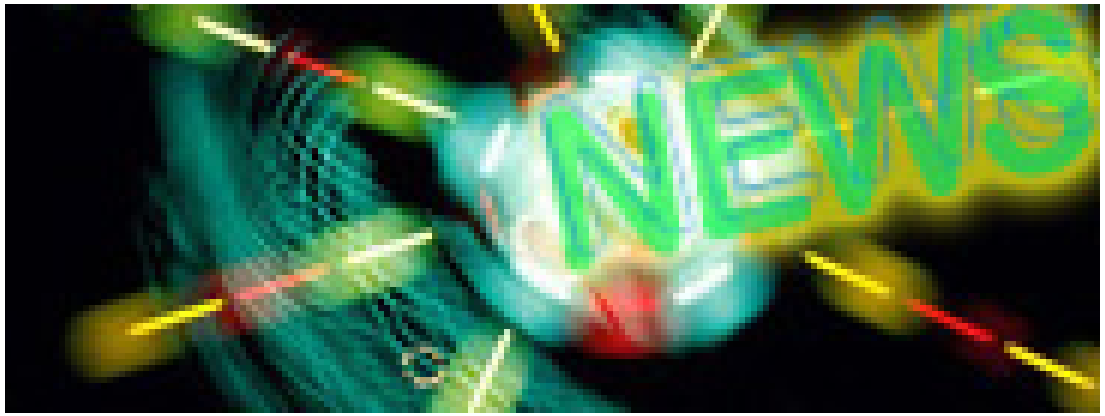
National Science Foundation

WHERE DISCOVERIES BEGIN

Ani Aprahamian



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Research Highlights - Examples

NSF - External Home page

http://www.nsf.gov/

NSF - Mathematical and Physics Sciences Directorate

NSF - Physics Division

Budget (FY2007-2008)

New Initiatives (???)

