U.S. DEPARTMENT OF ENERGY

Office of Nuclear Physics Program Update

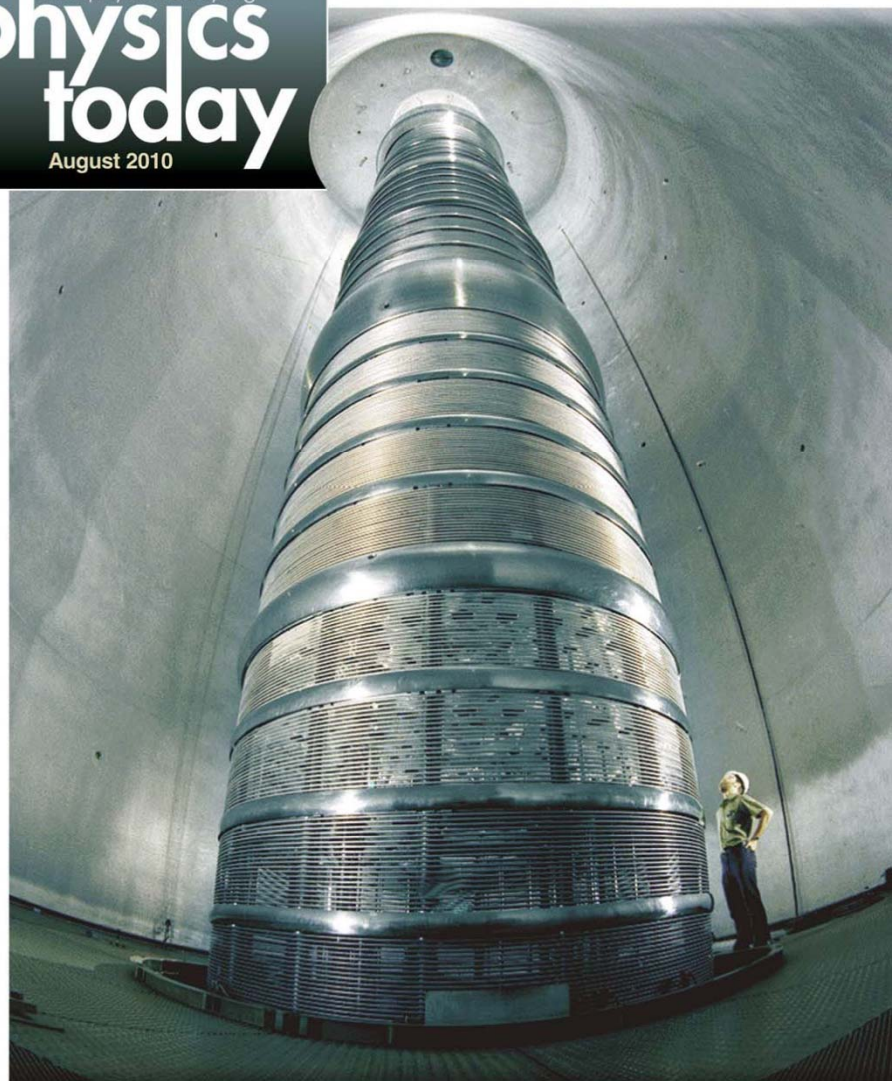
DOE/NSF Nuclear Science Advisory Committee Meeting
July 30, 2010

Timothy J. Hallman
Associate Director for Nuclear Physics
Office of Science, U.S. Department of Energy

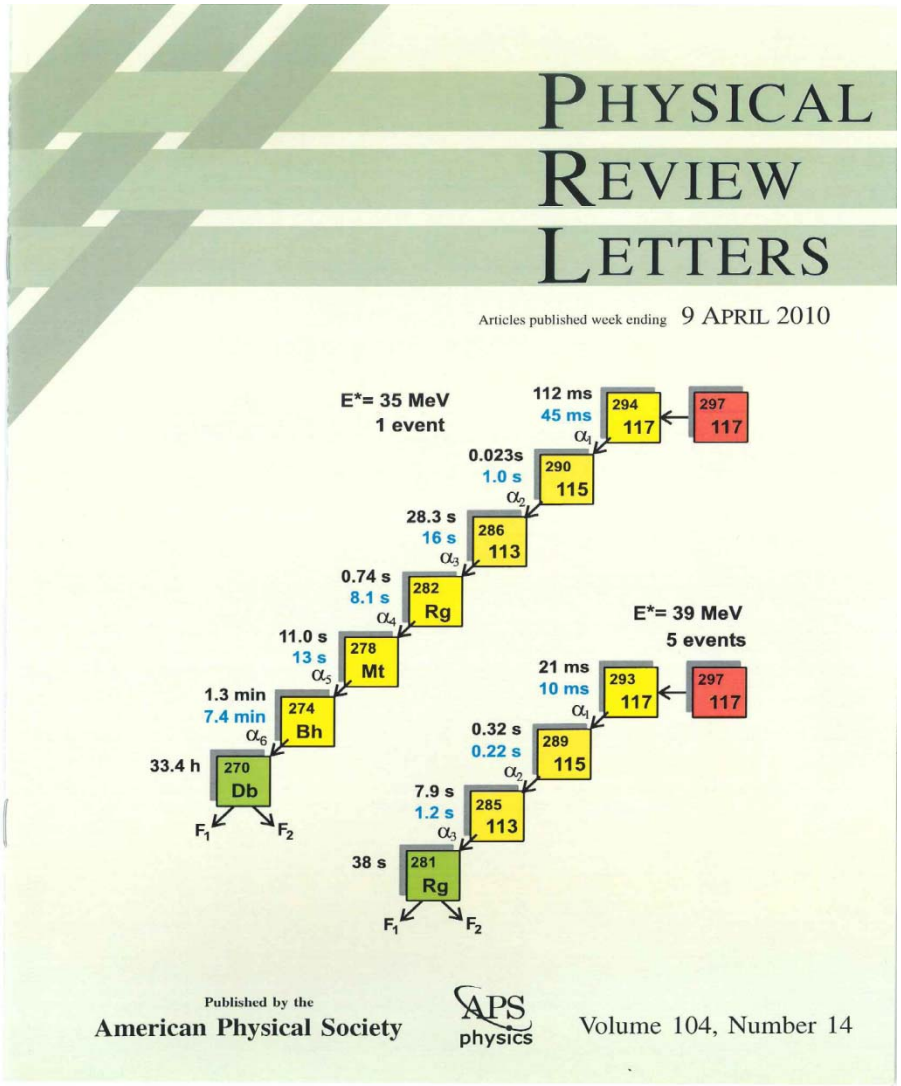
Outline

- Program News
- FY2011 Congressional Markup
- Future Challenges
- Office of Nuclear Physics News

