Irradiation Facilities at Los Alamos and Sandia

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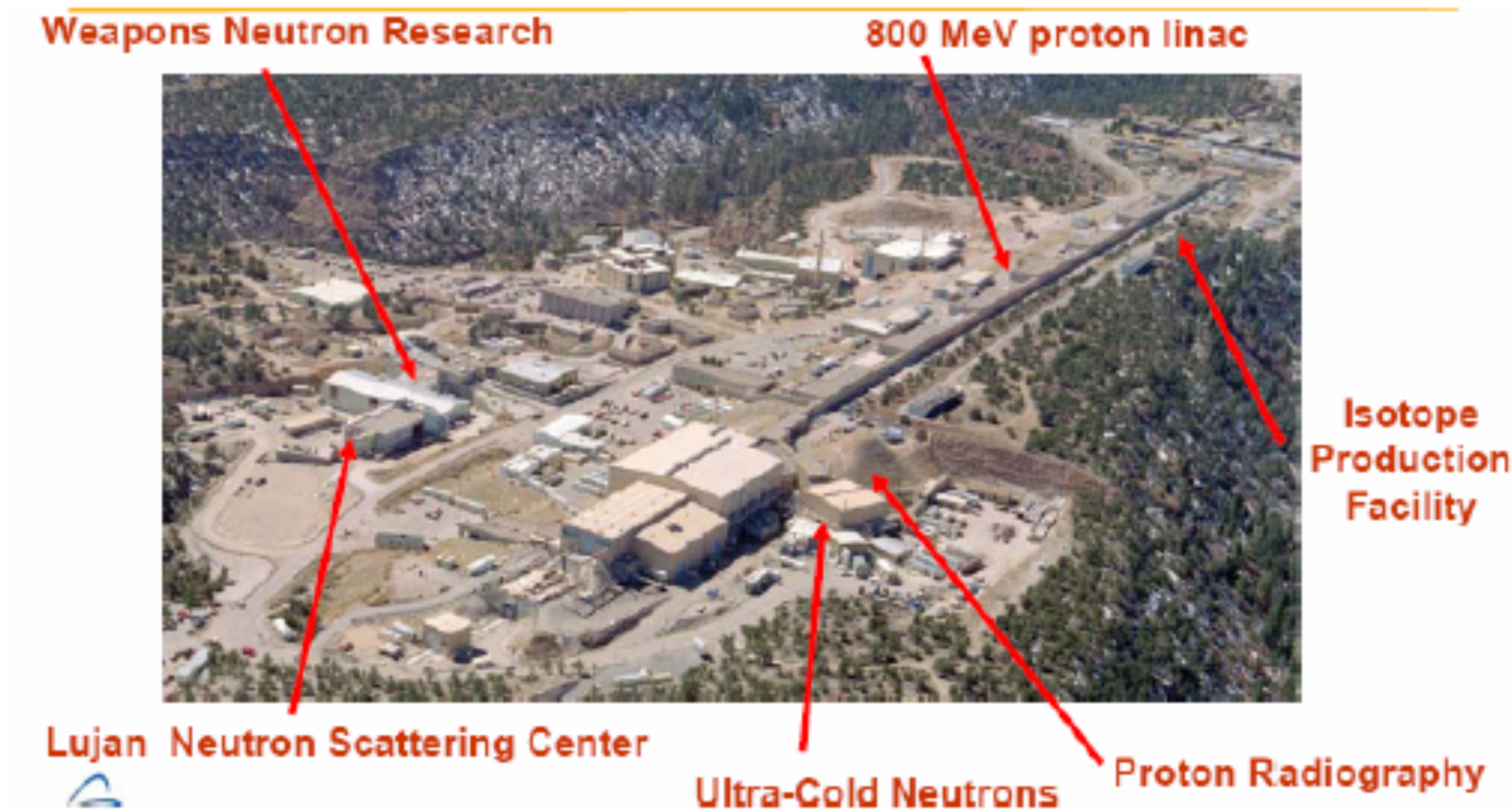
Los Alamos and Sandia National Laboratories each have facilities that can provide irradiation environments relevant to HEP needs.