DUSEL

MRI

DNDO

Solicitation on PetaApps: NSF 07-559

Solicitation on PFCs: NSF 07-567

Normal Grants

People - Invitation

Press Release 07-068

The Kapok Connection: Study Explains Rainforest Similarities

Research explains how ocean currents carried seeds from South America to Africa

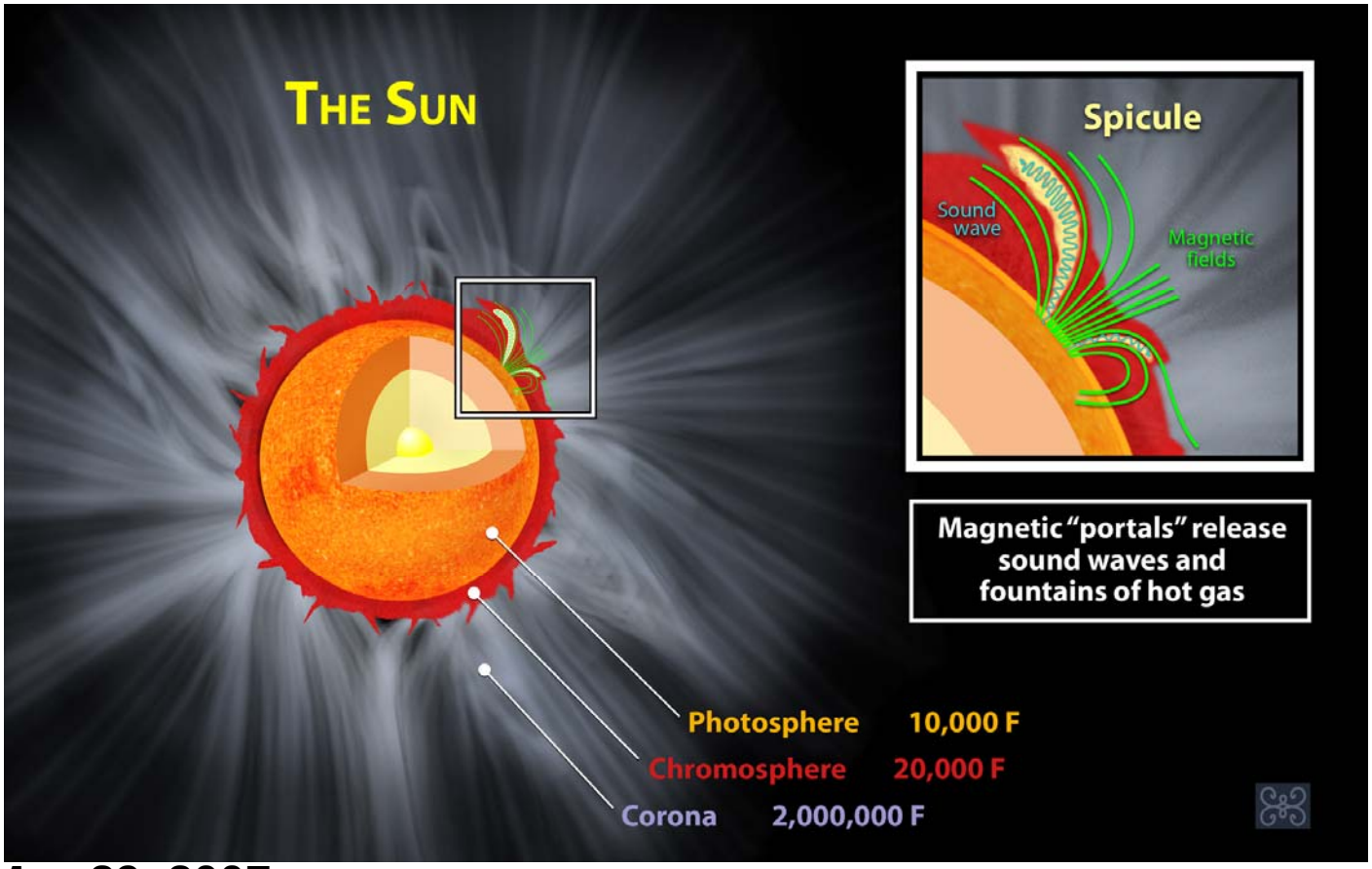
June 15, 2007

Kapok tree seeds traveled across the ocean from South America to Africa after continents split.
Credit and Larger Version

Press Release 07-060

Magnetic Field Uses Sound Waves to Ignite Sun's Ring of Fire

Research explains century-old mystery about the interior of the sun

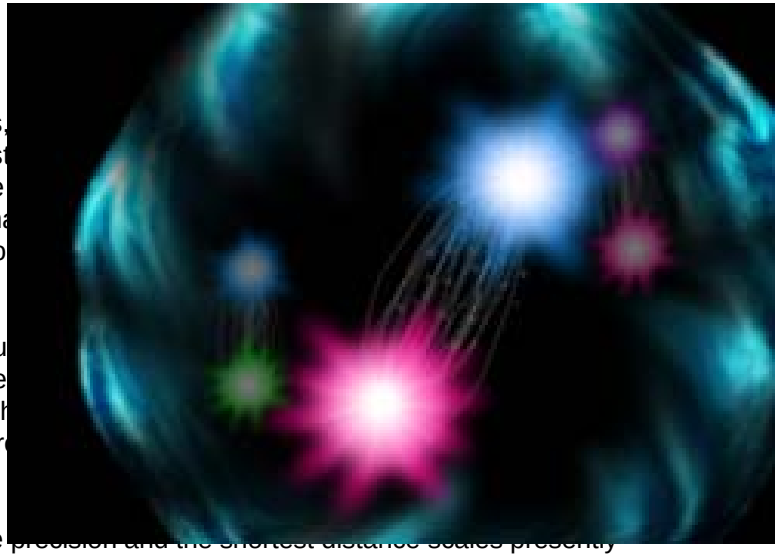


May 29, 2007

Sound waves escaping the sun's interior create fountains of hot gas that shape and power a thin region of the sun's atmosphere which appears as a ruby red "ring of fire“ around the moon during a total solar eclipse, according to research funded by the National Science Foundation (NSF) and NASA.

NSF - Mathematical and Physics Sciences Directorate

Finding the Charge In the Pion



The strong "nuclear" force is believed to be mediated by the exchange of gluons between quarks, neutrons and nuclei, which in turn account for nearly all the visible matter in the universe. The "st properties, and it is important to find relatively simple systems for which experiments can provide system is the pion - the lightest known strongly interacting particle, with about one seventh the ma pion, such as its precise mass, its lifetime (less than one microsecond), and the spatial distributio clues about the nature of the strong force.

The pion is often pictured as built from one each of the lightest quarks and anti-quarks; in fact, qu predicts that it exhibits precisely this structure in the limit of very-high-energy scattering experime these two tiny contributors, but instead from a "sea" of additional quark-antiquark pairs, along with more complex at lower energies. One important question is to determine the energy region where emerges.

Recently, determination of the pion's charge distribution has been pushed to the highest possible precision and the shortest distance scales presently accessible with modern techniques. A charge distribution is measured by observing the pattern of electrons that scatter from the desired object that is placed in front of an intense electron beam. Since pions have such a short lifetime, the experiment uses a container of hydrogen, whose nuclei (each consisting of a single proton) are continuously surrounded by a "cloud" of pions which in turn serve as the "target" for the beam.

The new results from this experiment indicate that the short-distance scale studied in this experiment is still far from the region where the simple quark-antiquark picture of the pion emerges, but the information is still useful for understanding the more complex contributions from gluons and the quark-antiquark "sea." Plans are now underway to push these measurements closer to the transition region with the planned energy upgrade at Jefferson Lab.

The experiment was carried out at the **Department of Energy's Jefferson Lab in Newport News, Virginia, by an international collaboration including groups from Canada and the Netherlands, as well as several groups supported by the NSF Nuclear Physics Program, including the University of Maryland, Hampton University, James Madison University, the College of William and Mary, and California State University - Los Angeles. The experiment constituted the Ph.D. thesis of NSF-supported graduate student Tanja Horn from the University of Maryland.**

Primary Strategic Outcome Goal:
Discovery: Foster research that will advance the frontiers of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering.
Secondary Strategic Outcome Goals:
Learning: Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.

