NCNR

NIST CENTER FOR NEUTRON RESEARCH

National Institute of Standards and Technology
U.S. Department of Commerce

Rob Dimeo, Director

NIST MISSION

Developing neutron measurements and making them available to the scientific community is central to the NIST mission

A MAJOR NATIONAL USER FACILITY

Research quantities of neutrons can only be produced at major, centralized facilities

DELIVERING HIGH IMPACT

NIST continues to be a source of excellent science with neutrons

BUILDING FOR THE FUTURE

NIST's neutron measurement capabilities continue to improve

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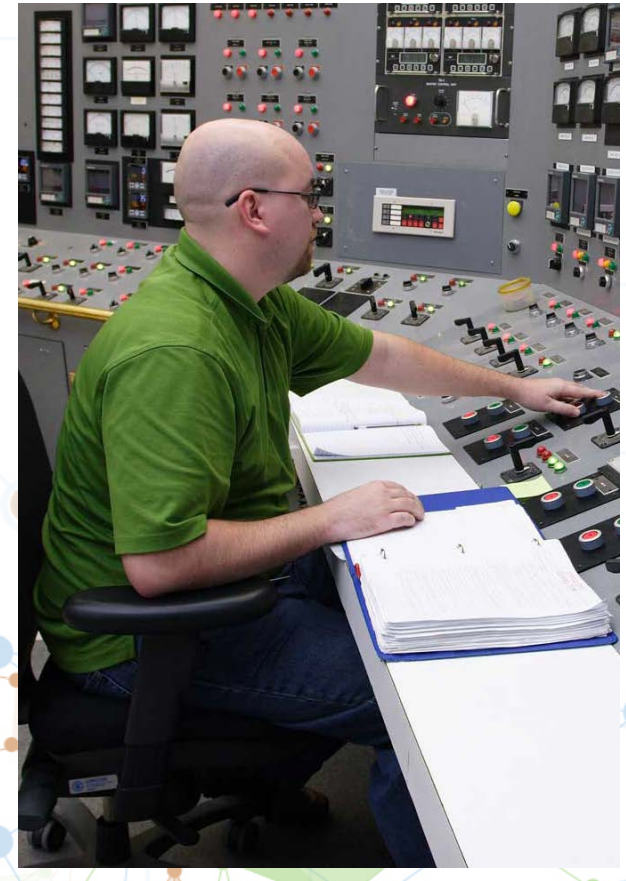
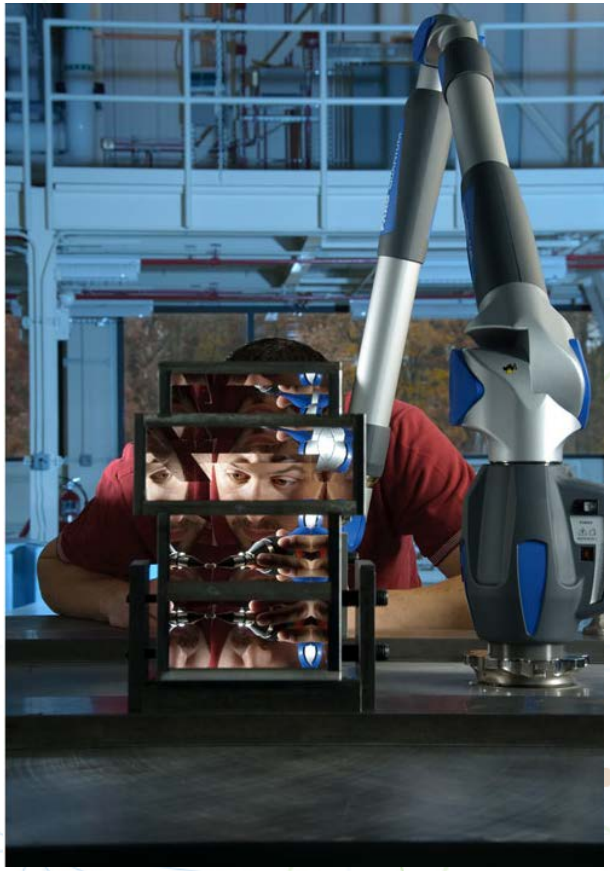
Promoting U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.

Ensuring the **availability of neutron measurement capabilities** to **meet the needs of U.S. researchers** from **industry, university and other Government agencies**.

Operate the NIST Research Reactor cost effectively while ensuring the safety of the staff and general public



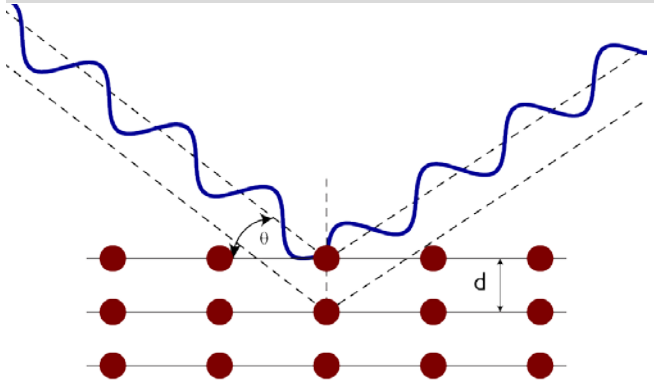
Develop neutron measurement techniques, develop new applications of these techniques, and **apply** them to science and engineering problems of national interest



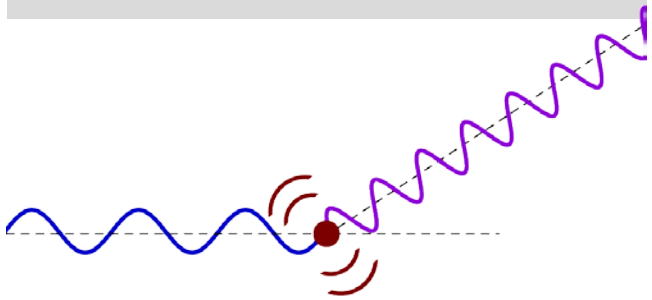
Serve the needs of researchers from industry, university, and government by operating the research facilities of the Center as a national user facility

THE POWER of NEUTRONS

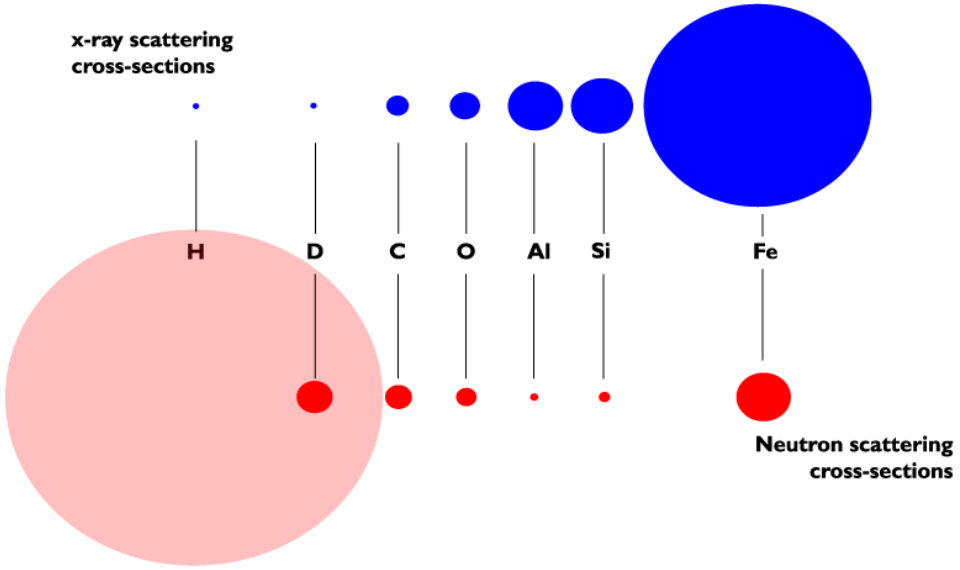
λ ~ interatomic spacing



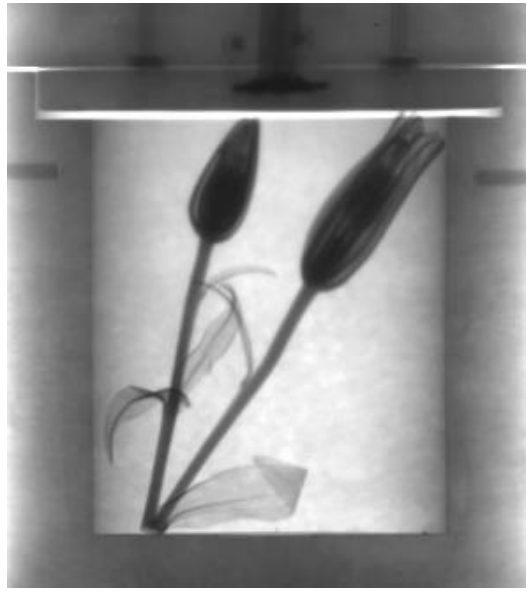
E ~ atomic motion



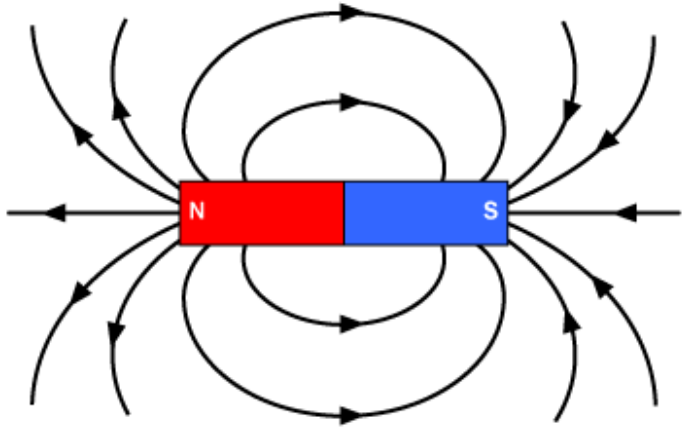
Scattering power varies randomly across the periodic table and from isotope to isotope



