



A Preview of Research Projects at NC State University PULSTAR Reactor

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Outline

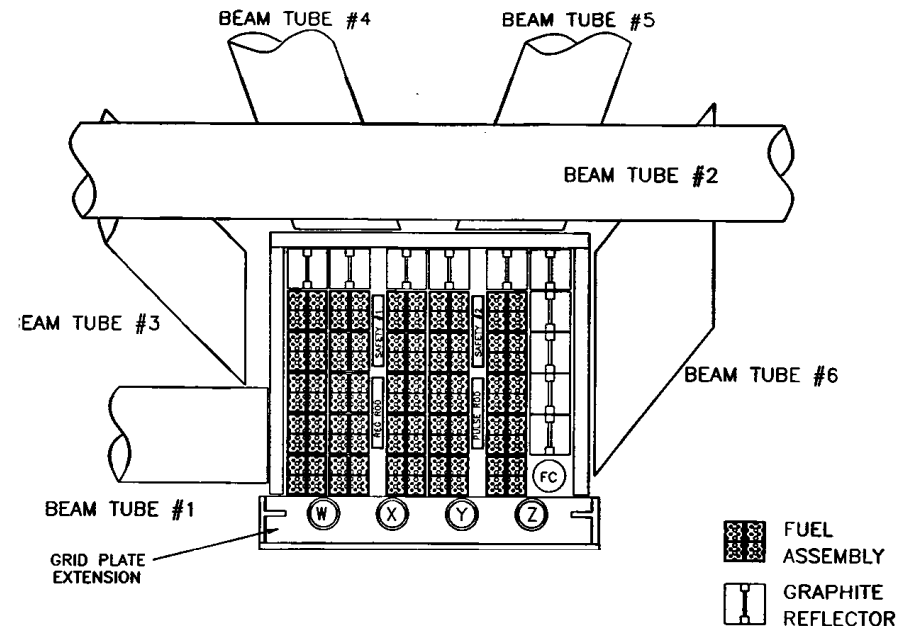
- PULSTAR reactor

- Research projects
 - Ultra-Cold Neutron Source
 - Intense Slow Positron Beam
 - Powder Diffractometer
 - Neutron Imaging

- Future plans

PULSTAR Reactor

- ❑ 1-MW power
- ❑ 5 x 5 array of fuel assemblies
- ❑ 5 x 5 array of pins
- ❑ Sintered UO_2 pellets
- ❑ 4% enriched
- ❑ Open tank
- ❑ Light water moderated and cooled



PULSTAR NUCLEAR REACTOR
5 X 5 REFLECTED CORE # 3
(NOT TO SCALE)

FIGURE 3

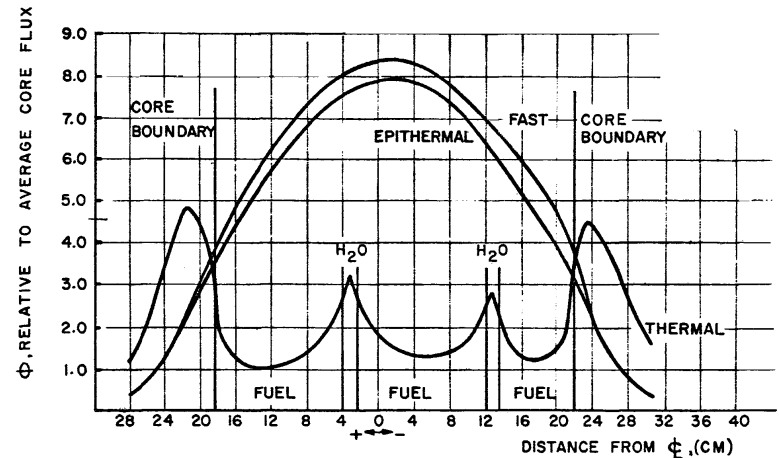
PULSTAR Attributes

□ Design

- Heavy loading of U-235
~12.5 kg
- Low Moderator-Fuel Ratio
- Thermal flux peak at core periphery

