $550,000,000.
- Michigan State University selected for award.



NP and Isotopes Program

- **The FY 2009 President's Request proposes to transfer the Isotope Production Program from the Office of Nuclear Energy to the Office of Science: Office of Nuclear Physics.**
  - The program is renamed the *Isotope Production and Applications Program*
  - Includes Isotope Production Infrastructure and a new initiative entitled Research Isotope Development and Production – priorities will be defined by NSAC and peer review

- **NP program has the expertise and experience in operating facilities and developing technologies that are relevant to the production of stable and radioactive isotopes. Transfer will allow the strengthening of synergy between the two communities and opportunities for new collaborations.**

- **Ultimate responsibility of the Isotope Program resides with NE until there is an Appropriation, but indications the program will transfer are positive.**

- **NP is working closely with NE, isotope stakeholders (federal agencies, industry, researchers) in anticipation of the transfer.**

- **NP has played the lead in setting up a federal DOE/NIH working Group to address issues of mutual concern and interest. (DOE BER, DOE NP and NIH)**

- **Workshop held August 5-7, 2008.**
  - The Nation's Needs for Isotopes: Present and Future
  - Assembled representative stakeholders- federal, research, industrial

- **Charged NSAC to prioritize research isotopes and develop long-term strategic plan**

- **Re-organized federal and community structure for isotope production**

Challenges

- Transfer of the Isotope Program is an exciting opportunity
- Build synergy between basic research programs and isotope development and Production – dedicated research isotope production and development program
- Define new and effective mechanisms of communication between Program and stakeholders
- Define core group of scientists and engineers needed to support program
- Define new pricing policy for research isotopes – will take several years

- Program is strained and underfunded
  - Cannot meet growing demands
  - Facilities require investment for robust operations
  - Staffing levels are inadequate

- Setting priorities is a necessity
- Developing a strategic plan in the context of broad needs vs those specific to a particular interest group is a necessity; must consider available funds
- Optimum use of existing resources is a necessity
- Exploring partnerships with other federal agencies, universities and commercial entities to leverage investments

FY 2009 Committee Mark

- The Committee provides $512,080,080 for Nuclear Physics, $2,000,080 above the President's Request. Within the available funds, the Committee recommends $24,900,000 for the Isotope Production and Applications program. The Committee recommends $5,000,000 within the available funds for the Research Isotope Development and Production Subprogram to develop and implement a research and production strategy consistent with the National Academy of Science study entitled ''State of the Science of Nuclear Medicine.''
  - Recommended level of support for the Isotope Program necessitates almost $3,000,000 of funding transferred from base NP program.
    - Will result in reduction of research initiatives by 30-45 FTEs.
    - Mitigation by stimulus funding is a possibility
  - Recommended level of support for the research isotopes is $2,000,000 above President's Request (covered with increase in bottom line), and other $3,000,000 can be distributed within Isotope Program.

The Secretary's Overarching Criteria to Guide the Budget

Secretary's Criteria for Areas of Research and Investment Focus

THRESHOLD CRITERIA: What is the benefit and does it advance DOE goals?

- Significant impact on economic prosperity, GHG emissions, and national security.
- Meaningful science—taking risks for breakthrough results
- Open to partnerships with other programs, industry, and/or international partners

1. Is the proposed spending likely to have transformative impacts?

- Create jobs
- Avoid GHG emissions
- Decrease oil imports

2. How close are we to technology innovation, demonstration, and deployment?

- Near term: Less than 5 years
- Mid-term: 5-15 years
- Long-term: 15+ years

3. Are we making the appropriate risk/benefit analysis?

- Transformational solutions are generally higher risk than incremental improvements
- Are we searching for solutions that will have significant (material) impact?
- Will (or could) the solution be cost-effective?