The University of New Mexico HEP group has been facilitating irradiations at both sites since 2007. We have developed experience with device handling, fixturing, thermal control, transport, dosimetry, and interface with laboratory procedures. We organize irradiation runs, staff shifts, and contribute pre-irradiation testing on some devices. If you'd like to collaborate, please contact me, seidel@phys.unm.edu. This talk will also give you information on how to arrange independent projects.

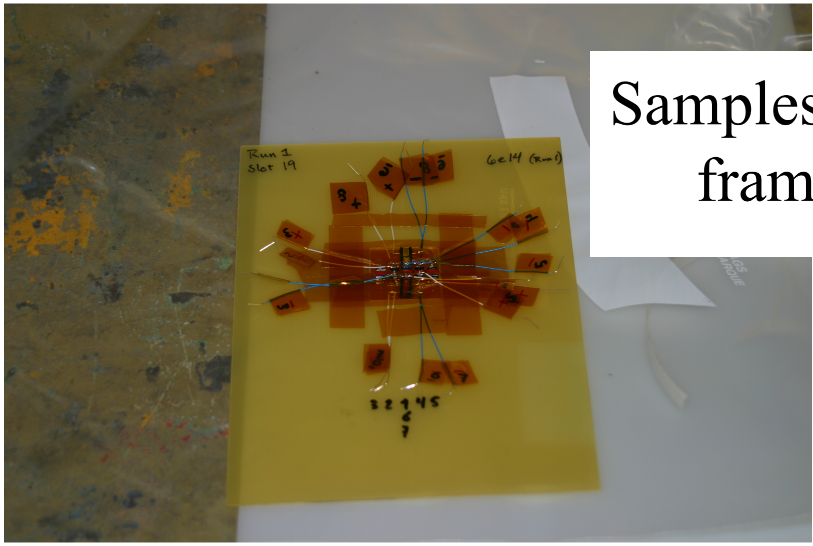
At LANL: The Los Alamos Neutron Science Center (LANSCE) Weapons Neutron Research (WNR) Facility provides an 800 MeV proton beam (linac), a derived tungsten spallation neutron beam, and a dedicated facility for SEU testing.



