# RACE Project

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# RACE Project

- Design, model, and conduct ADSS experiments
- Predict and analyze subcritical multiplication and source-driven transients
- Map source importance & flux in and around a variety of ADSS
- Provide a bridge between MUSE and TRADE

# RACE consortium members

- IAC (3 faculty & 2 post-docs)
- Texas university partnership
  - Texas A&M NSC TRIGA (Prof. Charlton)
  - UT-Austin NETL TRIGA (Prof. O'Kelly)
  - Other cores & reactors
- UNLV TRP (Ph.D. student)
- U of Michigan (Prof. Lee)
- ANL-West (G. Imel and several others)

# Driving neutron sources:

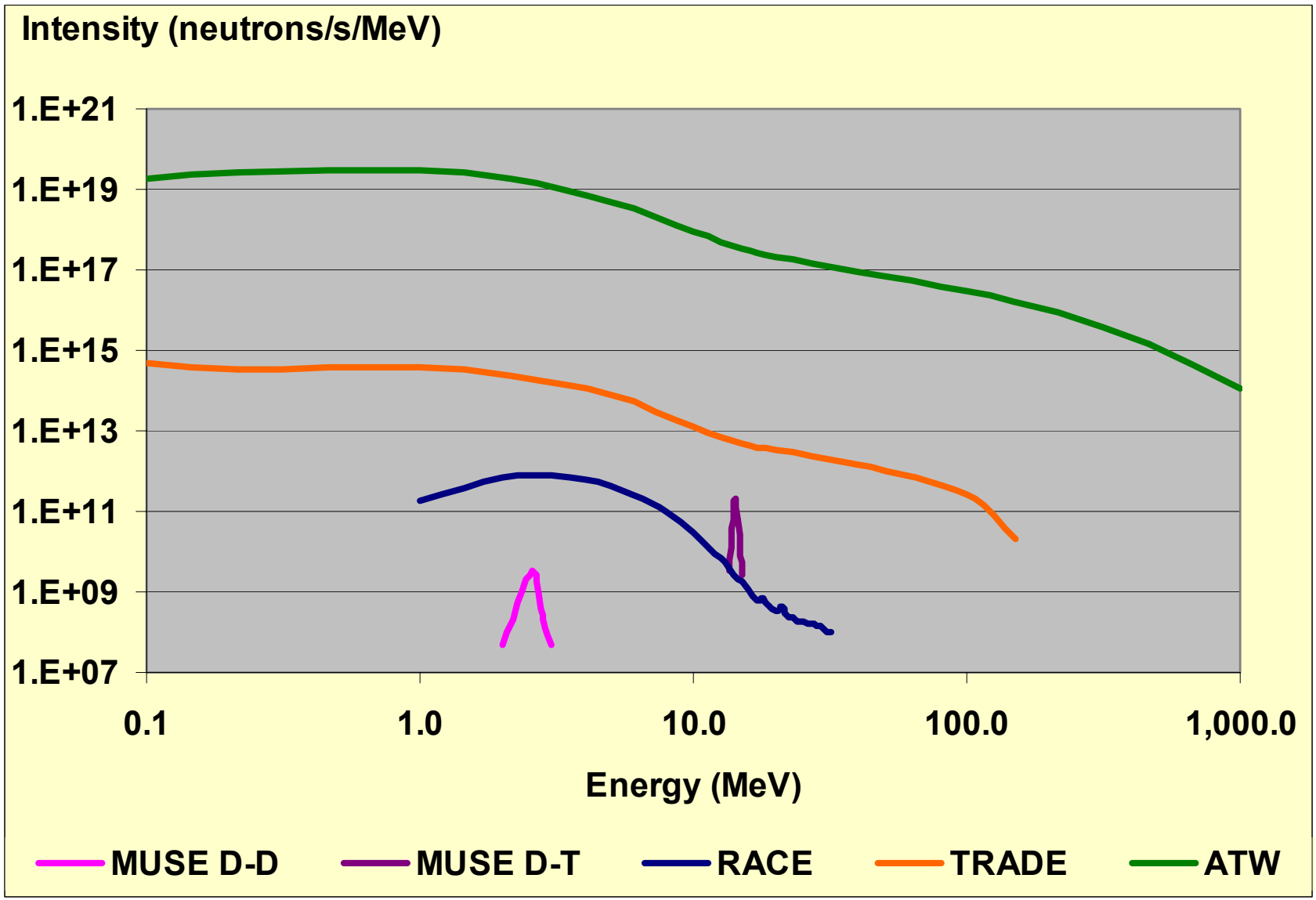
- MUSE DT-neutron source:
  - ~1.5x$10^{10}$ n/s, 2.45 & 14.1 MeV
- TRADE $p^+$ source:
  - ~$10^{15}$ n/s, ~100 MeV

