NCNR
A National User Facility
The mission of the NIST Center for Neutron Research is to ensure 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.

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

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

General User Access
TECHNICAL MERIT based – No user charges

2 proposal calls/year
Independent reviews for technical merit

Collaborative Access
Merit based via instrument owner

Proprietary Use
Confidential results
User pays full cost recovery per OMB A-25
20 MW
D$_2$O moderated
30 fuel elements

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

Licensed through 2029
NCNR INSTRUMENT LAYOUT
March 2016

NSE
10M SANS
30M SANS
aCORN
PGAA
MAGIk
PBR
HFBS
DCS
CNI
30M SANS
PHADES
NIOF
NIOF-A
REFL
USANS
VSANS
CANDoR
BT8
NDP
BT4/FANS
NIF
DIFF
BT1
MACS
BT7
~250 operating days
First guide hall ~1990

Guide hall extension 2010

THEN
U.S. Research Participation at the NCNR
NCNR RESEARCH PARTICIPANTS

- **50** U.S. corporations
- **183** Universities
- **37** U.S. government labs

Yearly participants from 1986 to 2015, with a peak of 2,436 in 2015.
WHERE CAN YOU DO NEUTRON SCATTERING?
...fully instrument and staff those sources so that they achieve the highest level of scientific productivity and serve the broadest possible user community.
To improve access and to enable the user community to grow it is critically important to increase the number of instruments at major facilities in the US. The size of the US user community is currently limited by the number of instruments.

Scientifically successful access today, especially for new users, depends on the active assistance and collaboration of facility instrument scientists at a scientific level.
The US neutron scattering community is ~35% of that in Europe.

The US scientific community would produce more high quality science if it had **more good neutron scattering instruments**.
NCNR
A Facility for Science
NEUTRONS – AN IDEAL PROBE PARTICLE FOR SEEING DIFFERENTLY

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

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

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

Magnetic

Penetrating
Piezoelectrics

mechanical energy ↔ electrical energy

RELAXED EQUILIBRIUM

COMPRESSED

CHARGE SEPARATION
Piezoelectrics

Credit: J. Stroscio, R. Celotta/NIST
Relaxor ferroelectric has *record-setting* piezoelectric effect

Piezoelectrics
PZN-4.5%PT

Sample
atoms in a crystalline sample

Detector

Monochromator
A crystal that sorts and forwards neutrons of a certain wavelength (energy)

Analyzer
A crystal that sorts and forwards to the detector neutrons that have exchanged energy with the sample by a specific amount

M100 Galactic Nucleus
Hubble Space Telescope

before corrective optics

Wide Field Planetary Camera 1

after corrective optics

Wide Field Planetary Camera 2

http://hubblesite.org/newscenter/archive/releases/1994/01/image/a/
Magnetocalorics

magnetic energy ↔ thermal energy
Magnetocalorics

magnetic energy ↔ thermal energy

Credit: Talbott, NIST
Magnetocalorics

When the neutrons collide with the atoms they change direction - they are scattered elastically.

**Sample**
Atoms in a crystalline sample

**Detected**
Records the directions of the neutrons and a diffraction pattern is obtained. The pattern shows the positions of the atoms relative to one another.

**Monochromator**
A crystal that sorts and forwards neutrons of a certain wavelength (energy)

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Metal-Orgamic Frameworks

W.L. Queen et al., Chem. Sci. 5, 4569 (2014).
Metal-Orgnic Frameworks

W.L. Queen et al., Chem. Sci. 5, 4569 (2014).
SHEAR THICKENING FLUIDS

Videos courtesy of the U.S. Army Research Lab

3 layers of ballistic nylon
SHEAR THICKENING FLUIDS

Videos courtesy of the U.S. Army Research Lab

2 layers of STF + nylon
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 in October 2015
All photos used for the slides describing non-Newtonian fluids and metal-organic frameworks are licensed under the Creative Commons License.

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Shear thickening schematic reproduced with permission from N.J. Wagner and J.F. Brady, Physics Today 62(10), 27. Copyright 2009, American Institute of Physics.