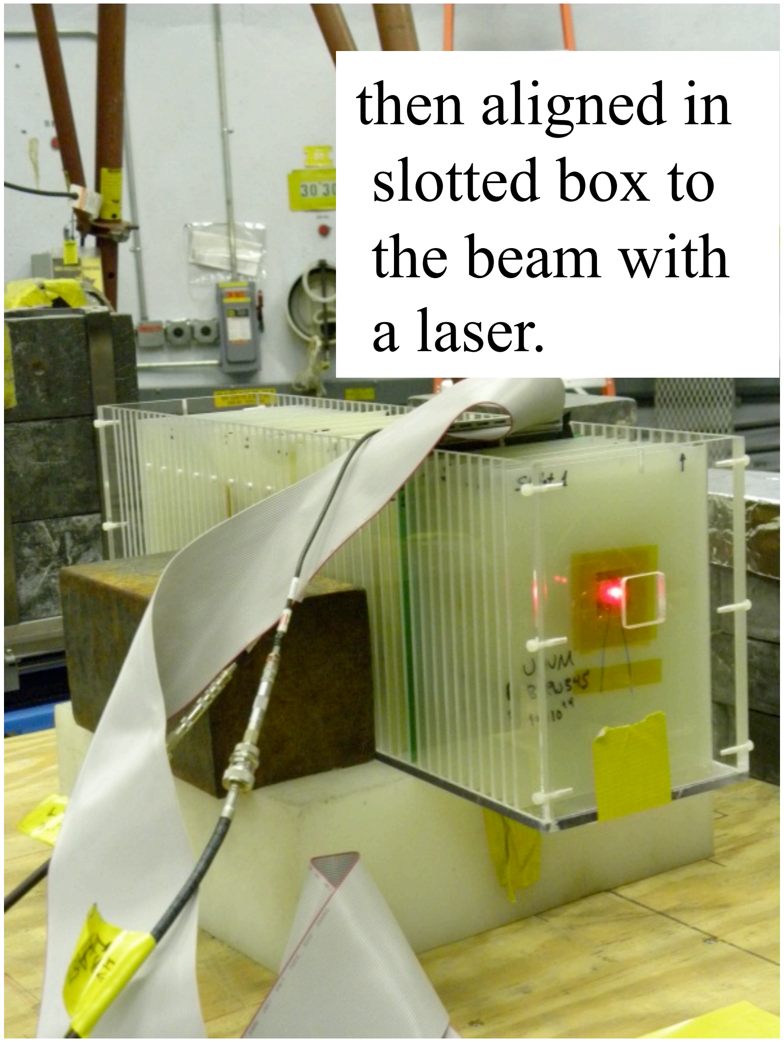
Protons

- typical operation has 83 nA average beam current
- 5×10^{11} particles per pulse at a rate of 1 Hz.
- high intensity pulse mode is also available: up to a few $\times 10^{13}$ protons per pulse with currents up to a microamp.
- quasi-gaussian beam spot diameter in range 1 to 8 cm.
- beam can be structured at the nanosec to microsec level.