- RACE linear electron accelerator:
  - Up to 1 x $10^{13}$ n/s
  - Intermediate energy: spallation spectrum plus small tail up to 30+ MeV

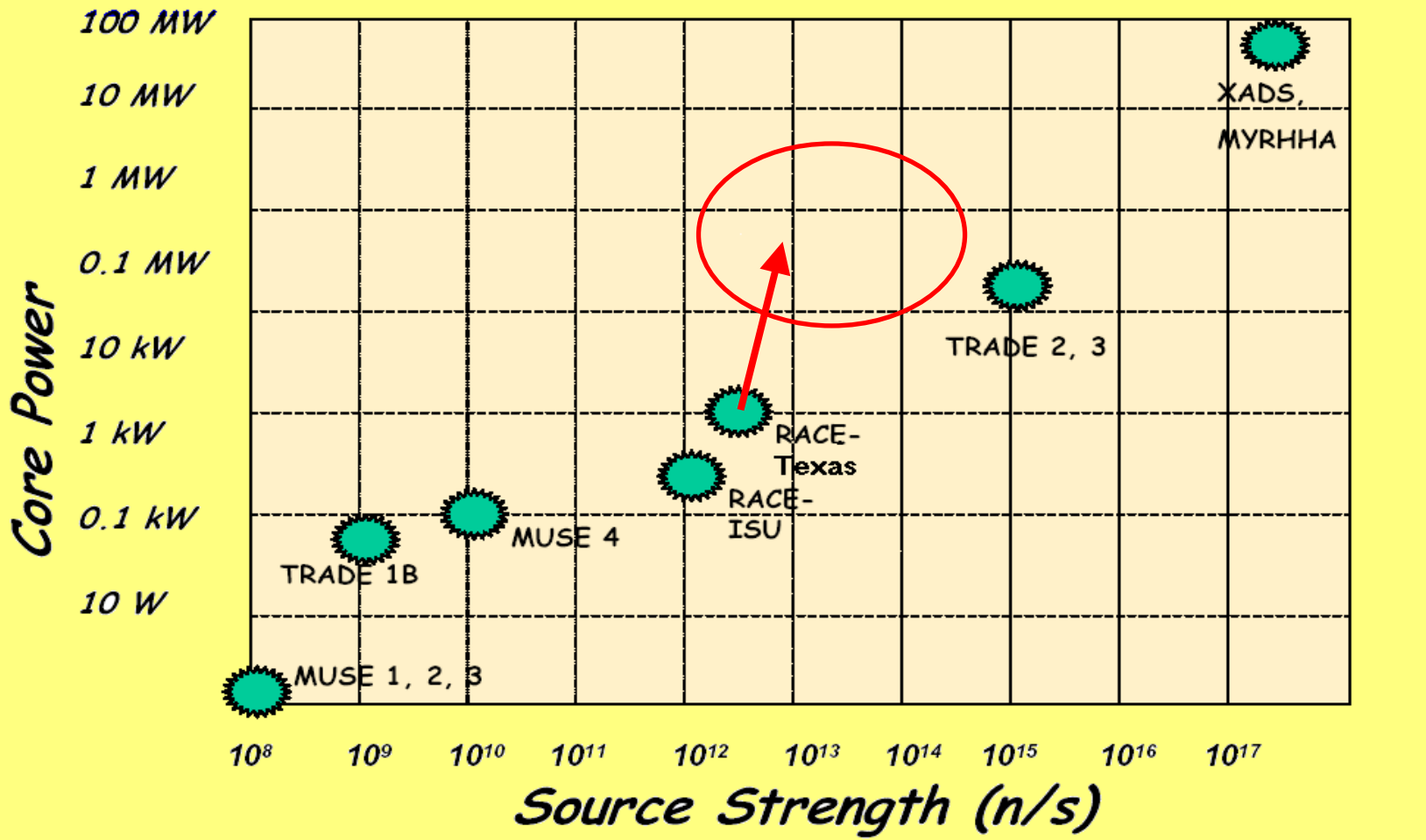
# RACE ADSS Characteristics

| University | nominal power (MWth) | peak power (MWth) | target location | fuel type | fuel compo-sition | fuel enrich-ment | keff |
|---|---|---|---|---|---|---|---|
| ISU | 0 | 0 | center | plates | U-Al Alloy, Al clad | <20% | 0.7-0.95 |
| UT-Austin | 1 | 1000 | edge | rods | U-ZrH | <20% | ~0.92 to 1.0 |
| Tx A&M 1 | 1 | 1000 | edge, graphite column | rods | U-ZrH "FLIP" fuel | 70% | ? to 1.0 |
| Tx A&M 2 | 1 | 1000 | center | rods | U-ZrH | <20% | ? to 1.0 |
| Tx A&M 3 | 0 | ? | center | rods | U-ZrH | <20% | 0.90 to 0.95? |

# Source spectral comparison



# Beam-Reactor Coupling Experiments



# Experiments at ISU-IAC

- Mini-tank
  - Thermal testing of the target
  - No fuel - 1 plate - 10 fuel plates separated by ½" polyethylene
- Large tank with graphite reflector
  - No fuel
  - 10 fuel plates in water