Headlines from Oak Ridge National Laboratory

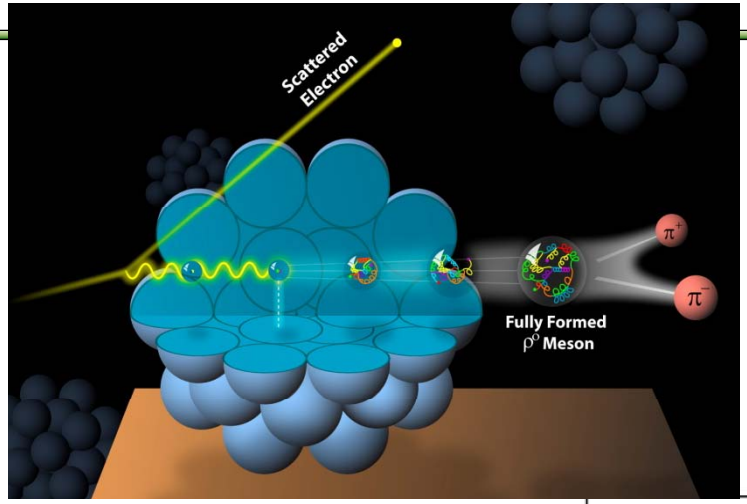


Doubly magic shell game (Sn 132)

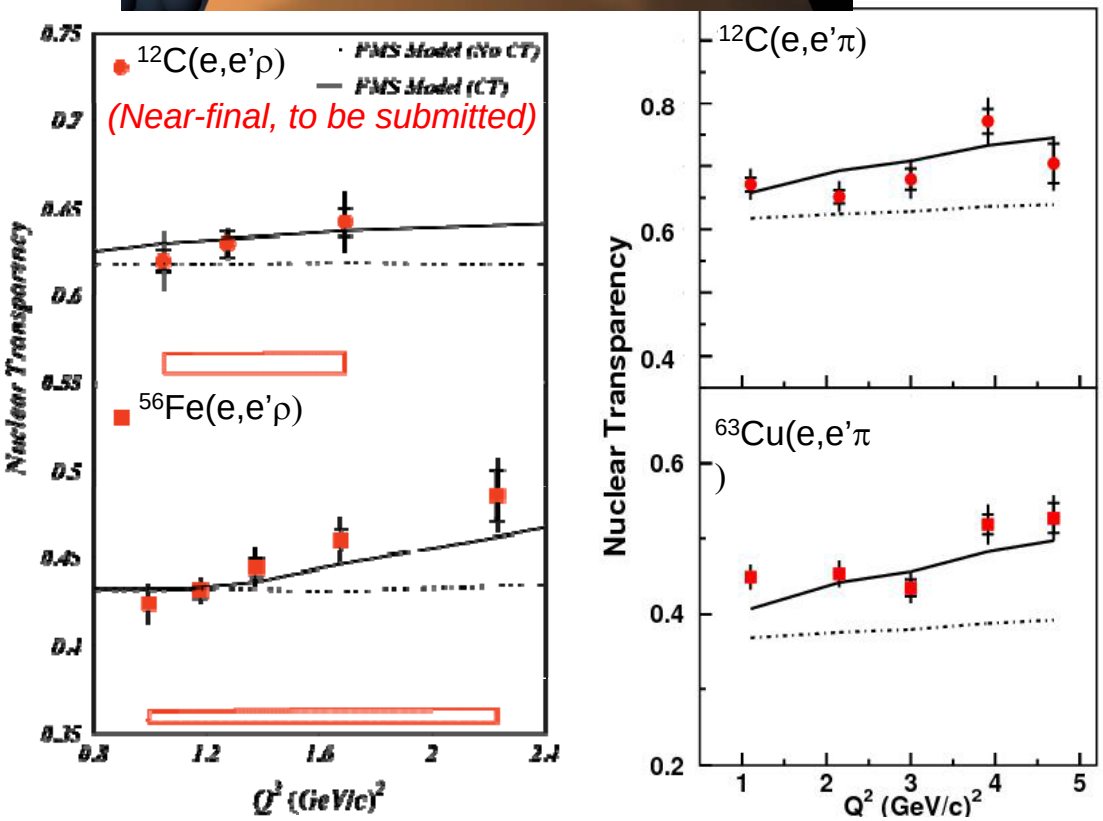


Discovery of element 117

Conclusive evidence at TJNAF for the onset of Color Transparency



Color Transparency refers to the *vanishing* of the strong hadron-nucleus interactions for sufficiently fast hadrons. The energy scale where *the nuclear medium becomes more transparent* due to this phenomenon has now been conclusively determined.



