

VULCAN – The Roman God of Fire and Metal Working at the SNS

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Presentation Outline

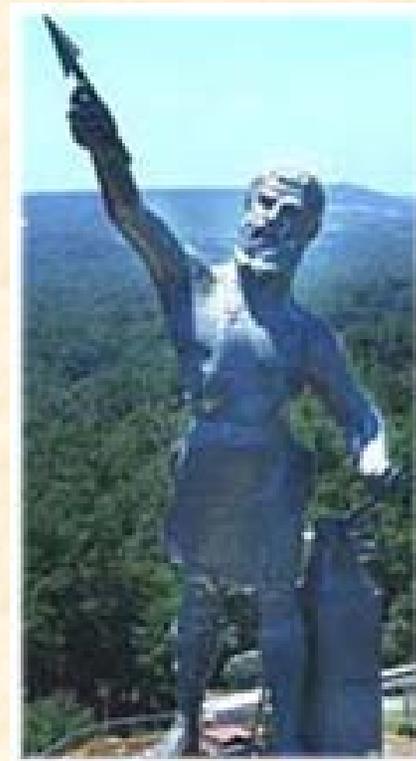


- **Historical account**
- **Conceptual design**
- **Estimated performance**
- **New research opportunities**

VULCAN History Review



- 1996-1999, workshops to define scientific needs
- October 1999, Instrument Scientist hired
- January 2000, workshop in Atlanta to finalize scientific cases
- May 2000, instrument named VULCAN
 - By Tom Holden
 - After the Roman God of fire and metal working
- June 2000, conceptual design presented and approved
- October 2001, JINS Workshop
 - 160 attendees
- November 2003, funding received from Canada Foundation for Innovation

