The Los Alamos Neutron Science Center Status and Plans for the Future

PAC 2007

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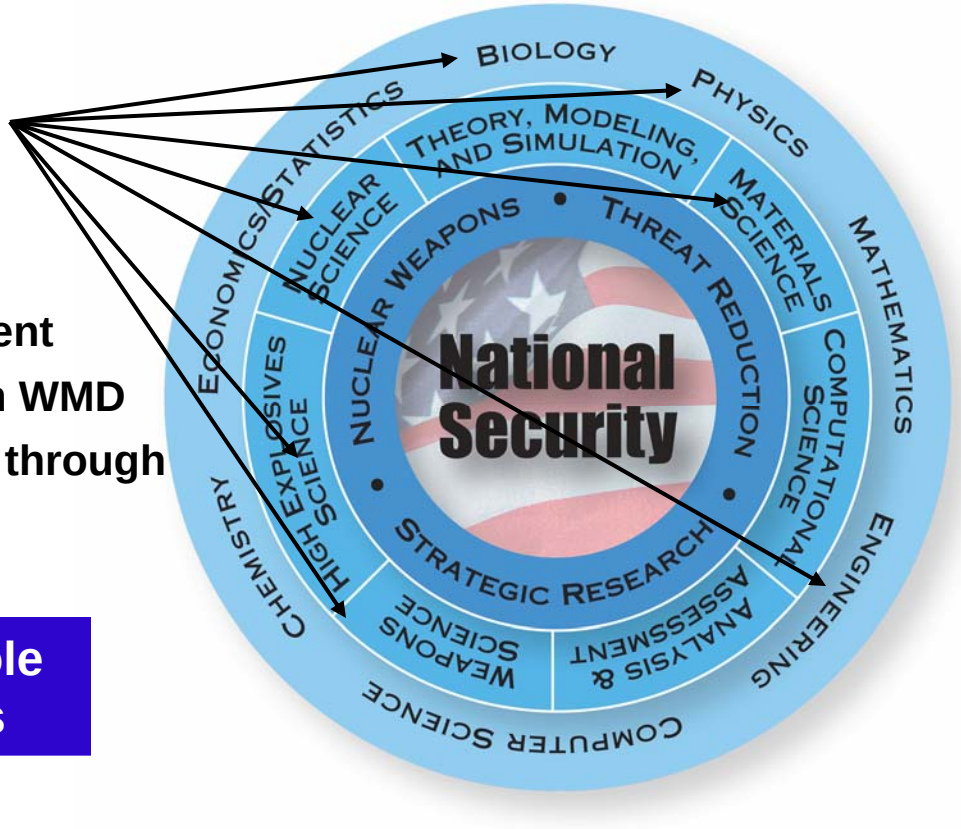
NNSA

Our National Missions Set LANL's Science and Capability Requirements

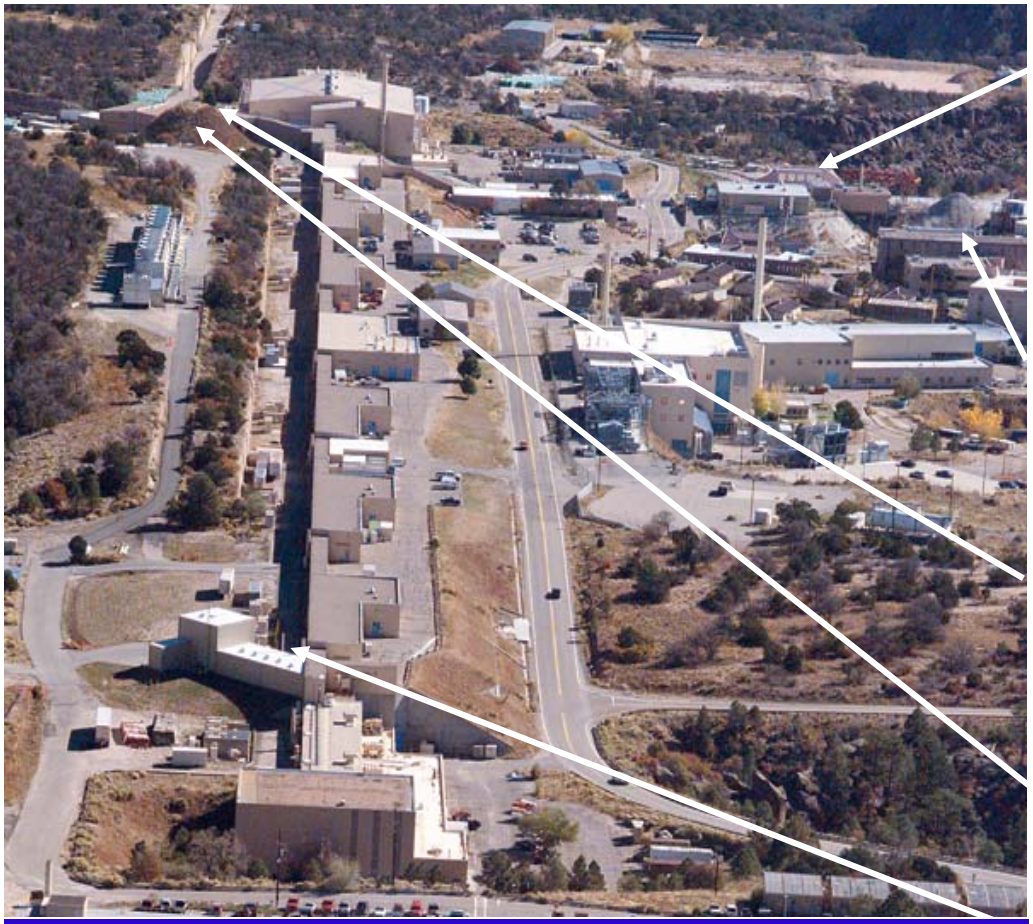
- **Key *disciplines* and *capabilities* support**

- **Our *national* missions.**
  - **Ensuring the US nuclear deterrent**
  - **Reducing the global threat from WMD**
  - **Investing in our Nation's future through Strategic research**

LANSCE has an enabling role in meeting these missions



LANSCE Provides the US and International Research Communities a Diverse Set of Premier Facilities



Unique, highly-flexible beam delivery to multiple facilities 8 mo/yr @ 24/7 with 1500 projected user visits

Lujan Center

- *Materials science and condensed matter research*
- *Bio-science*
- *Nuclear physics*
- *A National BES user facility*

WNR

- *Nuclear physics*
- *Semiconductor irradiation*

Ultra-cold Neutron Facility

- *Fundamental Nuclear Physics*

Proton Radiography

- *HE science, dynamic materials science, hydrodynamics*

Isotope Production Facility

- *Nuclear Medicine*
- *Research isotope production*

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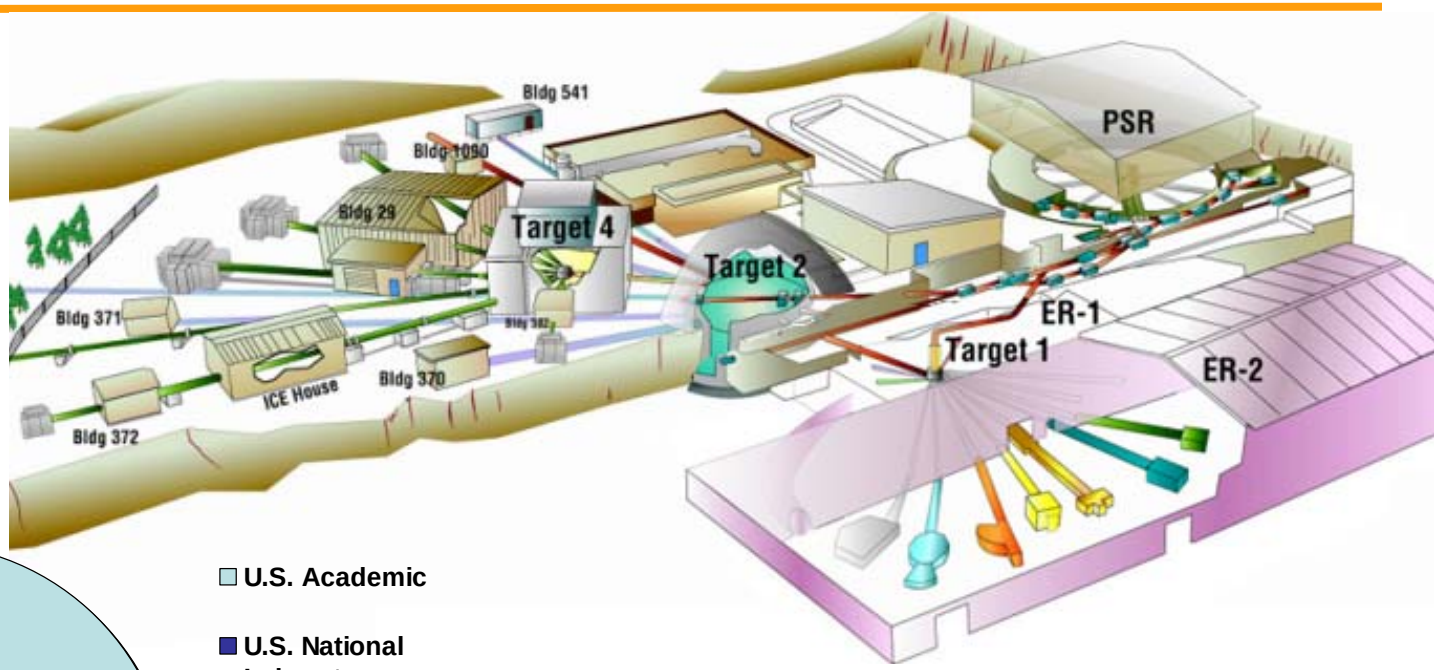
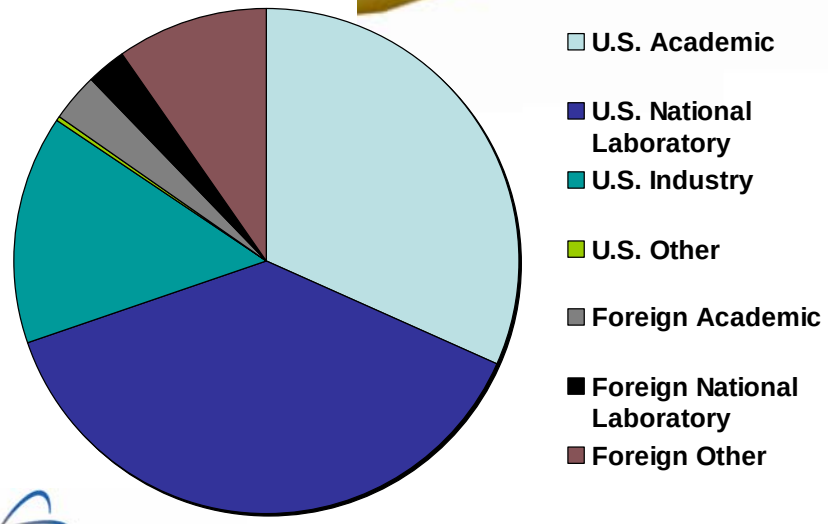
Both Lujan Center and WNR Operate Simultaneously to Support Over 1500 User Visits Each Year