Penetrating



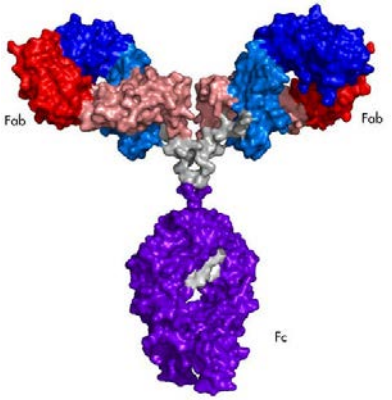
Magnetic



MULTIDISCIPLINARY

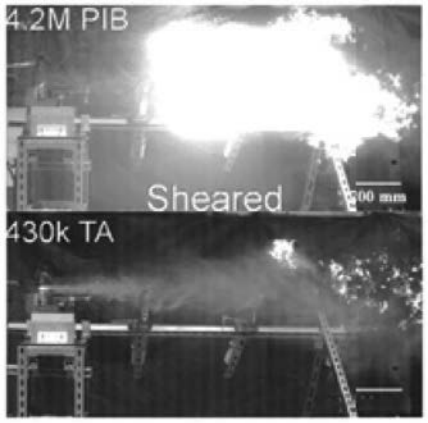
BIOLOGY

Castellanos et. al., Using SANS to characterize the NISTmAb reference material



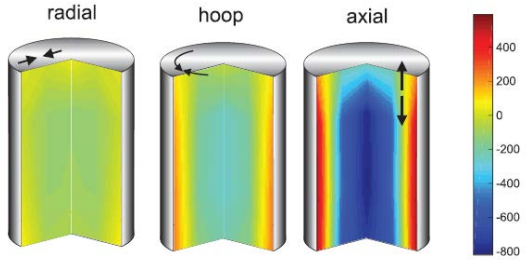
SOFT MATTER

J.Kornfield et. al., Safer jet fuel via megasupramolecules



ENGINEERING

T. Gnäupel-Herold et. al., Residual stresses in additive manufactured parts

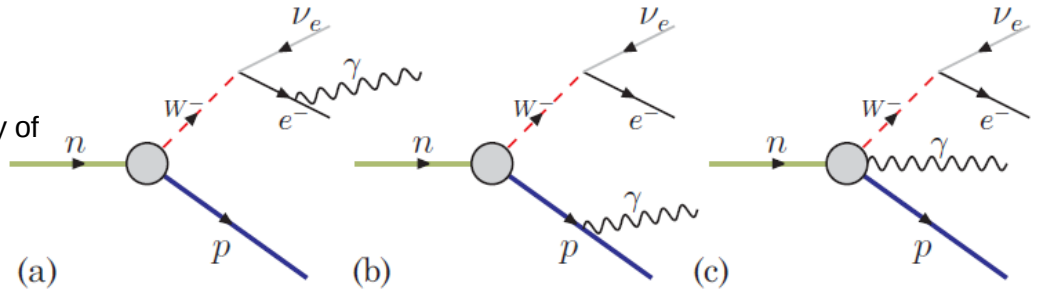


ARCHEOLOGY

R. Bishop et. al., Mayan trade routes

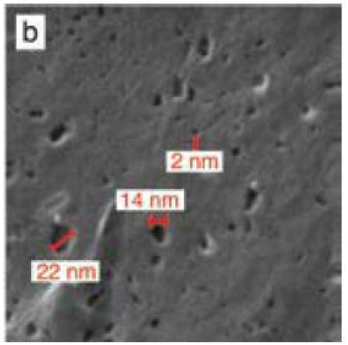
NEUTRON PHYSICS

F. Weitfeldt et. al., Radiative beta-decay of the free neutron



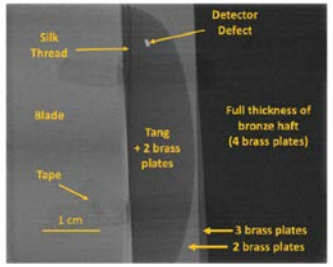
GEOLOGY

H.E. King et. al., Foamy porosity in gas shale



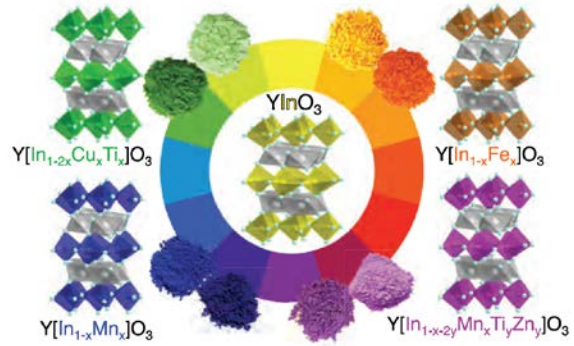
CULTURAL HERITAGE

R. Livingston et. al., Chinese jade and bronze dagger axes



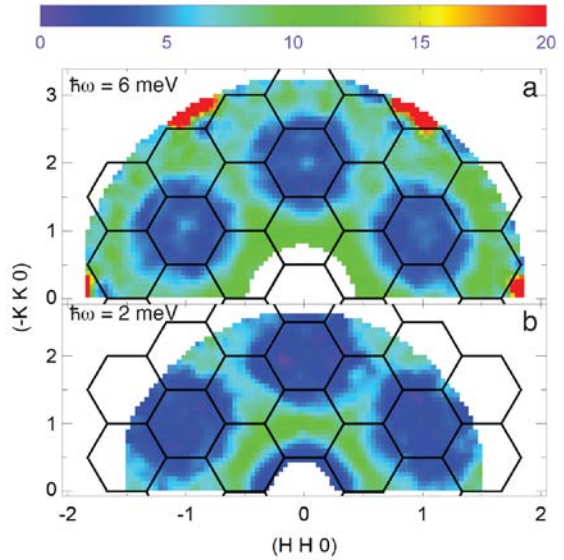
CHEMICAL PHYSICS

M. Subramanian et. al., Rational pigment design



CONDENSED MATTER

Y. Lee et. al., Quantum spin liquid state in herbertsmithite



INSTRUMENT OWNERSHIP & ACCESS

INSTRUMENT OWNERSHIP

NIST-owned

Partnership-owned (participating research team):
interagency partnerships (e.g. NSF/NIST CHRNS),
consortium-owned (e.g. nSoft, iPRIME/ExxonMobil)

INSTRUMENT ACCESS

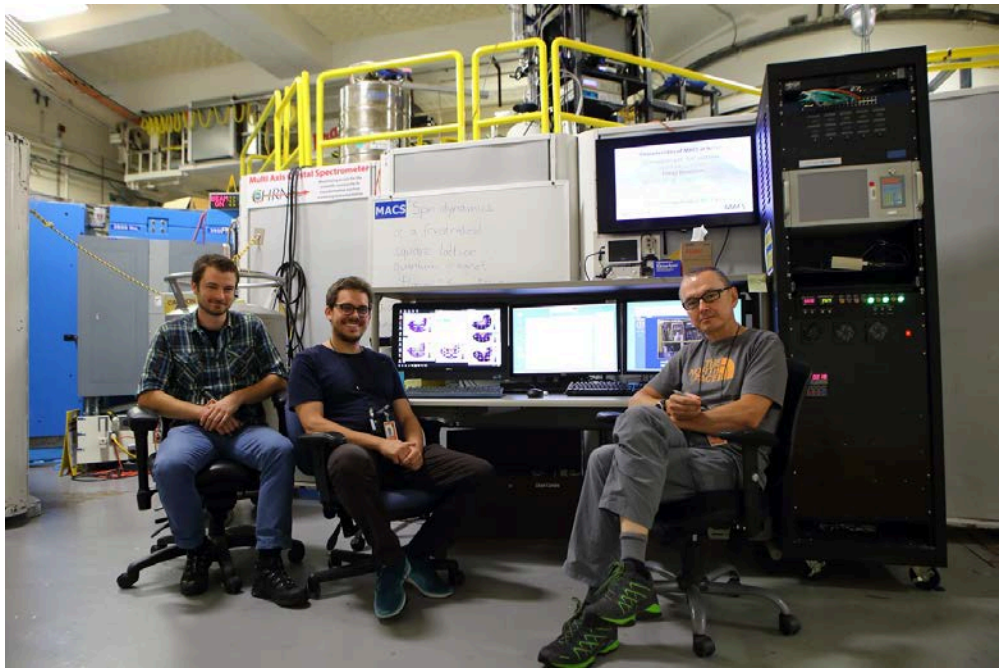
General user access (competitive proposal-based)

Collaborative access (merit-based via instrument “owner”)

Consortium-based access

Partnership-based access

Proprietary access



USER ENGAGEMENT

User Group Executive Committee

The executive committee represents the users, provides input to management regarding user concerns, administers a periodic user survey and post-experiment survey, and provides a forum for keeping the community informed about issues impacting users of the NCNR.