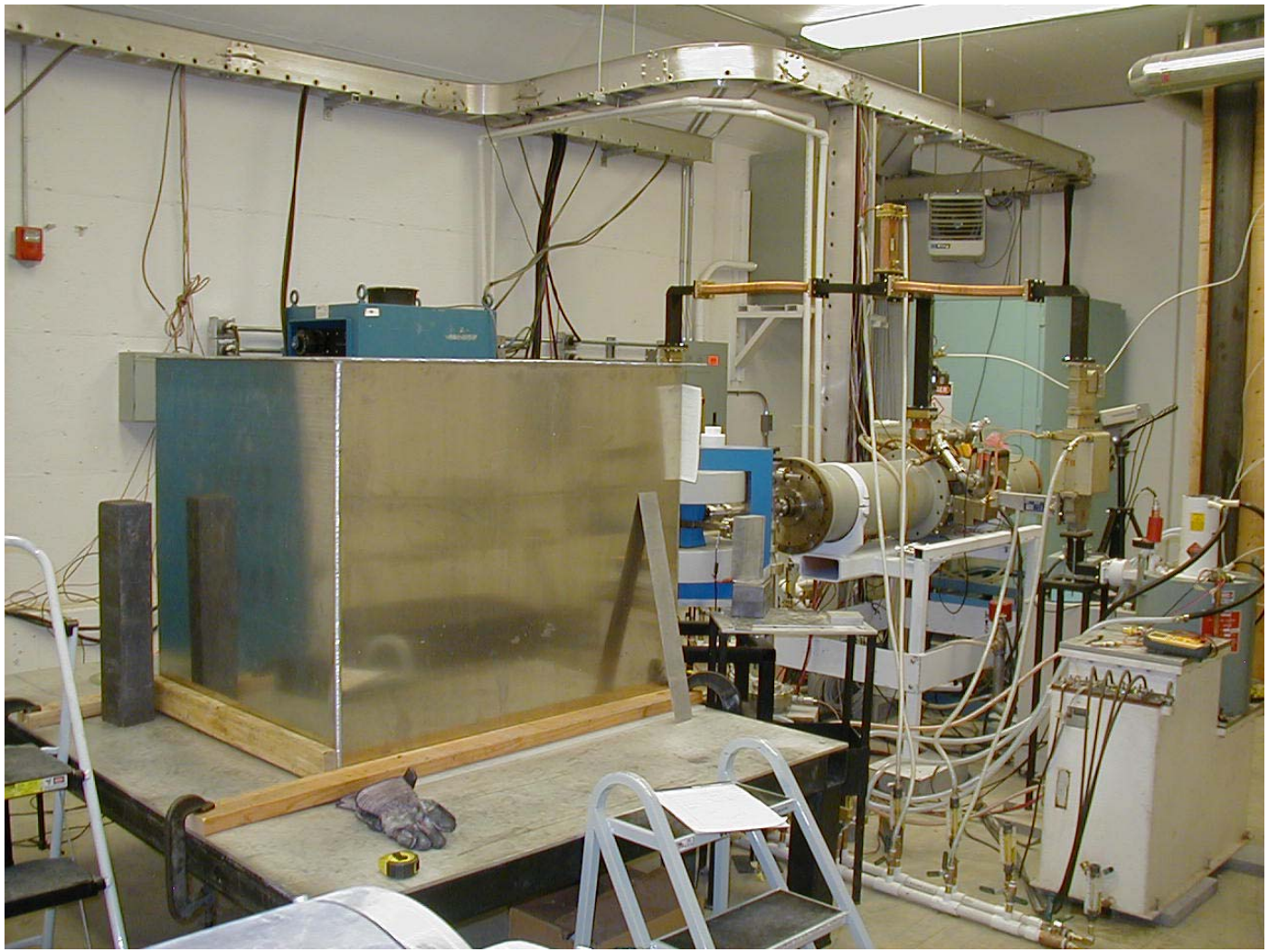
# ISU Electron Linac for mini-tank

- 30-40 MeV electron linac
- Conditions for experiment:
  - 25 MeV
  - 12 mA instantaneous
  - 3 μs pulsewidth
  - 60 Hz
- ➔ 540 W beam power