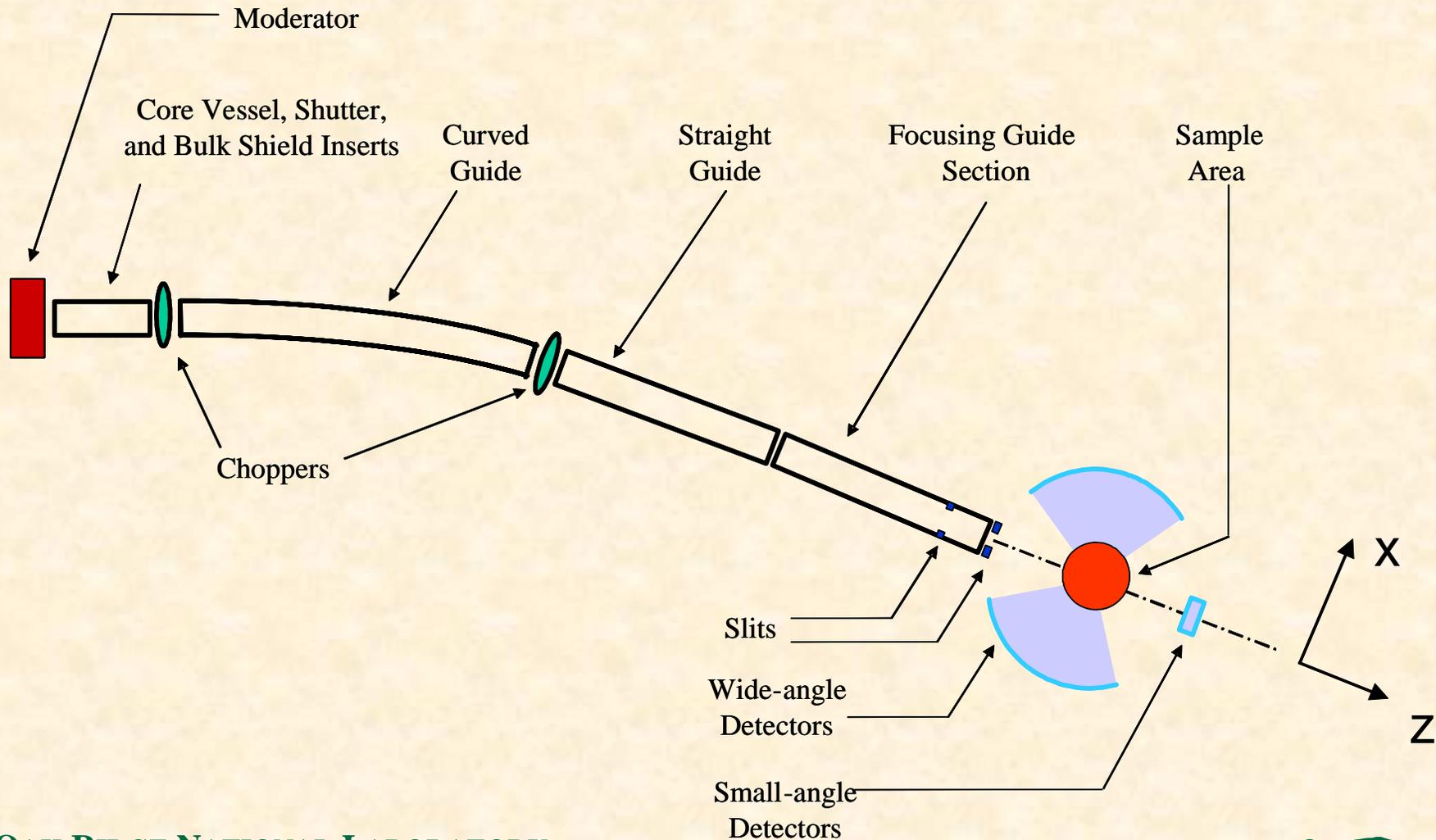


Finalized Performance Requirements

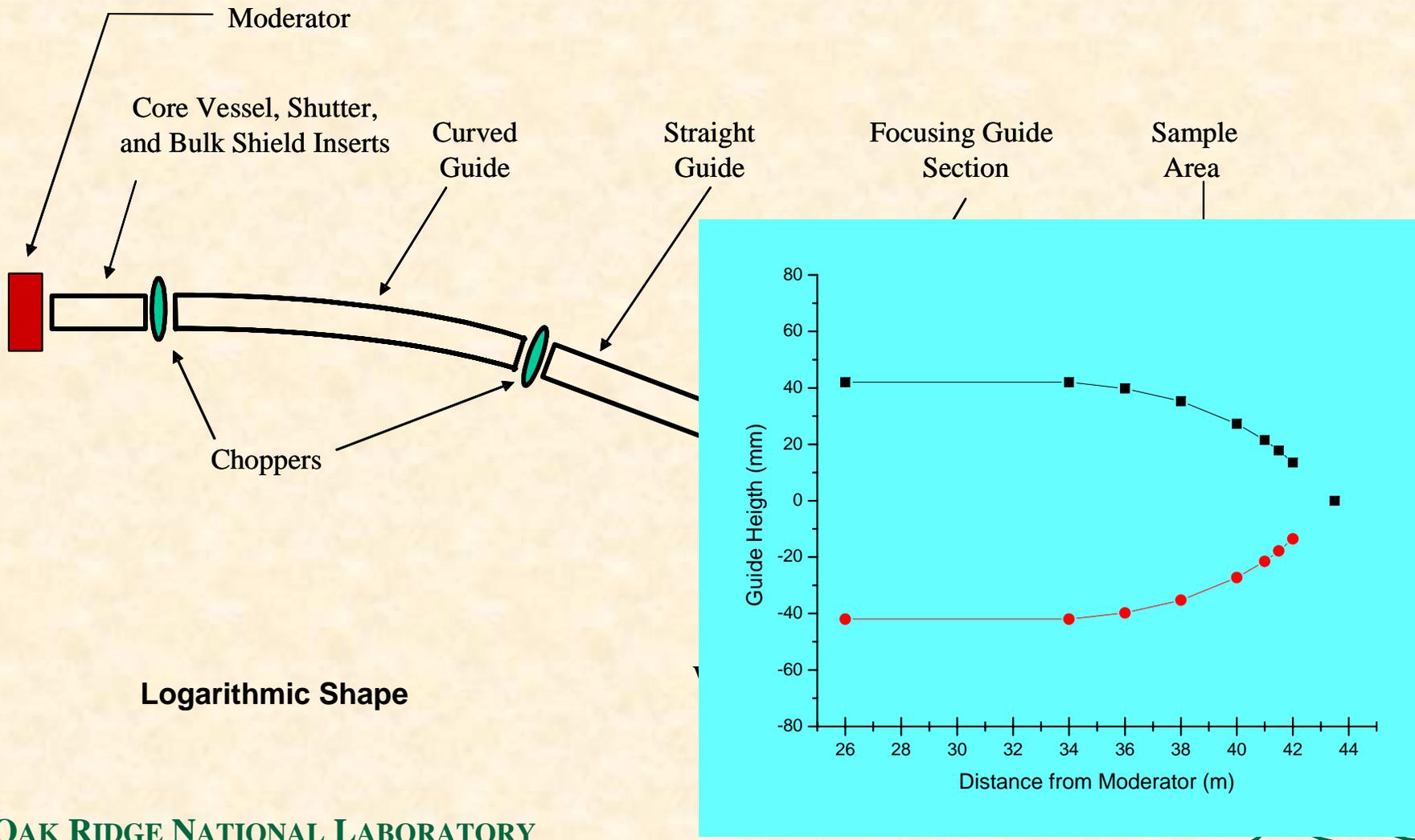


- Rapid volumetric (3D) mapping with a sampling volume of 1 mm³ and a measurement time of **minutes**
- Very high spatial resolution (**0.1 mm**) in one direction with a measurement time of minutes
- **~20** well defined reflections for in-situ loading studies
 - 0.2% resolution
- Ability to study kinetic behaviors in **sub seconds**
- **Simultaneous in-situ** characterization capabilities
 - dilatometry
 - weight
 - microstructure
- Ancillary equipment such as **furnace and load frame** be an integrated part of the instrument

