Accelerators For ADSS

Frank Harmon

Idaho Accelerator Center

Idaho State University

August 2003 ADSS Workshop

Coupled Source and Multiplying Assembly

Multiplication of source neutrons,

$$n = n_{inj}/(1-k).$$

The multiplication comes from fission neutrons.

If the source is pulsed,

$$n(t) \sim \exp[\, -t/T(1-k)].$$

T is the life time of a generation of prompt neutrons.

T ~ 10-7 sec?

Coupled Source and Multiplying Assembly Time Dependence

Historically this scheme has been used to study neutron life time, control worth, transient effects on materials, etc.

The the usual methods to modulate the “source” have been,

- Pulsing reactors (reactivity change)
- Pulsed accelerator driven systems

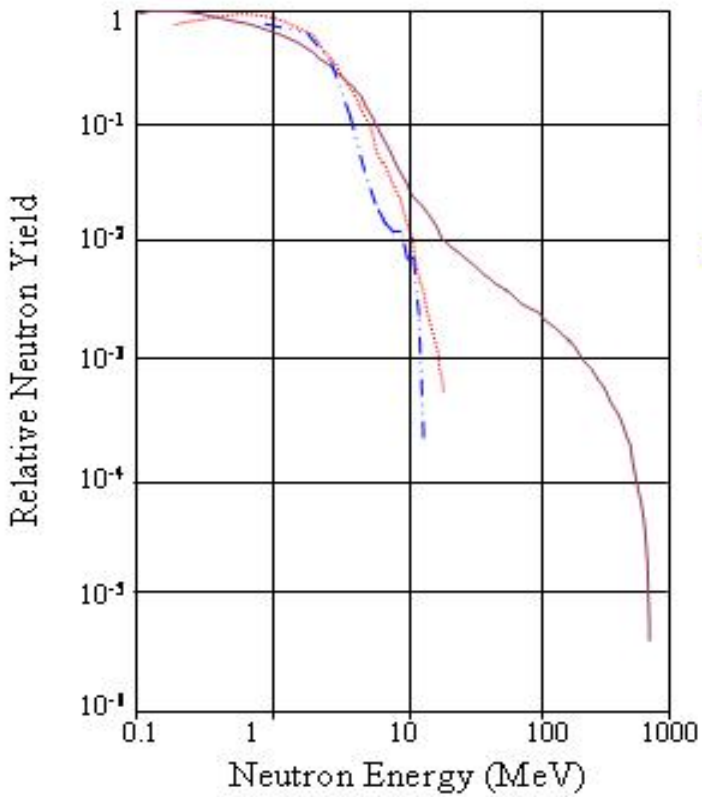
Some Characteristics of Accelerator Neutron Sources

Process	Example	Relative neutron cost/unit energy
(d,T)	200keV T on d	2.5
(d,n)	35MeV d on Li	3.5
(gamma,n)	40MeV e on Pb	1
Spallation	1Gev p on Pb	0.02

RF Electron Linacs

- Photonuclear and photofission neutrons
- Yield/beam power second only to proton spallation
- Robust technology
- Flexible output characteristics
- Inexpensive
- Neutron spectrum similar to spallation source