Users

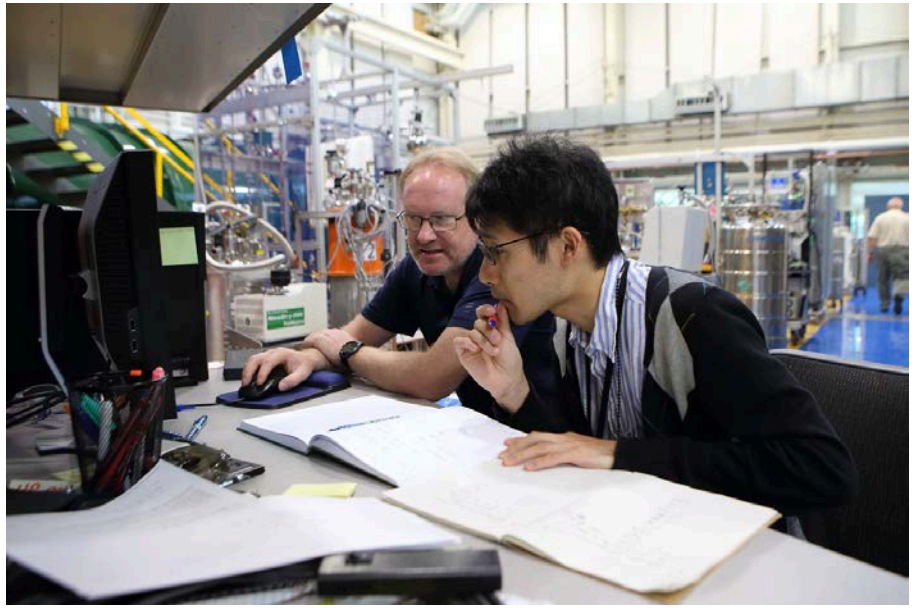
NCNR management frequently gathers feedback from users on-site for experiments via discussion and the NUG-issued post-experiment surveys.

Workshops

NCNR hosts occasional workshops to gather input from the user community on future neutron scattering instruments.

Topical Meetings

NCNR staff and leadership engage with the user community at scientific meetings and other venues such as the biennial American Conference on Neutron Scattering.



Beam Time Allocation Committee

The BTAC assesses external reviews of beam time proposals and recommends allocation of available instrument time. The BTAC also provides feedback to management on facility developments that could affect beam time allocation.

Los Angeles Times

https://www.latimes.com/science/sciencenow/la-sci-sn-government-shutdown-science-impact-20190215-story.html by Julia Rosen

Yumi Ijiri (Oberlin)

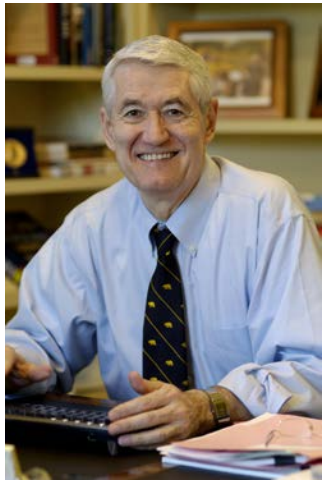
Mark Dadmun (UTK)

Jodie Lutkenhaus (TAMU)

Matt Helgeson (UCSB)

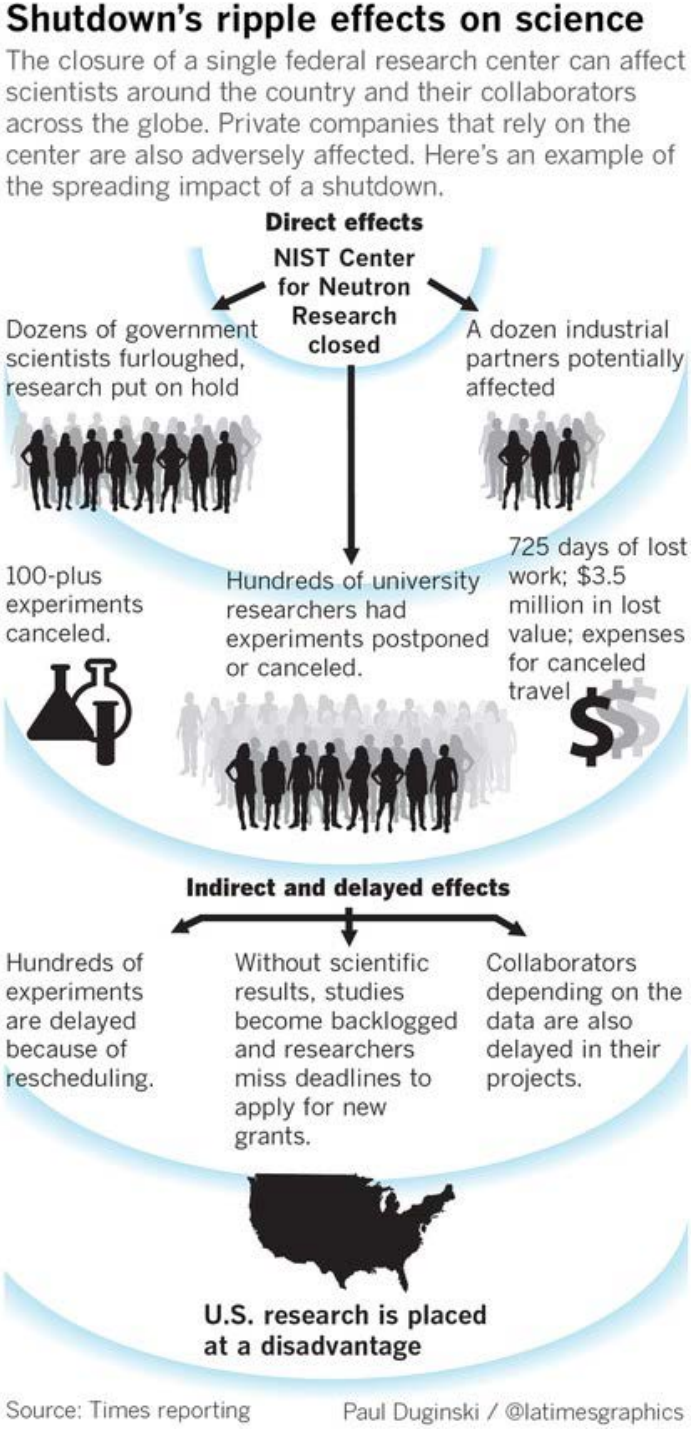
> “A slot at the NCNR is a precious commodity, and Helgeson’s students had spent six months meticulously preparing for theirs. But every day the shutdown limped on, their prospects grew dimmer and their nerves more frayed.”