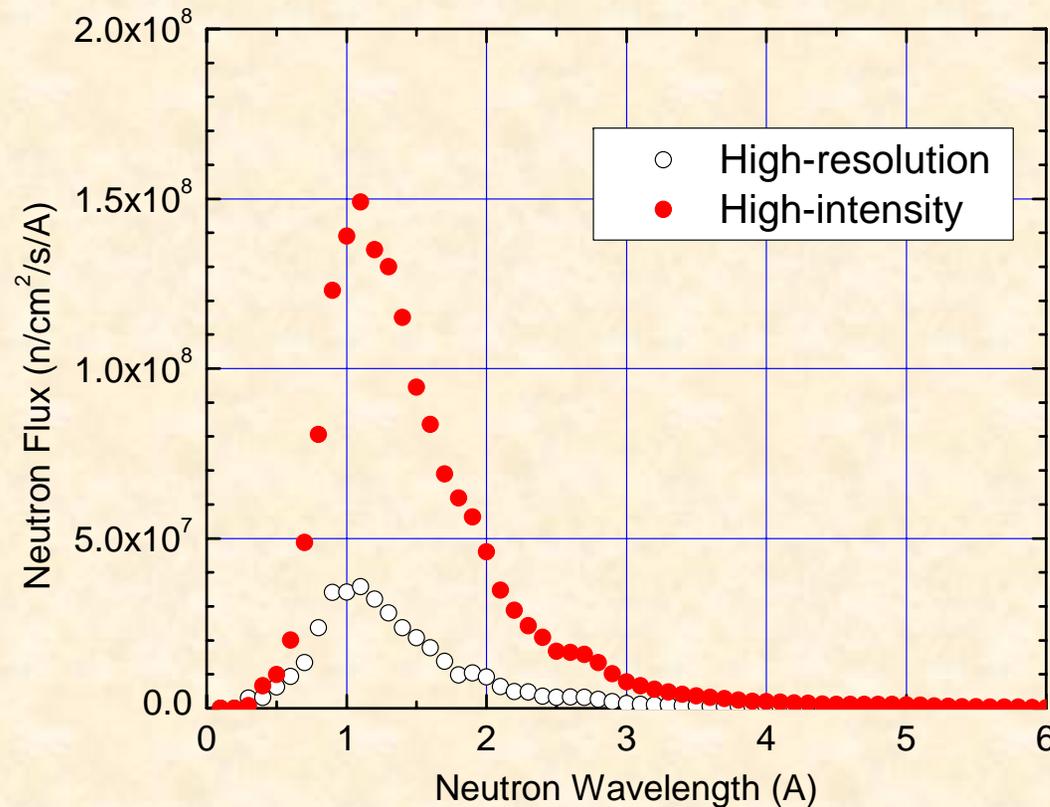
VULCAN Schematic Layout



VULCAN Schematic Layout



Calculated Flux on Sample Reaches 10^8 n/cm²/s in High-intensity Mode

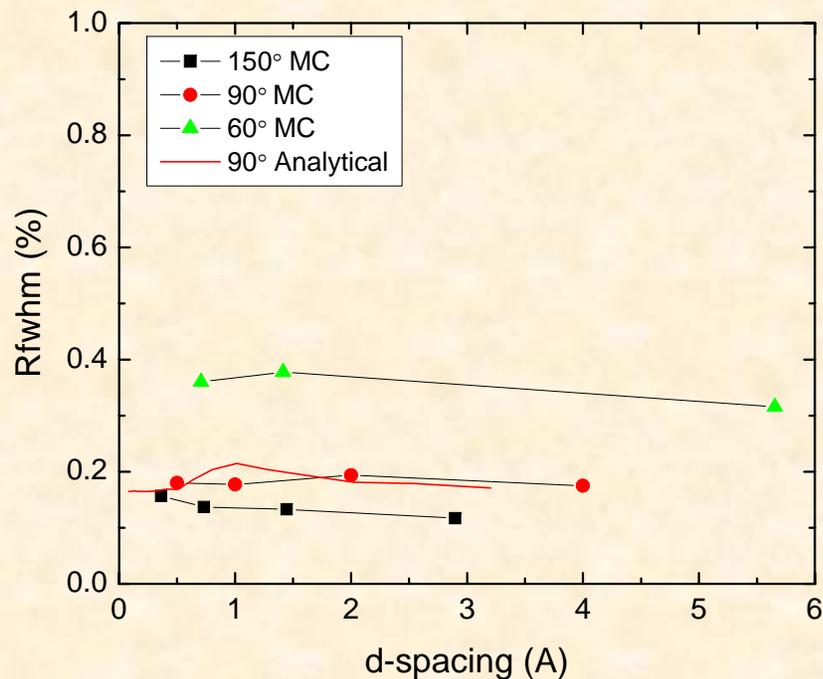


- Compared to no-focusing, this represents a gain of 1.3-4

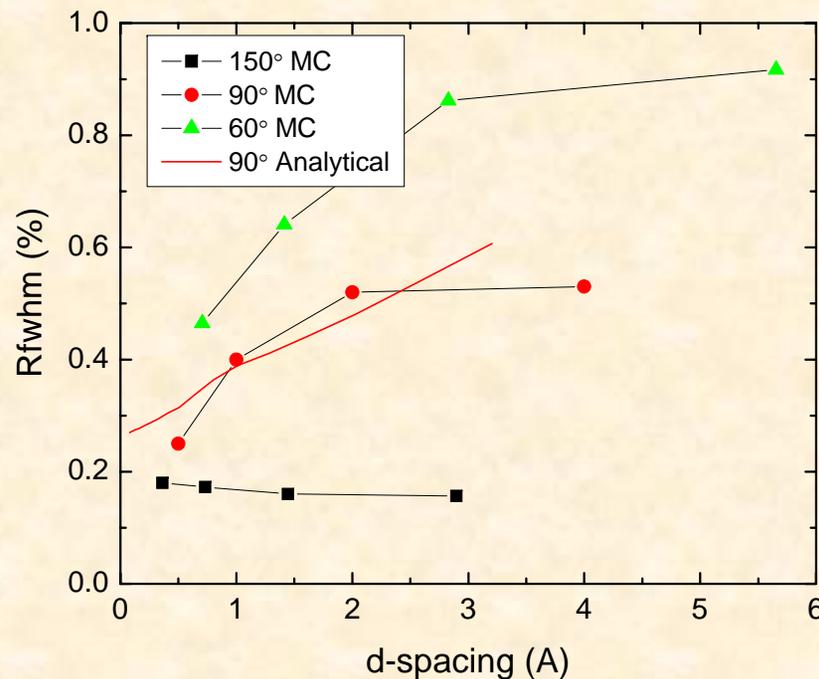
Estimated Resolution for Detectors in the Horizontal Plane