□ Benefits

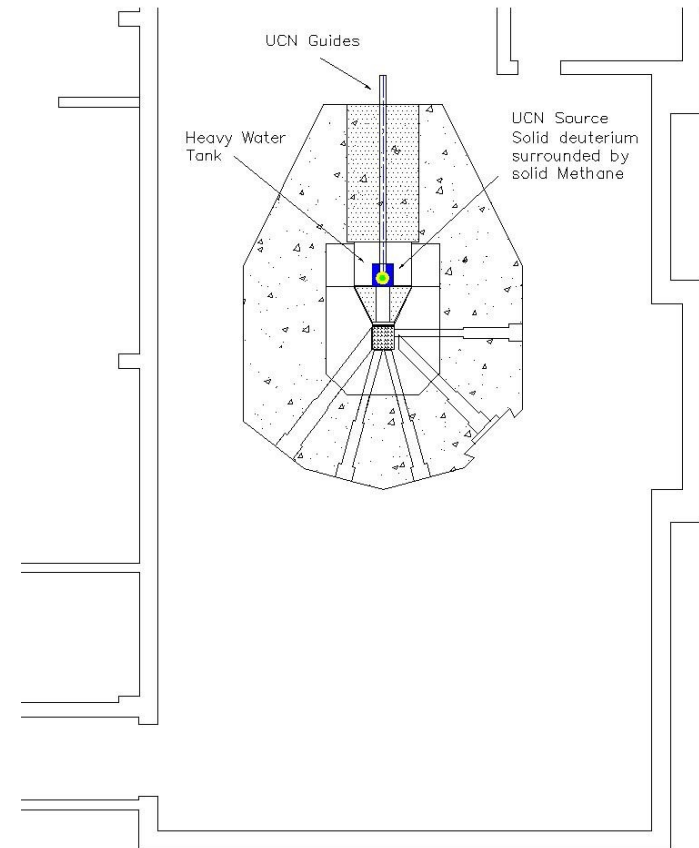
- High fast-neutron leakage
- Thermal flux at core face
 1×10^{13} n/cm²/s
- Long core lifetime