Mike Hore (CWU)



Bob Birgeneau (UC Berkeley)

Zach Porter, Stephen Wilson and Eli Zoghlin (UCSB)



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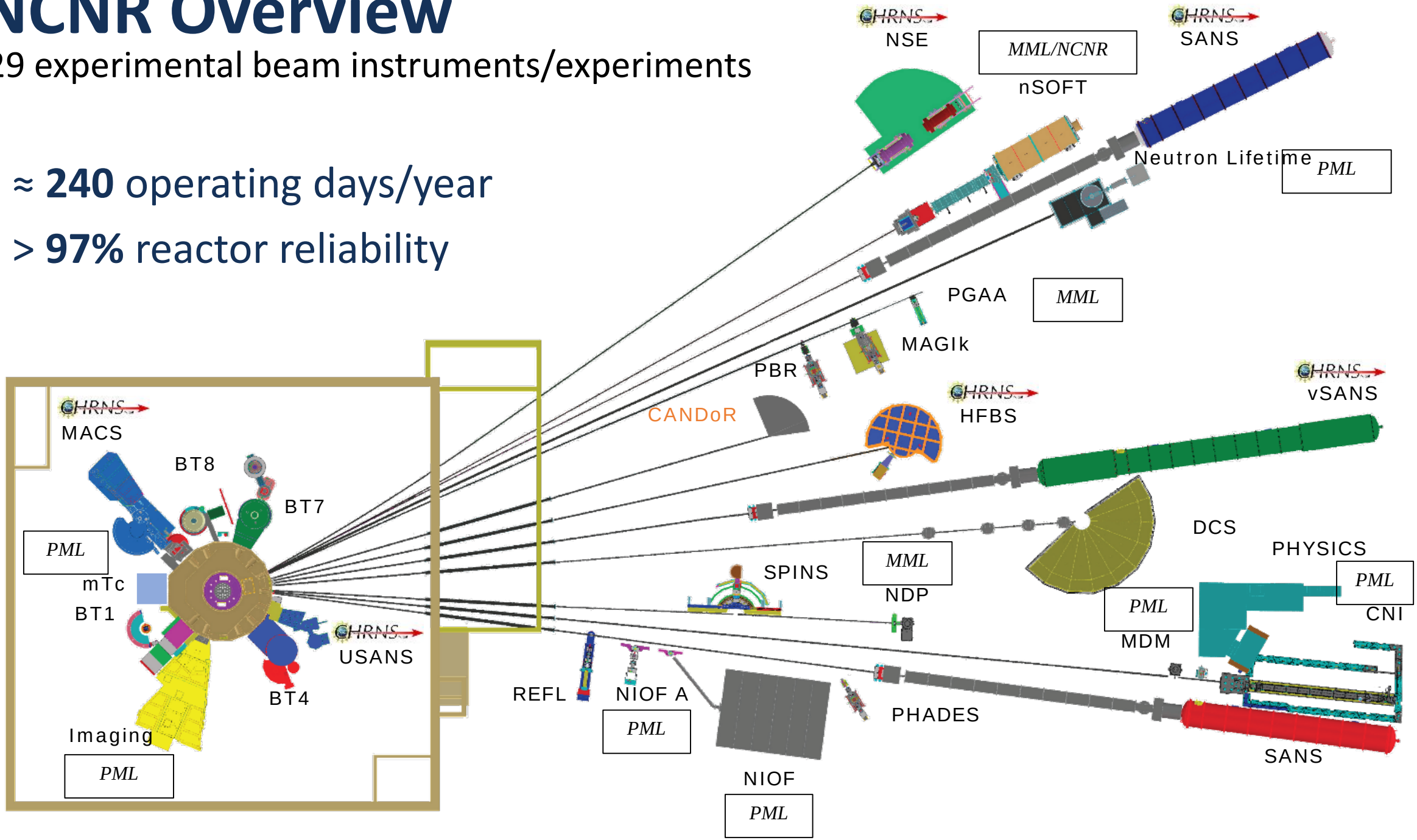
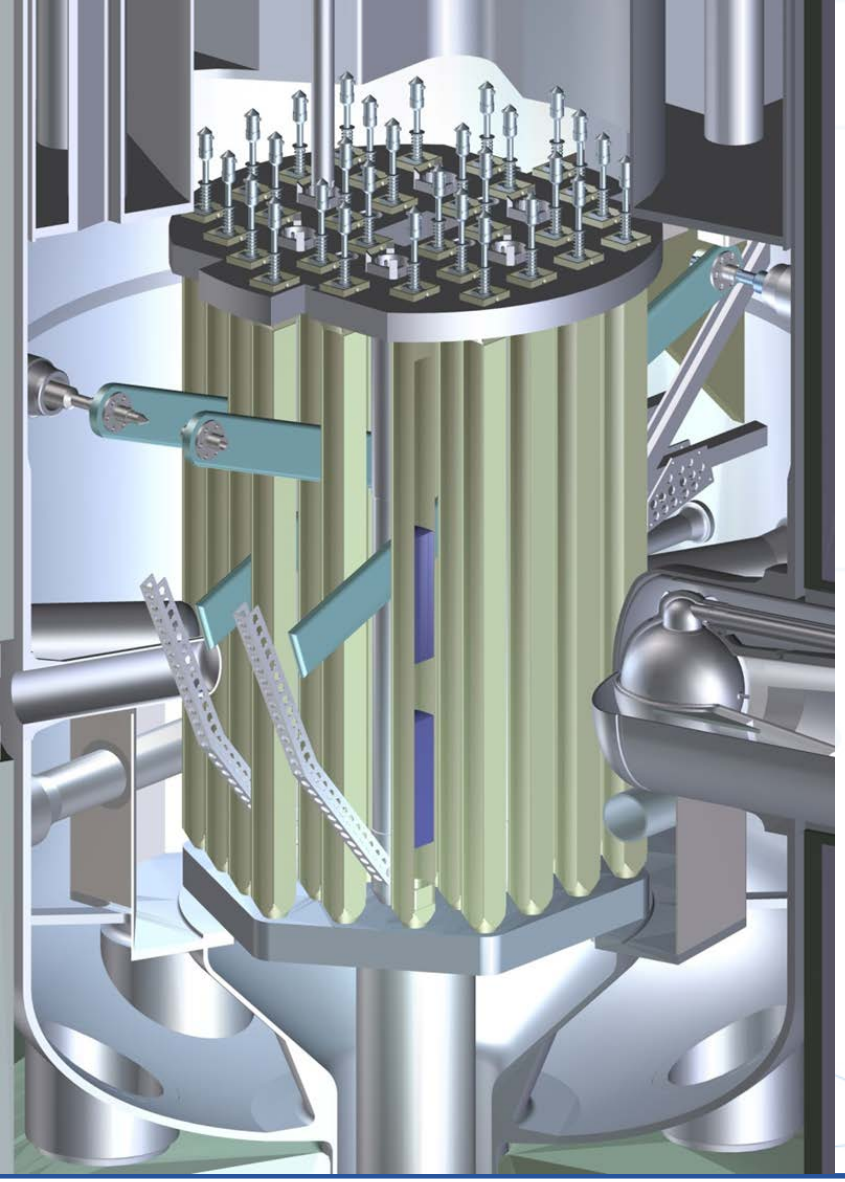
NCNR Overview

29 experimental beam instruments/experiments

≈ **240** operating days/year

> **97%** reactor reliability





NIST REACTOR

Regulated by the NRC

7 cycles/year

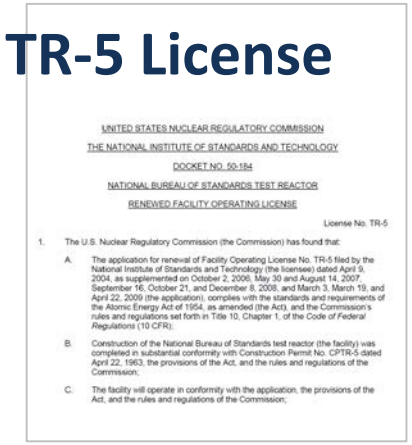
38 days/cycle

~240 days/year

Licensed through **2029**

SAFETY

TR-5 License



UNITED STATES NUCLEAR REGULATORY COMMISSION

THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

DOCKET NO. 50-184

NATIONAL BUREAU OF STANDARDS TEST REACTOR

RENEWED FACILITY OPERATING LICENSE

License No. TR-5

1. The U.S. Nuclear Regulatory Commission (the Commission) has found that:

A. The application for renewal of Facility Operating License No. TR-5 filed by the National Institute of Standards and Technology (the licensee) dated April 9, 2004, as supplemented on October 2, 2006, May 30 and August 14, 2007, September 16, October 21, and December 8, 2008, and March 3, March 19, and April 22, 2009 (the application), complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in Title 10, Chapter 1, of the *Code of Federal Regulations* (10 CFR);

B. Construction of the National Bureau of Standards test reactor (the facility) was completed in substantial conformity with Construction Permit No. CPTR-5 dated April 22, 1963, the provisions of the Act, and the rules and regulations of the Commission;

C. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

Nuclear Regulatory Commission inspects NCNR, NIST Security and Emergency Services annually

maintenance and surveillance activities
fuel handling
experiments
procedures
emergency preparedness
safeguards and security
organizational structure
qualifications and responsibilities
operational activities
design and design control
review and audit functions
radiation and environmental protection
operator requalification
material control and accounting

NCNR Safety Assessment Committee

Independent, external group reviewing annually: Reactor operations and engineering activities performed in compliance with license requirements, health physics program, industrial safety program, hazard review committee, NCNR Safety Evaluation Committee.

NCNR Executive Safety Committee

NCNR, MML, PML leadership and safety staff who meet monthly to discuss progress on development and implementation of safety programs and safety performance of NCNR.

NIST IRSC

SNM-362 license

NCNR Safety Evaluation Committee

Independent review of safety aspects of reactor operations; evaluates reactor operational activities, improving quality of operations programs, recommends corrective actions.

NCNR Hazard Review Committee

Independent group that reviews hazard assessments on all potentially hazardous activities conducted at the NCNR.