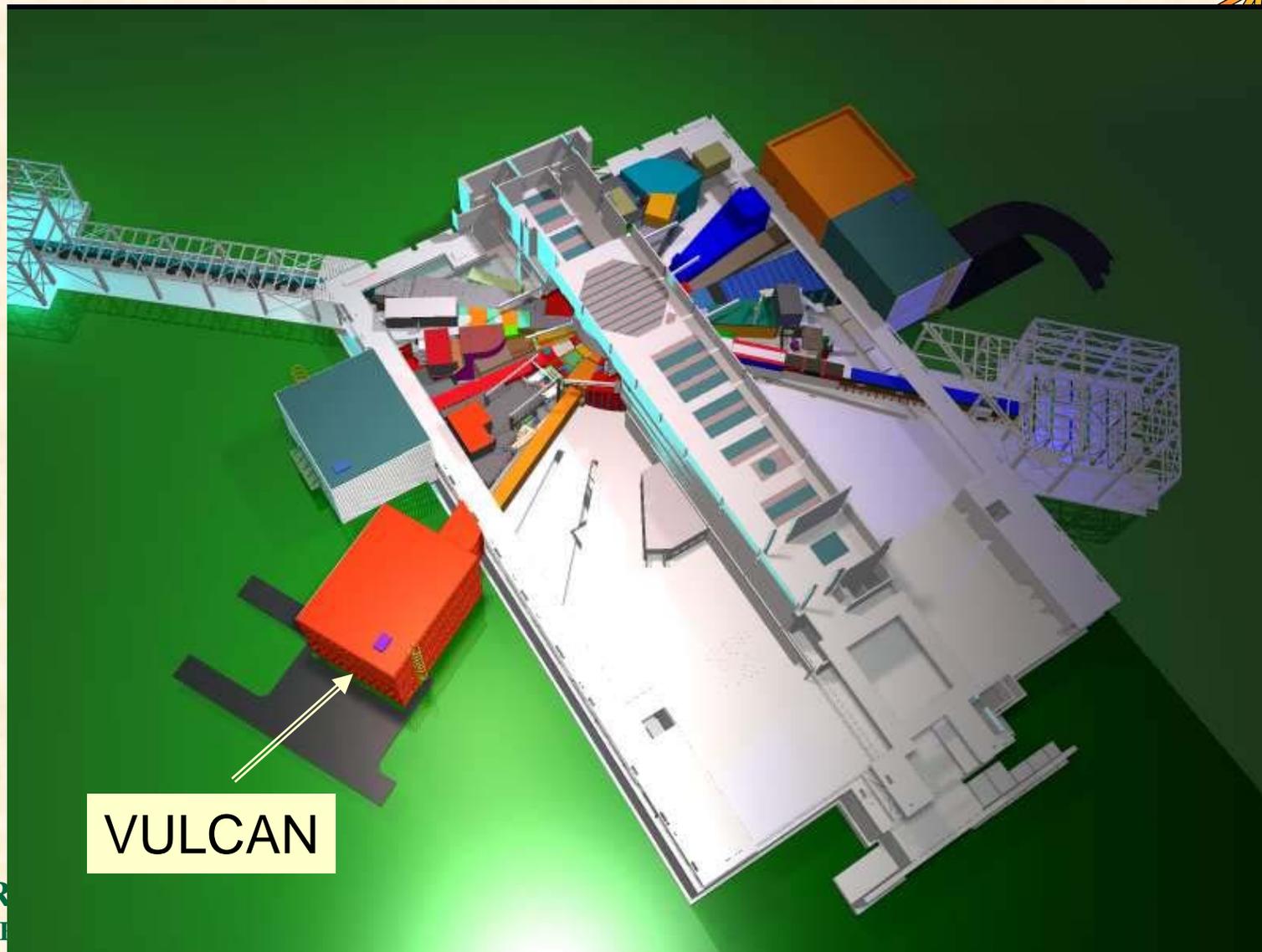
High-resolution configuration



High-intensity configuration



Neutron Instrument Suite at SNS



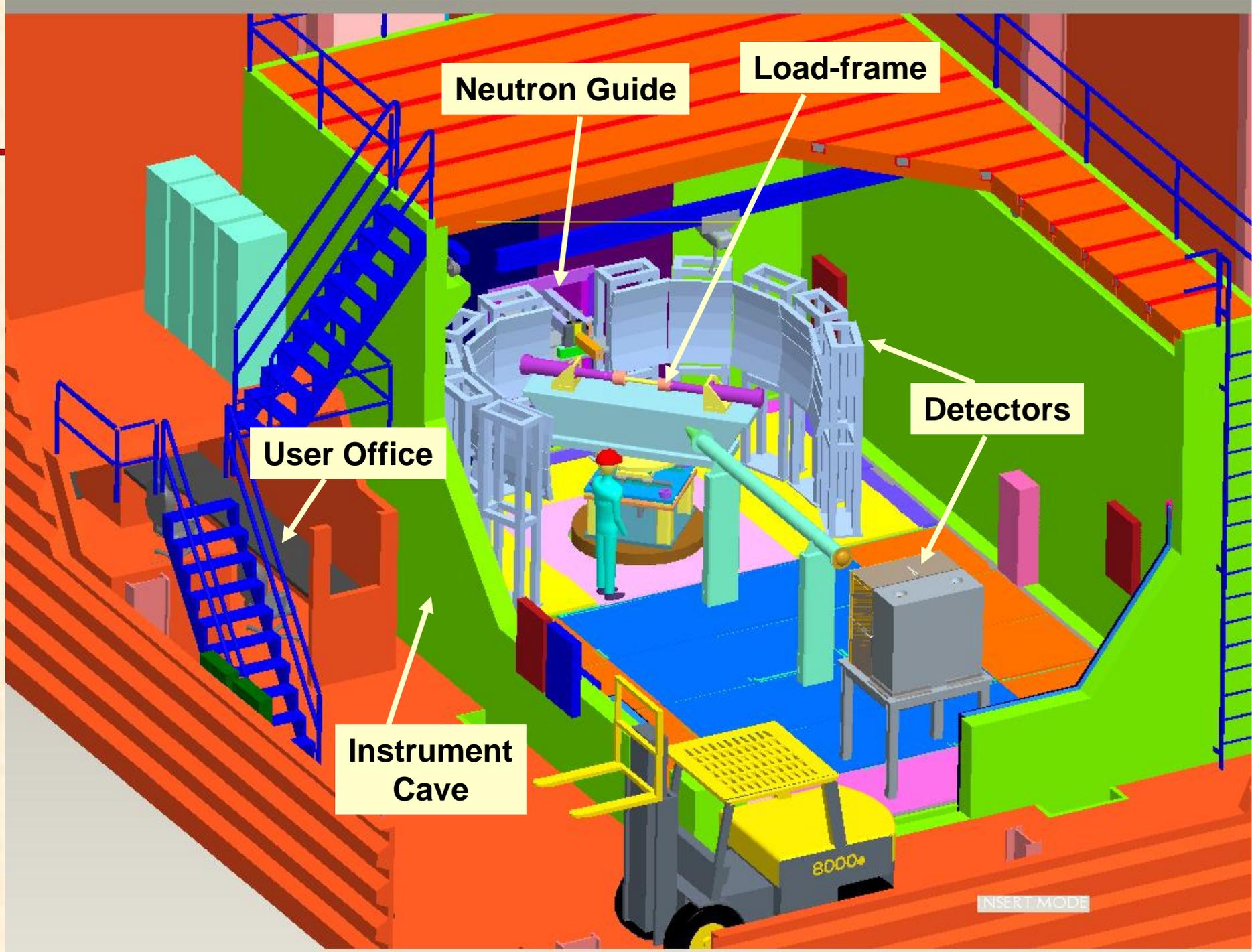
VULCAN

External Building Ground Breaking on June 23, 2006



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UT-BATTELLE



Neutron Guide

Load-frame

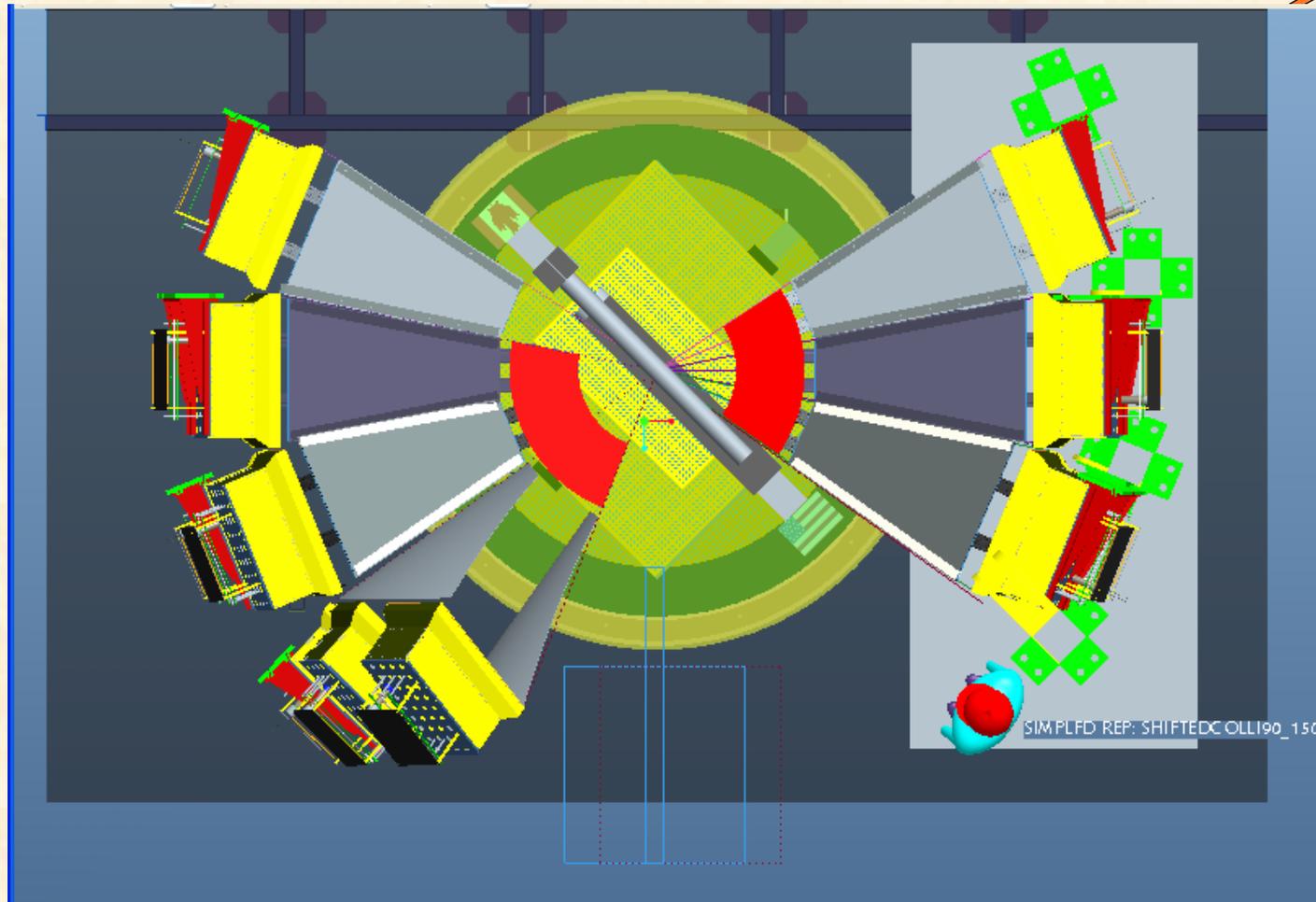
User Office

Detectors

Instrument Cave