Projects

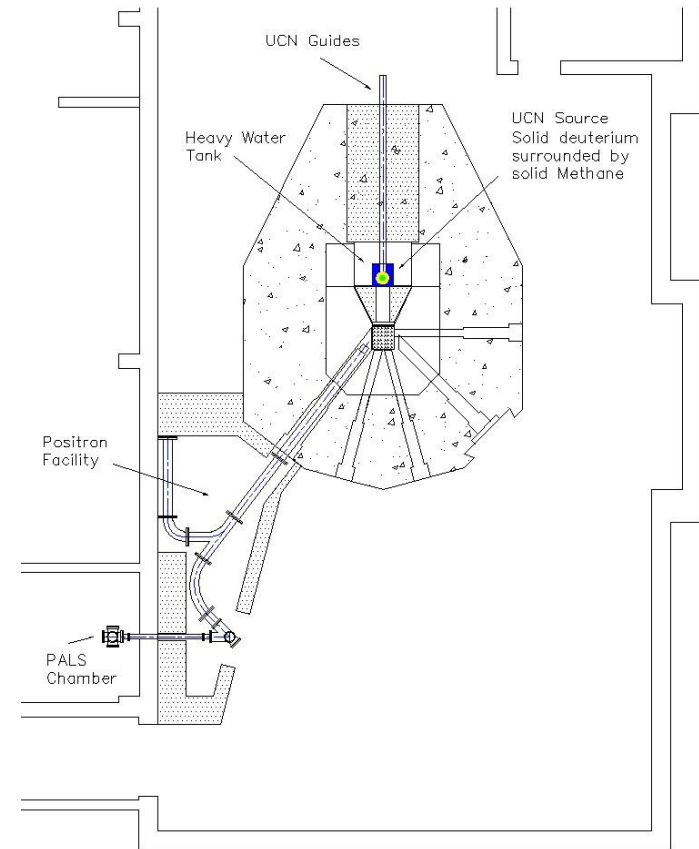
Projects

□ Ultra-Cold Neutron Source



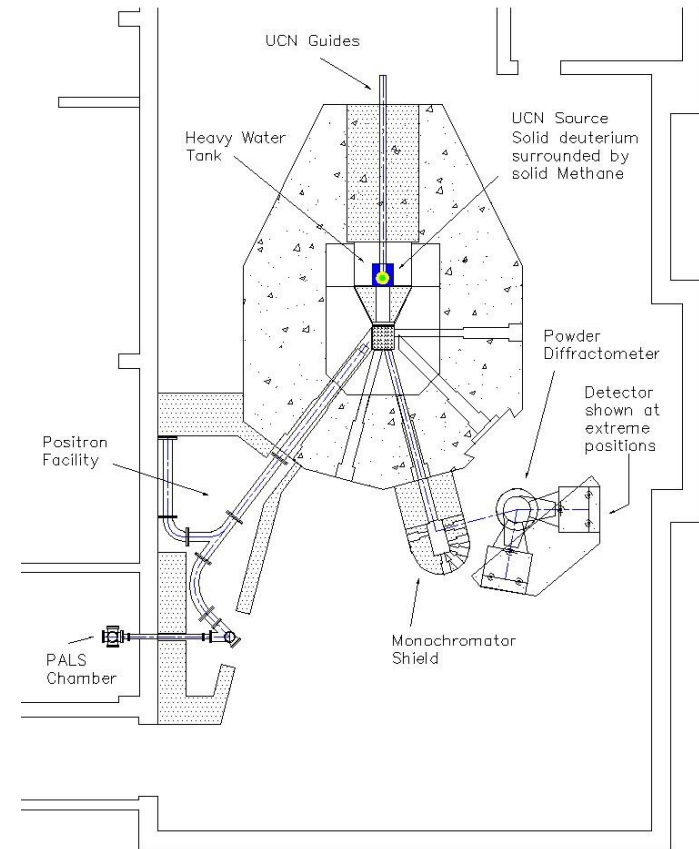
Projects

- ❑ Ultra-Cold Neutron Source
- ❑ Intense Slow Positron Beam



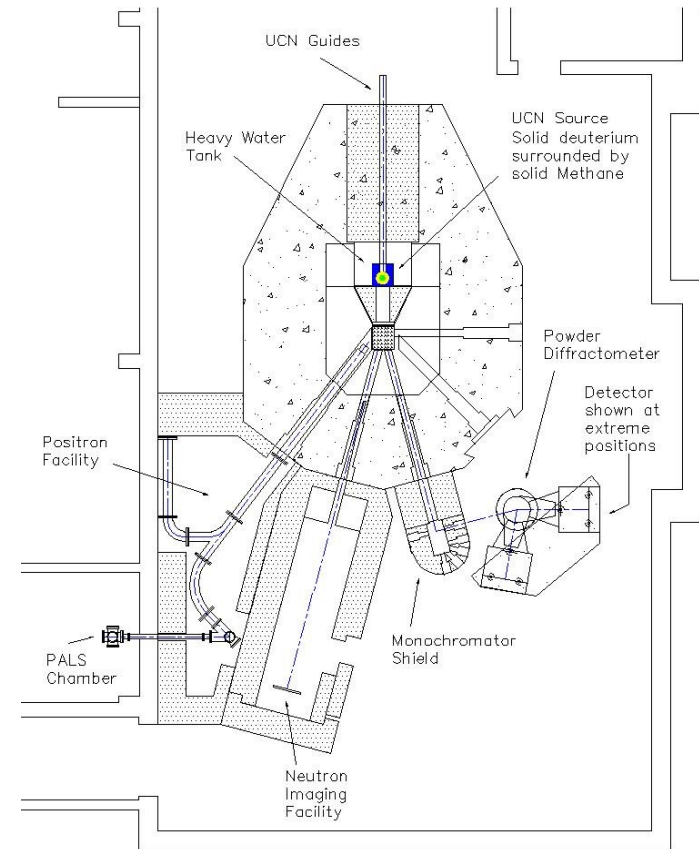
Projects

- ❑ Ultra-Cold Neutron Source
- ❑ Intense Slow Positron Beam
- ❑ Powder Diffractometer