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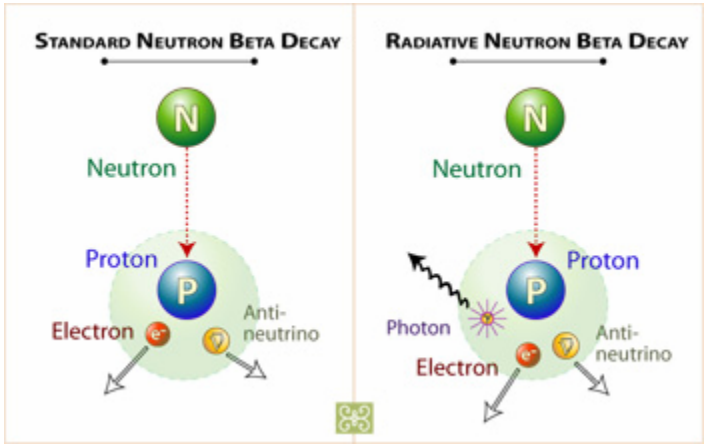
Researchers Observe Rare Light-emitting Decay of Neutrons

Neutrons -- the tiny particles that match with protons to form the innards of nearly every atom in the universe – decay when left to fend for themselves outside an atomic nucleus. For decades, researchers have predicted but never proved that roughly 1 in 1,000 of those decays will produce light in the form of an energetic photon.

Now, for the first time, researchers have caught the photons from that "radiative decay" in action. Reporting in the Dec. 21, 2006, issue of *Nature*, a team of researchers from the United States and Britain show results that may confirm neutron radiative decay.



The research was conducted by physicists at Tulane University, University of Michigan and University of Maryland (all supported by NSF) in collaboration with scientists at the National Institute of Standards and Technology Physics Laboratory and the University of Sussex in the UK.

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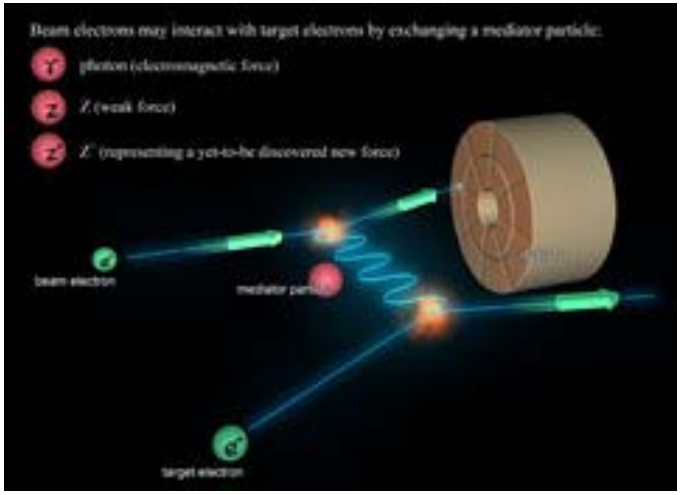
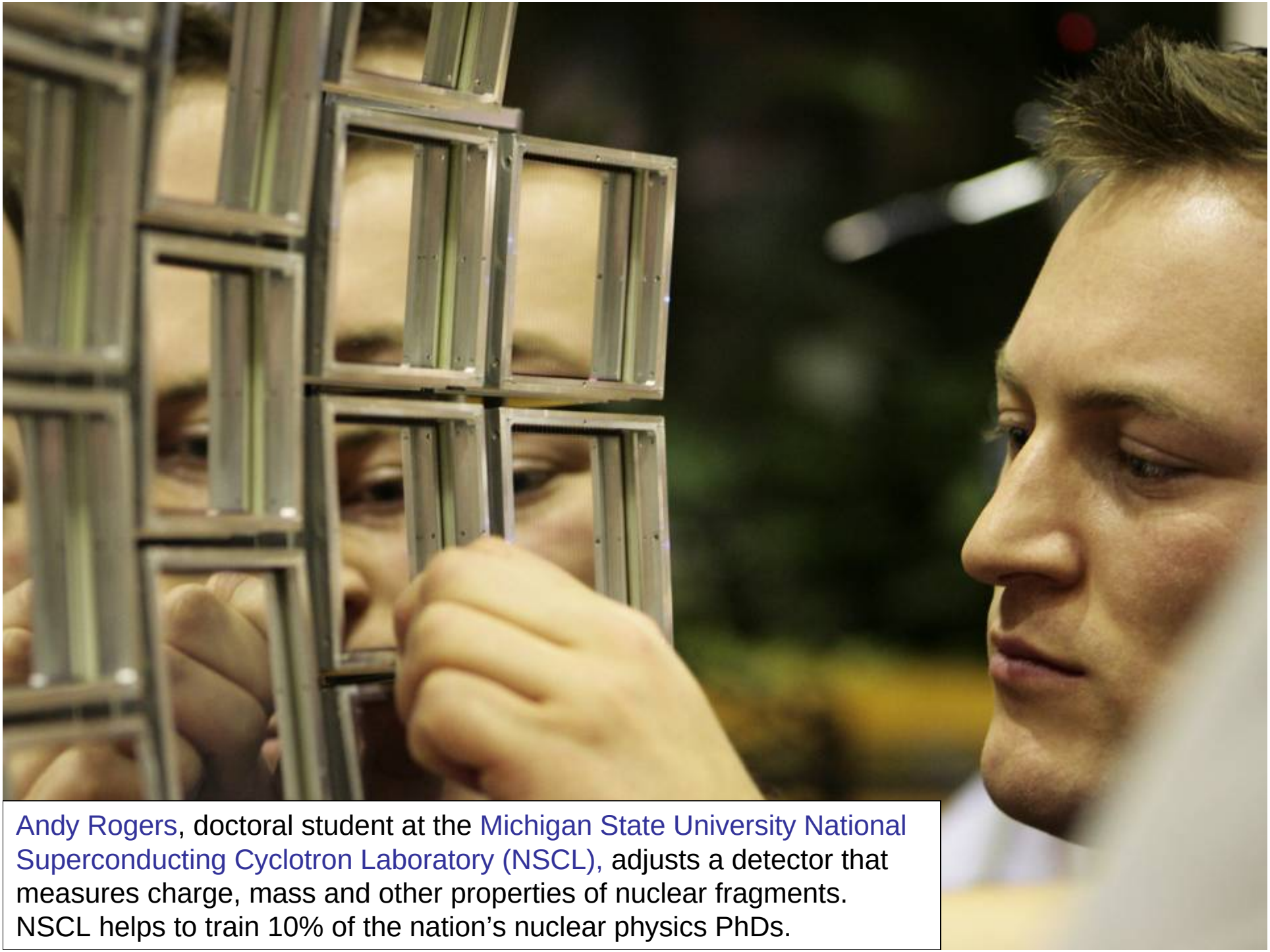
Searching for New Forces with the Electron's Weak Charge