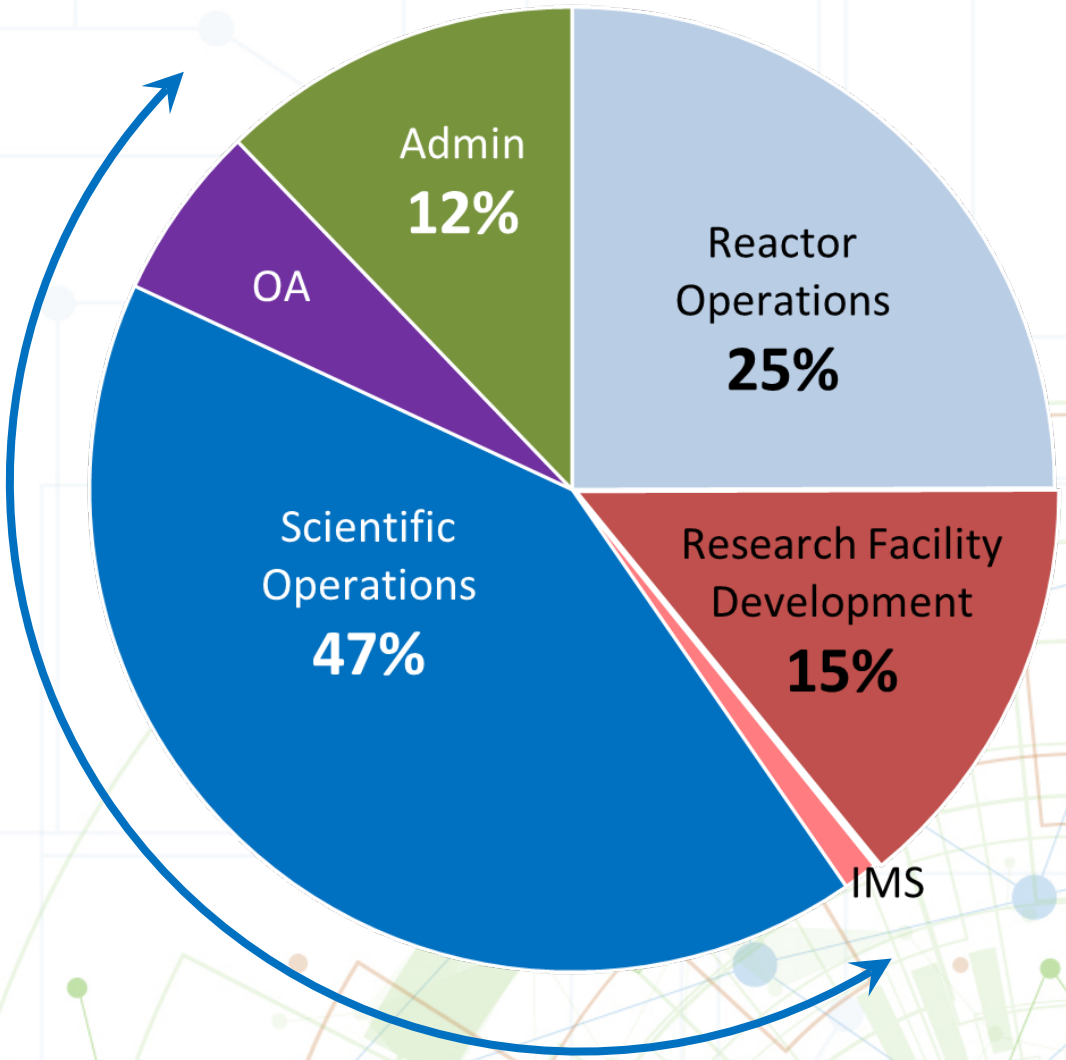
NIST ESC

NIST safety programs

BUDGET

$48M (STRS)

$3.2M (OA)



PARTNERSHIPS

Expanding the research community's access to NIST's neutron capabilities

CHRNS — Center for High Resolution Neutron Scattering (NSF / NIST)

Maximizing access for the scientific community to transformative neutron scattering instrumentation

NIST/NSF partnership
Operates 6 neutron scattering instruments
Robust user support
Education & outreach

Smithsonian (National Museum of Natural History)

Nuclear Laboratory for Archaeological Research &
Chemical analysis (INAA) of > 43000 archaeological artifacts

iPRIME (UMN) & ExxonMobil Research

SANS consortium for large scale structure in soft matter (e.g. polymers, complex fluids, petroleum mixtures)

General Motors

Neutron imaging/visualizing the operation of fuel cells for vehicles

nSoft

Development of advanced measurements of materials and manufacturing processes for manufacturers of soft materials (e.g. plastics, composites, protein solutions, surfactants, and colloidal fluids).

Photo credits: Ronald L. Bishop

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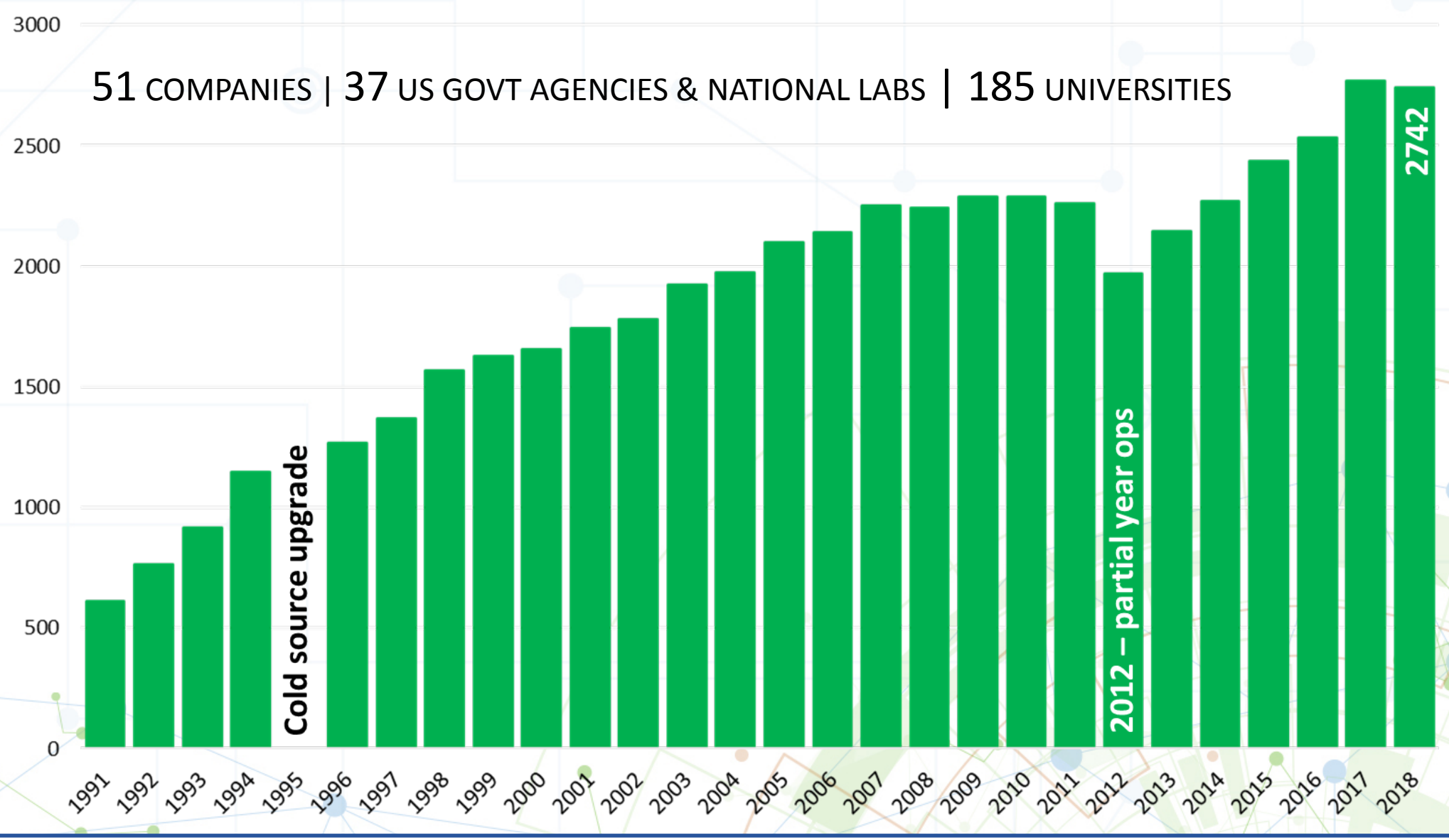
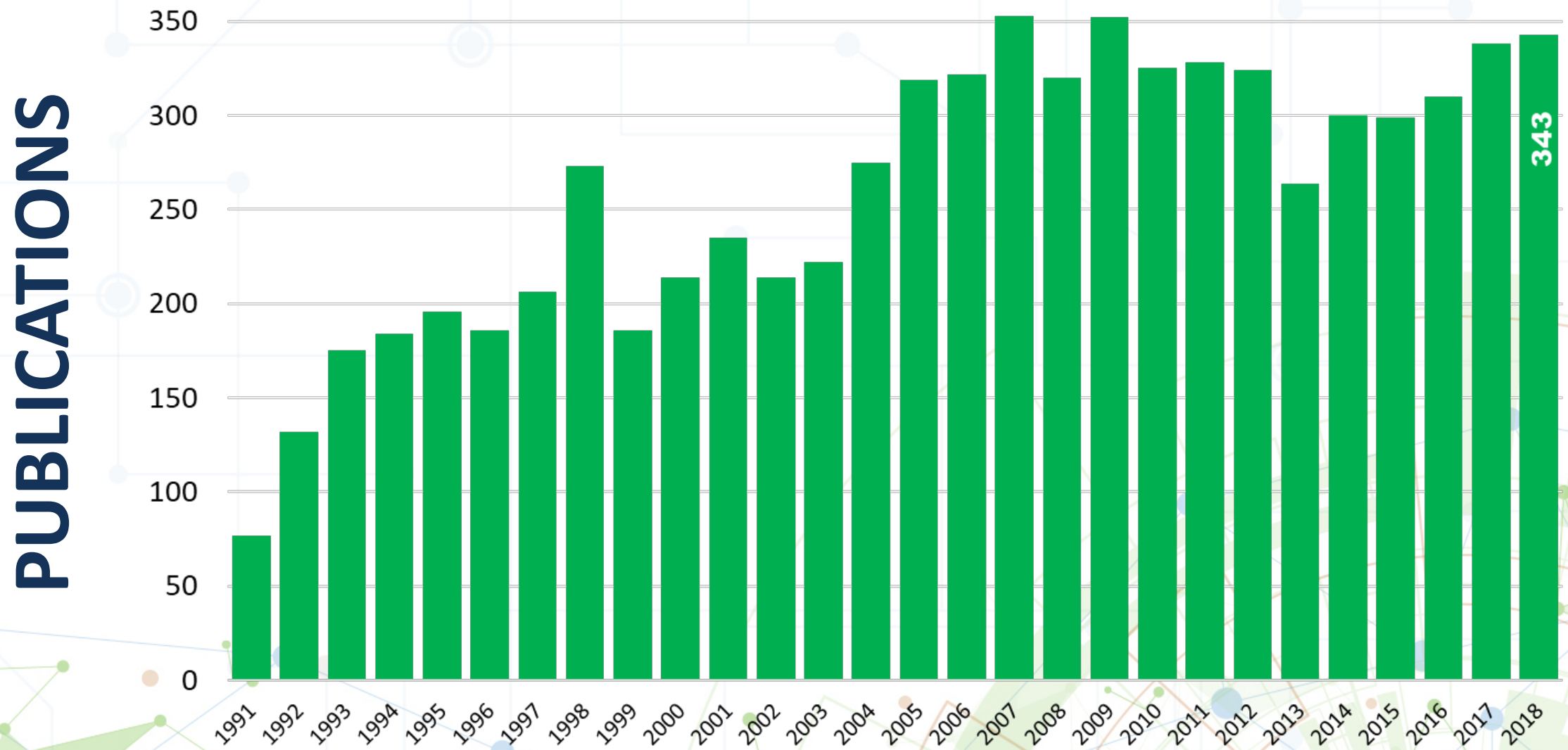
RESEARCH PARTICIPANTS