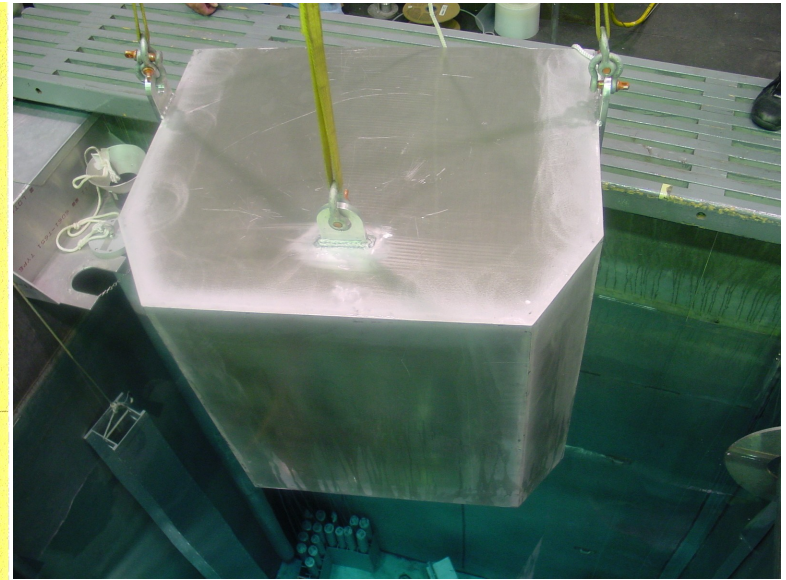
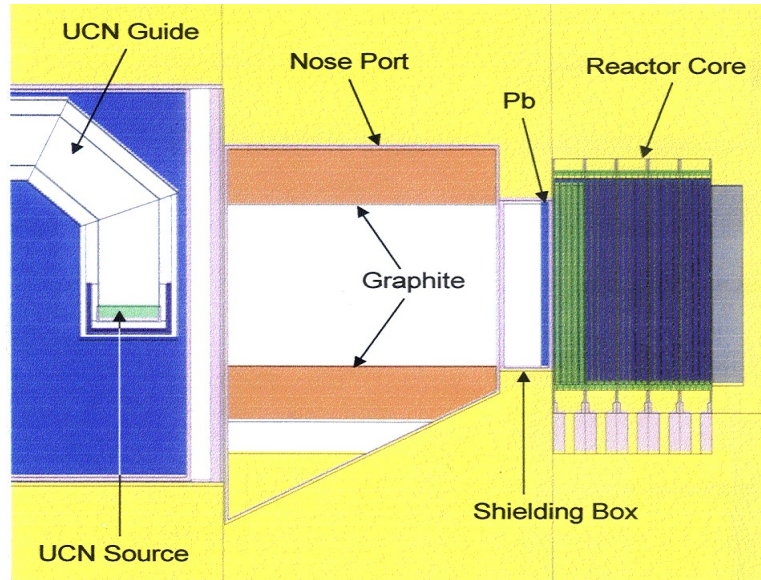
Projects

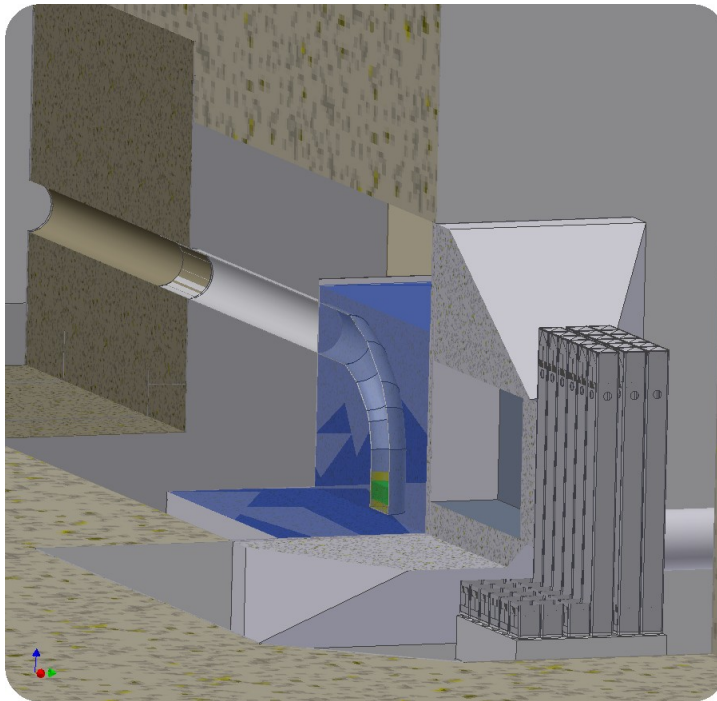
- ❑ Ultra-Cold Neutron Source
- ❑ Intense Slow Positron Beam
- ❑ Powder Diffractometer
- ❑ Neutron Imaging