- **Weapons Neutron Research - NNSA supported high-energy neutron user facility**





- **Lujan Center - BES supported low-energy neutron user facility**

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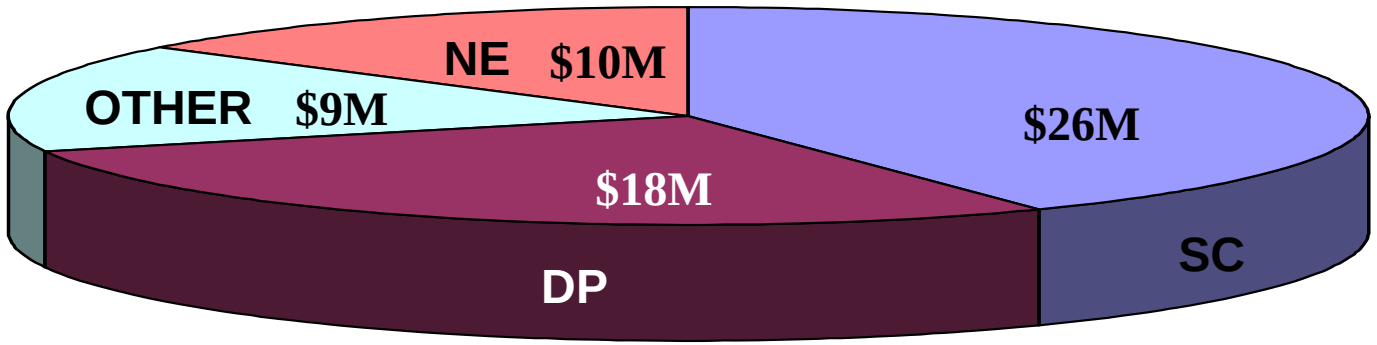
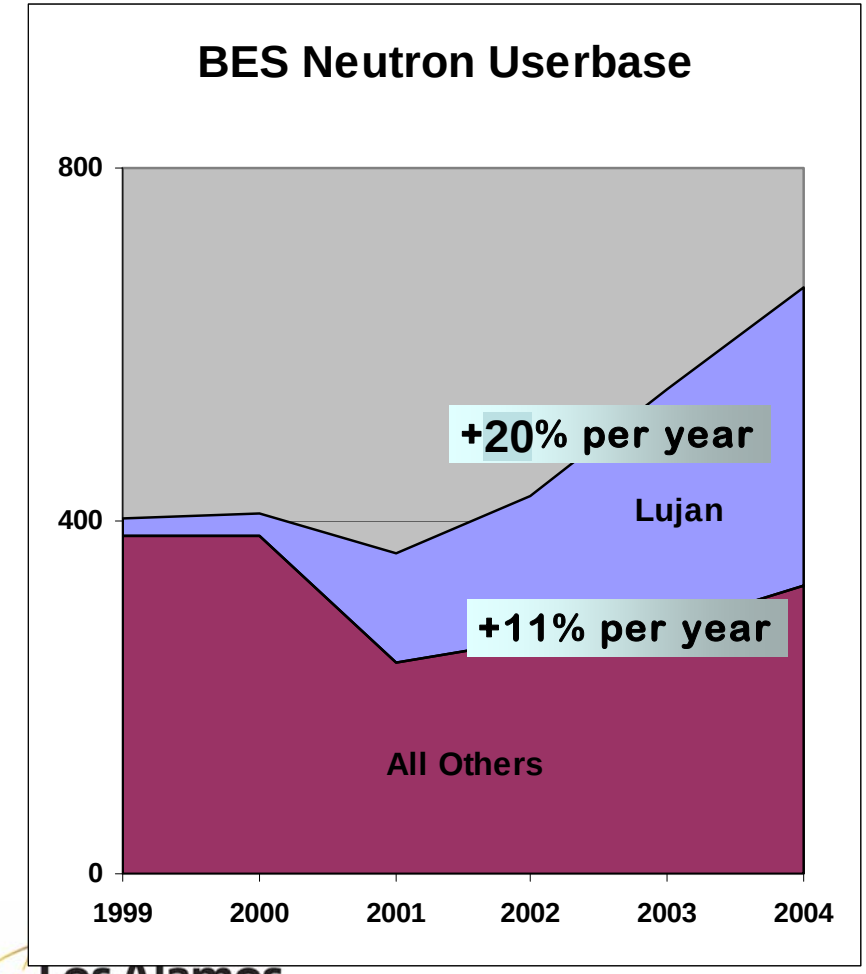
The Integrated Investment In Lansce-based Research Exceeds $110M Per Year

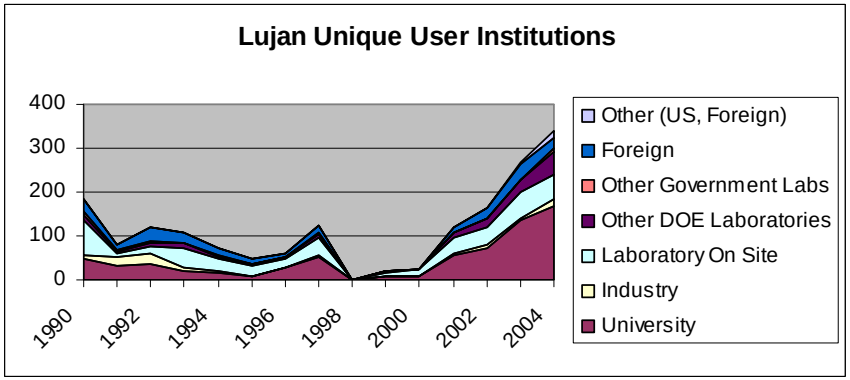
- Defense Programs invests ~$50M per year in operation of the facility -
- Another ~$30M of research investment addresses the needs of national security (> than just DP investment)

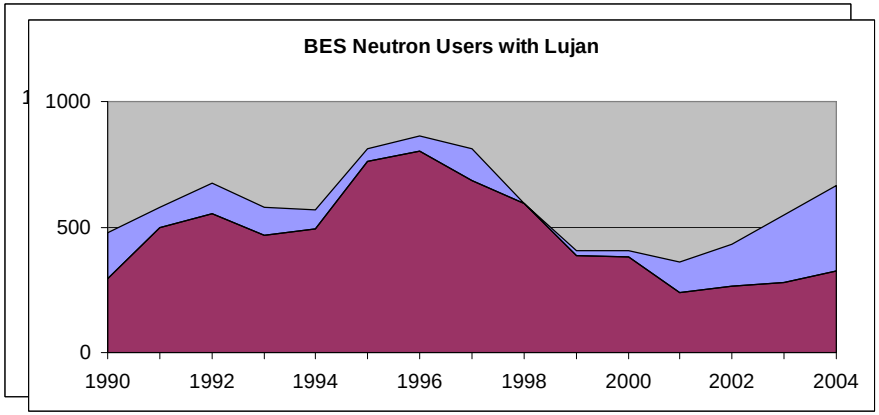


Estimated FY05 science investment = $63M

The Lujan Center Now Accounts for Half of the DOE Neutron User Base with a 20% Annual Growth Rate