Neutron Spectrum of Electron Linac and LANCE

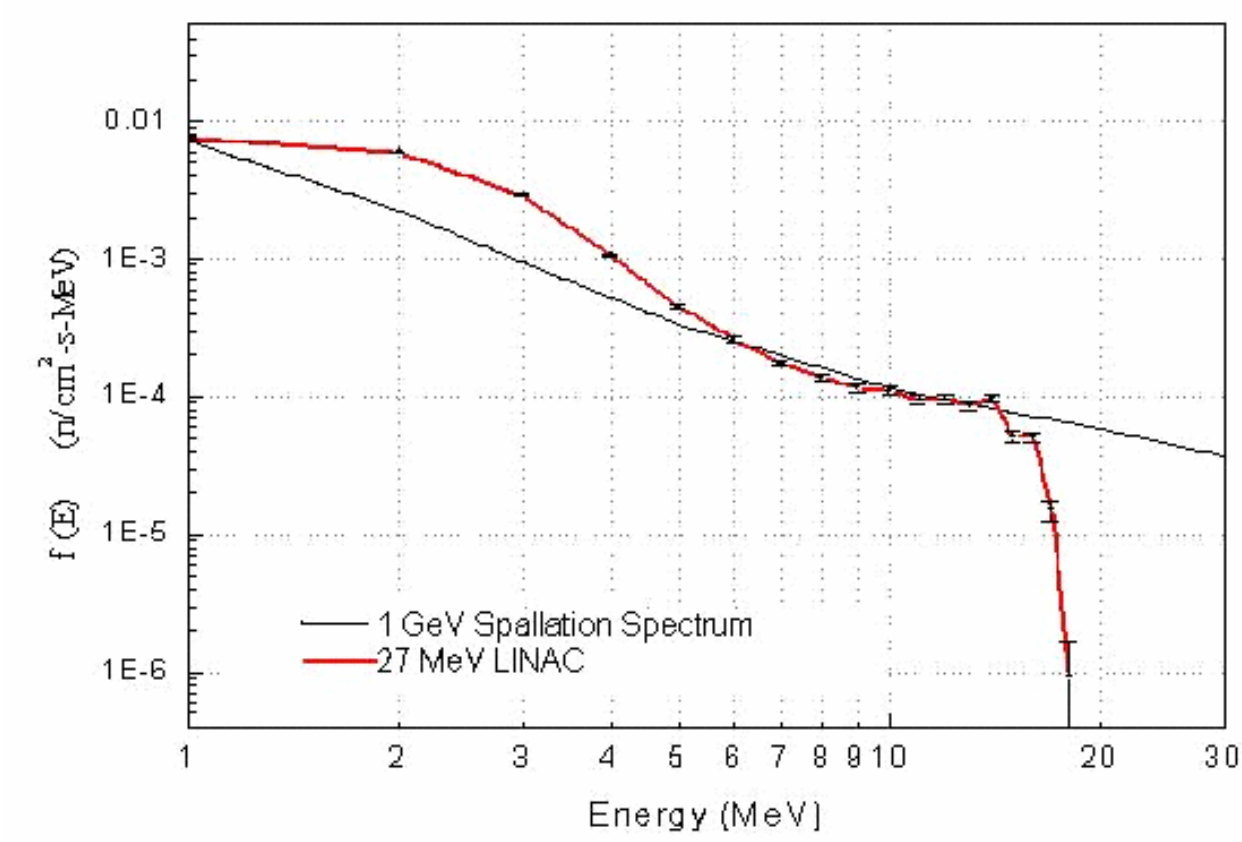


Dotted – 100 MeV electrons on U target

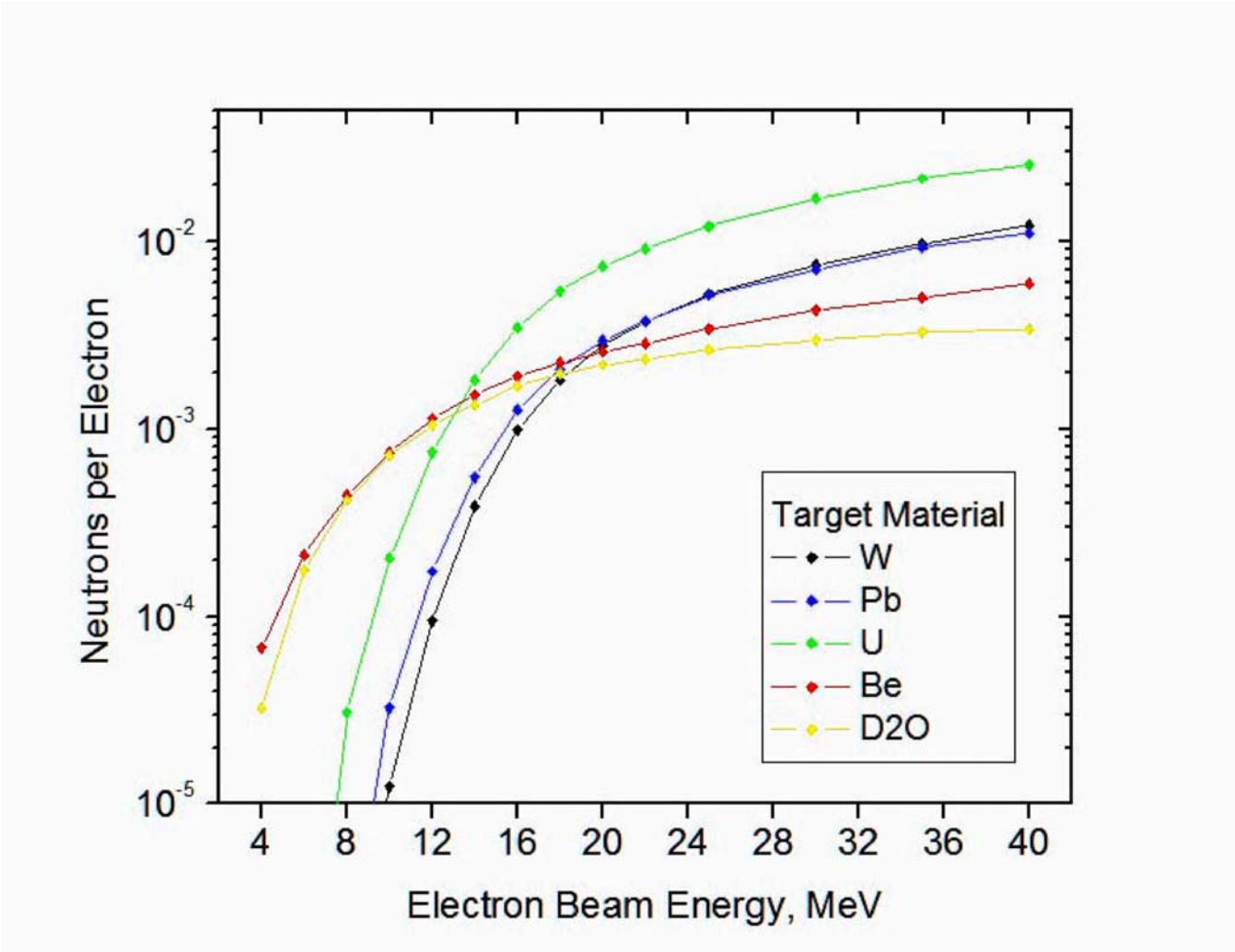
Solid – 800 MeV protons on W target (LANL Spallation Source)