51 COMPANIES | 37 US GOVT AGENCIES & NATIONAL LABS | 185 UNIVERSITIES



National Institute of Standards and Technology
U.S. Department of Commerce

NCNR



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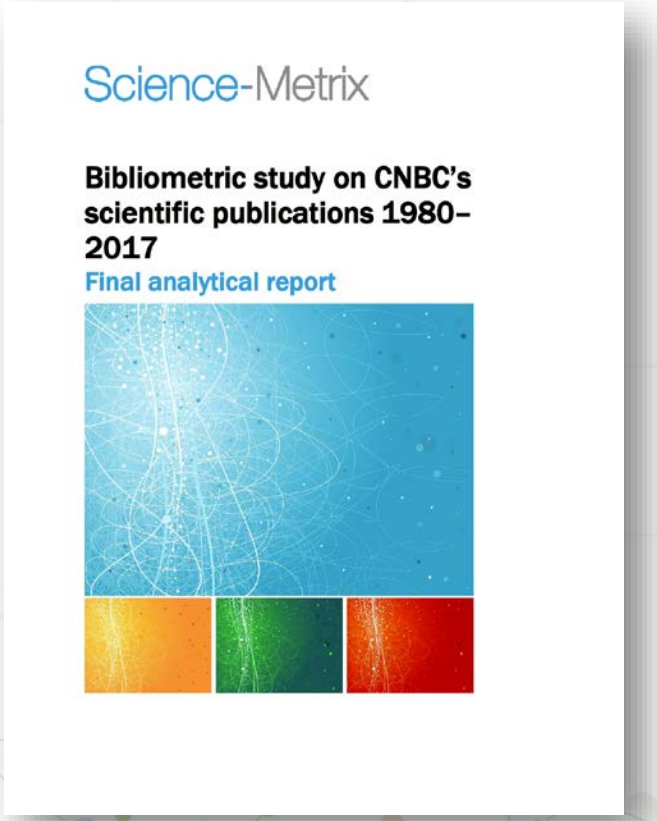
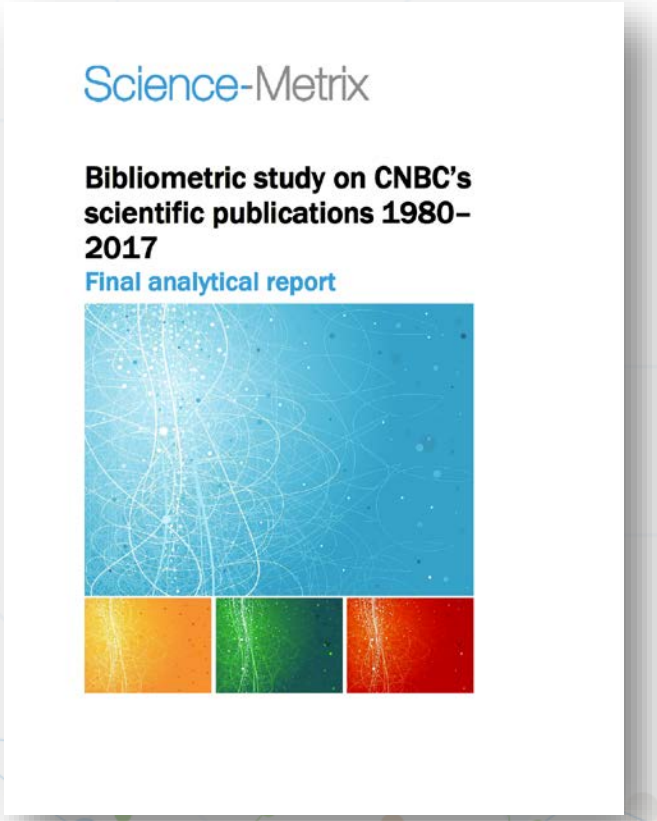
NCNR

FACILITY IMPACT



The current study uses the bibliometric record to capture the outcomes and achievements of the CNBC's teams and networks of collaborators from 1980 to 2017. It contextualizes the CNBC's activities through a comparison to three Canadian and five international benchmark institutions, which provide points of reference to guide the interpretation of bibliometric findings.

FACILITY IMPACT



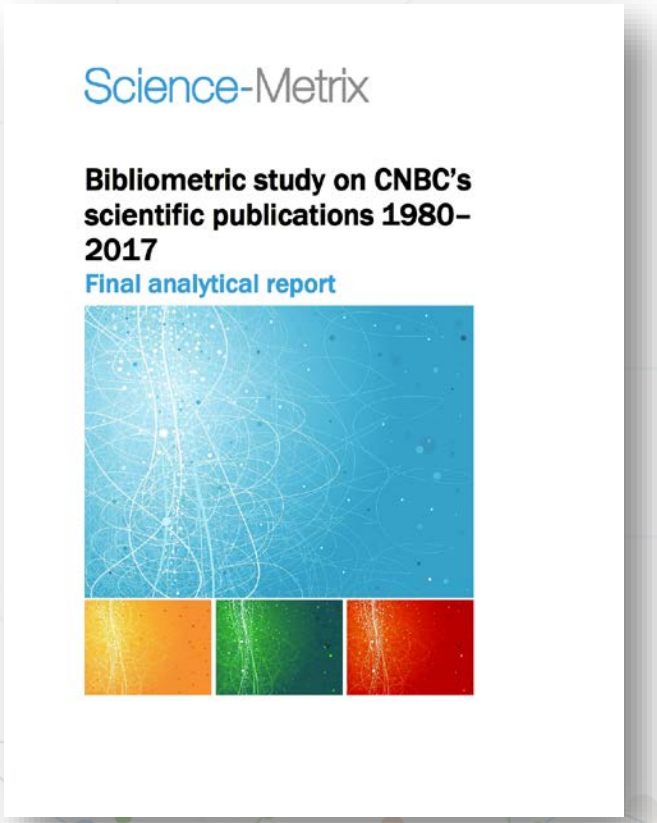
Average of Relative Citations

Institution	ARC*
Institut Laue-Langevin	1.03
Laboratoire Léon Brillouin (LLB)	1.06
Los Alamos Neutron Science Center (LANSCE)	1.30
Canadian Beam Neutron Centre (CNBC)	1.39
ORNL High Flux Isotope Reactor (HFIR)	1.57
NCNR	1.95