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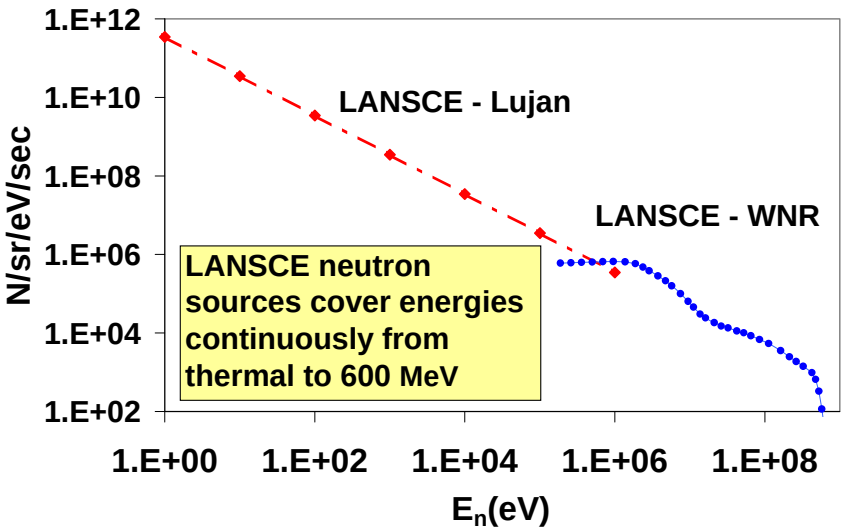
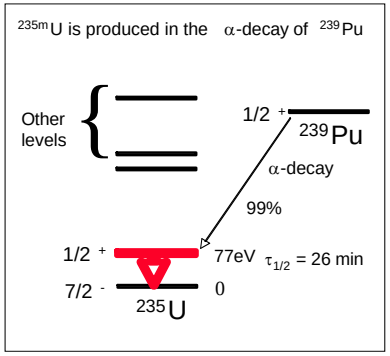
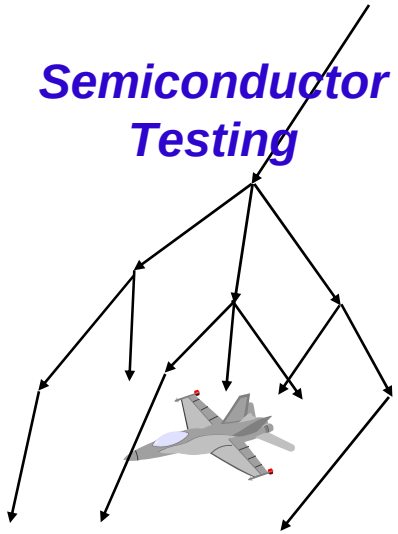
Nuclear Science At LANSCE Addresses Major Challenges Facing The Nation



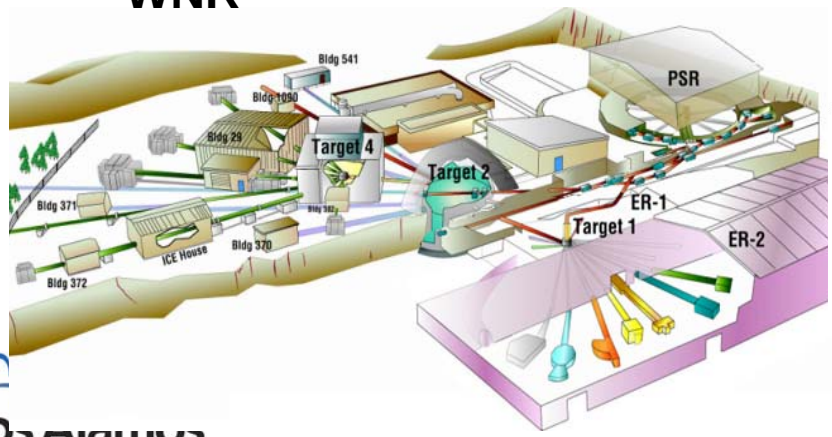


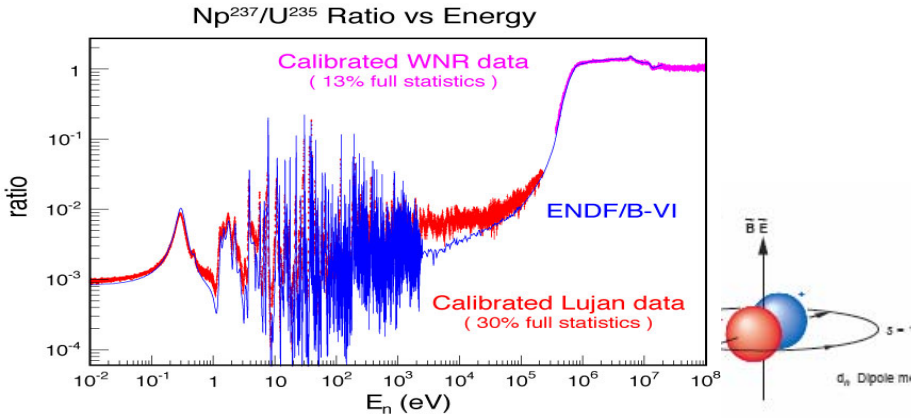
Defense Science

Semiconductor Testing



WNR





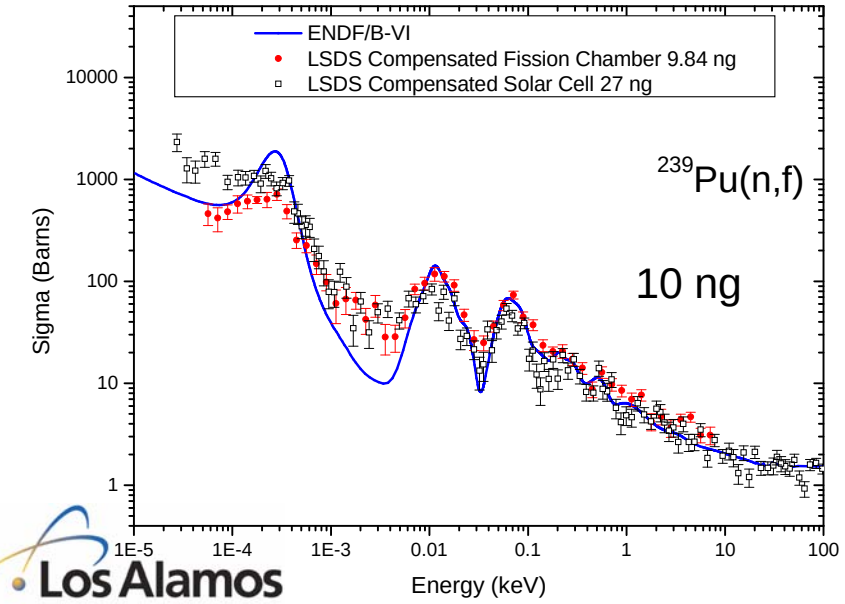
Energy Security

Fundamental Physics

Lujan Center

Measurement of Nuclear Cross Sections on Unstable Isotopes is a Principal Focus for Los Alamos Nuclear Research

Recent experiments with the Lead-Slowing-Down-Spectrometer demonstrated the ability to measure cross sections on very small samples (LANL, BNL, CEA, RPI)



Applications to:

- **NNSA stockpile stewardship, DHS nuclear data requirements**
- **GNEP & advanced fuel cycle cross section measurements**

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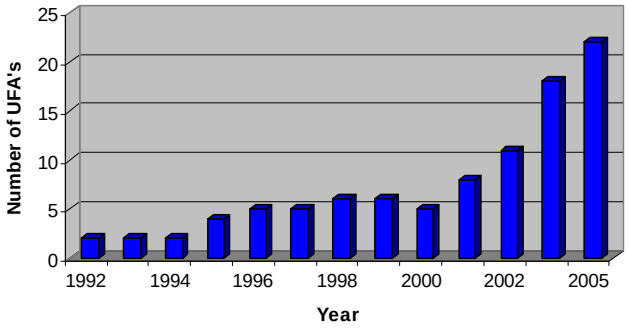
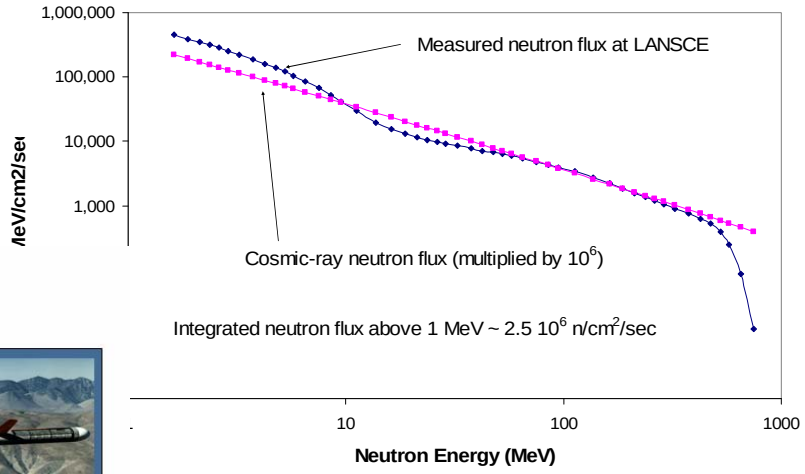
LANSCE/WNR Is A Unique National Resource For Single-event-upset Testing Of Critical Components