Ultra-Cold Neutron Source

Nose Port





CN Source

Solid methane

1-cm thick

Cup shape around
UCN converter

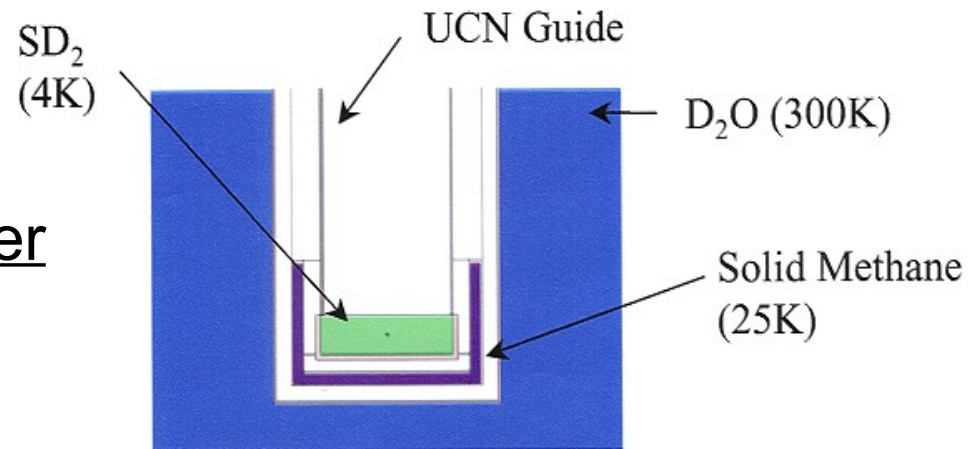
UCN Converter

Solid D_2

4-cm thick

1 liter

TRTR - 2005



Current Status

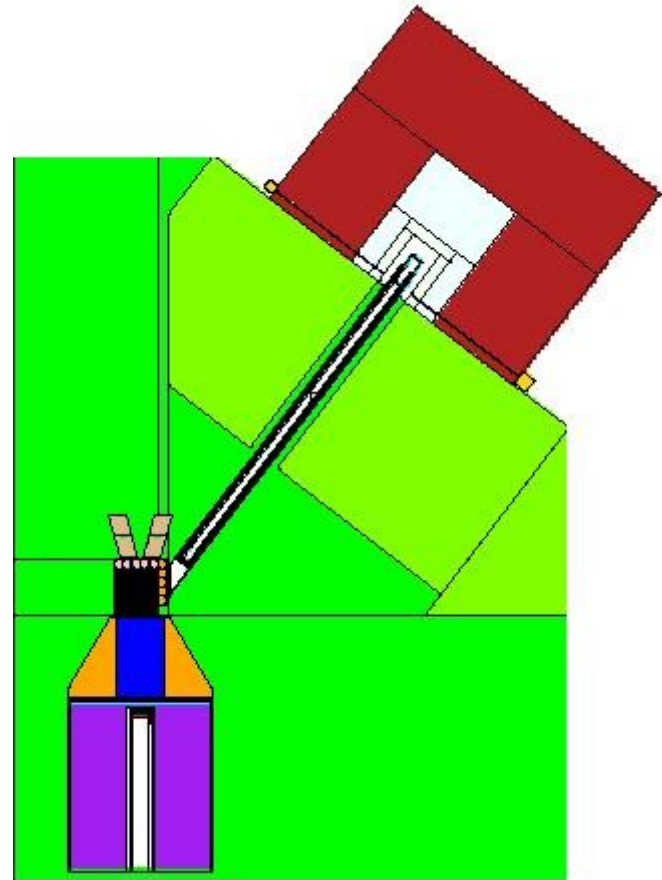
- Completed
 - Thermal Column removal
 - Nose Port designed and fabricated

- Design Phase
 - Cryo-system
 - Neutron guide

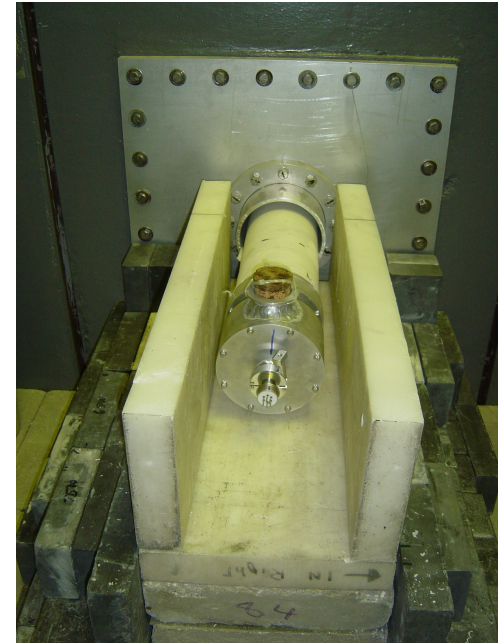
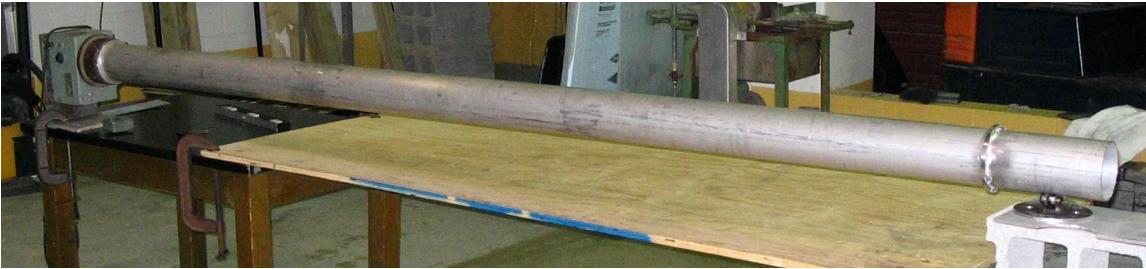
Intense Slow Positron Beam