INSERT MODE

Detectors & Collimators Assembly

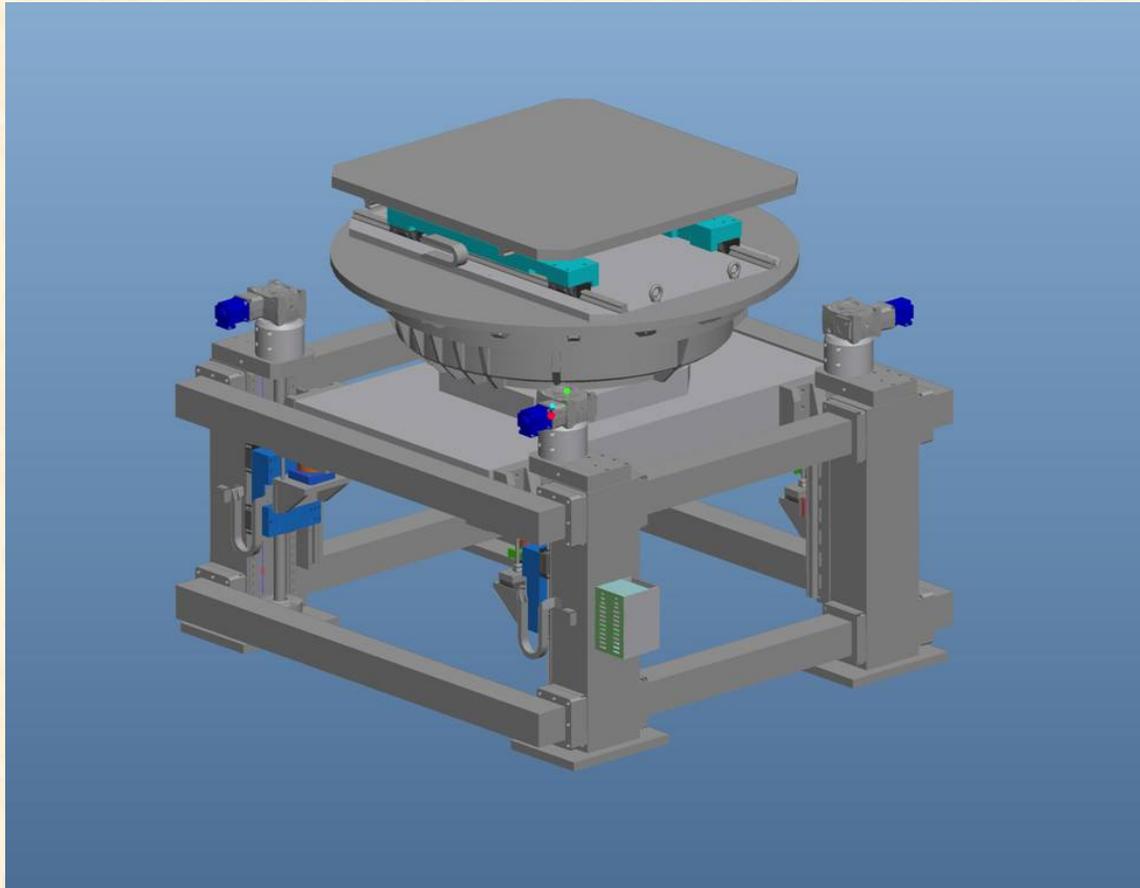


OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

45deg load frame, collimators at
400mm from sample

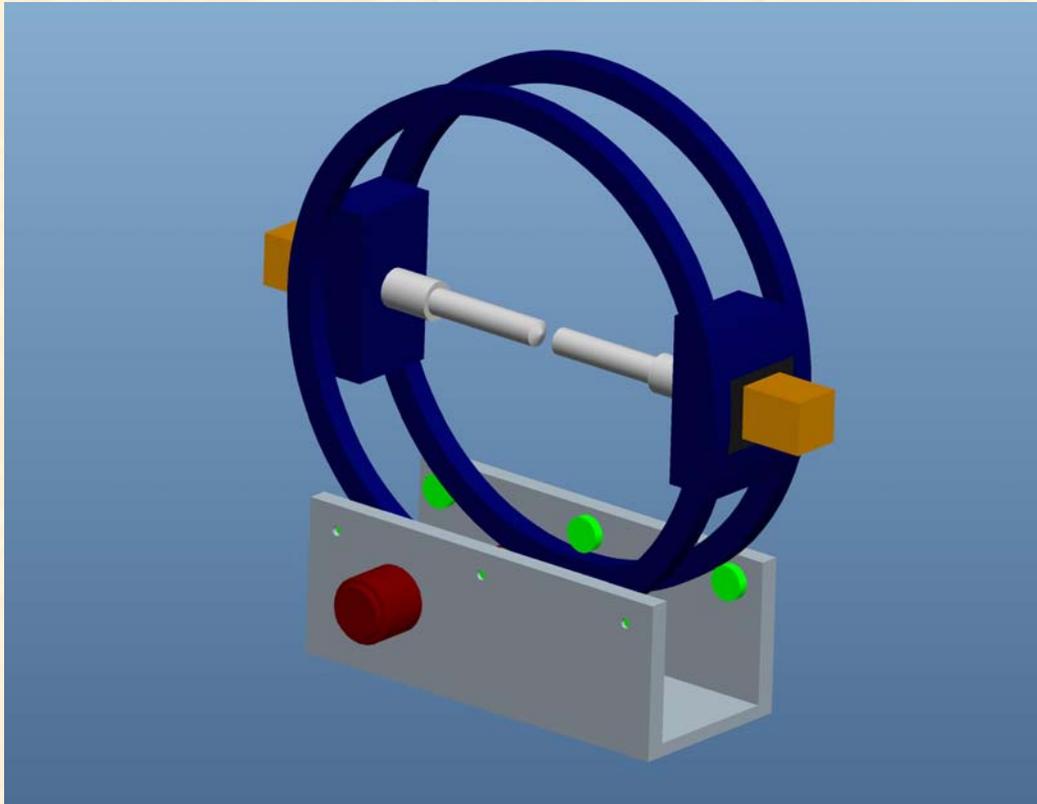


Preliminary Design for VULCAN Sample Table Is Complete

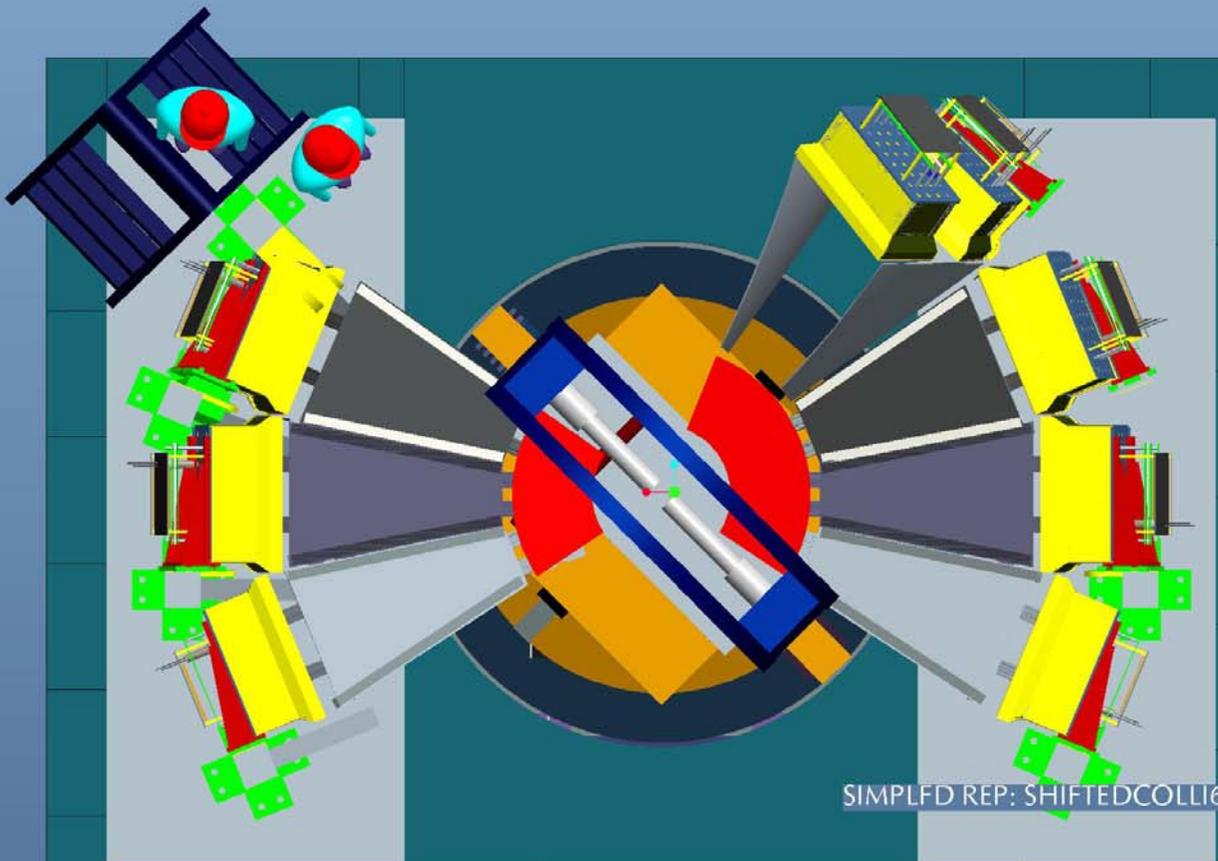


- A center piece of the VULCAN diffractometer, this sample table is designed to maneuver a large industrial-sized specimen or equipment (up to 2 ton) with high precision (0.01 mm) over a large travel range (0.5 m in x-y-z, and 360-deg. rotation).
- The sample table has a foot-print of 2.5 m and weights 8 ton. The top mounting surface is at 1.5 m from the beam center in fully retracted position allowing a specimen as tall as 3 m to be mapped.
- Scheduled delivery is September this year