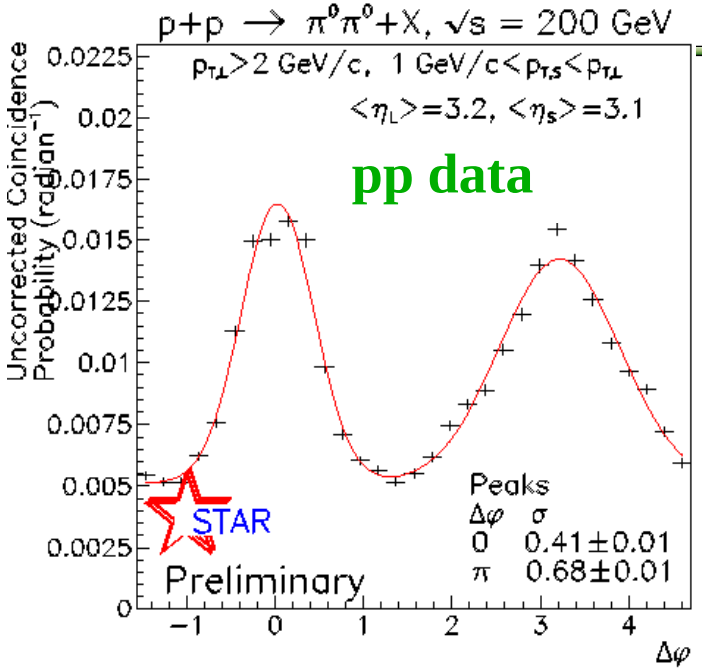
FMS: Frankfurt, Miller and Strikman, Phys. Rev., C78: 015208, 2008

- CLAS E02-110 directly produced ρ -mesons from highly-energetic photons, and observed the nuclear medium to become more transparent at higher space-time resolution (Q^2) of the photon. *(to be submitted)*

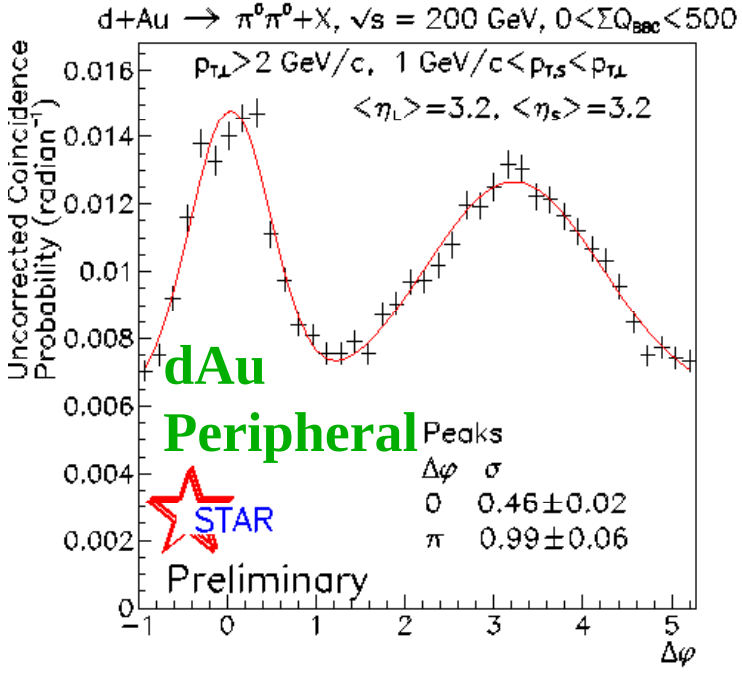
- The energy scale found is consistent and confirms the findings of a companion Hall C E01-107 experiment, that produced π-mesons rather than ρ-mesons.

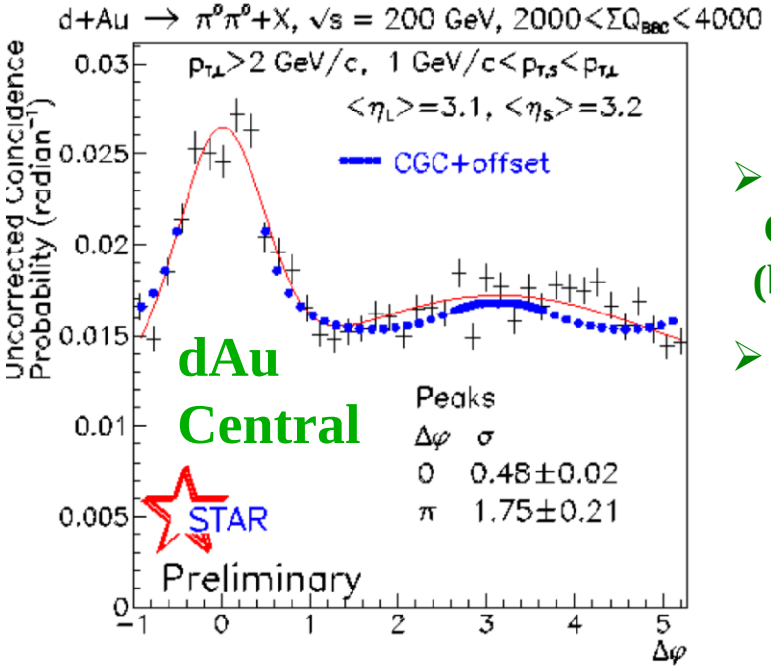
(X. Qian et al., PRC81:055209 (2010),
B. Clasie et al, PRL99:242502 (2007))

Evidence for Saturated Gluon Densities in QCD Matter at RHIC



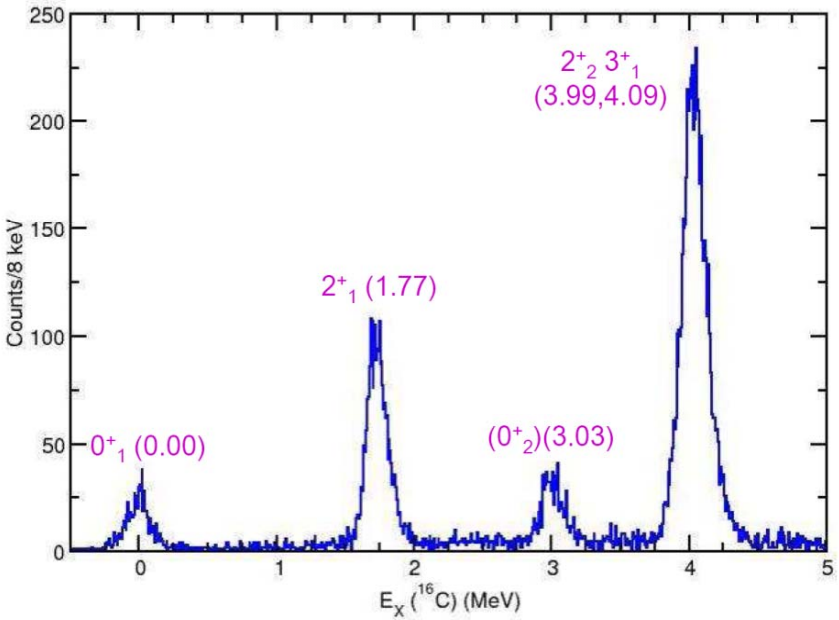
- A unique predicted property of cold QCD matter is the saturation of gluon densities at very low Bjorken x, from balance between gluon splitting and recombination.
- Suitably low x may be accessed in forward hadron production in d+Au collisions at RHIC.
- New results for forward ππ correlations show clear suppression (vis-à-vis pp) of away-side jet peak in central dAu, where inter'n with coherent gluon field in nucleus should ⇒ "mono-jets".