Dashed – 20 MeV electrons on Pb target

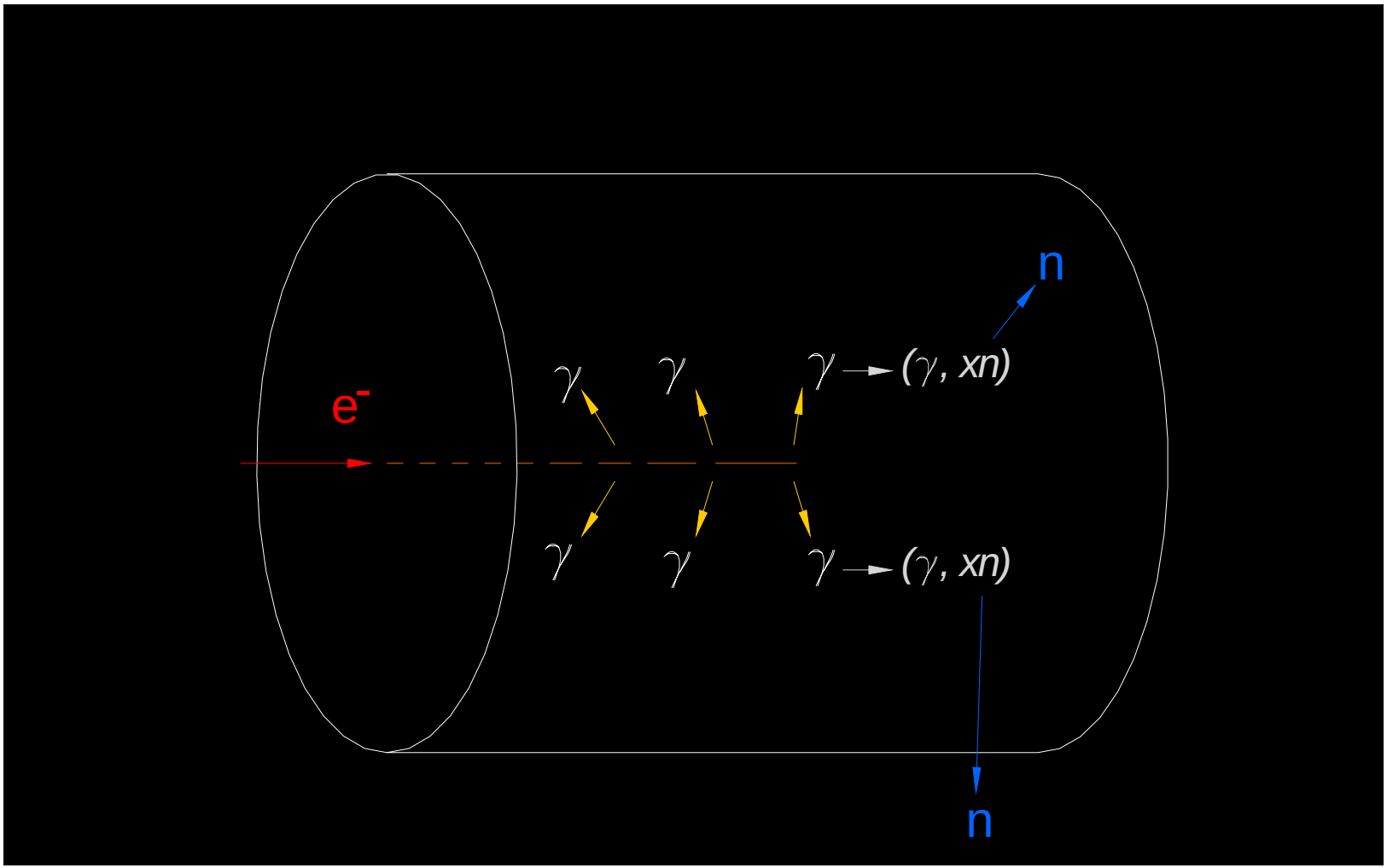
Photonuclear and Spallation Neutron Spectra



