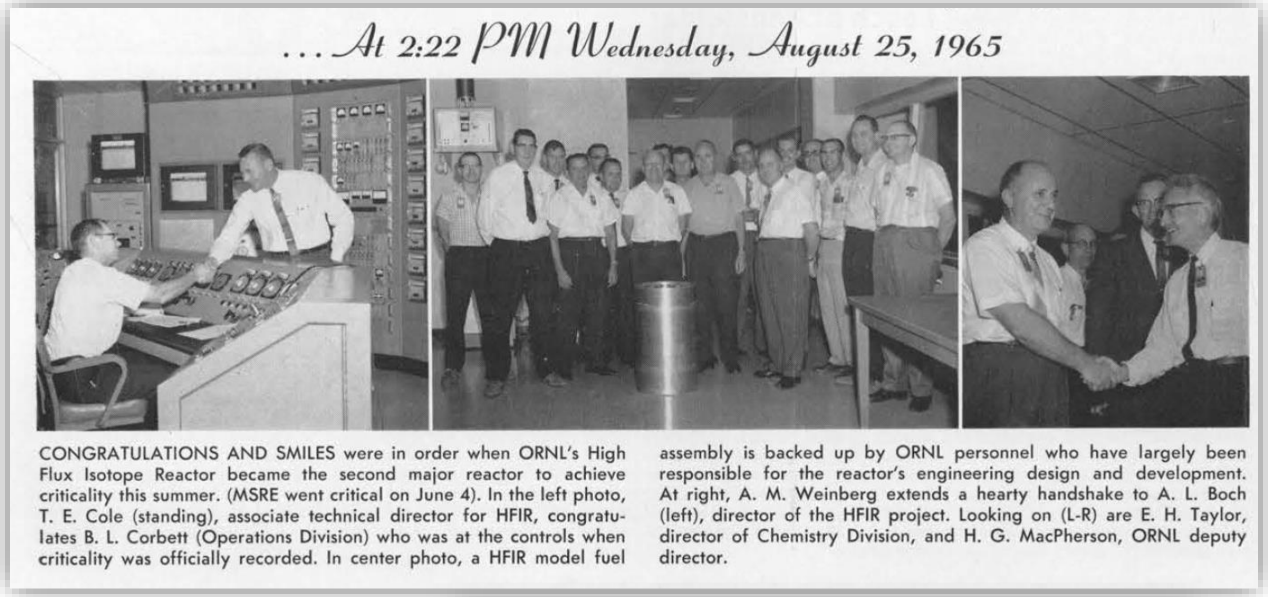
A Very Brief History and Description of the High Flux Isotope Reactor (HFIR)

Josh Pierce

Neutron Technologies Division

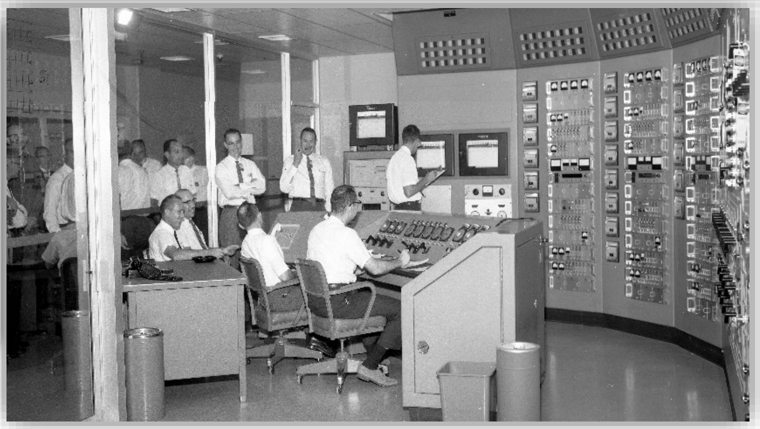
Turned on in 1965

- *Primary purpose was to produce transuranic elements*
  - *Elements such as berkelium, californium, and einsteinium*
  - *Only source of californium-252 in North America*
  - *Also has beam ports that allow access to thermal neutrons*
- *Shut Down for a few years to evaluate neutron radiation embrittlement of vessel*
  - *1986-1990*
- *Otherwise run continuously*
  - *Currently fuel 7 cycles a year*