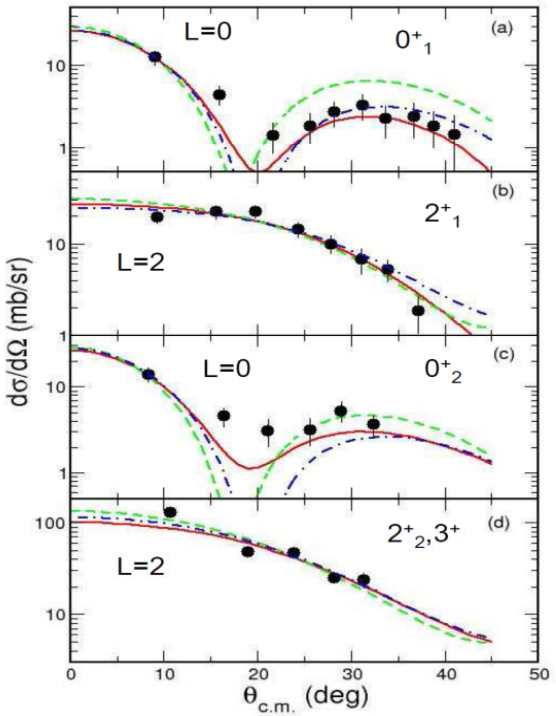




- Results consist-ent with Color Glass Condensate (beforehand) predictions
- Nuclear gluon densities could be quantitatively characterized @ EIC.

Shell Structure of Neutron-Rich Nuclei at ATLAS





^{15}C(d,p)^{16}C in inverse kinematics with HELIOS

A. Wuosmaa et al., Western Michigan, Manchester, ANL collaboration

^{15}C beam produced with in-flight method ($2 \times 10^6 s^{-1}$)

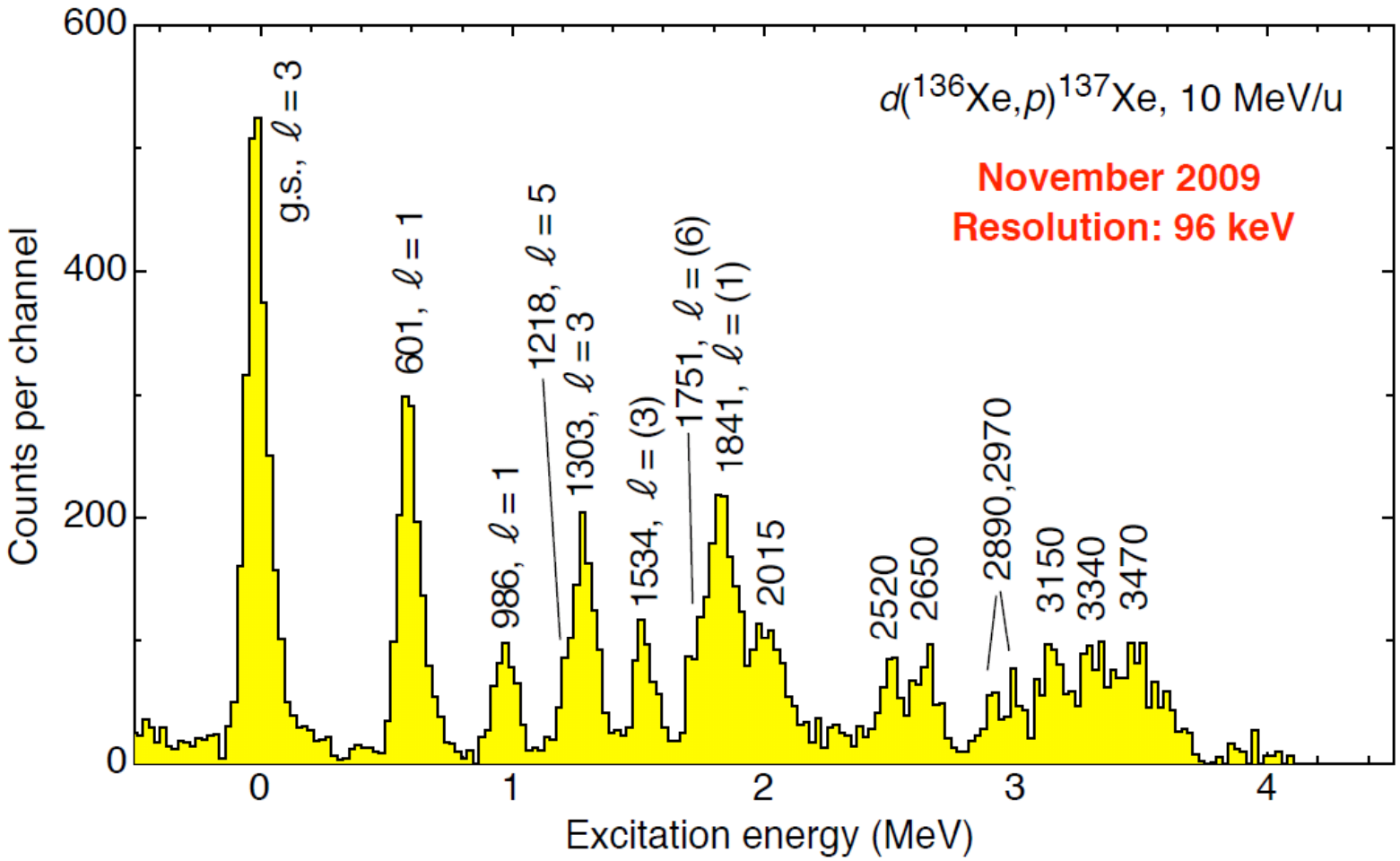
Are the motions of the protons and neutrons decoupled in ^{16}C?