Goals and Targets to Direct FY2010 Budget and Stimulus
DOE's Priorities and Goal

Priority : Science and Discovery: Invest in science to achieve transformational discoveries

1. Organize and focus on breakthrough science
2. Develop and nurture science and engineering talent
3. Coordinate DOE work across the department, across the government, and globally

Priority : Clean, Secure Energy: Change the landscape of energy demand and supply

1. Drive energy efficiency to decrease energy use in homes, industry and transportation
2. Develop and deploy clean, safe, low carbon energy supplies
3. Enhance DOE's application areas through collaboration with its strengths in Science

Priority : Economic Prosperity: Create millions of green jobs and increase competitiveness

1. Reduce energy demand
2. Deploy cost-effective low-carbon clean energy technologies at scale
3. Promote the development of an efficient, "smart" electricity transmission and distribution network
4. Enable responsible domestic production of oil and natural gas
5. Create a green workforce

Priority : National Security and Legacy: Maintain nuclear deterrent and prevent proliferation

1. Strengthen non-proliferation and arms control activities
2. Ensure that the U.S. weapons stockpile remains safe, secure, and reliable without nuclear testing
3. Complete legacy environmental clean-up

Priority : ***Climate Change: Position U.S. to lead on climate change policy, technology, and science***

1. Provide science and technology inputs needed for global climate negotiations
2. Develop and deploy technology solutions domestically and globally
3. Advance climate science to better understand the human impact on the global environment

Priority : Science and Discovery

Invest in science to achieve transformational discoveries

1. **Focus on transformational science**
   - Connect basic and applied sciences
   - Re-energize the national labs as centers of great science and innovation
   - Double the Office of Science budget over 6 years
   - Embrace a degree of risk-taking in research
   - Create an effective mechanism to integrate national laboratory, university, and industry activities

2. **Develop science and engineering talent**
   - Train the next generation of scientists and engineers
   - Attract and retain the most talented researchers

3. **Collaborate universally**
   - Partner globally
   - Support the developing world
   - Build research networks across departments, government, nation and the globe

American Recovery and Reinvestment Act

Categories of Support in the Office of Science

- **Facility Construction** - Funds accelerate completion of a number of ongoing construction projects for major scientific user facilities, major items of equipment for those facilities, and laboratory infrastructure. General Plant Projects (GPP) update laboratory infrastructure and establish new laboratory research space, renovate existing laboratory space, demolish inadequate facilities, and improve utility systems across SC labs.
- **Facility Operations/Infrastructure** - Funds increase operations, experimental support, and infrastructure improvements at scientific user facilities across SC.
- **Research** - Funds support selected research programs across SC and are chosen to minimize out-year mortgages. Energy Frontier Research Centers are included.
- **Computing** - Funds support advanced networking; mid-range distributed computing; and computation partnerships in areas important to DOE energy missions.
- **Fellowships** - A program to support graduate students and early career scientists was proposed by SC and is under discussion within DOE.

American Recovery and Reinvestment Act
Projects Proposed by Nuclear Physics

NP Proposed Projects:

- Support the NP mission of fundamental and applied nuclear science
- Create or retain jobs (~375 jobs created)
- Reduce cost and schedule risk of construction projects and MIEs
- Enhance the capabilities of National User Facilities
- Augment computing capabilities for theoretical calculations on the lattice
- Enhance the Isotopes Program
- Provide research and training opportunities for junior researchers and researchers in skill areas that are short supply
- Minimize out year mortgages

New Initiatives

Proposed to use ARRA funds for new initiatives to advance basic and applied science for the nuclear physics program.

Research Isotope Production and Development Initiatives

- Utilizes some funds from research initiative and stimulus funding for alternative production techniques projects
- Dedicated to the production and development of stable and radioactive research isotopes important for the Nation
- Possible long-term benefits of these initiatives include:
  - Re-establishment of domestic production capability of stable isotopes
  - Develop alternative production techniques for critical isotopes at both labs and universities
  - Increase portfolio of production facilities to include universities

Applications of Nuclear Science and Technology Initiatives

- Developing technology and scientific approaches of relevance to applications is a strength of the NP program.
- Completely dependent on stimulus funding; Exploit basic nuclear science research and technological of relevance to applications.
- Focus on practical technologies for applications such as nuclear energy, nuclear medicine, advanced accelerator and instrumentation techniques, and nuclear security.