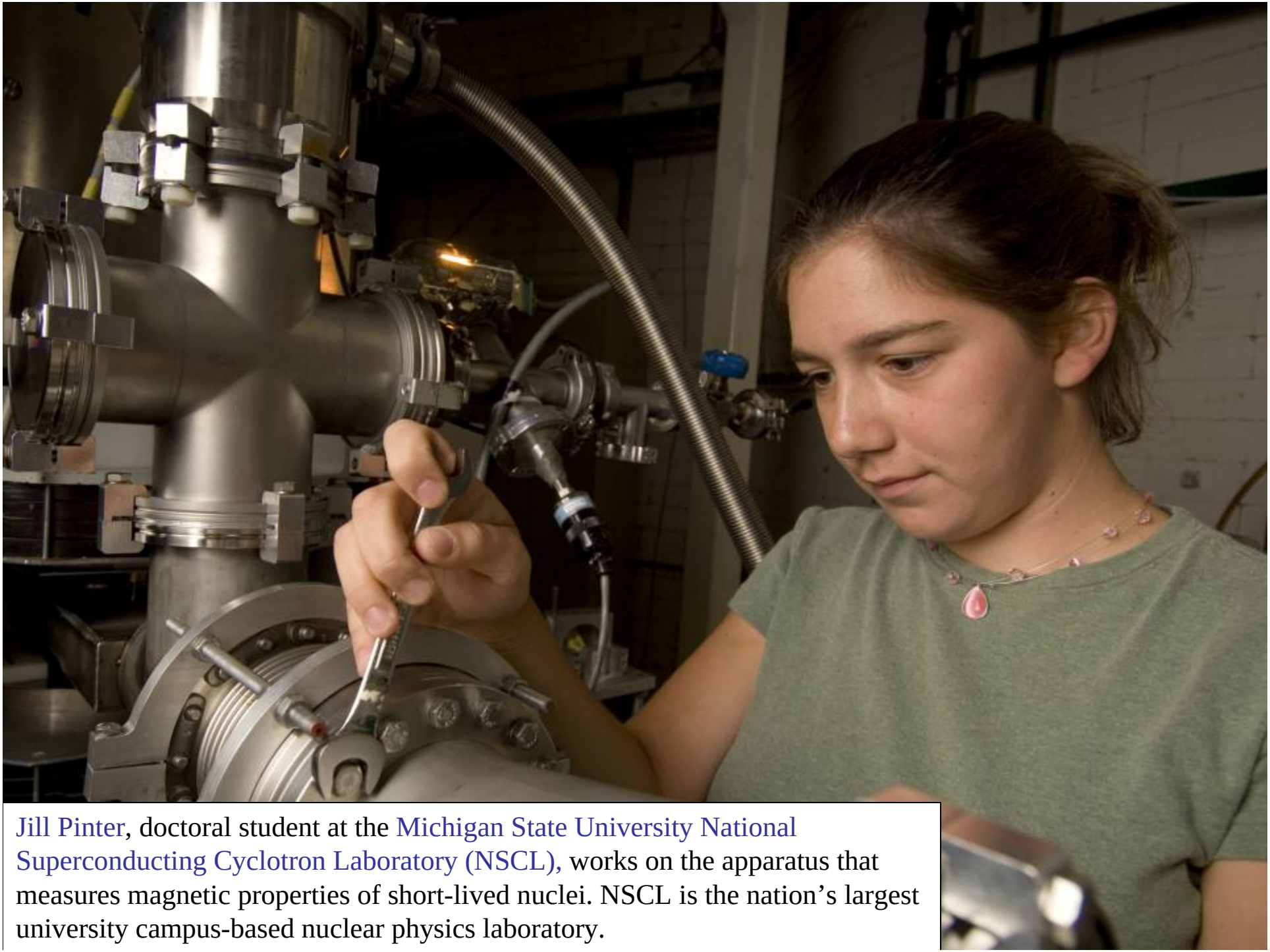


Cartoon representing how two electrons will interact by the exchange of particles. The two known forces of electromagnetism and the weak force are described by the exchange of a photon and a Z boson, respectively. This experiment searched for the exchange of possible new particles, which would represent a new force.