Industrial User Facility Agreements



Neutron flux

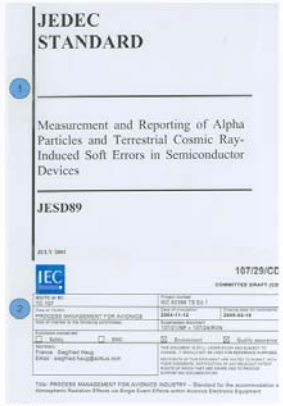


Electronic Warfare, Missile Guidance and Targeting, RADAR and SONAR				
ABRAMS	ERINTS	LAMPS	PATRIOT	THAADS
AGM - 130	HELLFIRE	LANTIRN	SEAWOLF	TOMAHAWK
AIM9 - X	HARPOON	LOS	SLAM	TSIP
ATIRCM	HTI	LOSAT	STANDARD	FALCONS EDGE
BRADLEY	IDECM	MHIP	STINGER	ROLAND
CRUSADER	IRIS	MLRS	TAURUS	EWATS
ALR - 67	AN/AQR - 22A	JSTARS	SCINS	IBAS
ALR - 69	ARSR - 4	RAI	AESA	ITAS
ALQ - 131	FLIR	RUG	HARM	ALR-66
Communications, Signal Processing and Intelligence				
ALADDIN	GPS	SINCGARS	TTC39	EPLRS
APSP	JTIDS	STU - 11	UYK44	CORNFIELD
AYK14	KG47	TACJAM	MONO LAKE	HAYFIELD
Aerospace, Avionics and Space				
737	A - 10	EUROFIGHTER	F - 14	P - 3
777	B - 52	FEDSAT	F - 15	RAFAEL
APACHE	B - 1B	F - 16	HC - 130	SKYBRIDGE
ARIANE 5	C17A	F - 18	JSF	SPACE SHUTTLE
ATF (F-22)	COMANCHE	F - 111	OPTUS	TORNADO

BOEING PHANTOM WORKS

Two Standards Stress Use of WNR for SEE Testing with Neutrons

Boeing Radiation Effects Lab


JEDEC STANDARD

Measurement and Reporting of Alpha Particles and Terrestrial Cosmic Ray-Induced Soft Errors in Semiconductor Devices

JESD89

- JESD89 issued by JEDEC (2001)
- Used mainly by IC vendors for ground SEU measurements
- WNR mentioned 14 times in the standard
- IEC 62396 issued by TC-107 Committee of IEC (apprvd 2005)
- Applies only to avionics
- WNR mentioned 22 times in the standard

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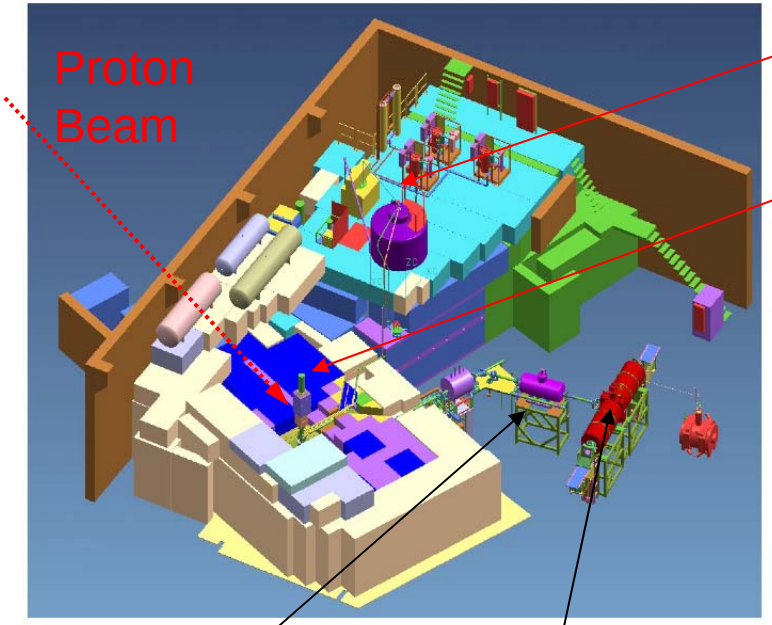
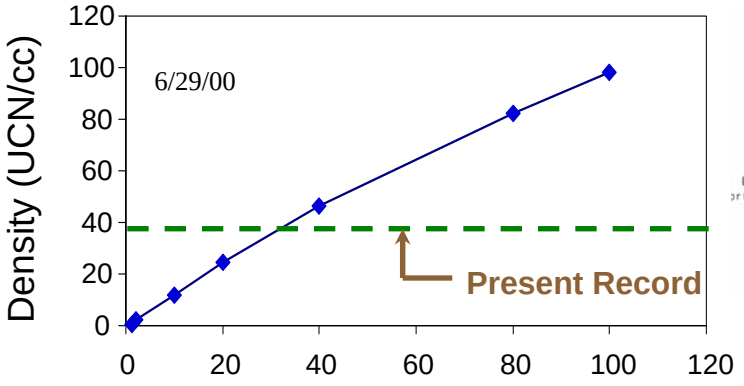
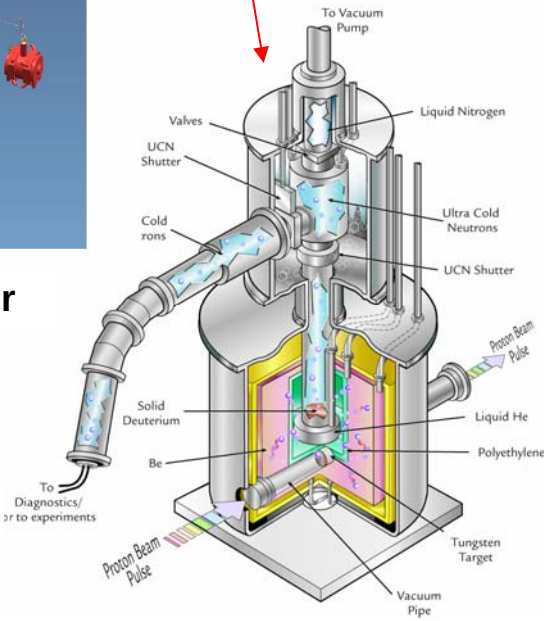
Fundamental Nuclear Physics: We Have Completed Construction Of An Ultra Cold Neutron Source And Are Beginning The First Experiment

- **UCN are generated by down-scattering spallation neutrons from liquid helium after moderation in a solid deuterium**
- **This technique allows systematic effects to be much smaller than with similar neutrons at reactors**
- **UCN production experiment achieved a world record in UCN density - calculations predict several hundred UCN/cc eventually**
- **The first experiment will be a precision polarized neutron-β-decay measurement**







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LANSCE Isotope Production Supports Continuing Medical Need And Research Capabilities

- Radioisotopes are produced for medicine, environmental tracers, basic and applied physical science R&D, and industrial products, e.g.:
  - ^{82}SR, cardiac imaging
  - ^{65,67}Cu, ^{32}Si for cancer/other research, treatment, diagnosis
- Customer base consists of over 250 hospitals, research institutions, and private sector companies
  - Major pharmaceutical manufacturers, such as GE Healthcare, Mallinckrodt, and DuPont, are customers
  - Growing demand
- The Los Alamos infrastructure includes irradiation facilities, hot cell processing facilities, and waste handling and storage/disposal facilities.

The new $23 M, 100 MeV Isotope Production Facility (IPF) at LANSCE.