The proton irradiation hall ("the Blue Room") beamline with monitoring

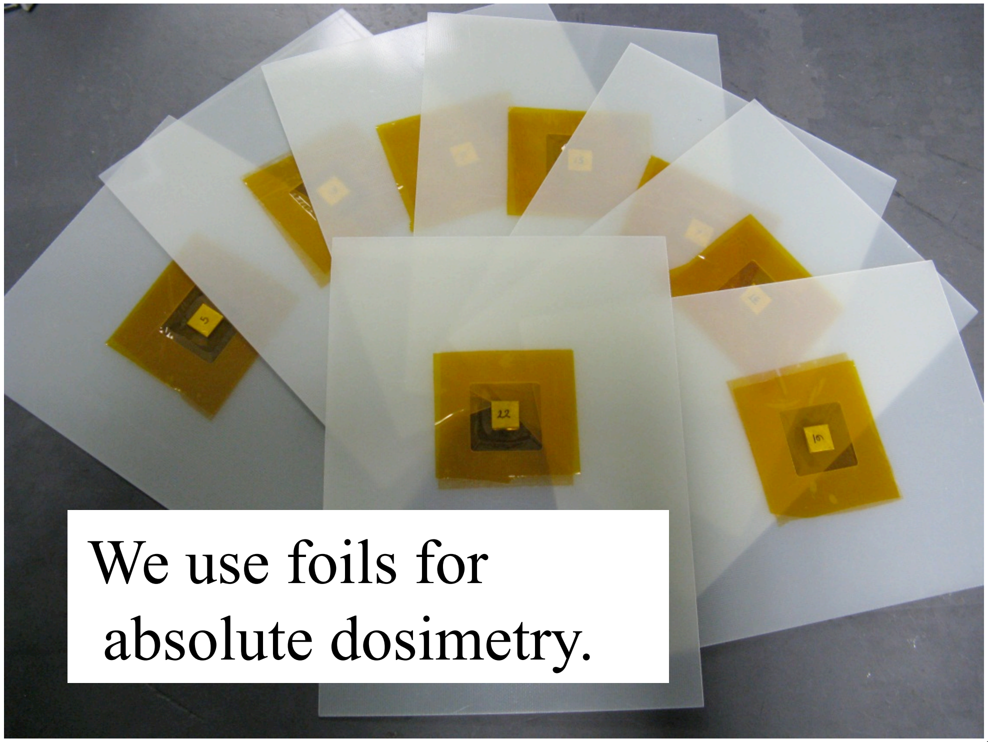


Samples mounted in frames at UNM



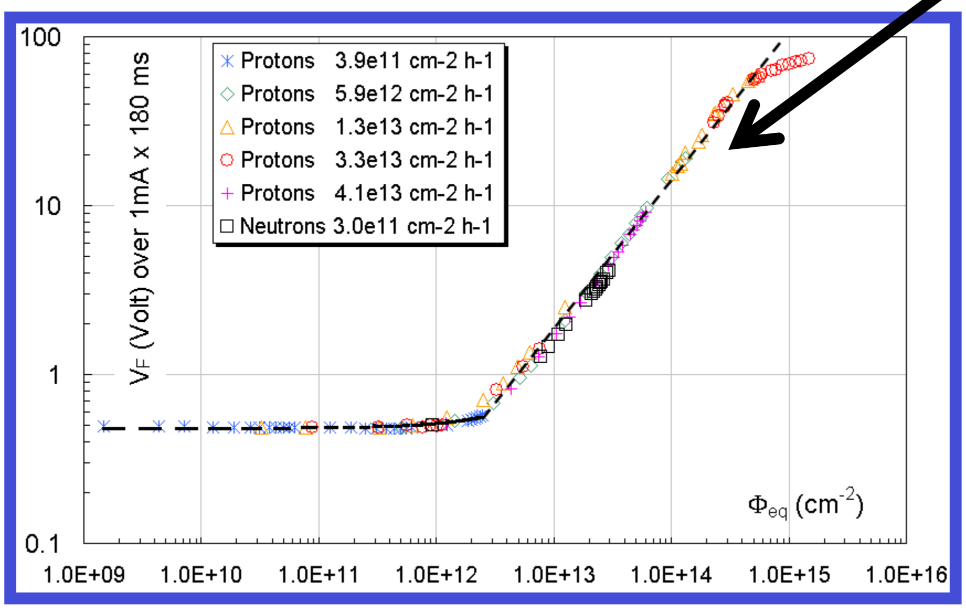
then aligned in slotted box to the beam with a laser.

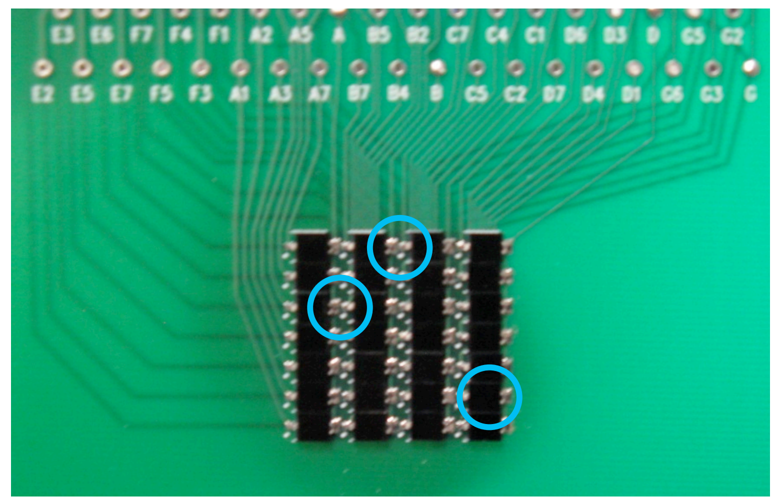
Power is available in the radiation enclosure for monitoring and operation of active devices. Under standard (83 nA) conditions, the temperature remains constant without intervention.



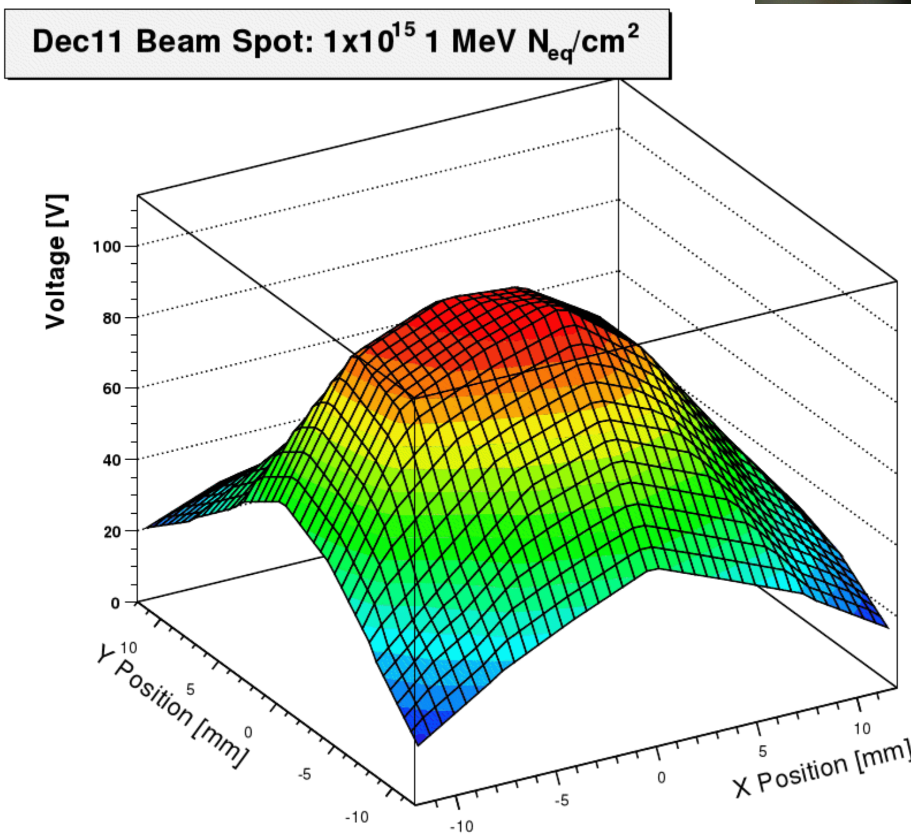
We use foils for absolute dosimetry.