Permission Granted
Credit: Stanford Linear Accelerator Center

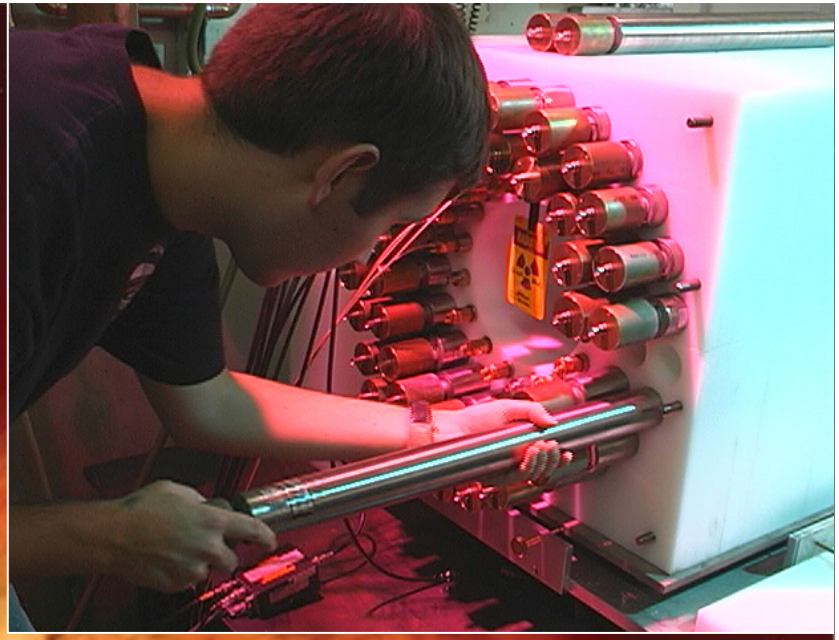


Andy Rogers, doctoral student at the Michigan State University National Superconducting Cyclotron Laboratory (NSCL), adjusts a detector that measures charge, mass and other properties of nuclear fragments. NSCL helps to train 10% of the nation's nuclear physics PhDs.

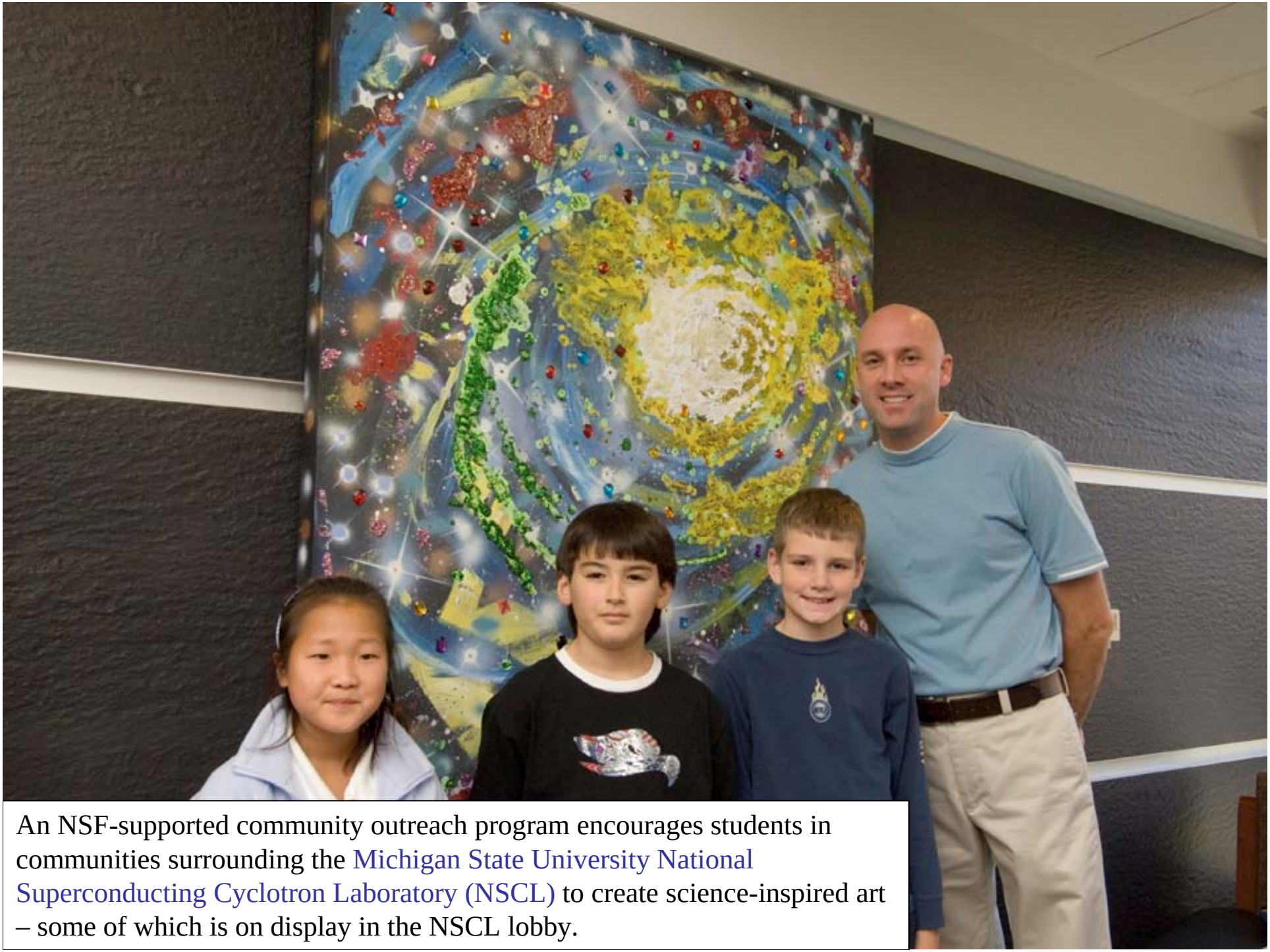


Jill Pinter, doctoral student at the Michigan State University National Superconducting Cyclotron Laboratory (NSCL), works on the apparatus that measures magnetic properties of short-lived nuclei. NSCL is the nation's largest university campus-based nuclear physics laboratory.