Curves are DWBA calculations with various optical-model potentials.

Extraction of spectroscopic factors, wave functions and $\nu(sd)^2$ matrix elements achieved.

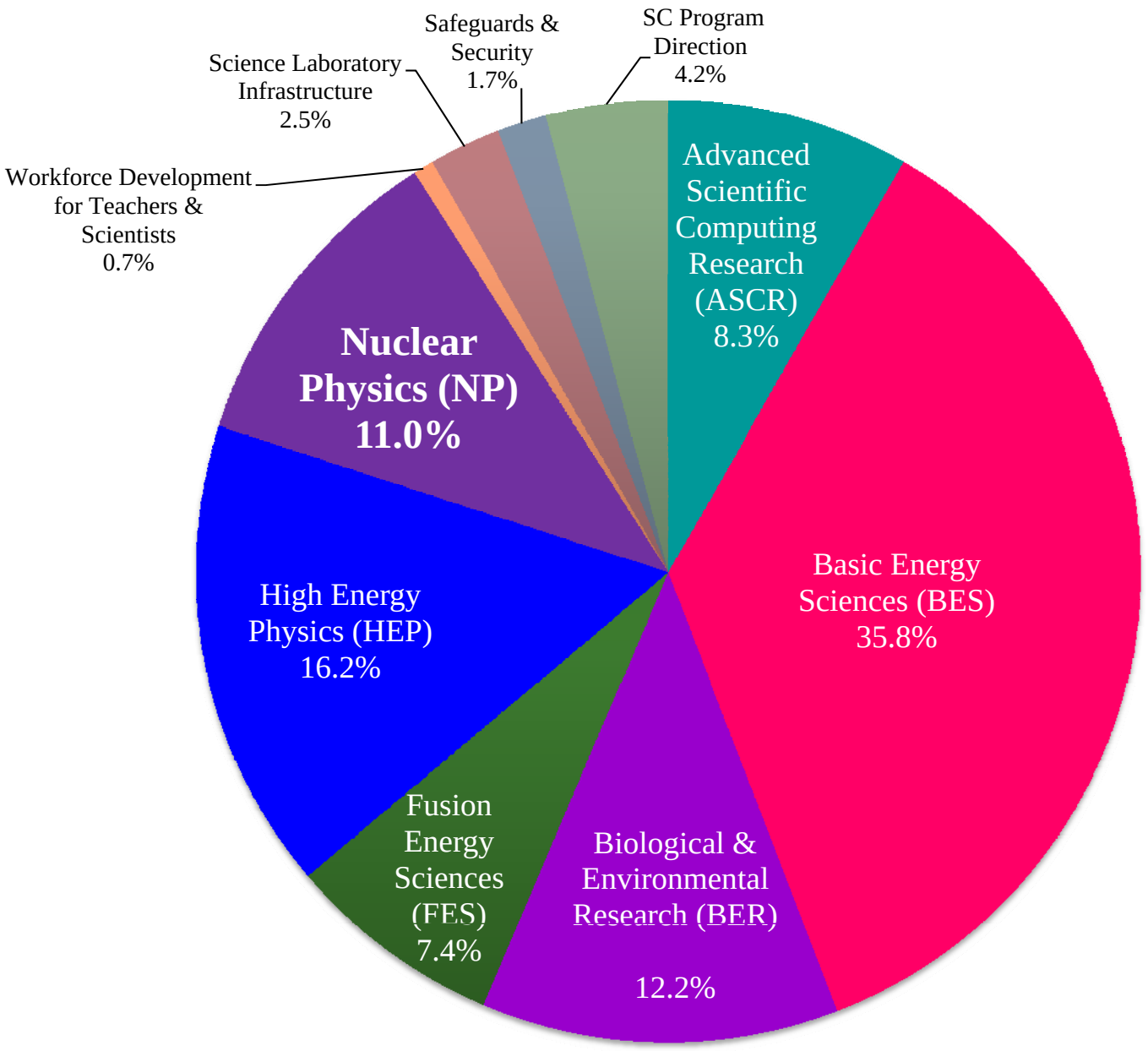
A. Wuosmaa et al., PRL submitted

Shell Structure near ^{132}Sn: preparing for CARIBU



- **Shell structure near N=82**
- **Next up with CARIBU: ^{134}Te and ^{132}Sn**
- **Also impact of octupole correlations in heavier Xe (A>140) nuclei**

Office of Science Programs
FY 2011 Congressional Request



FY 2011 Funding ($K)
Total = $5,121,437

ASCR, $426,000
BES, $1,835,000
BER, $626,900
FES, $380,000
HEP, $829,000
NP, $562,000
WDTS, $35,600
SLI, $126,000
S&S, $86,500
SCPD, $214,437

Nuclear Physics
FY 2011 Congressional Request

	FY 2009 Approp.	FY2009 ARRA	FY 2010 Approp.	FY 2011 Request	FY11 Request vs. FY10 Approp. $	FY11 Request vs. FY10 Approp. %
Medium Energy Nuclear Physics	116,873	+15,390	127,590	129,610	+2,020	+1.6%
Heavy Ion Nuclear Physics	194,957	+12,669	212,000	218,435	+6,435	+3.0%
Low Energy Nuclear Physics	94,880	+29,667	114,636	113,466	-1,170	-1.0%
Nuclear Theory	37,776	+17,237	41,574	44,709	+3,135	+7.5%
Isotope Program	24,760	+14,837	19,200	19,780	+580	+3.0%
Subtotal, Nuclear Physics	469,246	+89,800	515,000	526,000	+11,000	+2.1%
Construction	31,061	+65,000	20,000	36,000	+16,000	+80.0%
Total, Nuclear Physics *	**500,307**	**+154,800**	**535,000**	**562,000**	**+27,000**	**+5.0%**

* SBIR/STTR for FY 2009 was $11,773k. Comparable NP total w/SBIR/STTR in FY 2009 is $512,080k.