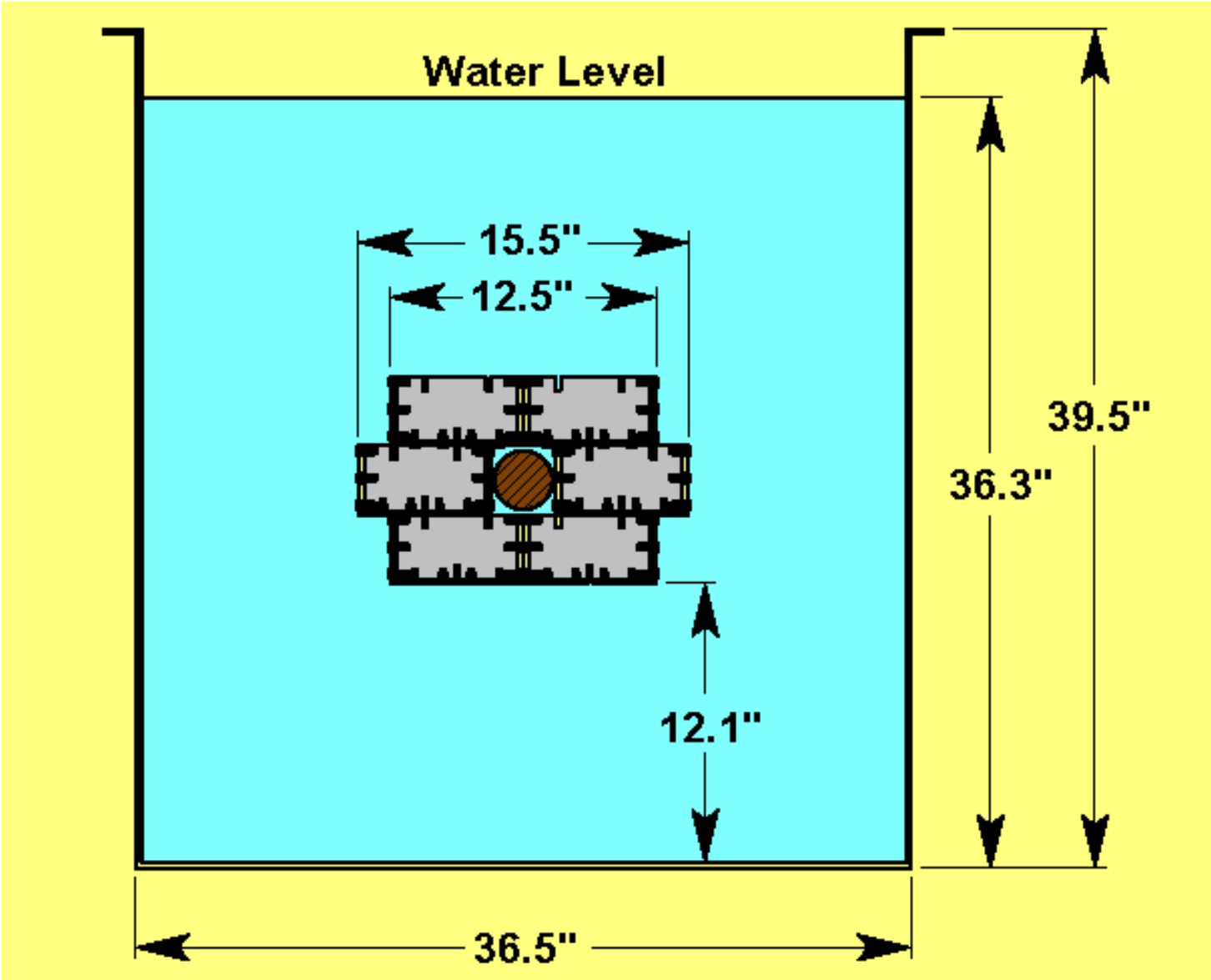
# ISU-IAC RACE target

- 75% W, 25% Cu; 2 3/4” dia. X 3” long
- Neutron production modeled with MCNPX
  - ~1.3 x $10^{12}$ neutrons/s/kWe @ 30 MeV
  - ~4 x $10^{12}$ neutrons/s @ 30 MeV, 3 kW
  - Or ~5 x $10^{11}$ n/s @ 25 MeV & 540 W
- Also a prompt, strong high-energy gamma ray signal