Chris Compton, research engineer at the Michigan State University National Superconducting Cyclotron Laboratory (NSCL), inspects prototype superconducting radio frequency cavities. NSCL is making strategic investments in next-generation accelerator technology.



Through its participation in the Joint Institute for Nuclear Astrophysics (JINA), the Michigan State University National Superconducting Cyclotron Laboratory fosters interdisciplinary work in nuclear astrophysics, including research on how elements are created in stellar explosions.



An NSF-supported community outreach program encourages students in communities surrounding the Michigan State University National Superconducting Cyclotron Laboratory (NSCL) to create science-inspired art – some of which is on display in the NSCL lobby.

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Nuclear Physics FY2007

- Physics Division: up 6+%
- NSCL operations: +$1M
- Nuclear Theory up 5%
  - Continuing to implement NSAC theory recommendations
- Nuclear Experiment flat
- Joint NSF/DOE DUSEL R&D
- **CAREER awards**
  - Silas Beane (New Hampshire)
  - Harald Griesshammer (George Washington U)
  - Manuel Calderon de la Barca Sanchez (UC Davis)

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FY2008 R&RA Budget Request ($M)

Research and Related Activities
(Dollars in Millions)

	FY 2006 Actual	FY 2007 Request	FY 2008 Request	Change over FY 2007 Request Amount	Change over FY 2007 Request Percent
Biological Sciences	$580.90	$607.85	$633.00	$25.15	4.1%
Computer and Information Science and Engineering	496.35	526.69	574.00	47.31	9.0%
Engineering	585.46	628.55	683.30	54.75	8.7%
Geosciences	703.95	744.85	792.00	47.15	6.3%
Mathematical and Physical Sciences	1,086.61	1,150.30	1,253.00	102.70	8.9%
Social, Behavioral and Economic Sciences	201.23	213.76	222.00	8.24	3.9%
Office of Cyberinfrastructure	127.14	182.42	200.00	17.58	9.6%
Office of International Science and Engineering[1]	42.61	40.61	45.00	4.39	10.8%
Office of Polar Programs	390.54	438.10	464.90	26.80	6.1%
Integrative Activities[2]	233.30	231.37	263.00	31.63	13.7%
U.S. Arctic Research Commission	1.17	1.45	1.49	0.04	2.8%
Total, Research and Related Activities	$4,449.25	$4,765.95	$5,131.69	$365.74	7.7%

Totals may not add due to rounding.

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FY2008 MPS Budget Request ($M)

Mathematical and Physical Sciences Funding

(Dollars in Millions)

	FY 2006 Actual	FY 2007 Request	FY 2008 Request	Change over FY 2007 Request Amount	Change over FY 2007 Request Percent
Astronomical Sciences	$199.75	$215.11	$232.97	$17.86	8.3%
Chemistry	180.70	191.10	210.54	19.44	10.2%
Materials Research	242.59	257.45	282.59	25.14	9.8%
Mathematical Sciences	199.52	205.74	223.47	17.73	8.6%
Physics	234.15	248.50	269.06	20.56	8.3%
Multidisciplinary Activities	29.9	32.40	34.37	1.97	6.1%
Total, MPS	$1,086.61	$1,150.30	$1,253.00	$102.70	8.9%

Totals may not add due to rounding.

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New Initiatives

Computing – PetaApps
Accelerating Discovery in Science and Engineering through petascale simulation and analysis.
Deadline: July 23,2007

DUSEL R&D – Deadlines past for this year, will repeat next year
NSF-DOE **deadline past**

MRI – **Deadlines past** and award to be announced soon.

DNDO – Panels to take place soon
NSF and DHS **deadline past**
Next year: April 2, 2008

Physics Frontier Centers

Program Solicitation

NSF 07-567 **Preliminary Proposal Due Date(s) *(required):***
August 29, 2007
Full Proposal Deadline(s)
January 30, 2008 **By Invitation Only**

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FY2008 Proposals

Target Date for Physics Division*

Wednesday September 26, 2007

* Must discuss/get permission if delayed

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NSF and DUSEL

- **#1 priority for new project start in NSF Physics Division**

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NSF People

NSF Director: Arden Bement

NSF Deputy Director: Kathie Olsen

MPS Assistant Director: Anthony Chan

Physics Division Director: Joe Dehmer

Nuclear Physics (experiment):

Bradley D. Keister

Ani Aprahamian (also PNA)

Nuclear Physics (theory):

Bradley D. Keister

Interested in joining us?