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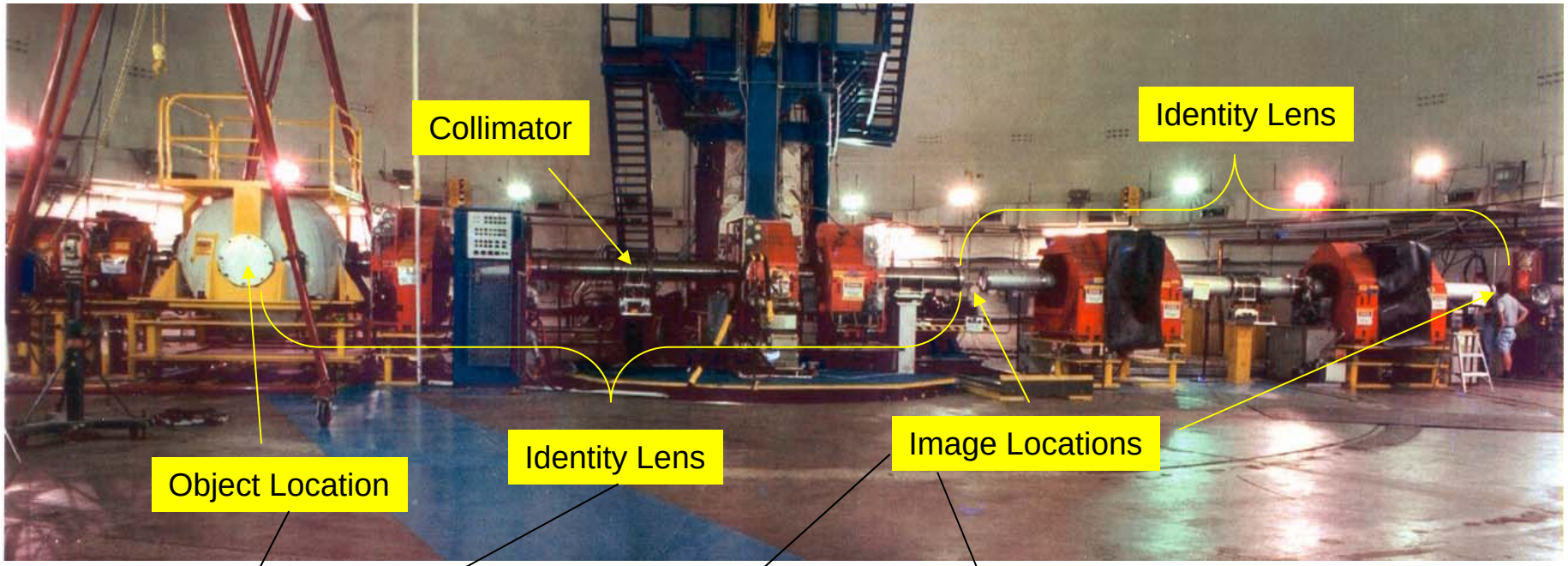
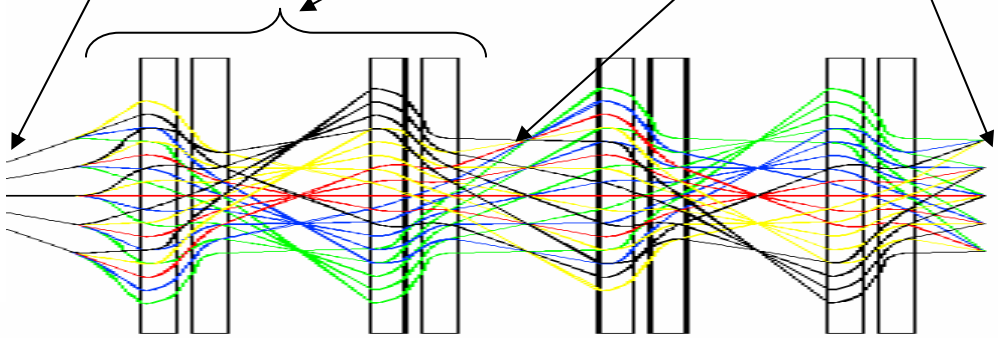
The Prad Facility At LANSCE Provides A Unique Tool To Study Materials And Hydrodynamics Under Extreme And Dynamic Conditions





Station 1

Station 2

800 MeV proton radiography has an areal density range of up to 50–60 g/cm^2

Bare resolution (rms)
Station 1: 178 μm @ 10cm FOV
Station 2: 280 μm @ 10cm FOV

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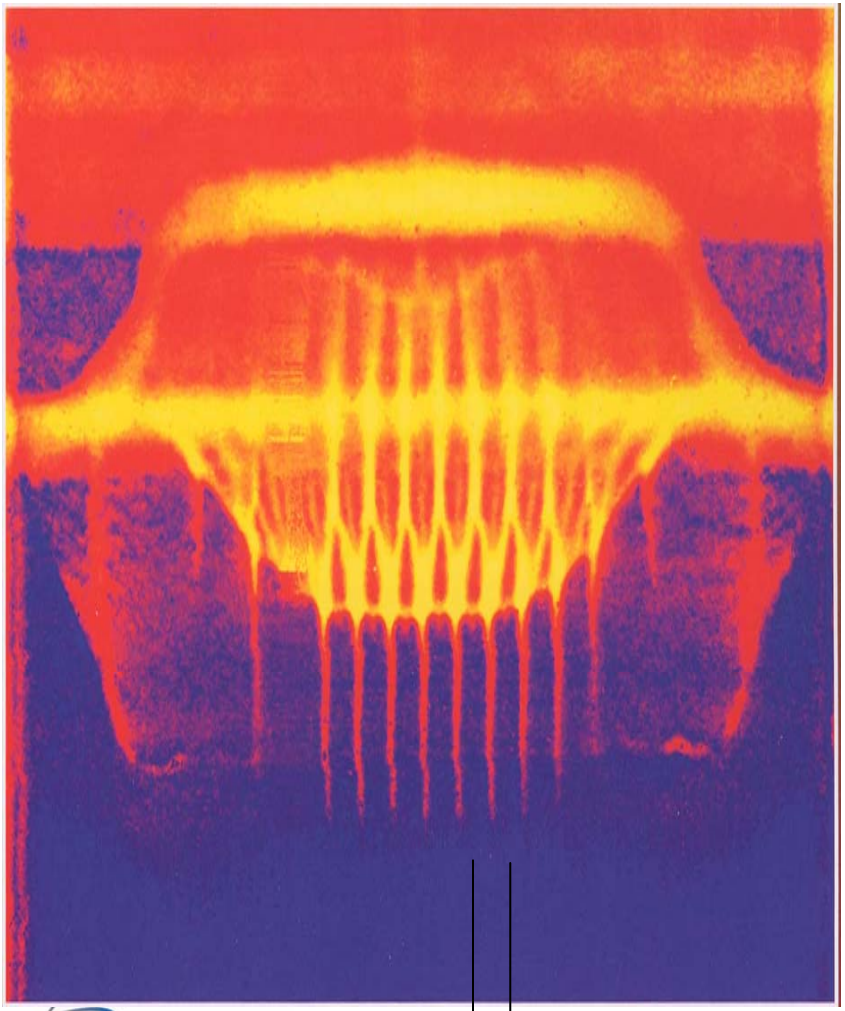
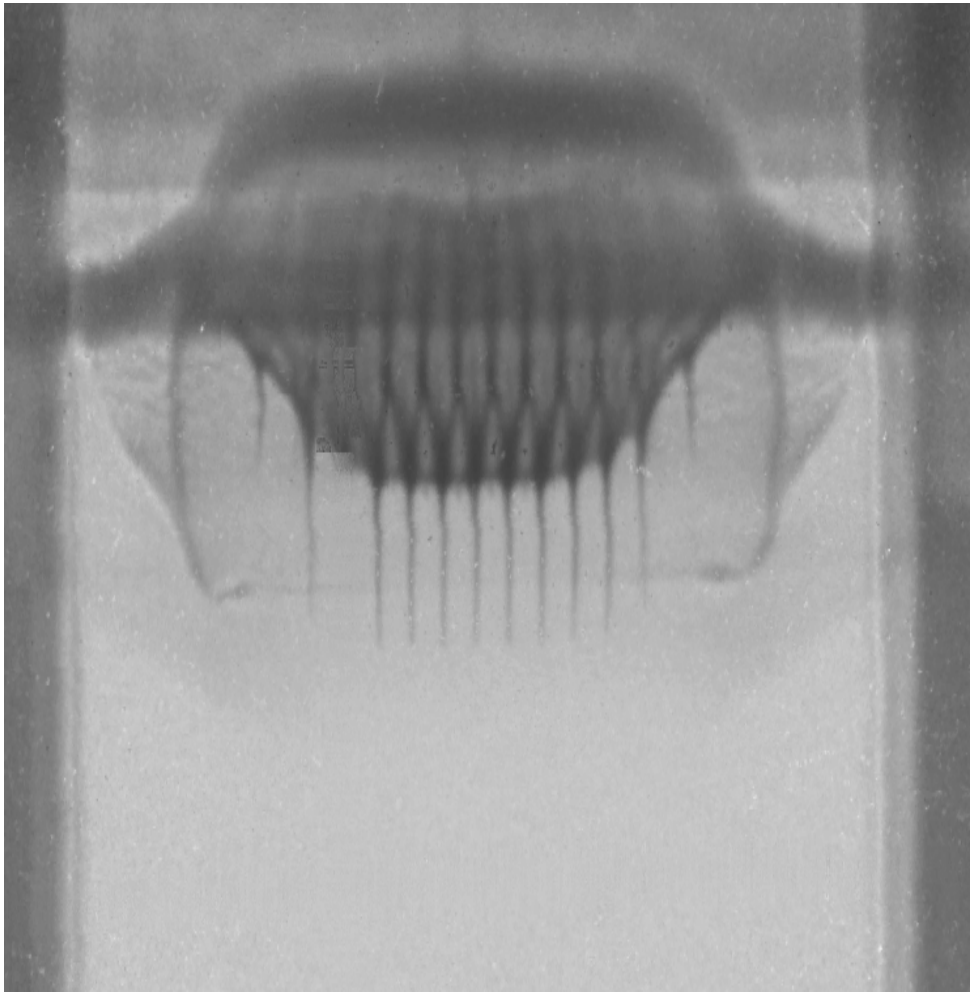
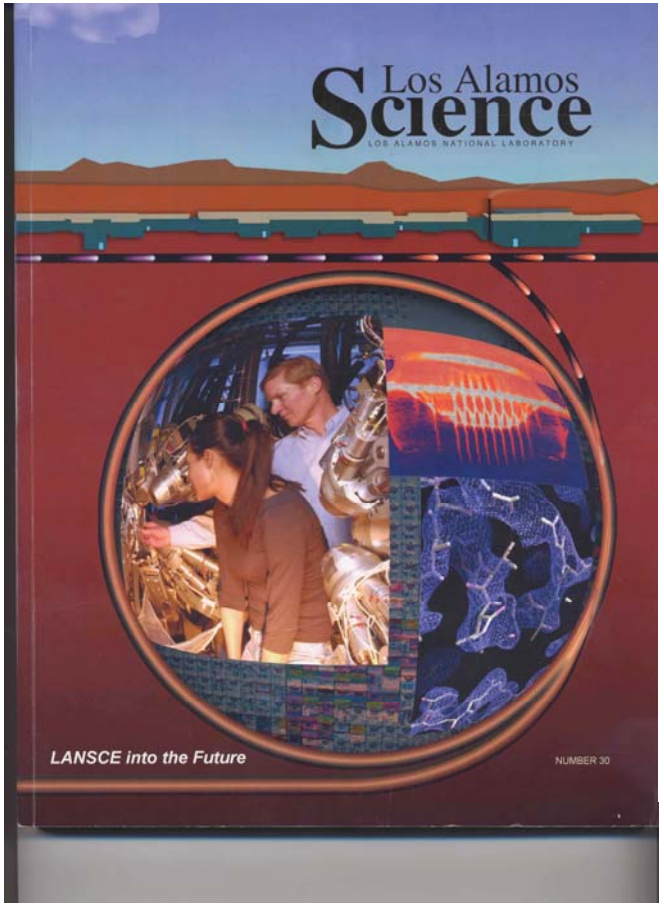
Proton Radiograph Showing Non-linear Growth Of Richtmeyer-meshkov Instability In Explosively Driven Tin