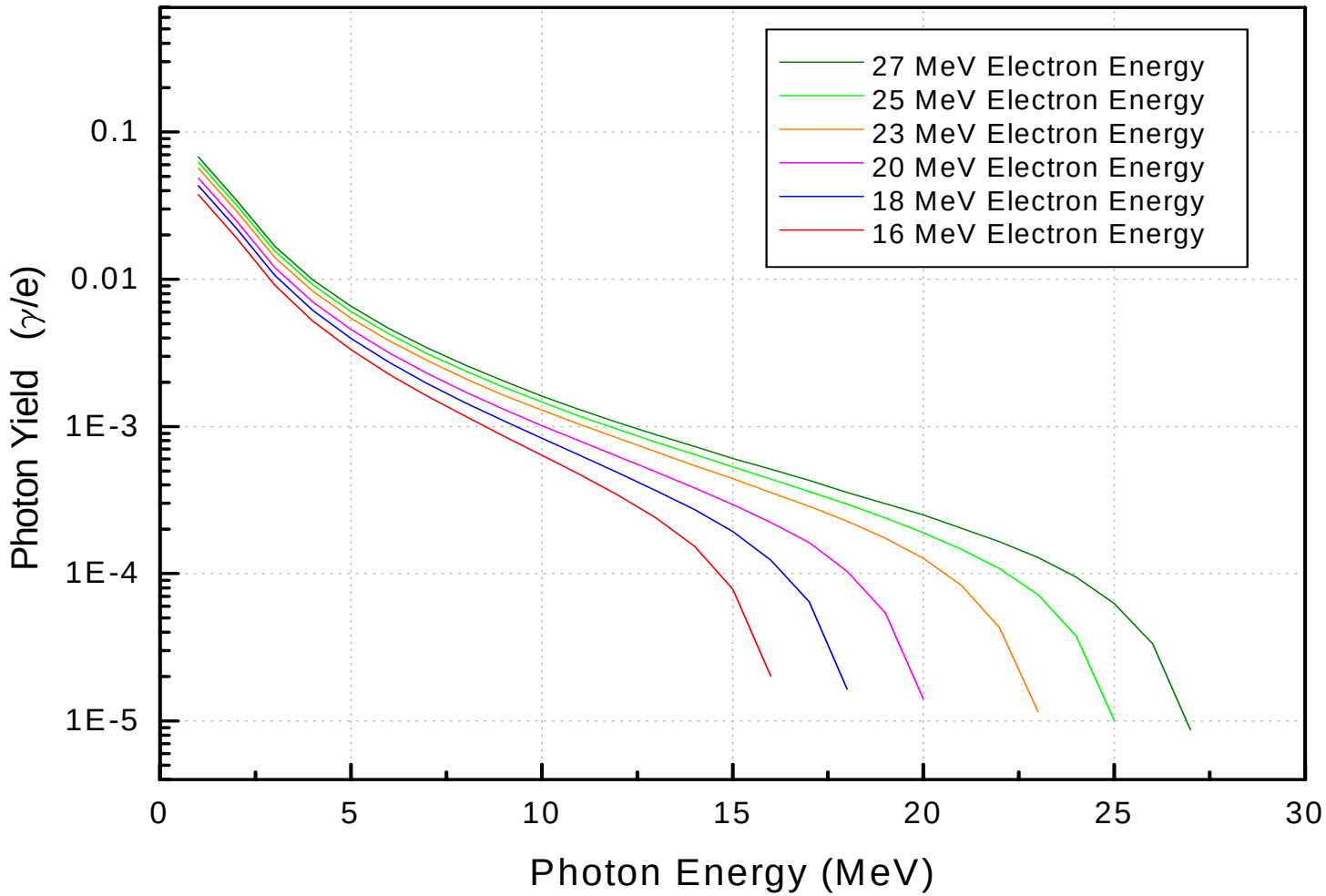
Choosing a Target Material