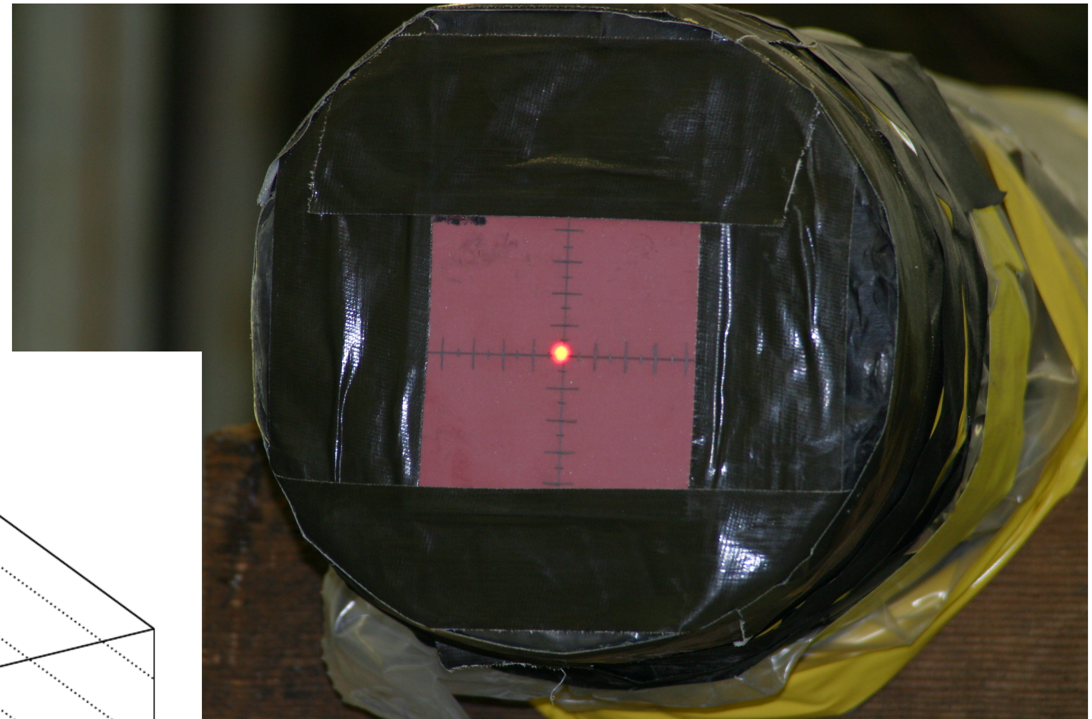
For fast real-time feedback on the fluence and beam shape, we include in the stackup two 7x7 arrays of OSRAM BPW34 diodes on a 4 mm pitch: their forward voltage is linearly proportional to fluence up to 10^{15} cm^{-2}.





The proton beam:

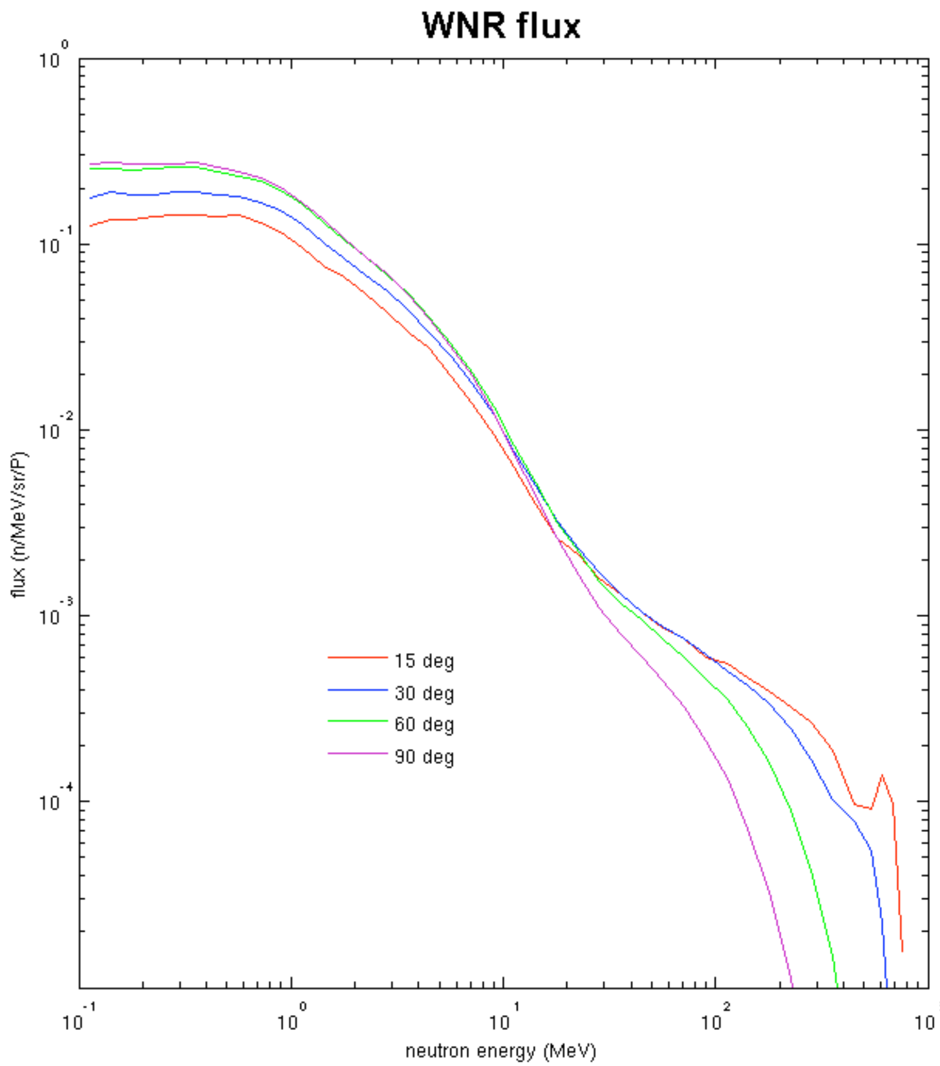




We typically optimize it to a sigma of ~8 mm. Larger devices can be oriented at an angle to it to improve uniformity of exposure.

Neutrons

- energy range from about 0.1 MeV to > 600 MeV
- operating range 40 – 100 Hz
- unmoderated tungsten target but filters can be inserted.
- Because the proton beam is pulsed, the energy of the neutrons can be determined by time-of-flight.
- ~10^6 n $cm^{-2}s^{-1}$ above 1 MeV per pulse



SEU testing facilities: ICEHouse I and II

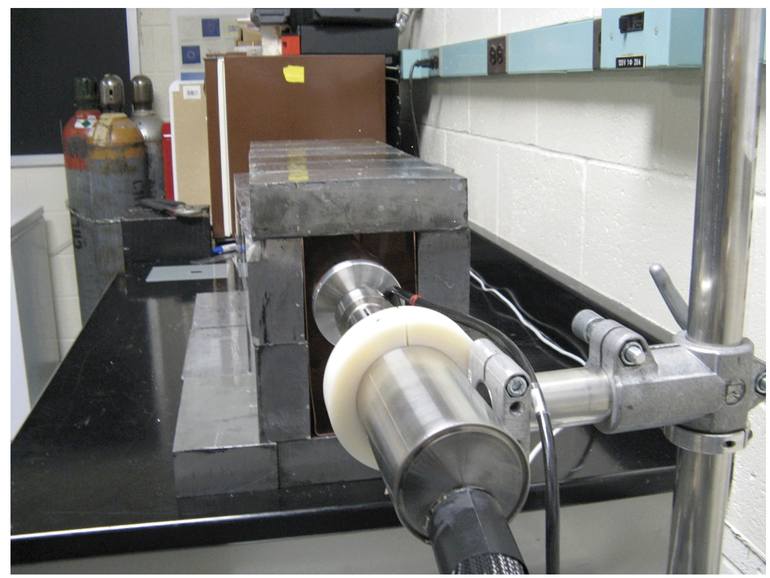
- located at 30°, these provide a natural cosmic ray background spectrum @ rate 10^6.