Backup Slides

NSF and DUSEL

- Well-matched to NSF mission:
  - Broad, multidisciplinary scientific program
  - New & unique opportunities for growth, diversity, interdisciplinary research
  - Intrinsically strong program for education, outreach

- DUSEL is a joint initiative within NSF between **Physics (lead), Engineering, and Geosciences**
  - Biology currently serving in advisory capacity

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Status of DUSEL Process

- Solicitation 3 (S3):
  - S3 called for proposals consisting of formal Conceptual Design Reports, project plan for design phase
  - Proposal deadline 09 January 2007
  - Open competition
  - Single site will be selected for further development, based on panel review
  - Chosen site will receive up to $5M award per year for up to three years for development of technical design
- **S3 review is currently in process**

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Our current plan targets a **FY2010 construction** (MREFC) start

This will be adjusted to optimally respond to budgets, project readiness, the approval process and other factors

Conceptual Design

Readiness Stage

Board approved

Construction

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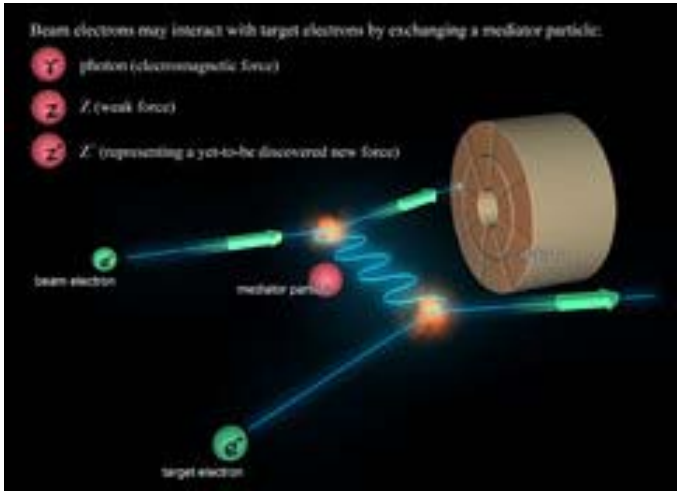

Cartoon representing how two electrons will interact by the exchange of particles. The two known forces of electromagnetism and the weak force are described by the exchange of a photon and a Z boson, respectively. This experiment searched for the exchange of possible new particles, which would represent a new force.

Illustration by Juna Kurihara, Stanford Linear Accelerator Center.

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The Physics Frontiers Centers (PFC) program supports university-based centers and institutes where the collective efforts of a larger group of individuals can enable transformational advances in the most promising research areas. The program is designed to foster major breakthroughs at the intellectual frontiers of physics by providing needed resources such as combinations of talents, skills, disciplines, and/or specialized infrastructure, not usually available to individual investigators or small groups, in an environment in which the collective efforts of the larger group can be shown to be seminal to promoting significant progress in the science and the education of students. Activities supported through the program are in all sub-fields of physics within the purview of the Division of Physics: atomic, molecular, optical, plasma, elementary particle, nuclear, astro-, gravitational, and biological physics. Interdisciplinary projects at the interface between these physics areas and other disciplines and physics sub-fields, e.g. biology, quantum information science, mathematical physics, condensed matter physics, and emerging areas of physics are also included.

The Bigger Picture…

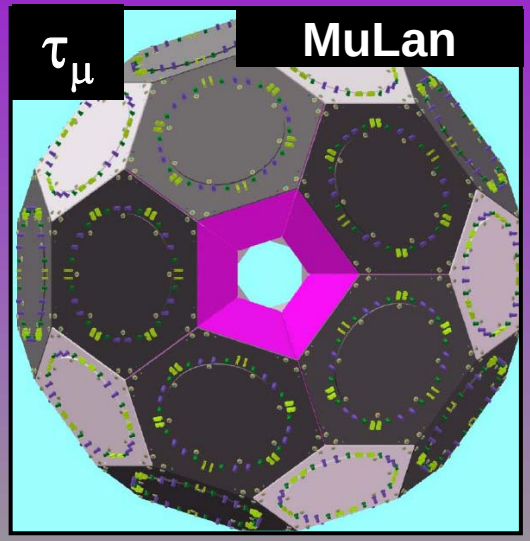
- Construction funds for projects of this size & scope are developed through the Major Research Equipment and Facilities Construction **(MREFC)** line at NSF

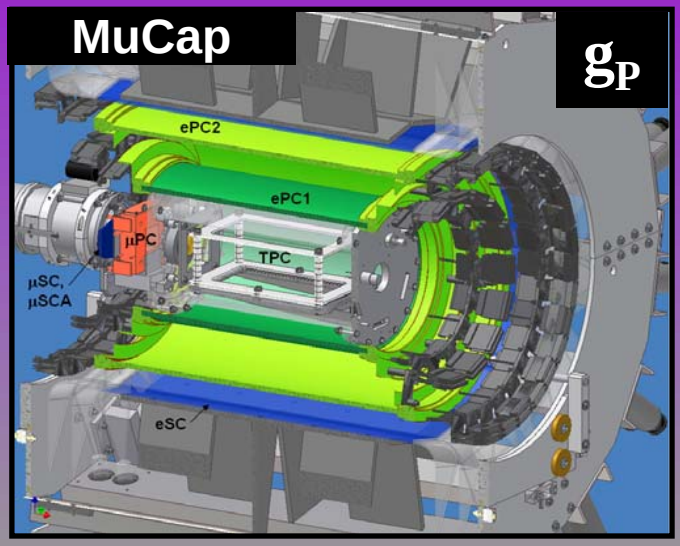
- MREFC projects are funded via separate congressional budget line items **(New money)**