Basic Design

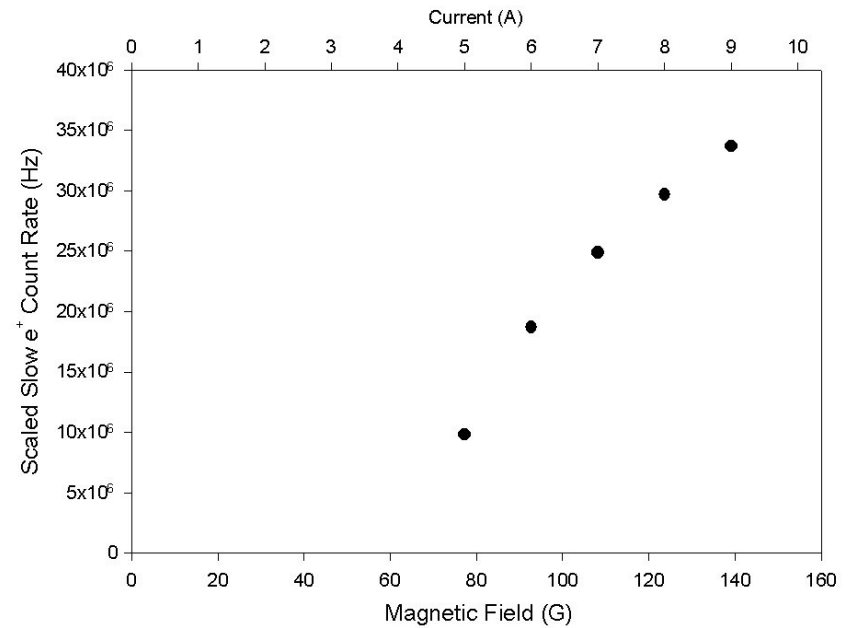
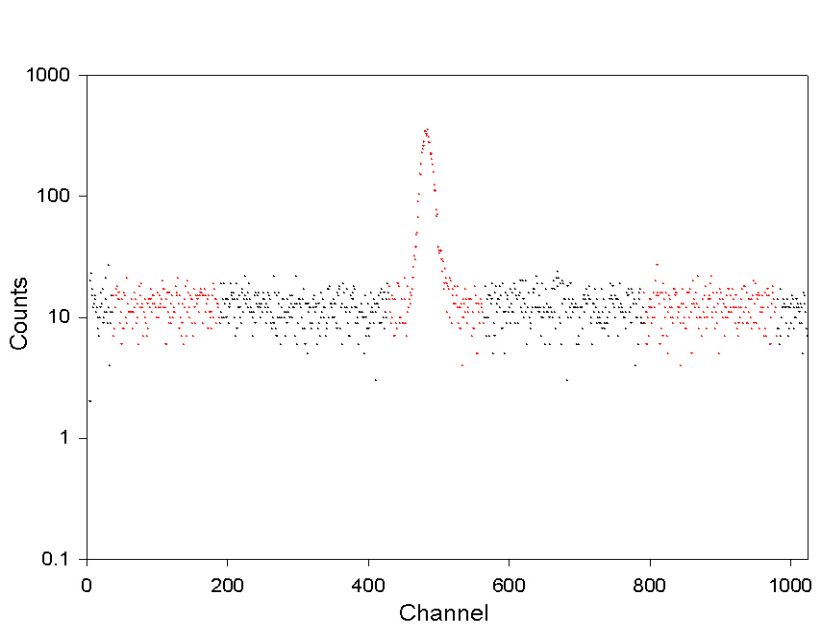
- High-energy γ -rays
 - Fission
 - Capture in cadmium
- Pair-production in Tungsten
- Magnetic Solenoid Transport



