Neutrons at NIST

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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.

NIST LABORATORIES

Physical Measurements Laboratory  Material Measurements Laboratory  Engineering Laboratory  Information Technology Laboratory  Communication Technology Laboratory  Center for Nanoscale Science and Technology  NCNR

MEASUREMENT LABORATORIES  TECHNOLOGY LABORATORIES  USER FACILITIES
28 instruments
250 operating days
2 proposal calls/year
Unique instruments to address the needs of the scientific community
20 MW
D$_2$O moderated
30 fuel elements

$\Phi = 1.5 \times 10^{14}$ n/cm$^2$/s
at mid-plane
(un-fueled region)

7 cycles/year
38 day cycles
~250 days/year

Licensed through 2029
Cold neutrons (long $\lambda$, small $E$) are well-suited for probing structure and dynamics of soft matter such as polymers and biomolecules.

Unit 2 CS serves 12 guides

Pee-wee CS serves MACS
The US scientific community would produce more high quality science if it had *more good neutron scattering instruments.*
Safe, reliable, good source of thermal & cold neutrons

- Replaced secondary cooling system
- Added capacity via new cooling tower cell
- Installed new electrical substation
- Upgraded thermal shield cooling system
- Instrumentation and control upgrades
- Replaced primary storage tank pumps
- Installed new cold source for MACS
- Spent fuel pool liner upgraded
- New emergency backup power systems installed
- Control rod supply ("shim arms")
- Liquid D$_2$ cold source
- Secure D$_2$O supply
- HEU to LEU conversion
- Age management
- Control room modernization program
- Plant instrumentation
- Replace primary pumps
- New de-min water supply
- Maintenance of all systems, etc…

Good neutron scattering capabilities

- VSANS, CANDoR, cold neutron imaging, engineering diffractometer
- Instrument development workshop in August 2014
- Sample environment
- Polarized neutron beam production/analysis

To 2029 & Beyond…
MAJOR REACTOR PROJECTS

- secondary cooling pump building
- electrical substation
- thermal shield cooling system
- pool liner
- cooling tower cell
Reactor control room modernization
Future Cold Source Layout

- Cutout for new guides
- LD$_2$ source
- BT-9 LH$_2$ source (2012)
WHY NEUTRON SCATTERING?

$\lambda \sim$ interatomic spacing

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

$x$-ray scattering
cross-sections

Neutron scattering
cross-sections

$E \sim$ atomic motion

Penetrating

Magnetic
TiAu: a magnetic system with no magnetic elements?

AFM order for $T < 36$ K

…↑↓↑↓↑↓↑↓…
Things on a very small scale behave like nothing that you have any direct experience about. They do not behave like waves, they do not behave like particles, they do not behave like clouds, or billiard balls, or weights on springs, or like anything that you have ever seen.

Determining the effective transverse coherence of a neutron wave packet