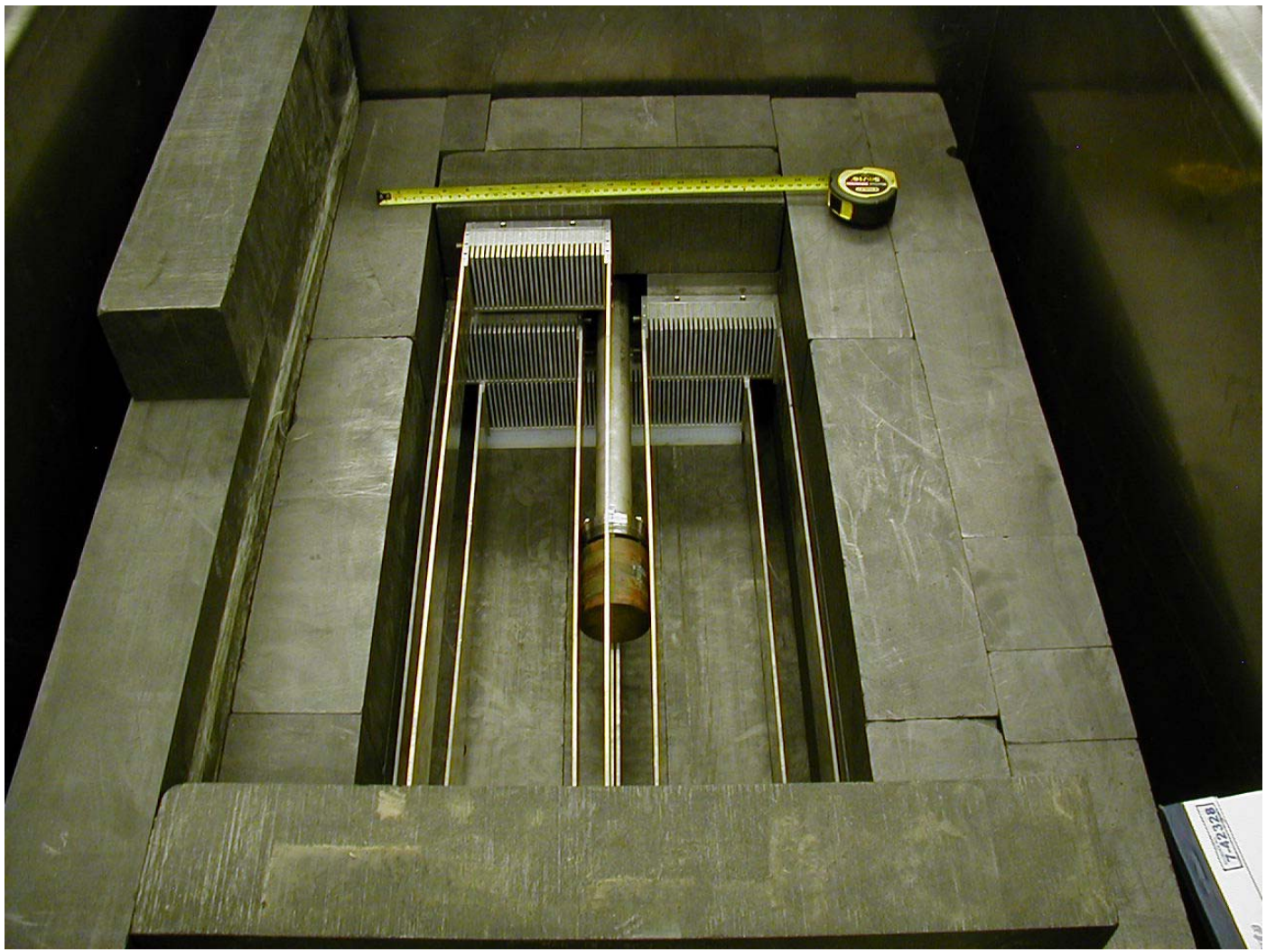
# Accelerator and “large” vessel



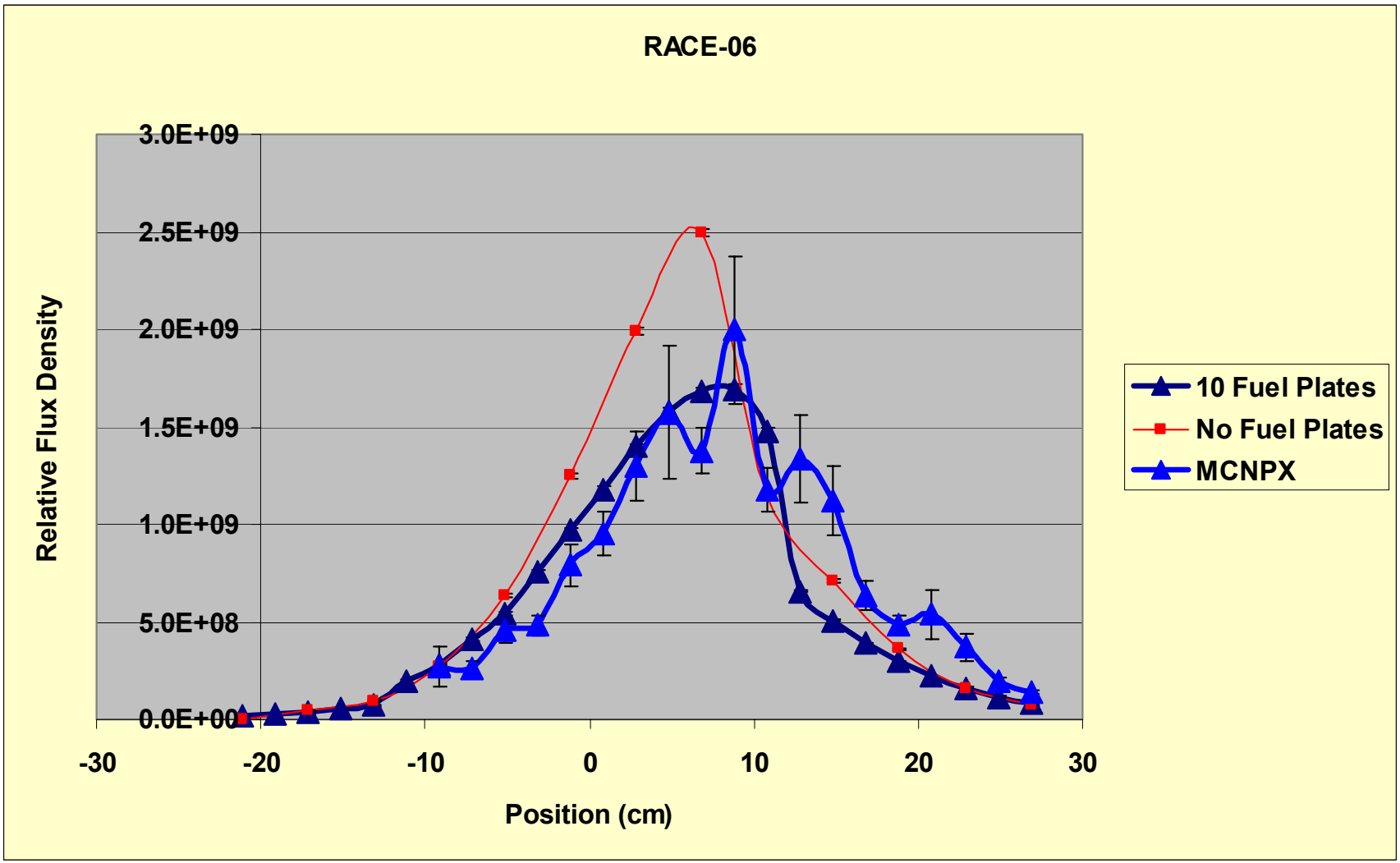
# Vessel, target, and fuel trays



# RACE fuel trays and target inside the graphite reflector



# Preliminary results: Gold activation versus MCNPX



# RACE at
# Texas A&M University