SC:

House Mark: $4,900 million ($221 million below President's Request)

Senate Mark : $5,012 million ($109 million below President's Request)

Direction given in the Senate language

NUCLEAR PHYSICS

The Committee recommends $554,000,000 for Nuclear Physics. A recent National Academy of Sciences report, Advancing Nuclear Medicine through Innovation, recommended increasing the Federal commitment to nuclear medicine research. Nuclear medicine could substantially accelerate, simplify, and reduce the cost of delivering and improving healthcare. However, the Committee is concerned that the Department is not using funds to directly support nuclear medicine research with human application. To this end, within the funds provided, $15,400,000 is for nuclear medicine research with human application. All of the added funds must be awarded competitively in one or more solicitations that include all sources—universities, the private sector, and Government laboratories—on an equal basis. Funding for nuclear medicine application research was previously within the Biological and Environmental Research program.

FY 2011 Congressional Request Highlights

TOTAL INCREASE FOR NUCLEAR PHYSICS	$27,000
• **12 GeV Upgrade** – per planned construction profile	+ 16,000
• **Research** at national laboratories and universities essentially maintains constant effort across the program; slow build-up of user community for new experimental Hall D at CEBAF; supports data collection at RHIC with STAR and PHENIX, and research at LHC; addresses critical staff shortages at low energy facilities; and provides an increase for topical theory collaborations and for the National Nuclear Data Center.	+ 9,302
• **Majorana Demonstrator R&D ramps up** – effort to demonstrate proof-of-principle for neutrino-less double beta decay, initiated in FY 2010; according to project profile	+ 1,700
• **Scientific user facilities** - operate near optimal levels RHIC - 3,720 hours (91% of optimal) CEBAF - 4,090 hours (100% of maximum level with 12 GeV schedule) HRIBF - 5,200 hours – commissioning new accelerator components (85% of optimal) ATLAS - 5,900 hours – commissioning new accelerator components (89% of optimal)	+ 7,186
• **FRIB** – engineering and design initiated per Cooperative Agreement with MSU (decrease is a result of FY 2010 Congressional plus-up)	- 2,000
• **FY 2010 MIEs ramp-up:**	
• **STAR HFT** – needed for RHIC high luminosity run in FY 2013	+ 1,500
• **RIB Science Initiatives** – forefront science opportunities around the world	+ 800
• **All other MIE funding** - decreases as several projects complete or ramp-down	- 8,413
• **Other** - maintains effort in other parts of the program, including an increase for cost of living for isotope production facilities	+ 925

Implementing the recommendations of the Long Range Plan

With the completion of the 12 GeV CEBAF Upgrade, researchers will address:

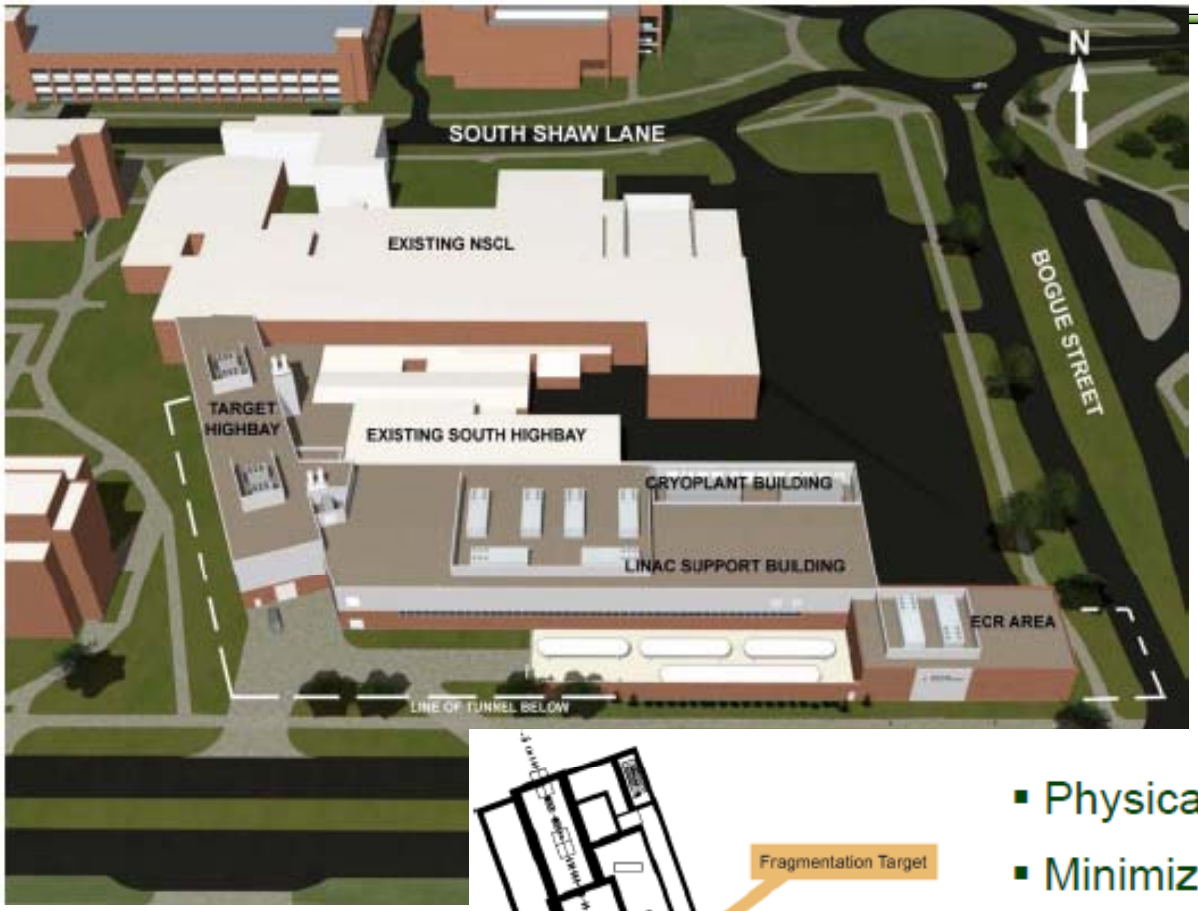
- The search for exotic mesons—a quark and an anti-quark held together by gluons, but unlike conventional mesons, the gluons are excited
- Physics beyond the Standard Model via high precision studies of parity violation
- The spin and flavor dependence of valence parton distributions—the heart of the proton, where its quantum numbers are determined
- The structure of atomic nuclei, exploring how the valence quark structure is modified in a dense nuclear medium
- Nuclear tomography to discover and explore the three-dimensional structure of the nucleon