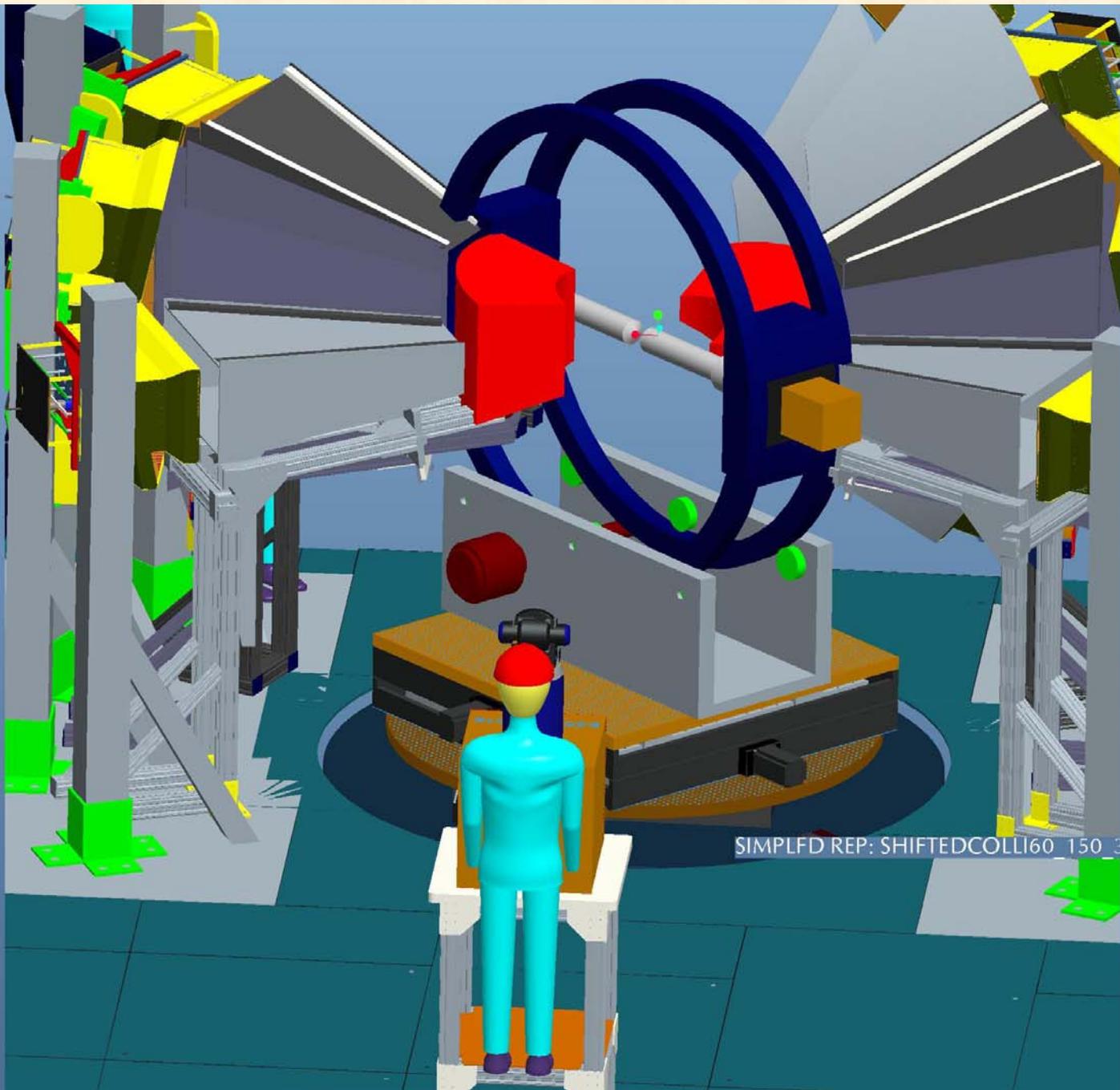
Load-frame Are Being Specified



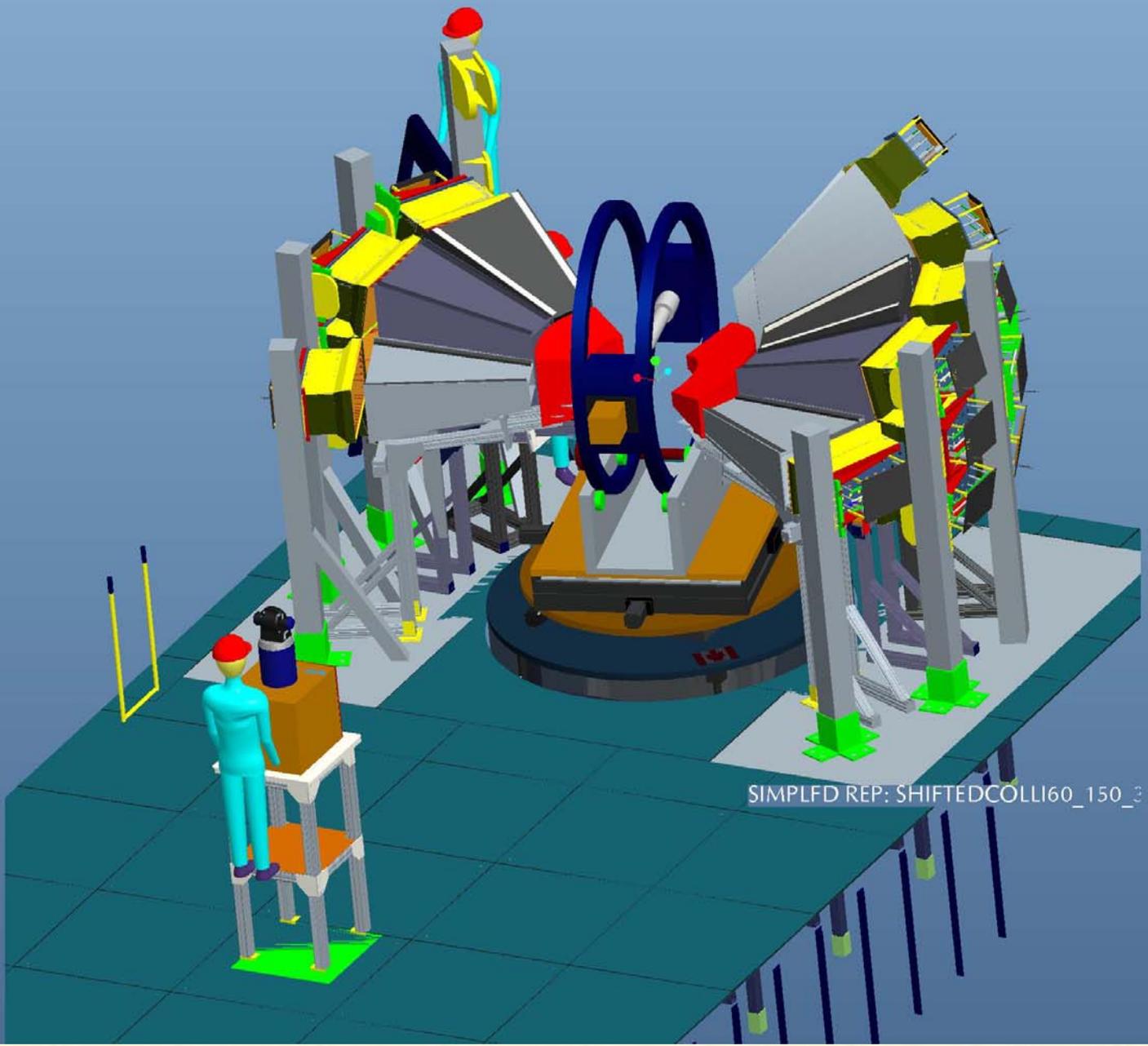
- **100 KN load capacity**
- **up to 30 Hz for fatigue tests**
- **Multi-axial loading including torsion**
- **Lamp and Vacuum Furnaces**
 - temperatures ranging 25-1500 °C