Our Future

- **LANSCE Refurbishment Project**
- **Capability Development to meet future missions**



The LANSCE-R Project will Provide Needed Linac Modernization to Ensure Reliable Bi-Decadal Operations

LANSCE-R is a 5 - 7 year refurbishment project phased to operate the user program

- **Replace 201 MHz RF system for the Drift Tube Linac (0.75 - 100 MeV)**
- **Replace High Voltage Power supplies and some klystrons for 805 MHz system for Coupled Cavity Linac (100 - 800 MeV)**
- **Remediate accelerator structures, supporting equipment and power supplies**
- **Install modern, maintainable Instrumentation and Control system**
- **Double H^- peak beam intensity**

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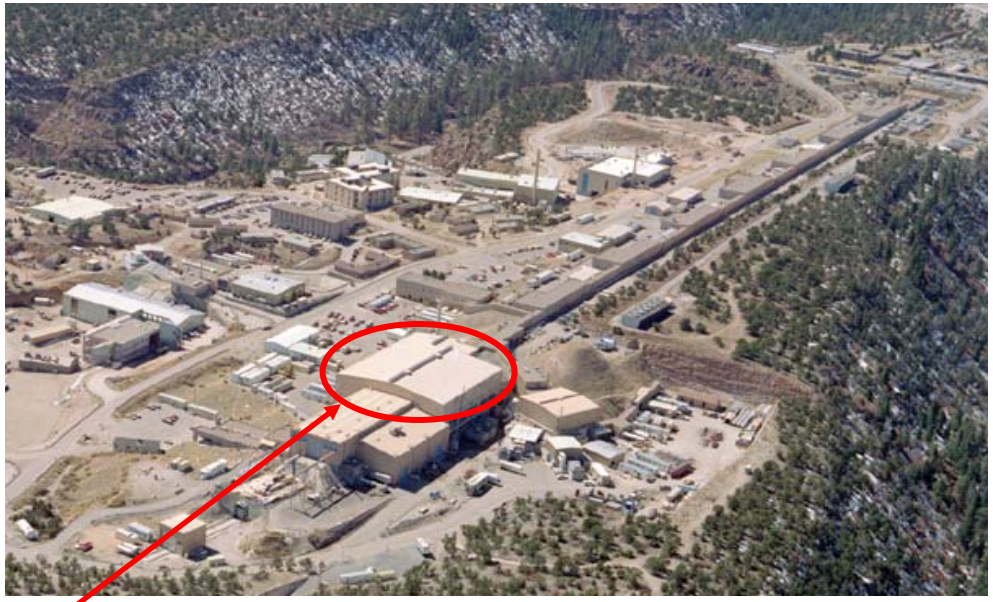
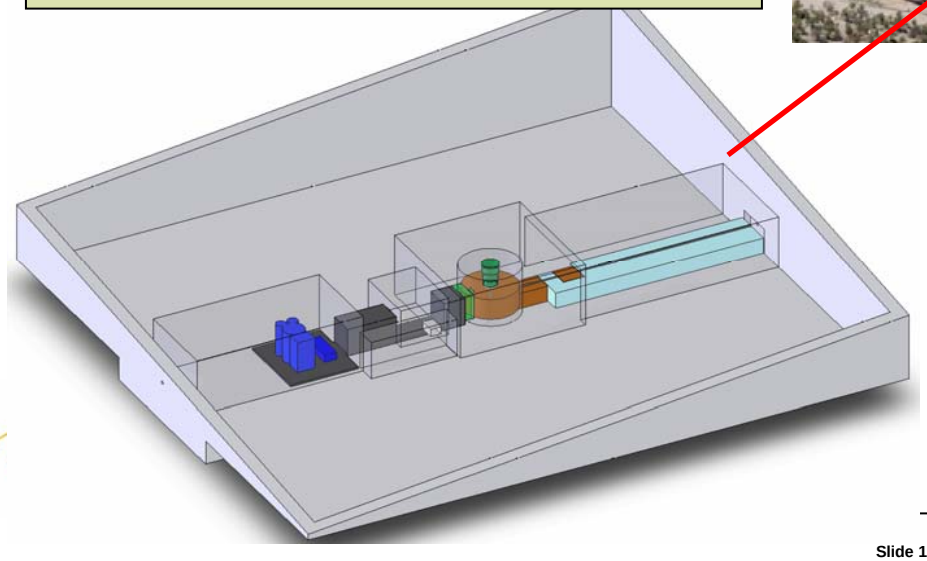
The Quickest Path To A Domestic Fast-spectrum Capability Is The Materials Test Station At LANSCE

Intense fast neutron spectrum over small volume.

- **Up to $2x10^{15}$ $n/cm^2/s$ (with beam current improvements), appropriate to prove fuel performance**
- **Spectrum nearly identical to FFTF**
- **Controlled temperature, coolant environment**
- **Prompt data retrieval for experimenters**

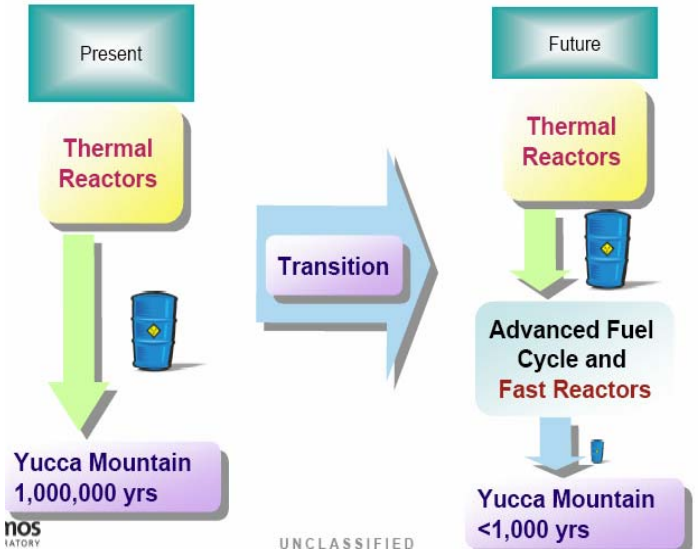




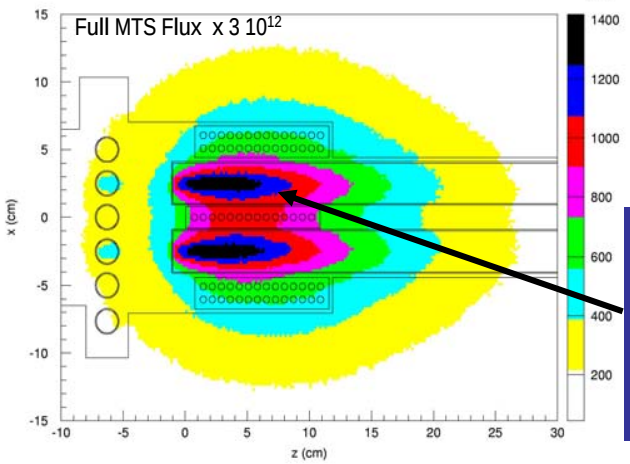
Design advanced thru prior year funds

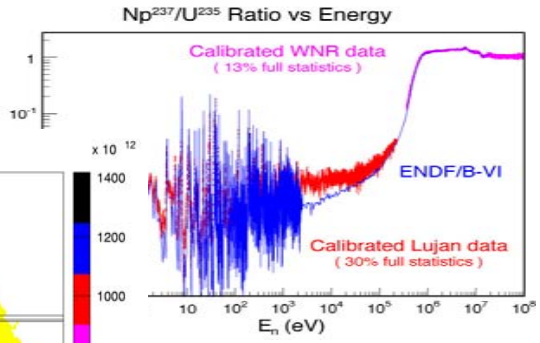
- **Cost range $57 - 73$M over 3 years**
- **FY07 funds appropriated (Senate)**
- **Can be on line in FY2010**

MTS Will Achieve Unparalleled Capabilities For Developing Fission And Fusion Fuels And Materials