. . . At 2:22 PM Wednesday, August 25, 1965

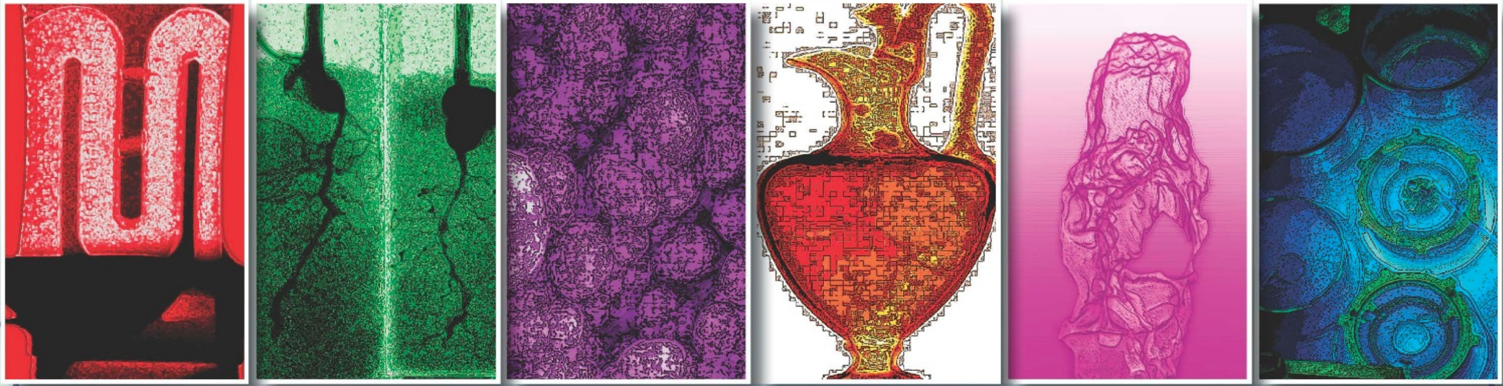
CONGRATULATIONS AND SMILES were in order when ORNL's High Flux Isotope Reactor became the second major reactor to achieve criticality this summer. (MSRE went critical on June 4). In the left photo, T. E. Cole (standing), associate technical director for HFIR, congratulates B. L. Corbett (Operations Division) who was at the controls when criticality was officially recorded. In center photo, a HFIR model fuel assembly is backed up by ORNL personnel who have largely been responsible for the reactor's engineering design and development. At right, A. M. Weinberg extends a hearty handshake to A. L. Boch (left), director of the HFIR project. Looking on (L-R) are E. H. Taylor, director of Chemistry Division, and H. G. MacPherson, ORNL deputy director.



4 Missions of HFIR now

A brighter future

The neutron scattering research facilities at HFIR contain a world-class collection of instruments used for fundamental and applied research on the structure and dynamics of matter. HFIR is also used for medical, industrial, and research isotope production; research on neutron damage to materials; and neutron activation analysis to examine trace elements in the environment. Additionally, the building houses a gamma irradiation facility that uses spent fuel assemblies and is capable of providing high gamma doses for studies of the effects of radiation on materials.



Neutron Scattering

Neutron scattering can provide information about the structure and properties of materials that cannot be obtained from other techniques such as x-rays or electron microscopes. There are many neutron scattering techniques, but they all involve the detection of particles after a beam of neutrons collides with a sample material. HFIR uses nuclear fission to release neutrons, which are directed away from the reactor core and down four steady beams. Three of these beams use the neutrons as they are created (thermal neutrons), and one beam moderates (cools and slows) the neutrons with supercritical hydrogen, enabling the study of soft matter such as plastics and biological materials. The thermal and cold neutrons produced by HFIR are used for research in a wide array of fields of study, from fundamental physics to cancer research. The high neutron flux in HFIR produces the world's brightest neutron beams, which allow faster and higher-resolution detection.