- Construction start requires approval from the National Science Board (NSB) and, ultimately, Congress

- Additionally, projects must pass a readiness threshold (Preliminary Design Stage) before they can move forward to the NSB for consideration

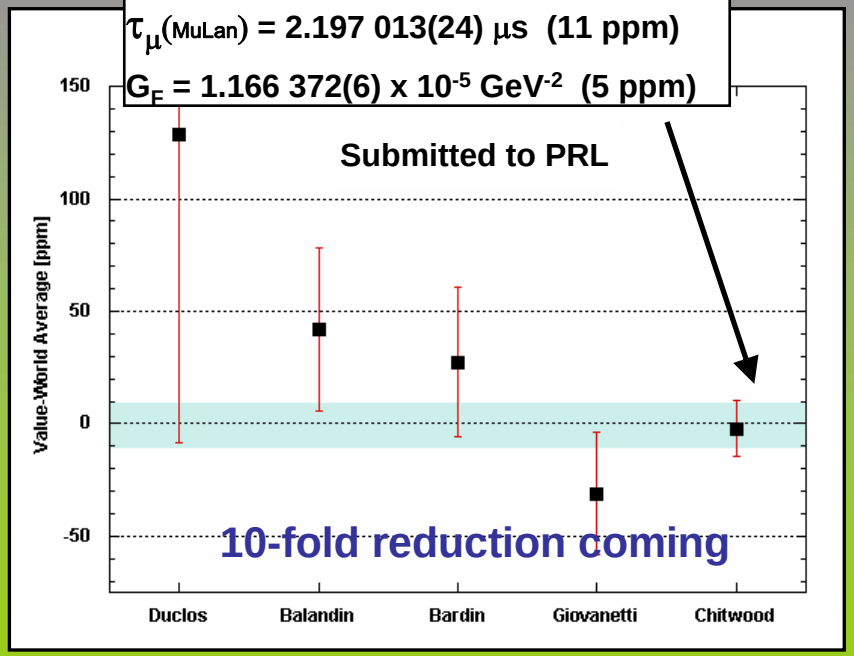
Two New Precision Muon Measurements

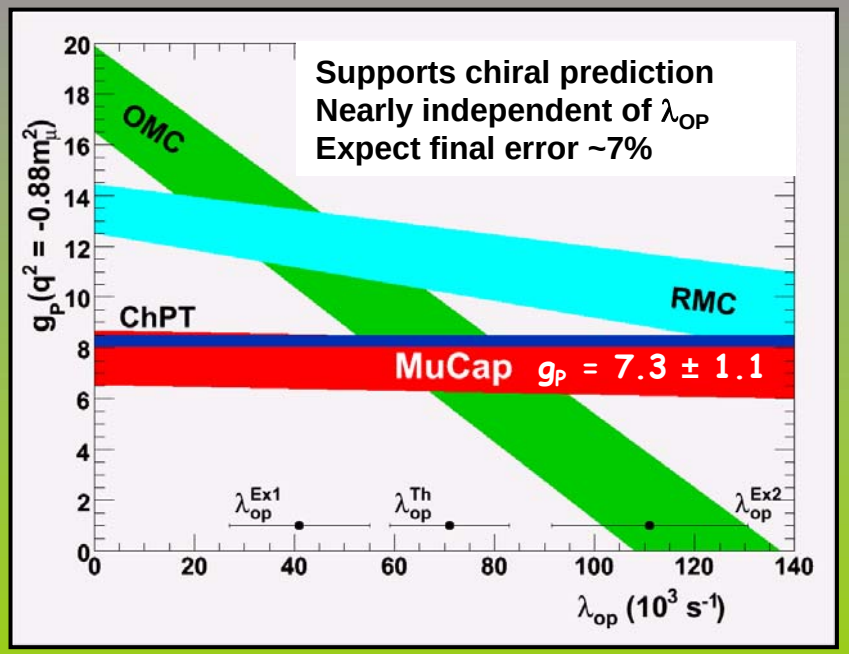




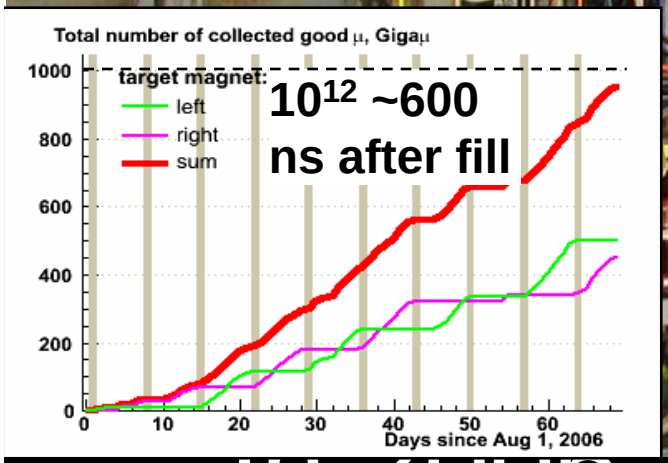
τ_μ(MuLan) = 2.197 013(24) μs (11 ppm)

G_F = 1.166 372(6) x 10^{-5} GeV^{-2} (5 ppm)





MuLan at PSI



In 2006: 10^{12} events on tape

additonal run planned