e^+ Transport Collimation

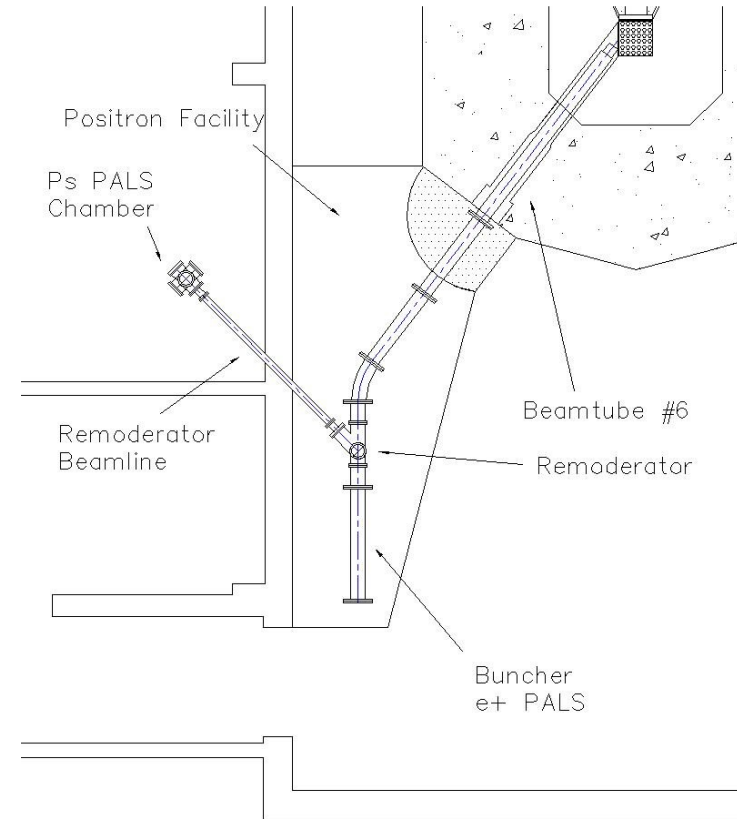


Testing and Design



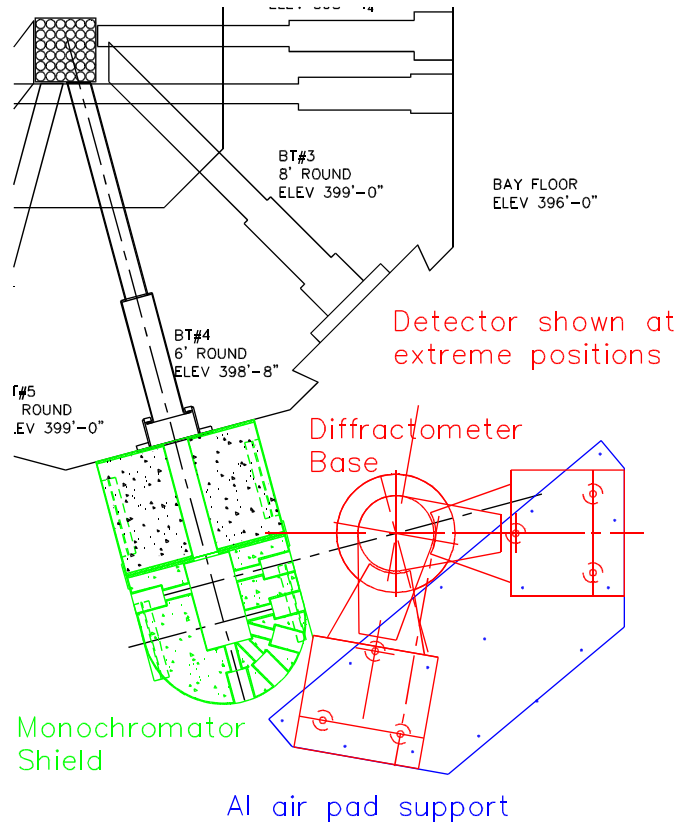
Second Generation Beam

- ❑ Optimize Core configuration
- ❑ Increase in converter/moderator size.
- ❑ Transport e^+ beam to research/user facilities