Irradiation Materials Testing

HFIR provides a variety of **in-core irradiation facilities**, allowing for a wide range of materials experiments to study the effects of neutron-induced damage to materials. This research supports fusion energy and next-generation nuclear power programs, as well as extending the lifetime of the world's current nuclear power plants. HFIR has the unique ability to deliver the highest material damage in the US.

The HFIR **Gamma Irradiation Facility** is designed to expose material samples to gamma radiation using spent HFIR fuel elements. The facility offers high dose rates and custom sample environments for the most innovative research.

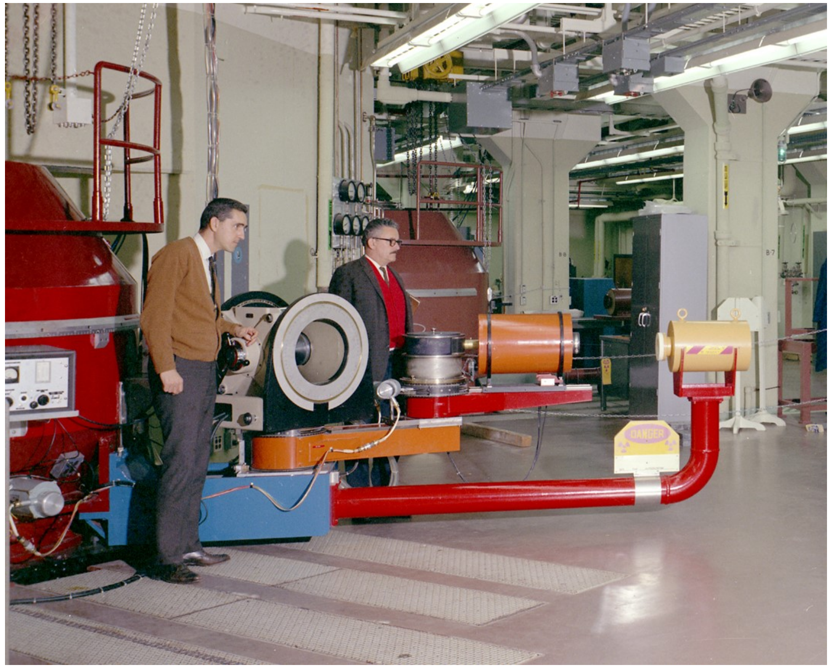
Isotope Production

Isotopes play an extremely important role in the fields of nuclear medicine, homeland security, energy, and defense, as well as in basic research. HFIR's high neutron flux enables the production of key isotopes that can not be made elsewhere, such as californium-252, selenium-75, and nickel-63, among others. Additionally, HFIR will produce plutonium-238, which is used to power NASA's deep space missions.

Neutron Activation Analysis

Neutron Activation Analysis (NAA) is an extremely sensitive technique used to determine the existence and quantities of major, minor, and trace elements in a material sample for applications including forensic science, environmental monitoring, nonproliferation, homeland security, and fundamental research.

