My Wish List for Detector Development Facilities

4/17

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Neutrons

Many experiments at Fermilab require understanding neutrons

- Mu2e
- Neutrino experiments

Invest in neutron test facility (in addition to neutron irradiation facility):

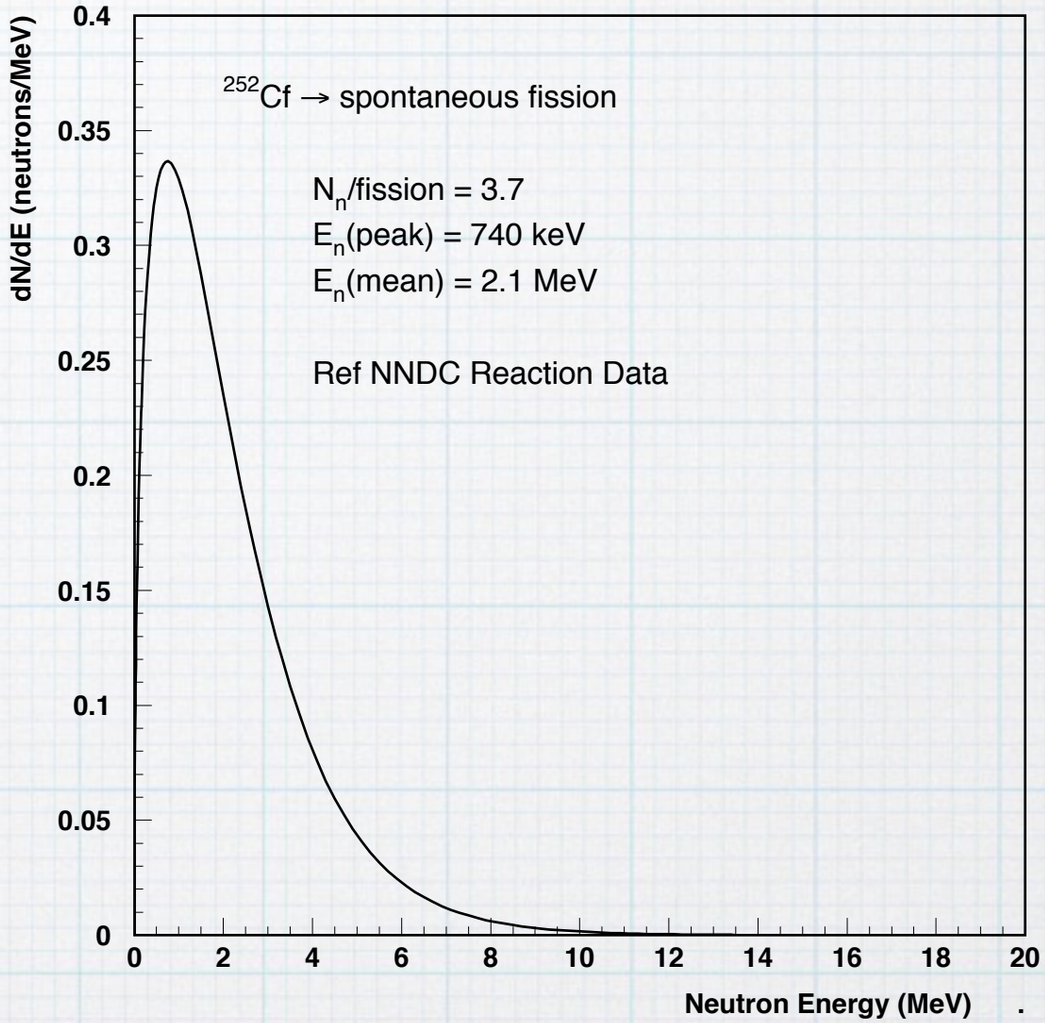
➡Appropriately designed shielded room(s?)

➡Neutron generator:

- commercially available
- well defined neutron energies
  E_n = 2.45 MeV(DD), 14.1 MeV(DT)
- control flux/time structure of neutrons (coincidence tagging for testing detectors)

➡New ^{252}Cf source:

- well defined/understood neutron energy spectrum
- AmBe/PuBe E_n spectra depend on component mixture/packing factors, etc.
- $t_{1/2}$ = 2.645 years



FNAL currently has a single ^{252}Cf source

Activation: 2.5 μCi

1.1e4 n/s over 4π

0.08 n/cm^2/s @ 1m

Desired Activation: 5,000 - 10,000 μCi

(2.1 - 4.2)e7 n/s over 4π

(160 - 320) n/cm^2/s @ 1m

Capability Expansion/Upgrades (1)

Thin films facility used by various divisions/users (coatings, mirroring, diamond polishing, etc)

Thin Films Facility Investments:

➡Photolithography
- Allow for surface metallization of complex patterns
- Enhance existing facilities

➡Oxygen Plasma Etch Machine
- Aid in surface preparation for adhesion of thin films
- Supplement/enhance existing facilities

➡Surface Materials Scientist/Chemist
- Better understanding of processes
- Assist with coatings, etc.