STAR Heavy Flavor Tracker (HFT)

STAR Heavy Flavor/Integrated Tracker (TPC ~ $11 - $15 M)
CD-0 in February 2009
Proposed start in FY10

- Combines two previous tracker proposals into single device
- Extend STAR's capability to measure heavy flavor production important for heavy ion and spin program; brings high precision tracking/vertexing capabilities to STAR (<10μm)
- Heavy quark production important for characterization of dense medium
- NSAC HI Subpanel; LRP

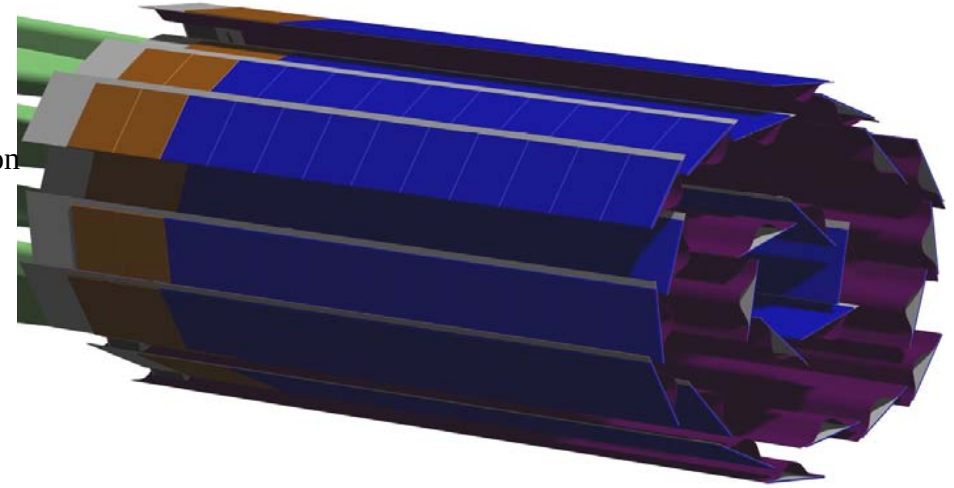
Project deliverables:

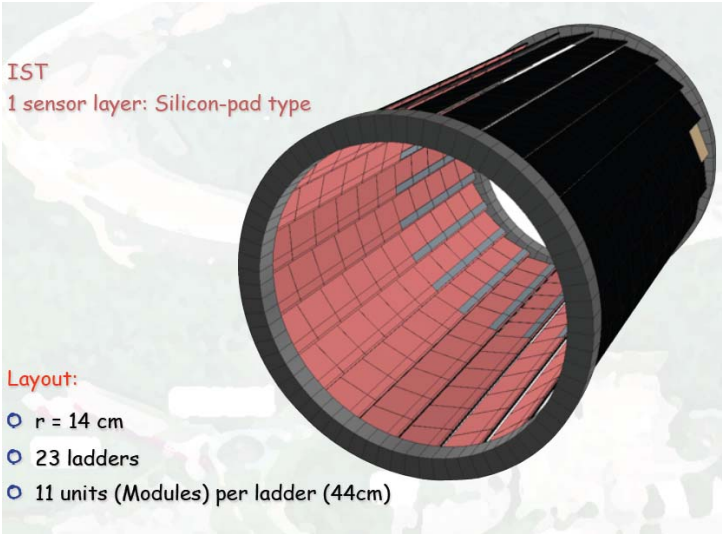
- PXL: 2 layers of silicon active pixel sensors;
- IST: 1 layer of single-sided silicon strip/pad detectors

Science:

