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

National Institute of Standards and Technology
U.S. Department of Commerce
NCNR
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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.
Serve the needs of researchers from industry, university, and government by operating the research facilities of the Center as a national user facility

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
THE POWER of NEUTRONS

\[ \lambda \sim \text{interatomic spacing} \]

\[ E \sim \text{atomic motion} \]

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

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

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

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

**SOFT MATTER**
*J.Kornfield et. al.*, Safer jet fuel via megasupramolecules

**ARCHEOLOGY**
*R. Bishop et. al.*, Mayan trade routes

**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

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 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.
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.

Source: Times reporting

Paul Duginski / @latimesgraphics
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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
Nuclear Regulatory Commission inspects NCNR, NIST Security and Emergency Services annually

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

Maximizing access for the scientific community to transformative neutron scattering instrumentation

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).

NIST/NSF partnership
Operates 6 neutron scattering instruments
Robust user support
Education & outreach
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NIST’s neutron measurement capabilities continue to improve.

NCNR
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

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

*ARC: Average of Relative Citations for 2000-2017

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

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

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

NCNR
Assessing the National Needs: OSTP Report‡

“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.”

“…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.”

Assessing the National Needs: OSTP Report

2002

“A LOT HAS HAPPENED IN THE LAST 17 YEARS

“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 these 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.”

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

**A LOT HAS HAPPENED IN THE LAST 17 YEARS**

*NCNR*
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-H₂)

National need: future NAS study
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