Example: Diamond Microstrip Detector

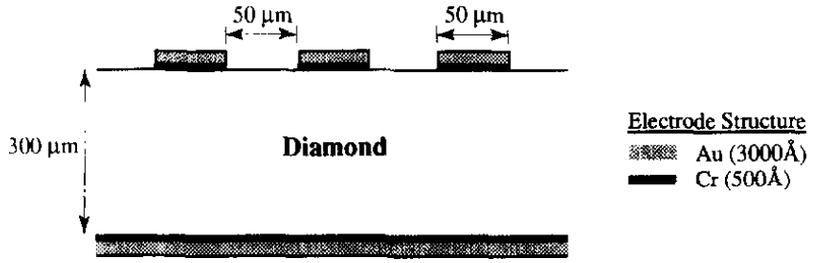


Fig. 1. Cross section view of the diamond microstrip detector.

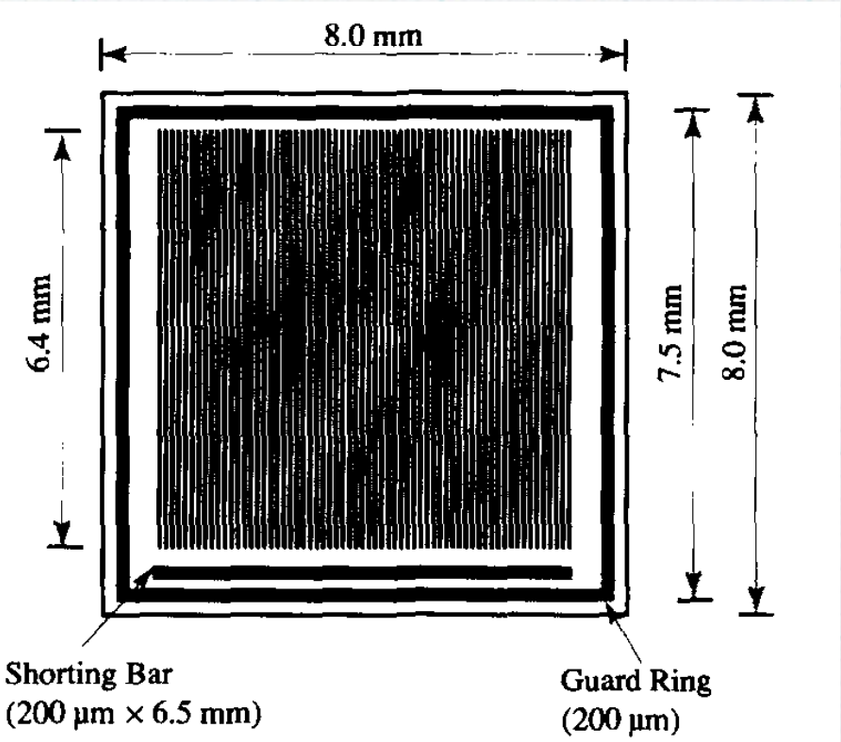
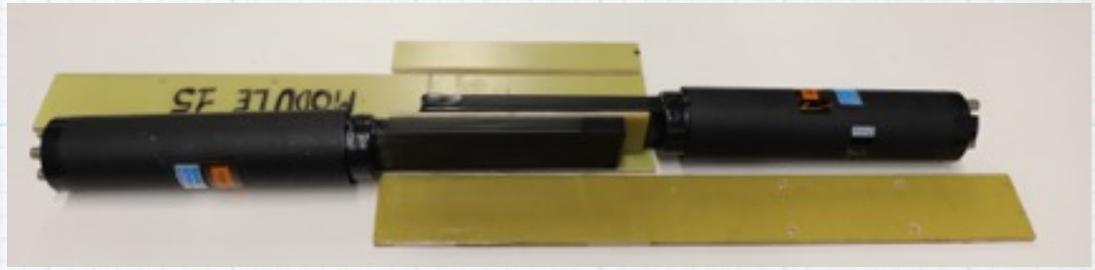


Fig. 3. Schematic view of the diamond microstrip detector.

F.Borchelt, et al., NIM A354 (1995) 318-327.

Capability Expansion/Upgrades (2)

Scintillators PMT assemblies used for test stands and test beam (triggers)



Scintillator Assembly/Maintenance Investments:

➡(Re-)establish scintillator "shop" (Lab 6)
- Catalog supply of PMT/bases
- Scintillator machining, wrapping, testing

➡Hire/Train new person to make/maintain scintillator detectors for test stands/ beam
- Anatoly Ronzhin will retire someday
- Capture/retain competence

➡Development of radiation tolerant scintillators for future experiments

Capability Expansion/Upgrades (3)

Intensity frontier experiments need access to lower energy particles to test/ characterize detector performance.
eg: NOvA, Short Baseline Neutrino Program, Mu2e observed particles < 5,000 MeV/c

Test Beam Investments:

➡Add low energy beamline (capability)
- Momentum selection 100 - 5,000 MeV/c
- 500 - 5,000 MeV/c short lived particles (K, π, μ)
- 100 MeV/c long lived particles e,p (μ)
- Rates > 1 Hz over momentum range

➡Irradiation Facility:
- 100-500 MeV protons
- Beam size few cm across (tunable)
- Φ ~ 1e4 - 1e12 p/cm^2/s (tunable)
- Proximity of irradiation and test facilities