*ARC: Average of Relative Citations for 2000-2017

1.0 = world average
1.2 → papers cited 20% more than world average

FACILITY IMPACT

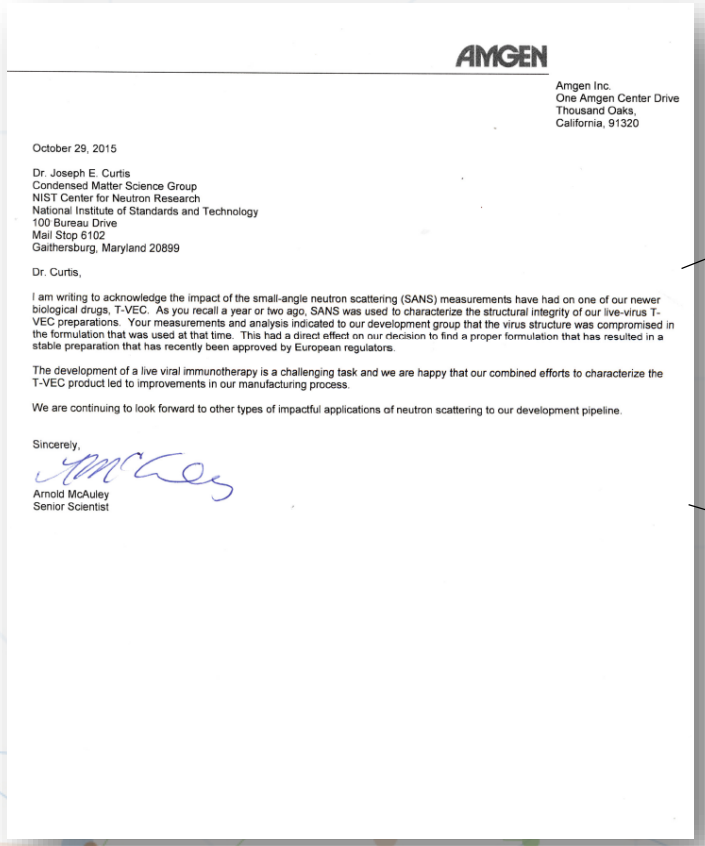


> The NCNR came in … first by a wide margin for all citation indicators

> The NCNR is … the only institution examined to have displayed consistently high performances across most indicators.

FACILITY IMPACT: IMLYGIC

Injectable formulation of T-VEC for treatment of melanoma



AMGEN

Amgen Inc.
One Amgen Center Drive
Thousand Oaks,
California, 91320

October 29, 2015

Dr. Joseph E. Curtis
Condensed Matter Science Group
NIST Center for Neutron Research
National Institute of Standards and Technology
100 Bureau Drive
Mail Stop 6102
Gaithersburg, Maryland 20899

Dr. Curtis,

I am writing to acknowledge the impact of the small-angle neutron scattering (SANS) measurements have had on one of our newer biological drugs, T-VEC. As you recall a year or two ago, SANS was used to characterize the structural integrity of our live-virus T-VEC preparations. Your measurements and analysis indicated to our development group that the virus structure was compromised in the formulation that was used at that time. This had a direct effect on our decision to find a proper formulation that has resulted in a stable preparation that has recently been approved by European regulators.

The development of a live viral immunotherapy is a challenging task and we are happy that our combined efforts to characterize the T-VEC product led to improvements in our manufacturing process.

We are continuing to look forward to other types of impactful applications of neutron scattering to our development pipeline.

Sincerely,

Arnold McAuley
Senior Scientist

“Your (SANS) measurements and analysis indicated to our development group that the virus structure was compromised in the formulation that was used at that time. This had a direct effect on our decision to find a proper formulation that has resulted in a stable preparation that has recently been approved by European regulators.”

Arnold McAuley
Amgen Senior Scientist

Approved by FDA

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INPUT from the SCIENTIFIC COMMUNITY

CHRNS Review Committee
NCNR User Group
NCNR Users
Beam Time Allocation Committee
National Academies' Panel of Assessment

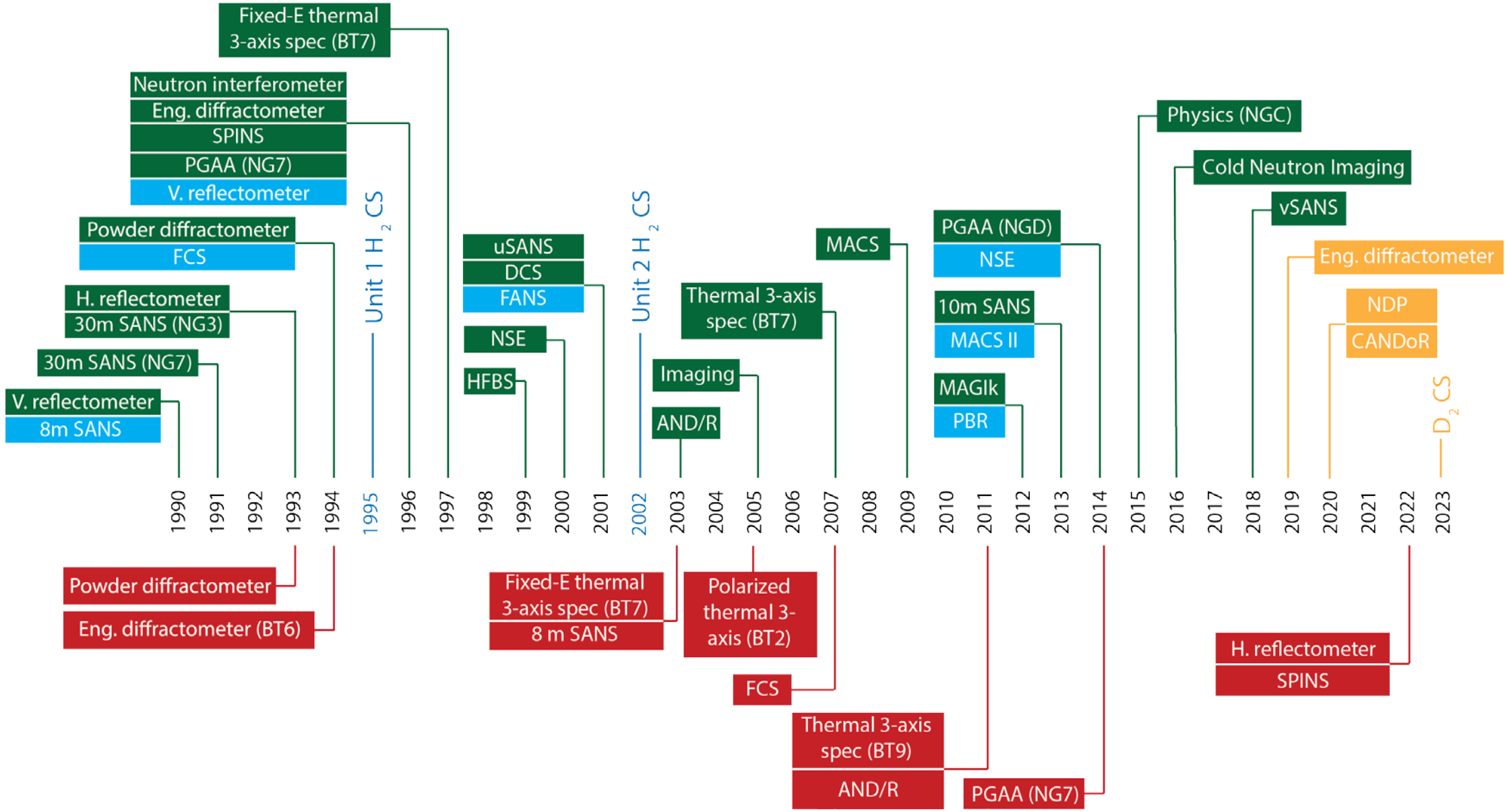
NCNR Expansion Workshop
July 17-19, 2006 | Bethesda, MD

Neutron Measurements for Materials Design & Characterization
August 21-22, 2014 | Potomac, MD