Pouring the foundation for the Hall D complex.

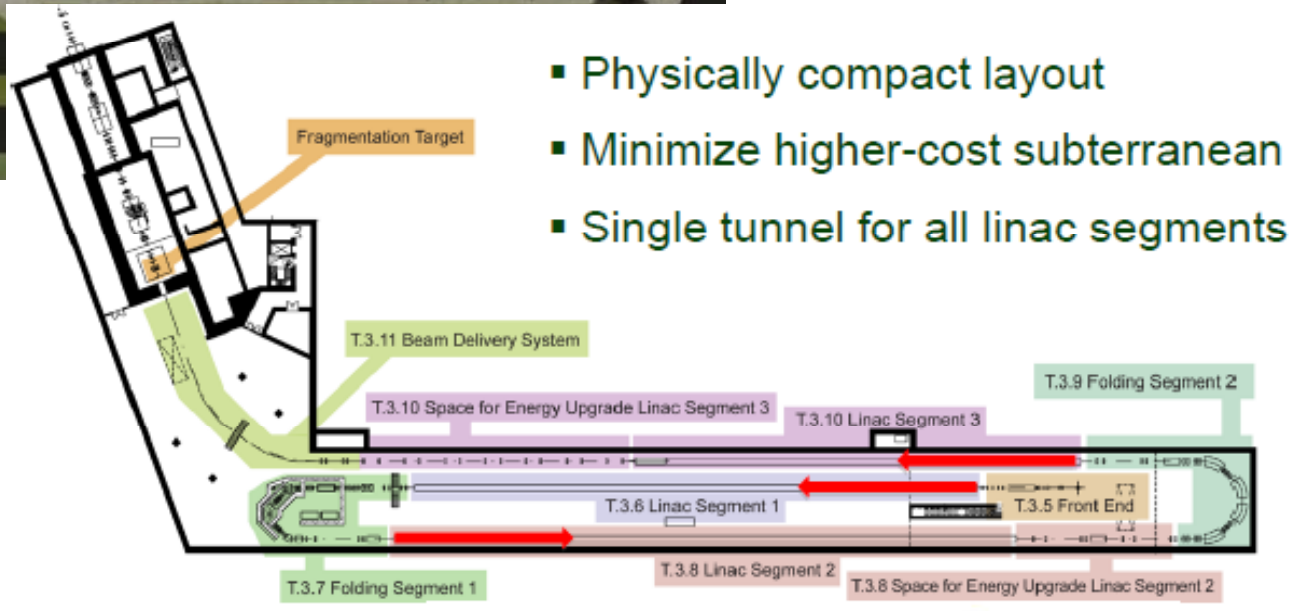
U.S. DEPARTMENT OF ENERGY

Hall D Tagger Area July 2010

Implementing the recommendations of the Long Range Plan : FRIB



Lehman review of readiness for CD1
July 27-29, 2010



- Physically compact layout
- Minimize higher-cost subterranean structures
- Single tunnel for all linac segments

Lehman CD1 Review July 27-29, 2010

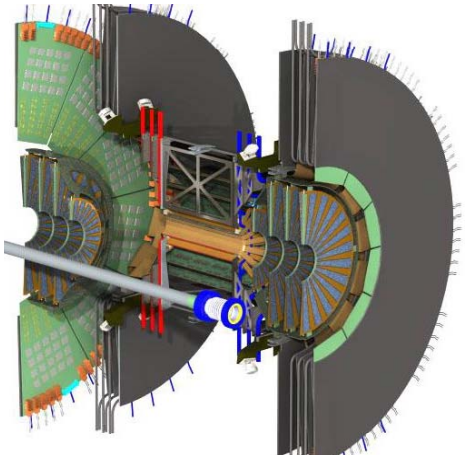
Recommendatrion:
Project is ready to request CD1 from the Acquisition Executive

Utility Relocation (MSU Contribution)

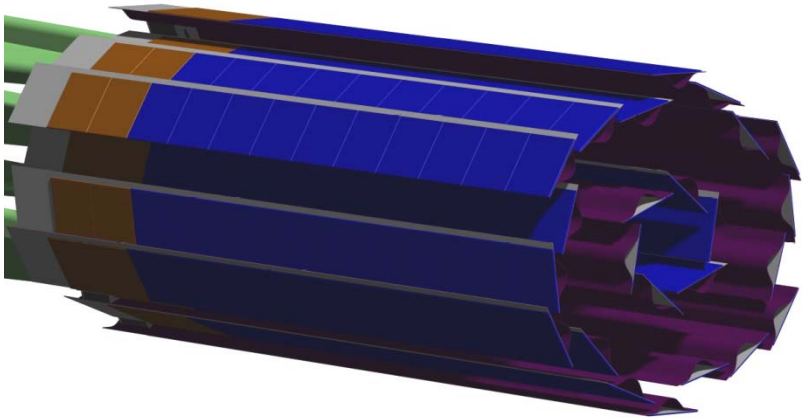
Utility Relocation (MSU Contribution)