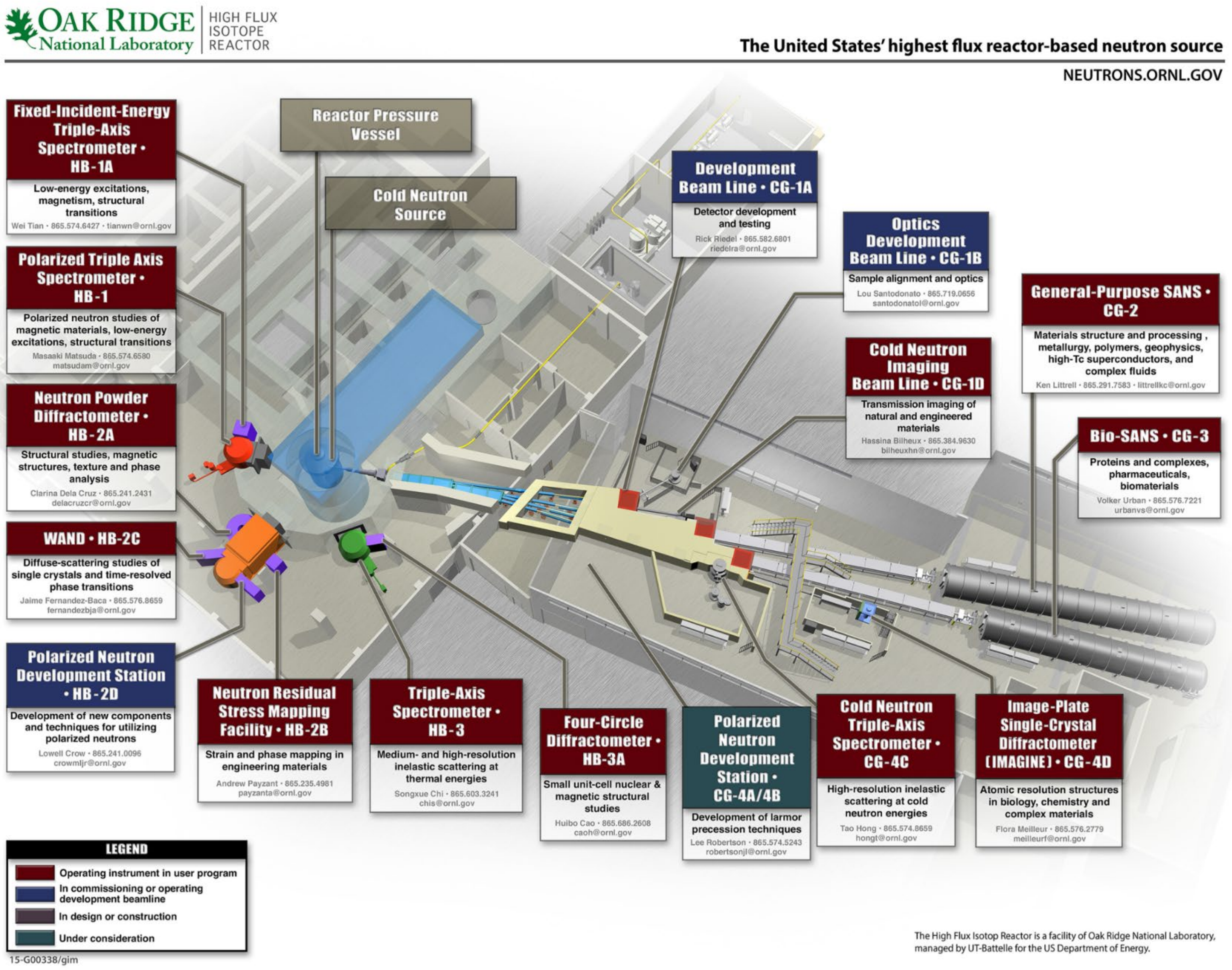
Neutron Scattering at HFIR



Moon and Koehler

- *Four thermal beam ports from the beginning*
- *In 2007 HB-4 was equipped with a cold hydrogen moderator*
  - *Neutrons scattering in the moderator, shifting their energy spectrum down towards the temperature of the moderator*
- *Cold Guide Hall built to accommodate new suite of neutron scattering instruments*

Neutron Scattering Instruments



Most Standard Types Represented

- Small Angle Neutron Scattering
- Diffractometers
- Triple Axis Spectrometers
- Neutron Imaging
- Wide angle diffractometer