SIMPLFD REP: SHIFTEDCOLLI60_150_3

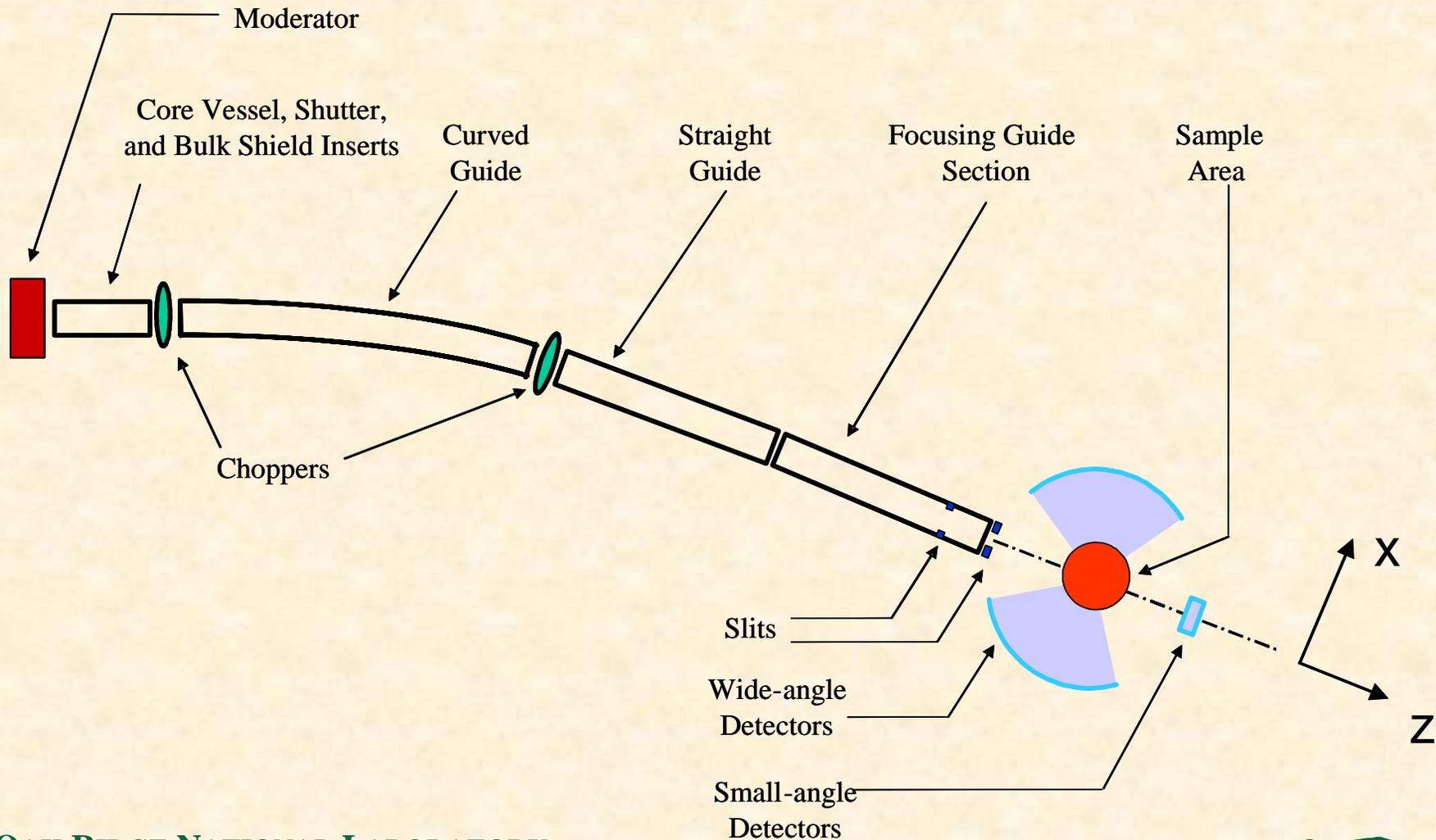


SIMPLFD REP: SHIFTEDCOLLI60_150 3



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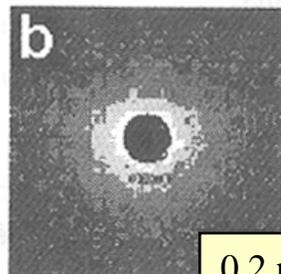
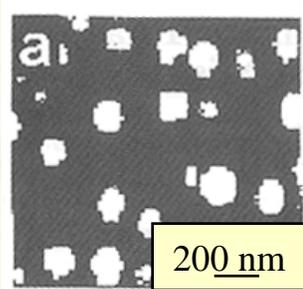
VULCAN Schematic Layout



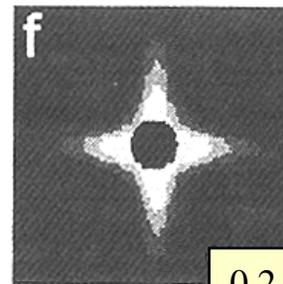
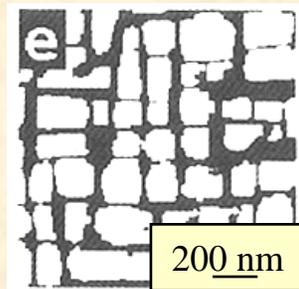
Simultaneous SANS and Diffraction Enable Understanding of Nanostructure Evolution



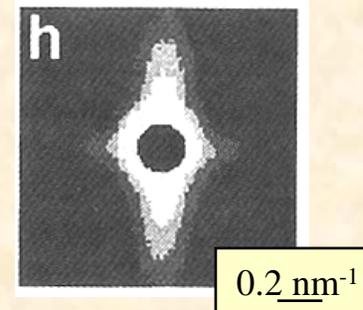
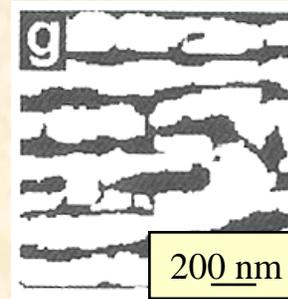
T=1048 K (0 MPa)
Misfit = 0%



T=1048 K (0 MPa)
Misfit = -0.5 %



T=1048 K (130 MPa)
Misfit = -0.5 %



Lattice misfits can be measured by diffraction

Nanostructure can be determined by SANS

Study of Ni-Al-Mo alloy, P. Fratzel et al., Solid-Solid Phase Transformations, 1999

Current Progress (Update)



- **External building to finish June 2007**
- **Neutron guides are being installed**
- **Double-disc chopper factory test May 2007**
- **Shielding design packages are out for procurement**
- **Sample positioner system awarded**
- **Load-frame out for bid**
- **Detector and radial collimator design (full complement)**
- **Incident beam slits and collimator design**
- **To be commissioned in 2008**

Exciting New Opportunities Are Awaiting with the Commissioning of VULCAN



- **In-situ study of transient behaviors during solidification**
- **Fatigue behaviors**
- **Deformation in nano-structured materials**
- **Residual stress in surface engineered materials**
- **Residual stress and deformation in amorphous materials**
- **Multiscale phenomena in phase transformation**
- **Influence of magnetism on mechanical properties**

...and more....