- Open charm measurements
- Thermalization
- Heavy quark energy loss and flow

PXL:
2 layers of 30x30 μm pixels at 2.5 and 8 cm radius





Rare Isotope Beam (RIB) Research Opportunities

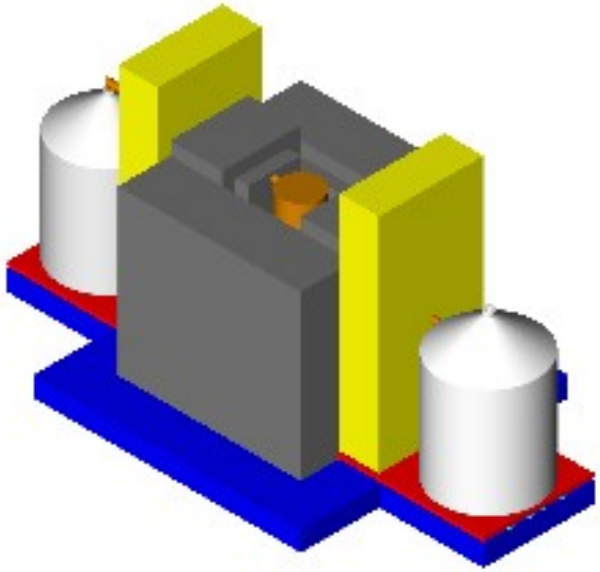
Multiple MIEs

CD-0 in February 2009

- Initiative to keep U.S. researchers at the forefront of rare isotope beam (RIB) research and prepare for FRIB
- Total of $50 million in out-years for investments in research capabilities (accelerator, instrumentation, research) at leading rare isotope beam facilities around the world
- 24 proposals received in FY09; preparing for peer review
- Expect multiple MIEs for accelerator/beamline components, ion sources, targets, and experimental instrumentation

Neutrino-less Double Beta Decay (DBD)
Majorana R&D

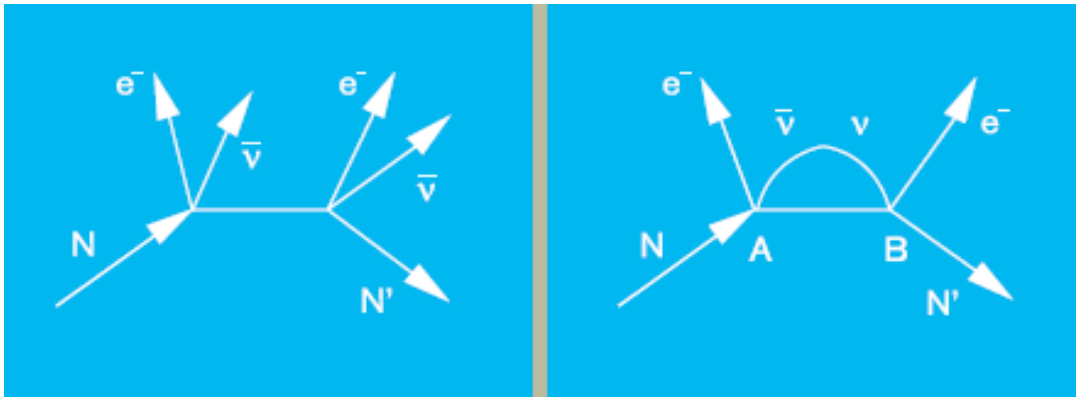
Majorana Demonstrator
CD-0 for DBD in November 2005



- U.S. lead effort, located in a deep underground mine
- Active material: enriched ^{76}Ge
- Cryogenic
- LRP, NSAC milestones, NuSAG, SC 20 yr; APS neutrino study
- NUSAG identified 3 of 5 experiments as highest priority for funding; used phased approach for project implementation
- One of alternatives for DBD experiment
- Collaboration has become international- U.S. and Germans will merge after a technology choice
- R&D is pursued for feasibility studies

Science:

- Observation of neutrinoless double beta decay establishes lepton number violation
- Neutrino-less double beta decay measures absolute value of neutrino mass and is the only process feasible for determining whether the neutrino is its own antiparticle



FY 2008/2009 Program Management Activities

DOE/NSF Nuclear Science Advisory Committee (NSAC)
- NSAC completed Performance Measures Report
- Subcommittee on Isotopes

National Academies of Science
- Decadal Study to start in FY 2010

DOE Reviews
- Site Selection for FRIB
- Heavy Ion Laboratory Research Review (Theory is planned for FY 2009)
- Annual Science and Technology (S&T) Reviews of the four NP User Facilities; isotope facilities
- Long list of project reviews

OSTP Working Groups
- Physics of the Universe
- Large Scale Science

OECD
- Global Science Working Group on Nuclear Physics (WGNP) - report completed. Organizing panel of funding agency representatives
- Global Science Working Group on Astroparticle Physics – will participate

FY 2008/2009 Program Management Activities (cont.)

Federal Working Groups

- Established DOE/NIH on nuclear medicine
- Organized DOE Working Group on Mo-99
- Now organizing federal stakeholders on Helium-3

Exascale Computing Workshop

- Sponsored by ASCR and NP; held January 26-28, 2009
- Charge was to explore the opportunities for exploiting computing at the exascale to address forefront nuclear physics
- Included nuclear theorists active in all areas of study, accelerator physicists, computer scientists, others
- Report expected in the near future

Office of Nuclear Physics