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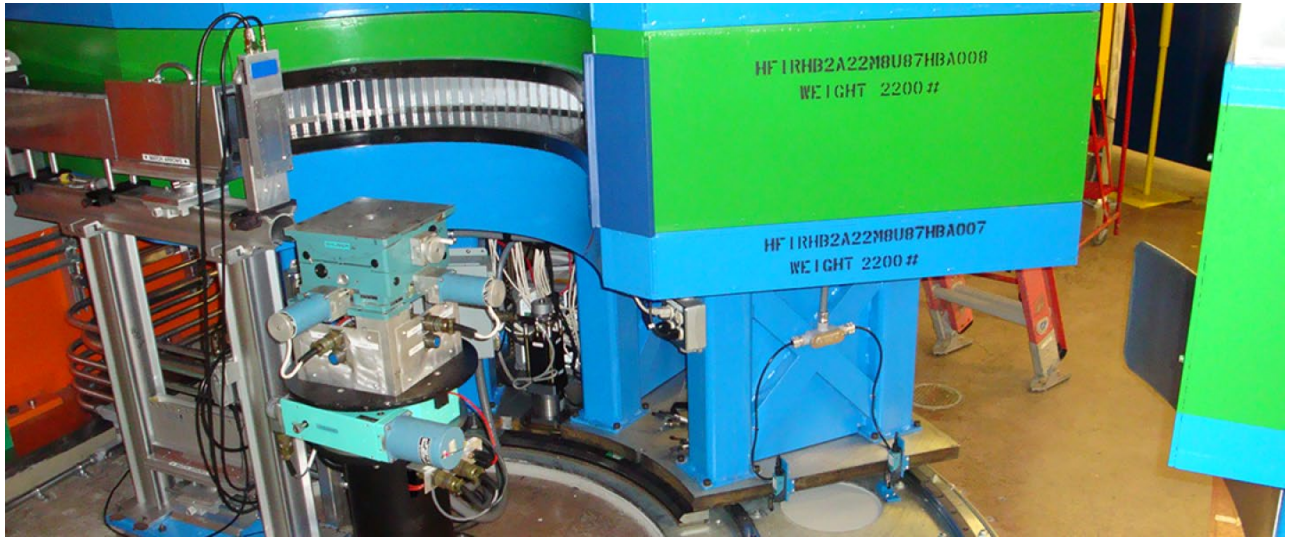

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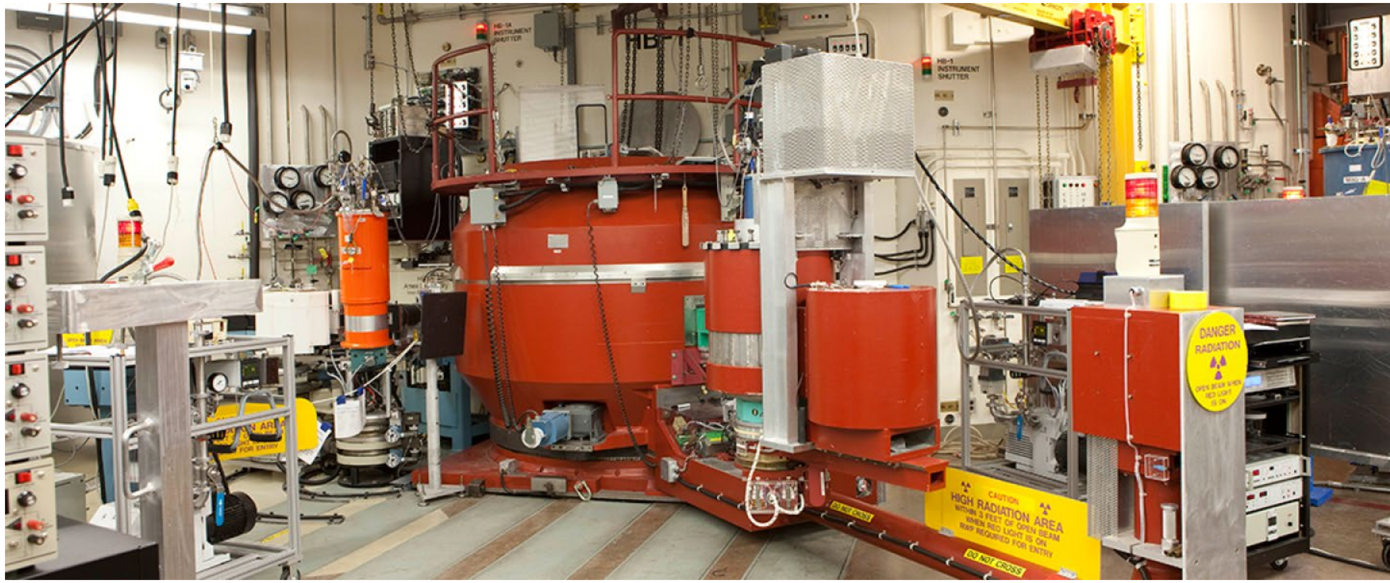