More information on WNR is available at wnr.lanl.gov.
LANL contact: Dr. Leo Bitteker, lbj@lanl.gov.

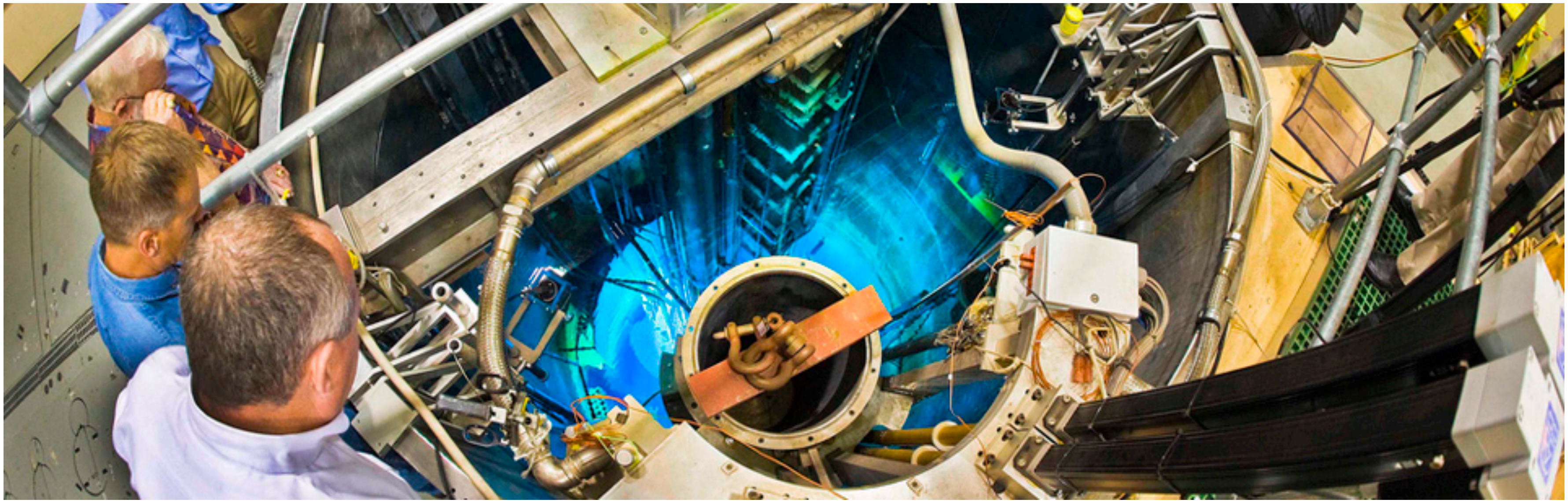
Every activity on any flight path requires a proposal. Calls for proposals are made yearly, typically in March. After submission of the proposal through a web interface, the PI is required to defend the proposal in an oral presentation to the LANSCE Program Advisory Committee, typically in April. Notifications are made in May for beamtime allocations during the period June – December. LANL does not charge non-industrial experimenters.

Typically the UNM group submits a proposal on behalf of ourselves and 5-10 collaborating institutions for two proton exposures of about 2×10^{16} p/cm^2 each, scheduled for July and December. This translates to about 72 hours of beam twice per year. Because of the small beam diameter, these runs are typically oriented toward silicon and diamond sensors, tracking modules, electronics chips, and small mechanical samples.

We have recently commissioned a gamma ray spectrometer at UNM dedicated to dosimetry and activation measurements for devices in these runs.