Implementing the recommendations of the Long Range Plan

Luminosity and detector upgrades are underway for RHIC

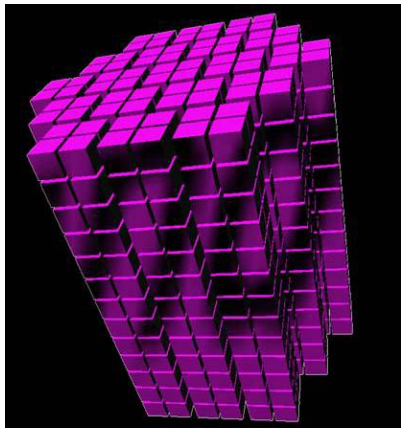


PHENIX Barrel and Forward Vertex Detector

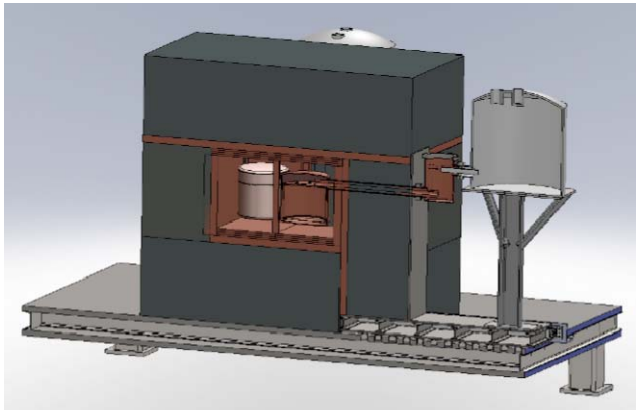


STAR Heavy Flavor Tracker

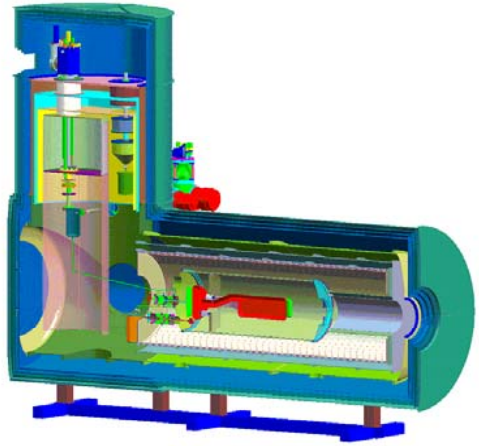
Investments in neutrons, neutrinos, and fundamental symmetries



CUORE receives CD2/3



Majorana Demonstrator Underway



R&D for nEDM

Research on Production of isotopes

Production and Developmental Research of Alpha-Emitting Isotopes

The Isotope Development and Production for Research and Applications (IDPRA) Program is committed to providing alpha-emitting radionuclides to the research community in adequate supply to support important applications development. The program currently possesses an Inventory of Th-229 recovered from legacy materials at Oak Ridge National Laboratory from which up to 550 mCi per year of the important daughter-nuclide Ac-225 can be recovered and distributed. The Office of Nuclear Physics also supports research and development into the safe, secure, and reliable production of a variety of alpha-emitting radioisotopes designated as high-priority by the Nuclear Science Advisory Committee on Isotopes.

Project Title	Institution	Project Description
Production of Thorium-229 in a Proton Accelerator	Oak Ridge National Laboratory	Investigate production of Thorium-229 (parent of Ac-225 and Bi-213) using low energy proton reactions on Th-230 and Th-232 targets
Production of Actinium-225	Los Alamos National Laboratory	Investigate the direct production of Ac-225 on Th-232 targets using 100 MeV, 200 MeV and 800 MeV protons
Production of Actinium-225 via High Energy Proton Induced Spallation of Thorium-232	NorthStar Medical Radioisotopes LLC Fermi National Accelerator Laboratory Argonne National Laboratory	Investigate direct production of Ac-225 using high energy (400 Mev and 8 GeV) proton spallation reactions on Th-232 targets
Production of Astatine-211 for U.S. Investigators	University of Washington	Optimize the production and recovery of At-211 using low energy alpha-particle irradiation of natural bismuth targets with dry distillation recovery of the gaseous product
Ionic Liquids as Solvents for Improved Production of Radioisotopes	Oak Ridge National Laboratory	Develop and test novel ionic-liquid solvents for separation of alpha-emitting radionuclides for isotope production applications and for alpha-emitting radionuclide generator systems
Production of Radium-223 and Thorium-227 from Legacy Actinium-227 at PNNL	Pacific Northwest National Laboratory	Investigate the recovery of Ac-227 from DOE legacy materials and develop novel generator concepts to recover Ra-223 and Th-227 for medical applications
Radioisotope Production at UC Davis	University of California	Optimize production of a variety of high priority radioisotopes, one of which is At-211 produced by low energy alpha particle irradiation of bismuth targets

Additional Program News

NSAC Committee of Visitors January 6-10, 2010

- **Responses discussed in NP**
- **Draft provided to Deputy for Science Programs for comment**
- **Expect formal submission to SC in about a week**

- **Implementation has been in progress: SBIR/STTR awardees information exchange meeting, Sept 13-14, 2010 Gaithersburg, Hilton**

Early Career Research Award Solicitation is out

- **Pre-Application deadline: August 13, 2010**
- **Full proposal due by November 9, 2010**

U.S. DEPARTMENT OF ENERGY

Outlook

At Present:

- Nuclear science continues to deliver discovery science and forefront advances in technology
- New opportunities for ground breaking research are being addressed
- Support for training and advancement of the next generation of scientists is increasing
- National needs for production and R&D on rare isotopes for research, medicine and national security are being addressed
- New advanced research tools that will provide new capability and maintain US leadership are being constructed

In the out-years:

- The United States continues to faces a number of challenges
- Actions which address national priorities directly affect the Office of Science and NP
- It is essential to continue to articulate the relevance and value of nuclear science research to national priorities
- As in the past, to insure continued vitality and balance in the field, NP will work closely with the community together to prioritize the most compelling research and technical developments

Office of Nuclear Physics