and
# The University of Texas at Austin

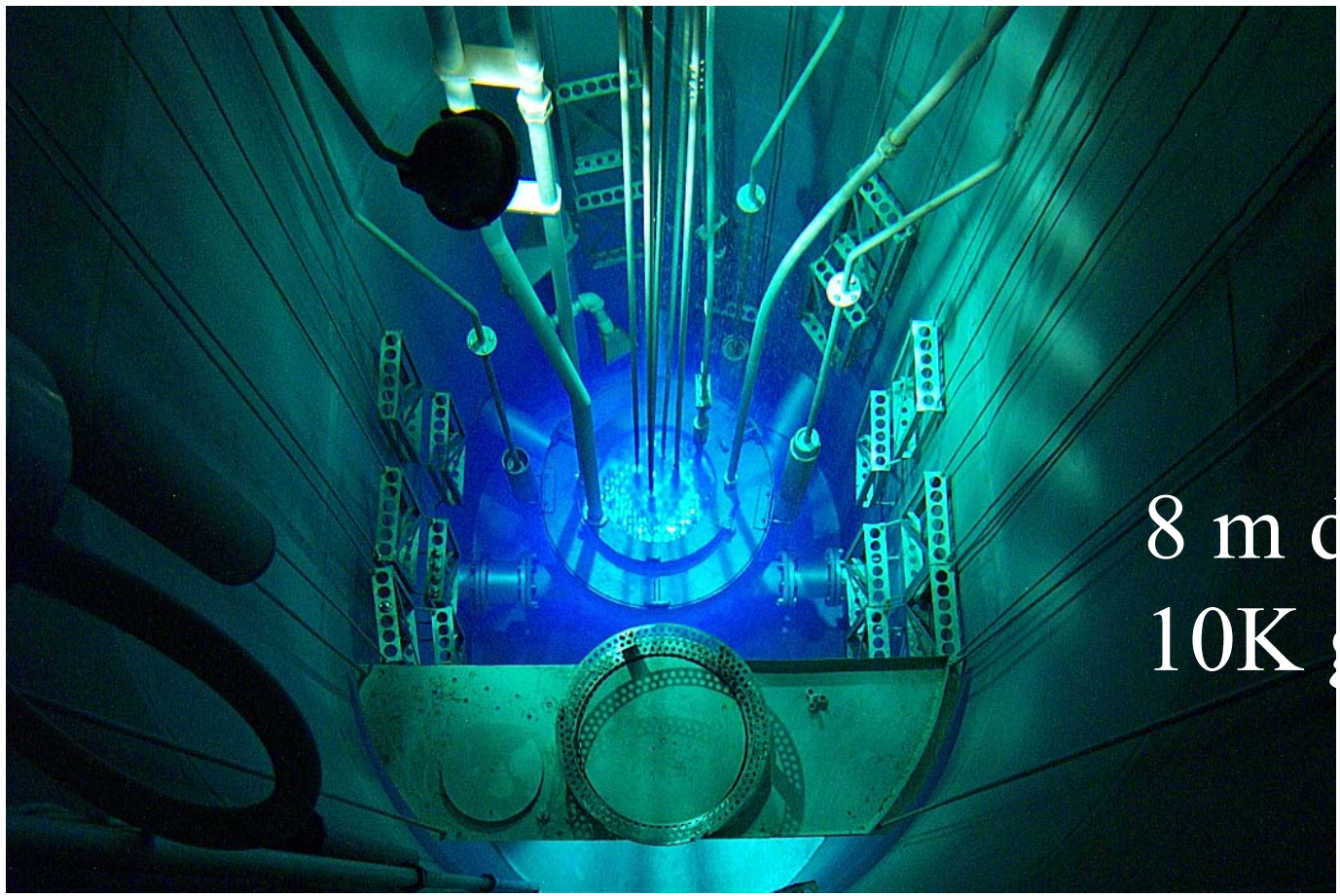
# Introduction

- Experiments are being planned at two research reactor facilities in Texas:
  - the 1-MW TRIGA reactor at the Nuclear Engineering Teaching Laboratory (NETL) at the University of Texas (UT)
  - the 1-MW TRIGA reactor at the Texas A&M University (TAMU) Nuclear Science Center (NSC)
- Experiments are to provide
  - facility which makes use of thermal system with power levels sufficiently high to provide thermal feedback
  - teaching tool that can be used to educate the next generation in advanced nuclear science