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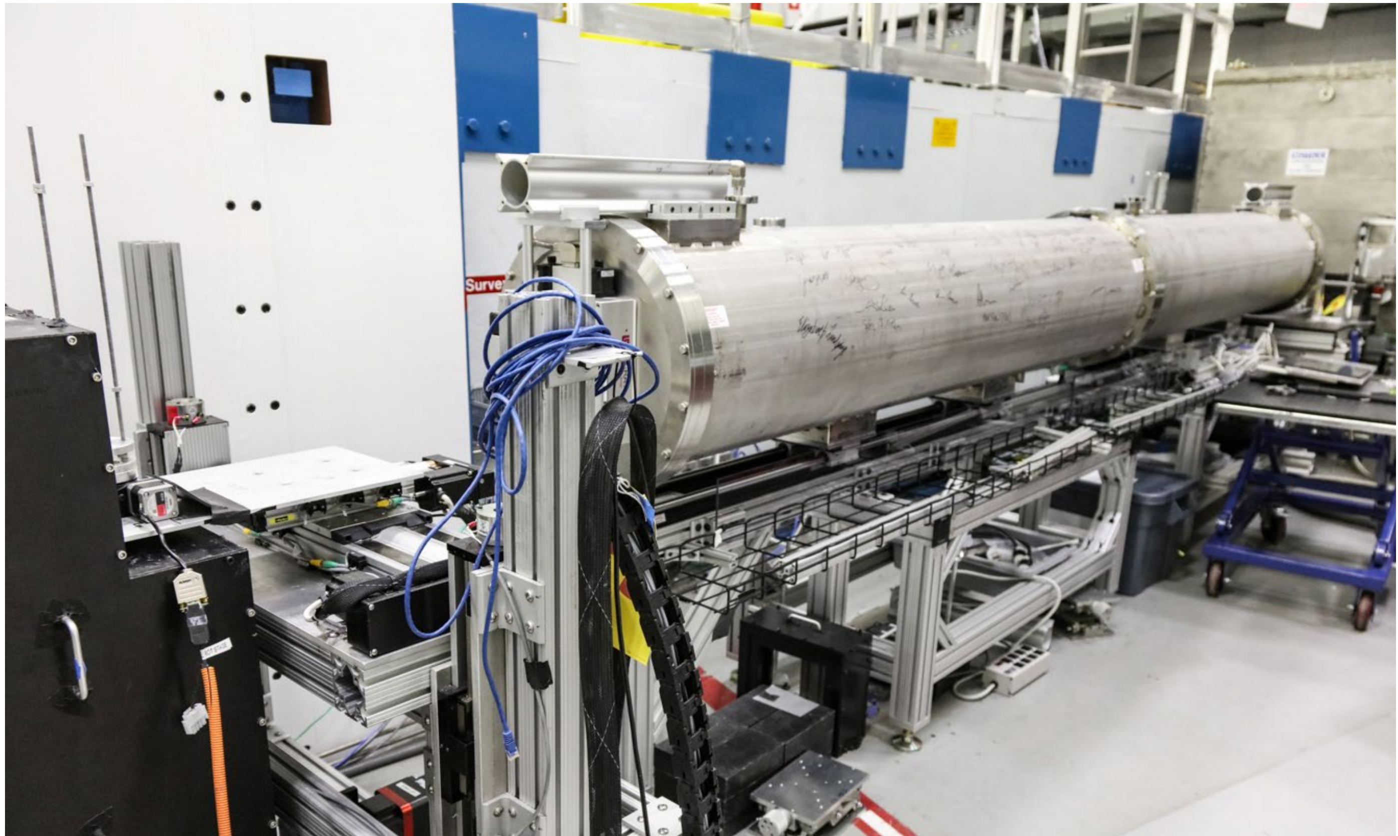