Neutron Powder Diffractometer

Current Status



Neutron Imaging

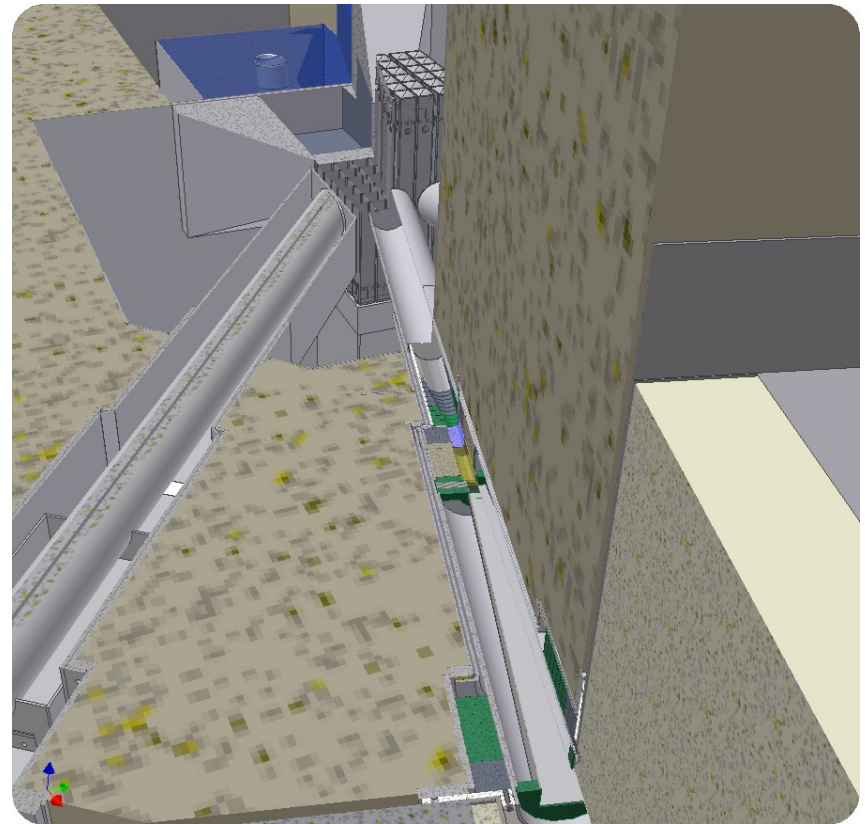
Neutron Collimator

□ Modular Design

- Filters
- Aperture
- Divergence angle

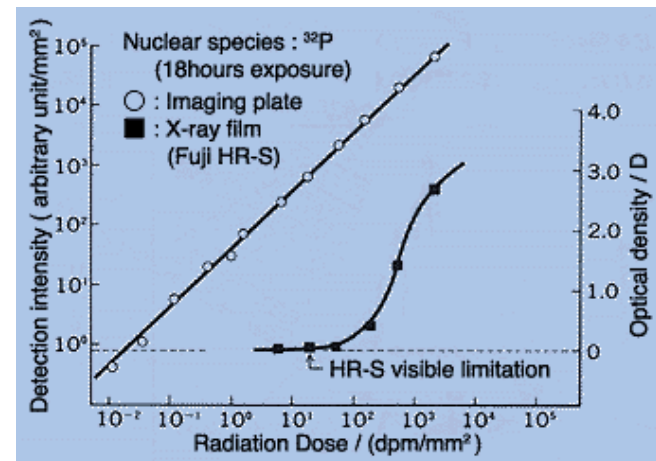
□ Results

- Thermal flux
 $2 \times 10^6 - 1 \times 10^7 \text{ n/cm}^2/\text{s}$
- 150 l/d



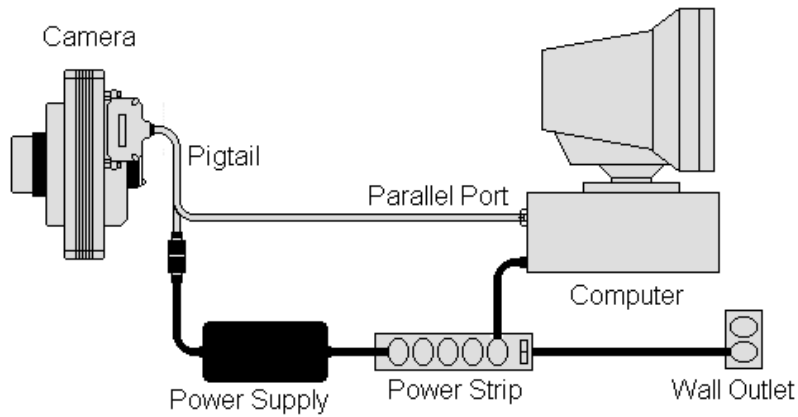
Radiography Systems

- ❑ Alternative to film
- ❑ Gd_2O_3 images plates.
- ❑ Linear dynamic range over 5 decades
- ❑ No darkroom or chemicals
- ❑ Reusable



Real Time Radiography and Tomography System

- ❑ Cooled CCD camera
- ❑ Li-6 loaded scintillation screen
- ❑ Computer controlled



Summary

- ❑ The development of the major facilities at the PULSTAR continues
 - Ultra-Cold neutron source
 - Positron source
 - Neutron diffractometer
 - Neutron imaging
- ❑ Explore new concepts
- ❑ Stage and test experiments