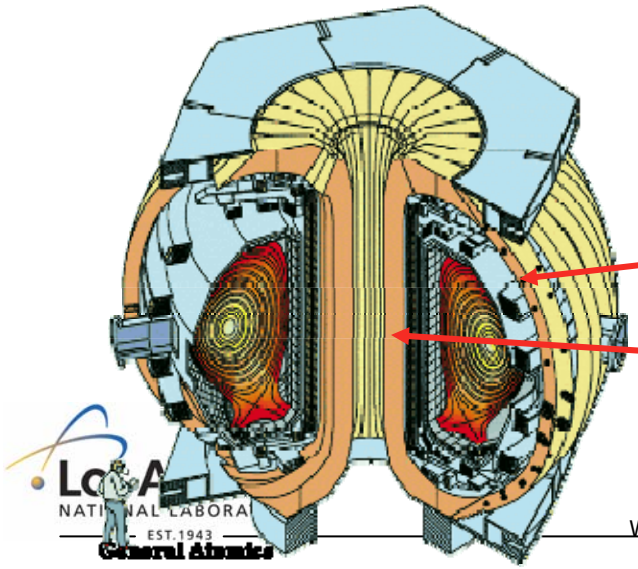


GNEP Fuel and Materials Development





Fuel burn up
Short-lived isotope production and cross section measurements



Fusion materials development by design

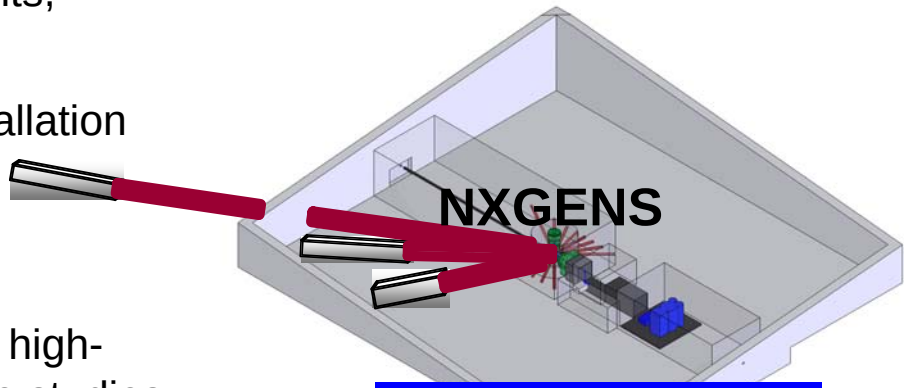
- *Wall: Structure, shielding, transmutation, cooling*
- *Magnets: High J, High T_c, High irradiation*

Wall must maintain integrity with 100 dpa over lifetime

In Conjunction with LANSCE-R, We Plan to Fully Exploit the Diverse LANSCE Capabilities at 800 MeV

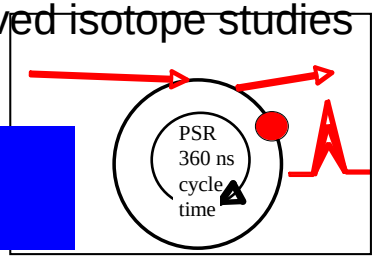
- **Materials Under Extreme Conditions -**
  - **Proton Radiography -** fully develop the capability to interrogate dynamic, high-energy-density matter.
  - **Materials Test Station** - high intensity irradiation of materials and fuels for fast fission systems
- **Neutron Scattering:**
  - **Lujan:** enhance production, add new instruments, expand user community, increase reliability
  - **NXGENS:** explore a high-power, long-pulse spallation source prototype flight path
- **Nuclear Science -**
  - **WNR -** enhance the intensity of epithermal and high-energy neutron production for short-lived isotope studies

PRAD Imaging Enhancements



LONG PULSE SPALATION SOURCE

WNR Pulse Stacking



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LANL Is Defining Its Signature Facility: LANSCE Has Responded With A Proposal Focused On Two Principal Scientific Thrust Areas

LANL/NNSA/DOE Missions and Laboratory Grand Challenges

National Security and Energy Security

Threat Reduction

Science-based prediction and fundamental research

Mission Requirements Drive Science Capabilities

LANSCE Scientific Thrust Areas

Materials Under Extreme Conditions:

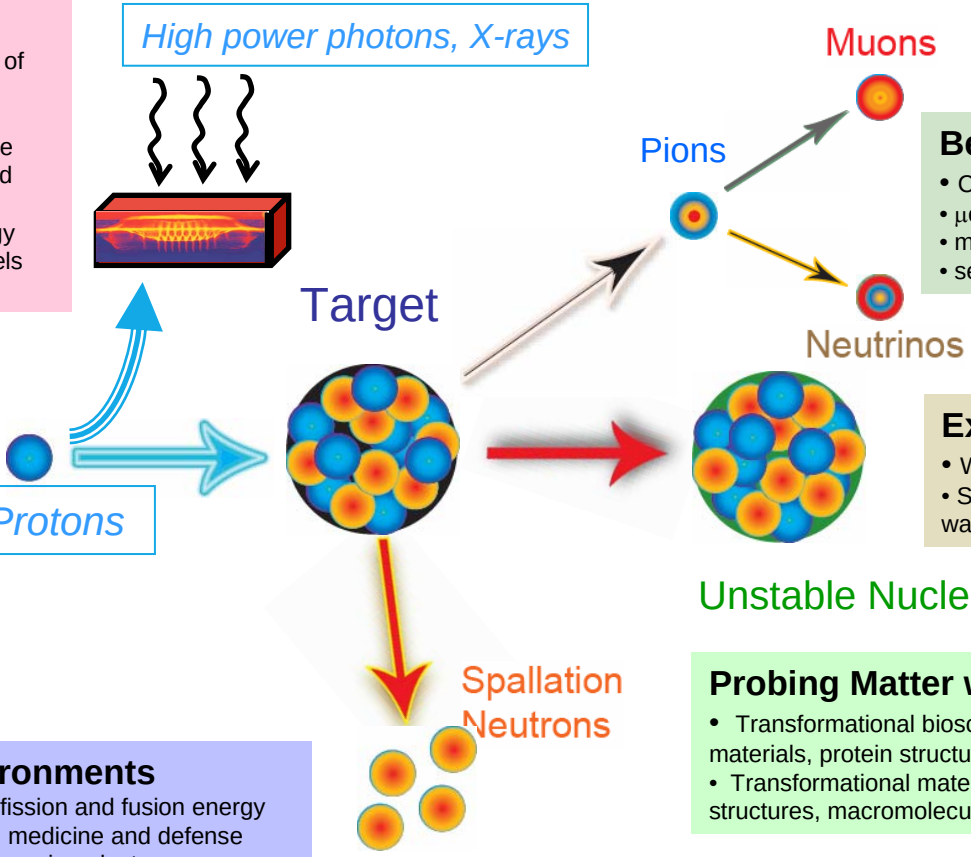
- ***Quasi-static response at extremes using neutron scattering***
- ***Dynamic response at extremes from condensed matter to warm-dense-matter***
- ***Radiation***

Fundamental and Applied Nuclear Physics

Future Signature Facility

LANSCE Will Provide Unique Capabilities To Probe Matter From Subatomic To Macromolecular State And From Condensed Matter To High-energy-density State

Extreme Material Science
- Understanding Shocks, hydrodynamics of weapons
- Understanding material response and failure from atomistic behavior to full scale
- Exploring warm dense matter - EOS and transport
- Developing fast fusion ignition for energy
- Validation of fundamental physics models for condensed matter and plasmas



Beyond the Standard Model
- Constraining the nEDM to > 6. 10^{-28} e-cm
- μe conversion
- measuring C-P violation in leptons
- searching for deviations in the CKM matrix

Exploring Unstable Nuclei
- Weapon nuclear physics
- S process nucleosynthesis - how matter was in the cosmos was formed

Probing Matter with Cold Neutrons
- Transformational bioscience - drug design, biomimetic materials, protein structure and function …
- Transformational material science - magnetic and nanoscale structures, macromolecular assemblies, soft matter …

Extreme Radiation Environments
- Developing fuels and materials for fission and fusion energy
- Producing radioisotopes for health, medicine and defense
- Understanding radiation effects on semiconductors

Neutron Nuclear Physics
- Weapon nuclear physics - enabling prediction
- Nuclear science of energy - understanding fuels and reactor performance