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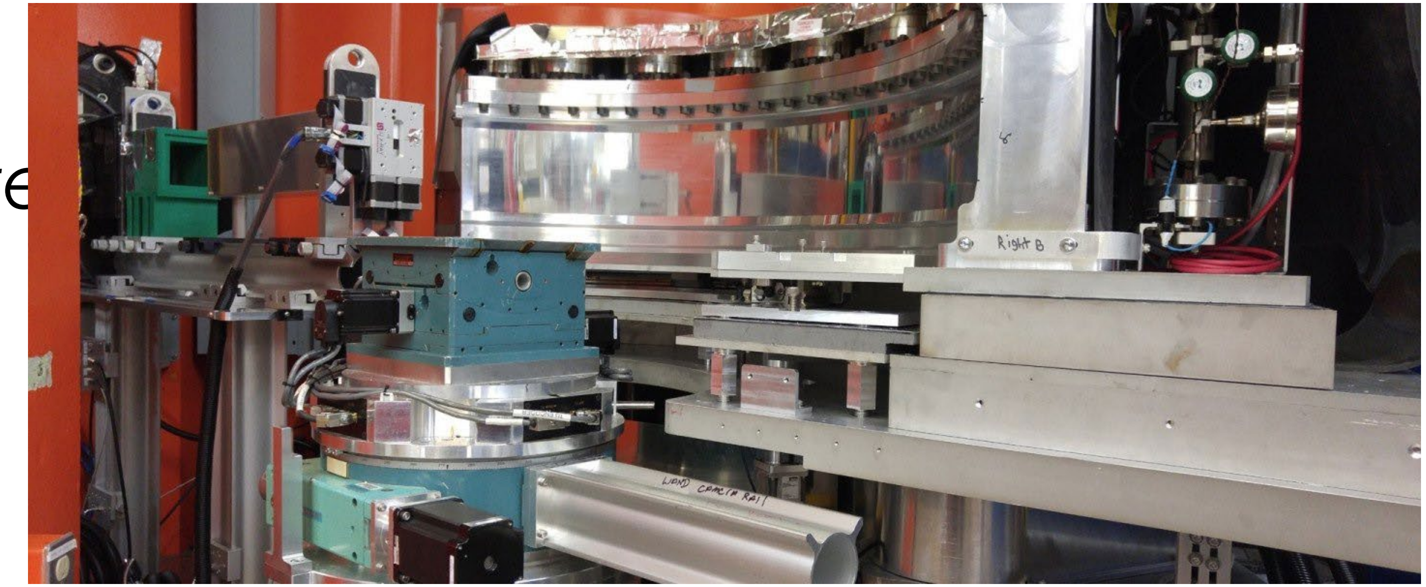

Upgrades Coming Soon!

- "Permanent" Beryllium reflector needs to be replaced soon
  - It physically swells over time with exposure to neutrons
- Replacement requires the removal of all beam tubes and all instruments from the thermal beam room
- An opportunity to reconfigure the cold guide hall to increase the performance of all the instruments

Questions?

Comments?

Corrections?