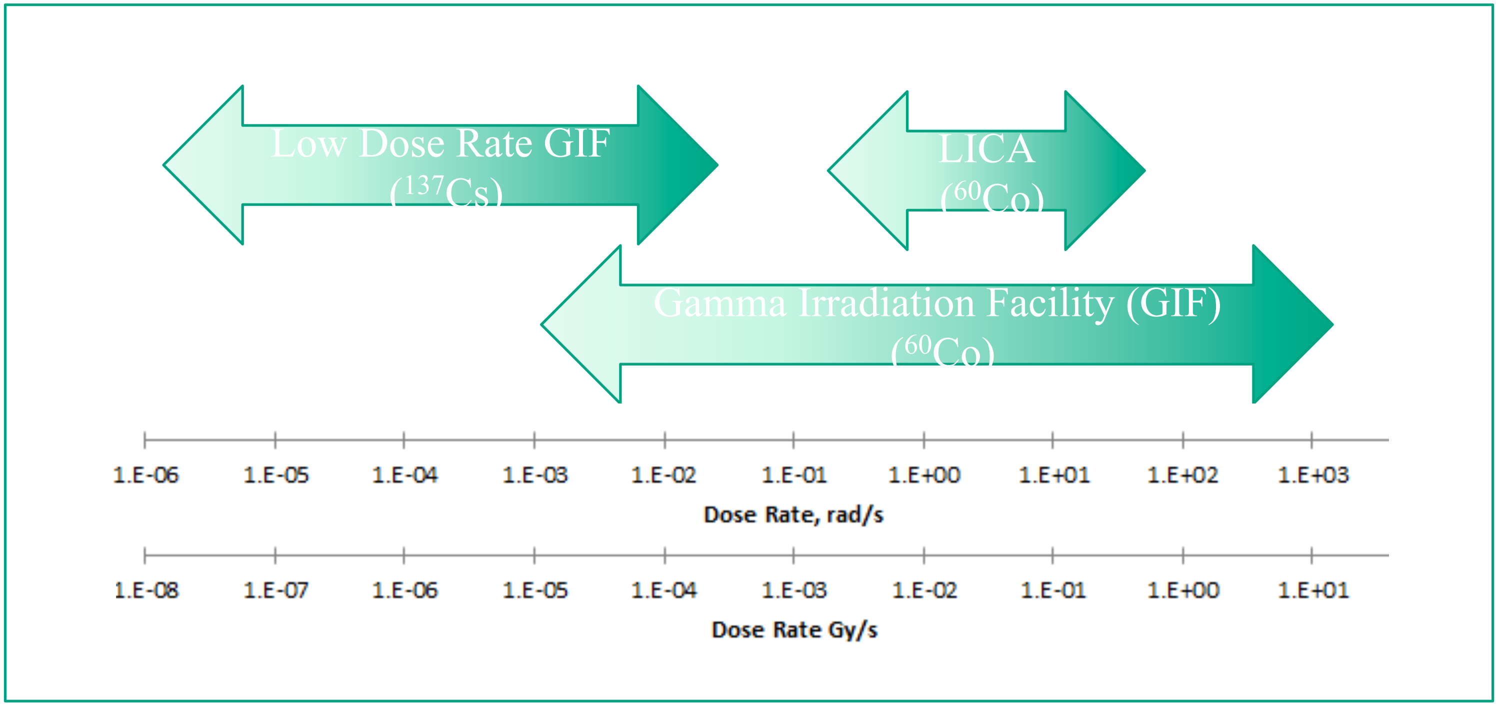


At Sandia: the Annular Core Research Reactor (ACRR)



provides a large central cavity with very little radiation gradient and the capability of high radiation intensity. The neutron spectrum can be selected through choice of containment vessel material (lead-boron to lead-graphite). Dimensions of the cylindrical vessels are 5” - 7” diameter, 28” - 44” depth: excellent for many larger mechanical samples as well as PC boards and cables. Dosimetry is provided by Sandia with 3% accuracy. About 9×10^{15} 1-MeV-n_{eq}/cm^2 can be achieved in a day.

Also at Sandia: The Gamma Irradiation Facility (GIF):



Dose rate capabilities of the Gamma Irradiation Facility and the Low Dose Rate Gamma Irradiation Facility. Typical irradiation times at the GIF are hours to days for in-air irradiations.

For more information, see www.sandia.gov/research/facilities/gamma_irradiation_facility.html and www.sandia.gov/research/facilities/annular_core_research_reactor.html.

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anyway.