Neutrons for Quantum Information Workshop
Nov 26, 2018 | NCNR

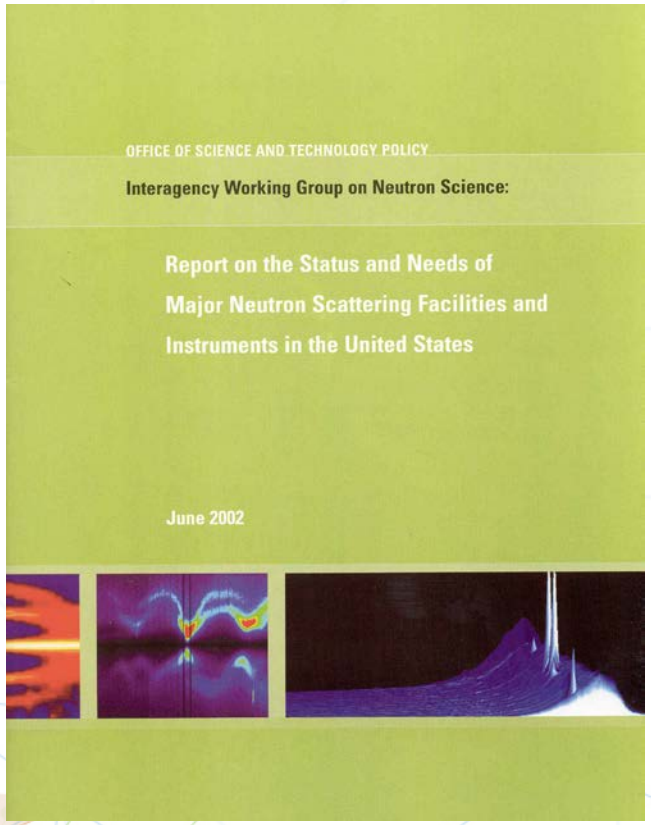
NCNR INSTRUMENT TIMELINE

Instrument became available for users
Major instrument upgrade
Projected availability for users
Instrument decommissioned



Assessing the National Needs: OSTP Report[‡]

2002



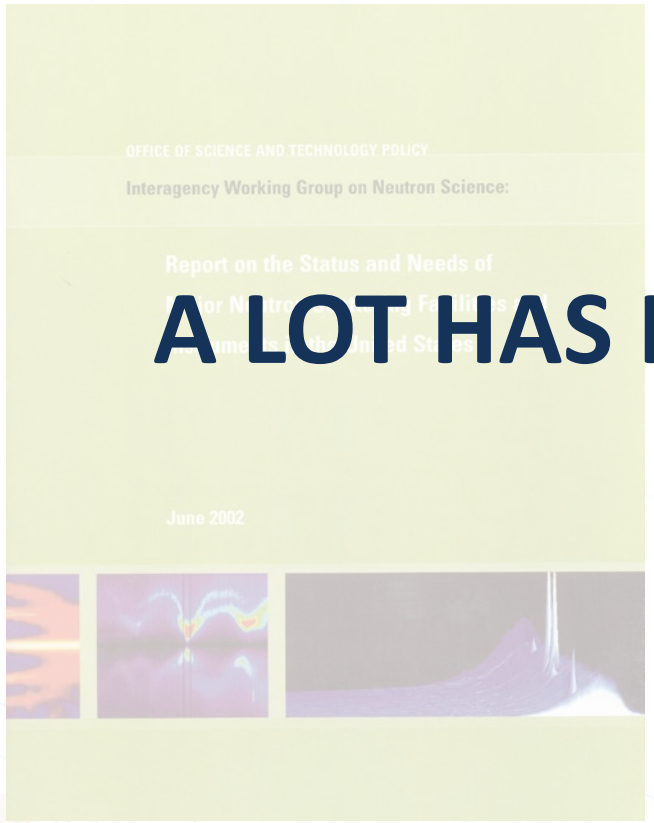
"The NIST facility is the only U.S. facility which currently provides a broad range of world-class capability."

"…it is also important to improve both the number and quality of neutron scattering instruments at the Nation's best neutron sources and to broaden access to those facilities by the U.S. research community."

"The highest priority for federal investments in neutron scattering is to fully exploit the best U.S. neutron source capabilities—including the SNS—for the benefit of the broadest scientific community."

[‡] From the Office of Science and Technology Policy Interagency Working Group on Neutron Science: *Report on the Status and Needs of Major Neutron Scattering Facilities and Instruments in the United States*, June 2002.

Assessing the National Needs: OSTP Report‡
2002



A LOT HAS HAPPENED IN THE LAST 17 YEARS

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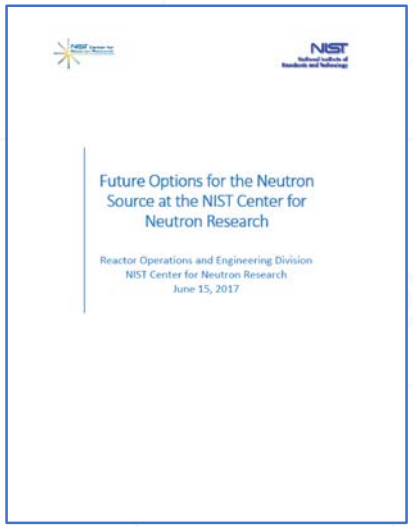
2005	FRM II user operations begin (Germany)
2006	**SNS first neutrons**
2006	OPAL first criticality (Australia)
2008	**IPNS ceases operations**
2008	J-PARC SNS first neutrons (Japan)
2009	ISIS STS begins operations (UK)
2010	HANARO begins cold source operations (South Korea)
2010	CARR first criticality (China) - awaiting user ops to start
2011	PIK (Russia) first criticality
2012	**NCNR completes cold neutron expansion project**
2012	CMRR user operations begin (China)
2014	**Lujan Center ceases BES-supported user operations**
2014	ESS construction begins (Sweden)
2016	RA-10 construction begins (Argentina)
2016	**SNS-STS receives conceptual design funding**
2017	CNBC ceases operations (Canada)
2018	CSNS commissioning completed (China)
2019	LLB to cease operations (France)
2019	BER II to cease operations (Germany)

A LOT HAS HAPPENED IN THE LAST 17 YEARS

THE LONG-TERM FUTURE OF NEUTRONS AT NIST



Future Options for the Neutron Source at the NCNR

June 2017

- Maintain NBSR in current configuration
- Major upgrade to the NBSR to enhance flux
- Replace the NBSR with a new reactor

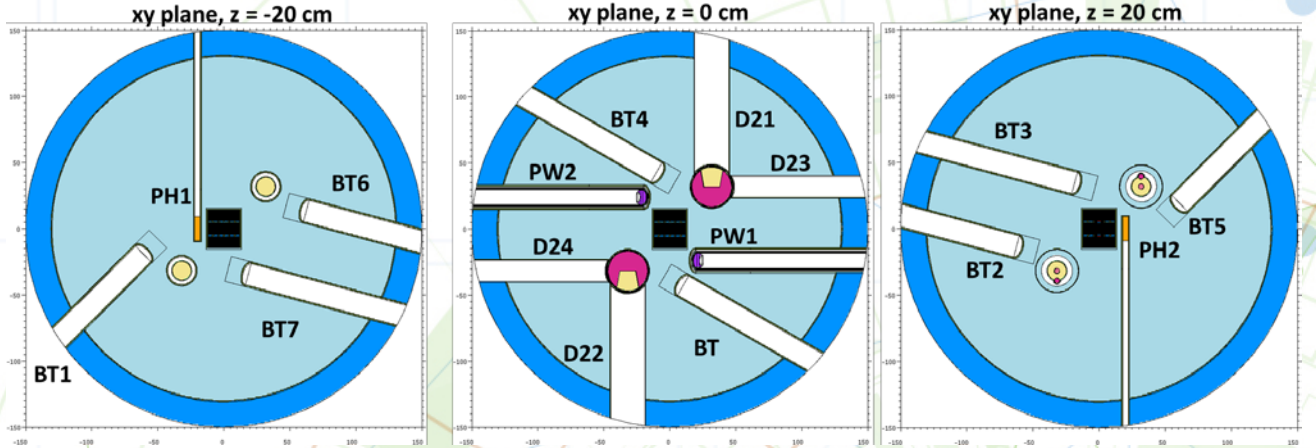
Replacement Neutron Source

Brainstorming conceptual designs

Emphasize science with cold neutrons

Exploit new developments in CNS technology (e.g. high brightness para-H_2)

National need: future NAS study



National Institute of Standards and Technology
U.S. Department of Commerce

NCNR

NIST MISSION

Developing neutron measurements and making them available to the scientific community is central to the NIST mission

A MAJOR NATIONAL USER FACILITY

Research quantities of neutrons can only be produced at major, centralized facilities

DELIVERING HIGH IMPACT

NIST continues to be a source of excellent science with neutrons

BUILDING FOR THE FUTURE

NIST's neutron measurement capabilities continue to improve