# UT NETL Reactor

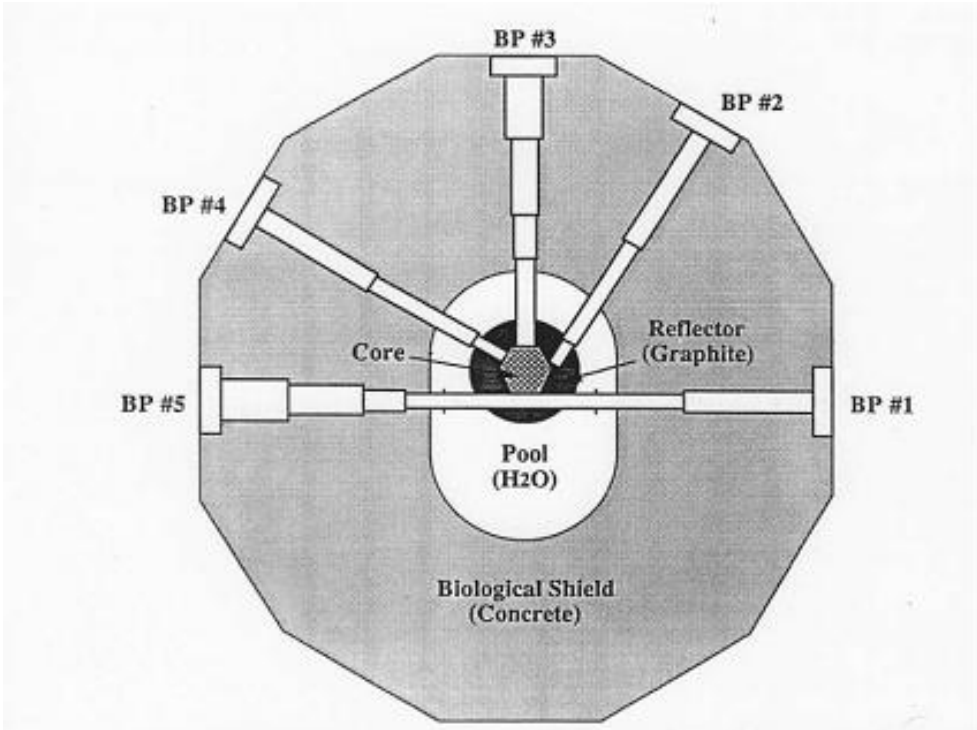
- UT NETL is home to a 1 MW TRIGA Mark II reactor
  - » construction completed in 1992
    - – making the UT-NETL the newest university research reactor in the U.S.
- This reactor is principally designed for use as a neutron beam facility

# NETL TRIGA Pool



# UT NETL Beam Ports

- BP#1 – Texas Intense Positron Source (TIPS)
- BP#2 – Neutron Depth Profiling System
- BP#3 – Texas Cold Neutron Source (TCNS) and the PGAA system
- BP#4 – Available for Development
- BP#5 – Thermal Neutron Imaging Facility



# Project Overview

- Design, construction, and evaluation of an accelerator driven neutron source at ISU
- Experiments at UT using the existing NETL TRIGA
  - source location in BP#5
  - source locations in center of core
- Experiments at TAMU using the existing NSC TRIGA
  - source location in BP#5 or BP#1
  - source locations in center of core
- Experiments at TAMU using a spent fuel core of TRIGA fuel

# RACE Progress

- Design studies completed at Texas A&M and UT
  - Fresh fuel and fresh reactor at UT
  - Texas A&M may build permanent ADSS
- Static and transient analyses completed at U of Mich
- New project approved at UNLV
- Six ADSS experiments at ISU-IAC

# Tentative Experiment Schedule

- ISU-IAC
  - Design & licensing — Aug ’03-Mar ’04
  - Construction — Feb-Apr ’04
  - Experiments — Apr-Dec ’04
- UT-Austin Experiments — Spring ’05-?
  - TRIGA, other
- Texas A&M Experiments — Fall ’05-’07+
  - TRIGA, used fuel core, LBE — Fall ‘06

# Conclusion

- ADSS Exp at ISU, UT, and Tx A&M
- Now thru 2006 or beyond
- Design, modeling, and execution
- Predict and measure subcritical multiplication and source-driven transients
- Recruit, educate and train students