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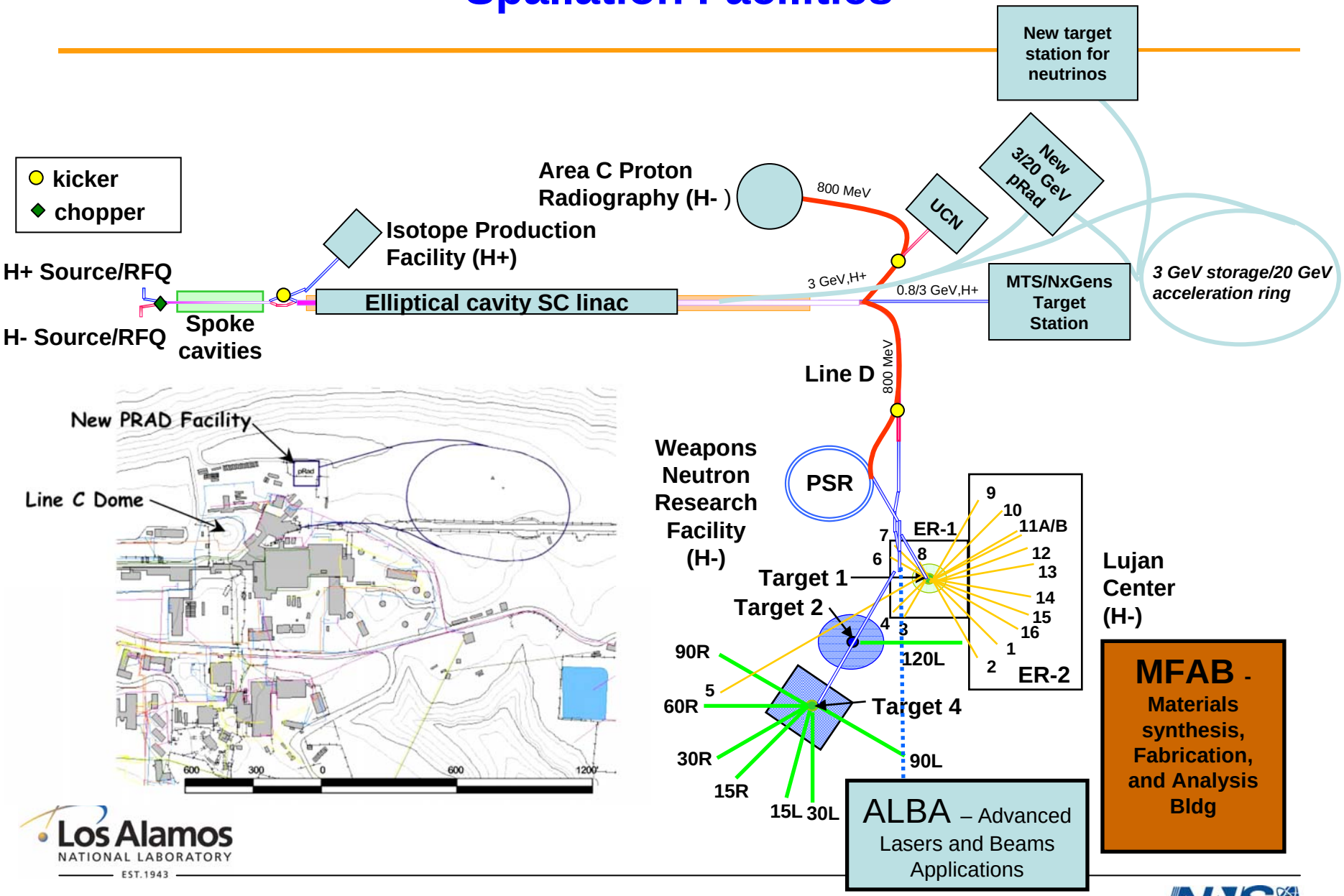
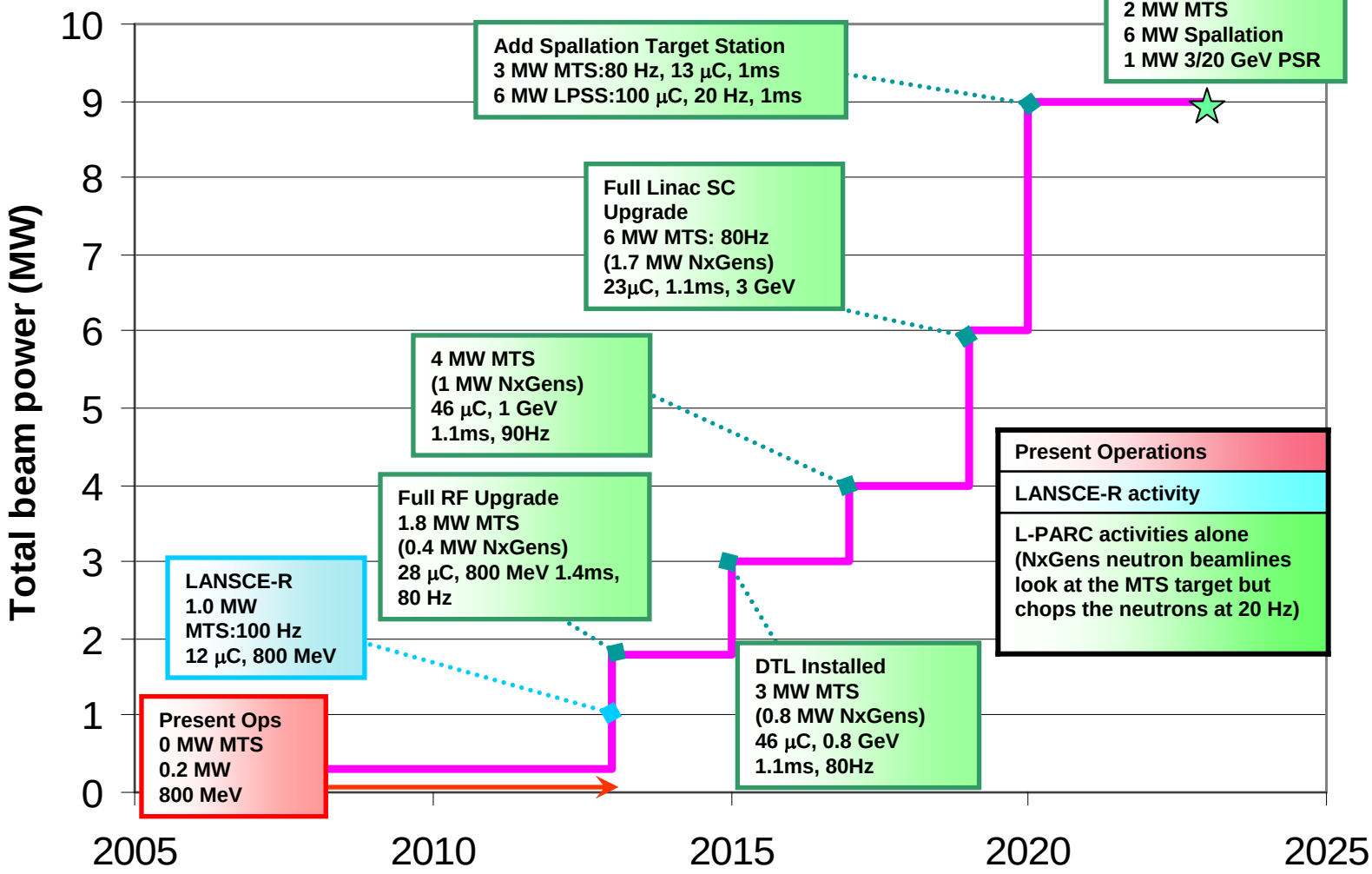
Significant New Capabilities Through MFAB, ALBA, and Spallation Facilities



Proposed LANSCE Performance Improvements



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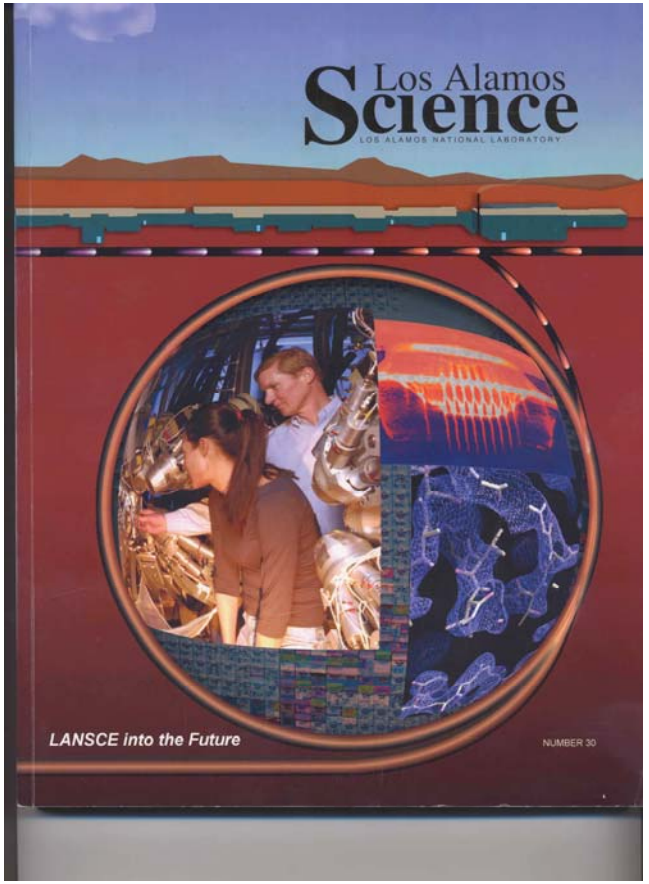
Summary: LANSCE is a Unique Multi-Purpose Research Center that is Productively Addressing Important National Missions

- **Interplay of basic and national security missions at LANSCE is unique and provides unique opportunities for innovation**
- **Present and planned capabilities support, and are adapted to, long-term national missions**
- **An institutional strategy is now planned that will revitalize LANSCE infrastructure and enable future investments for science over the next two decades or more.**
- **LANSCE can evolve to meet the future capabilities required of a Laboratory Signature Facility**



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