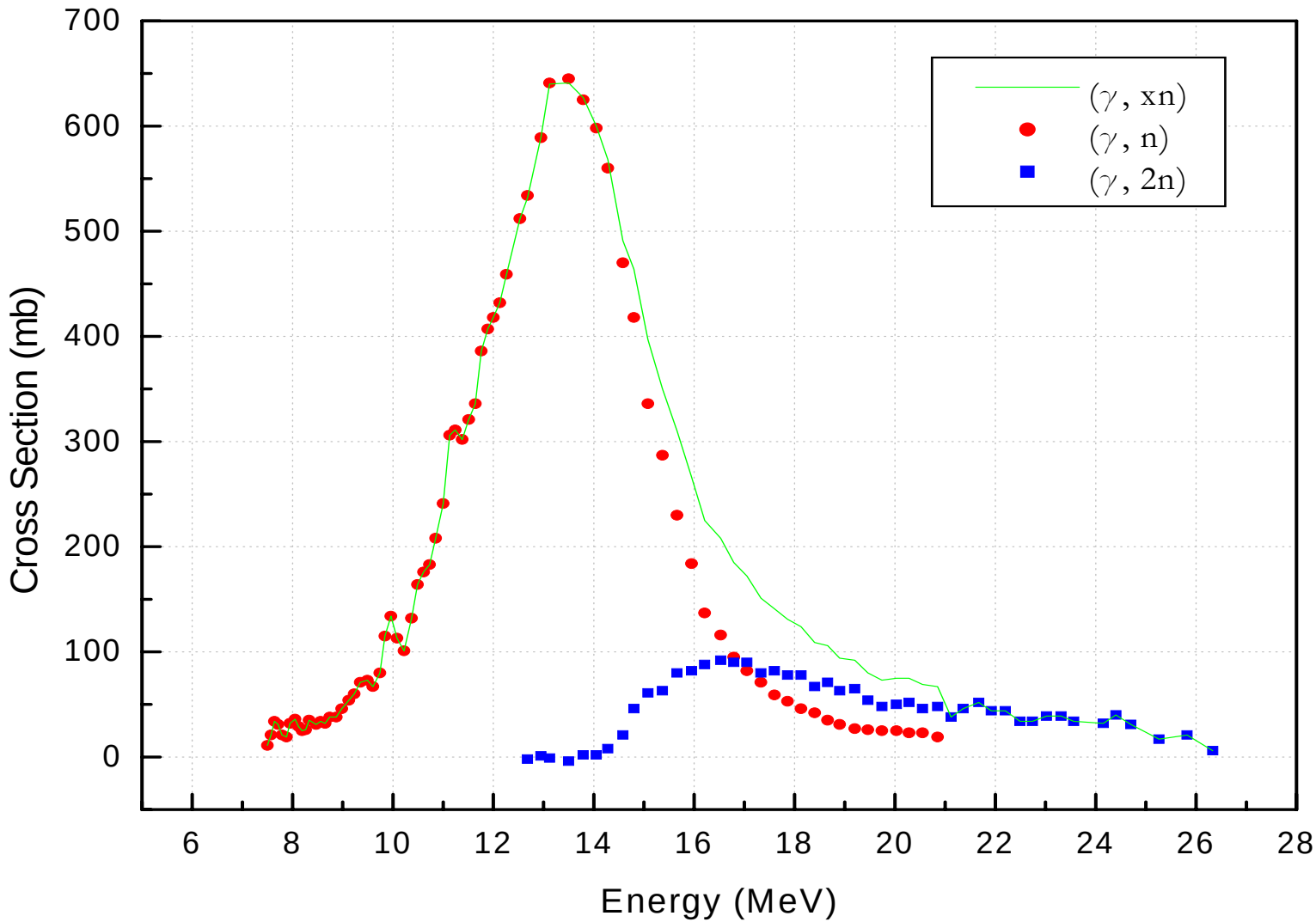
Production Processes



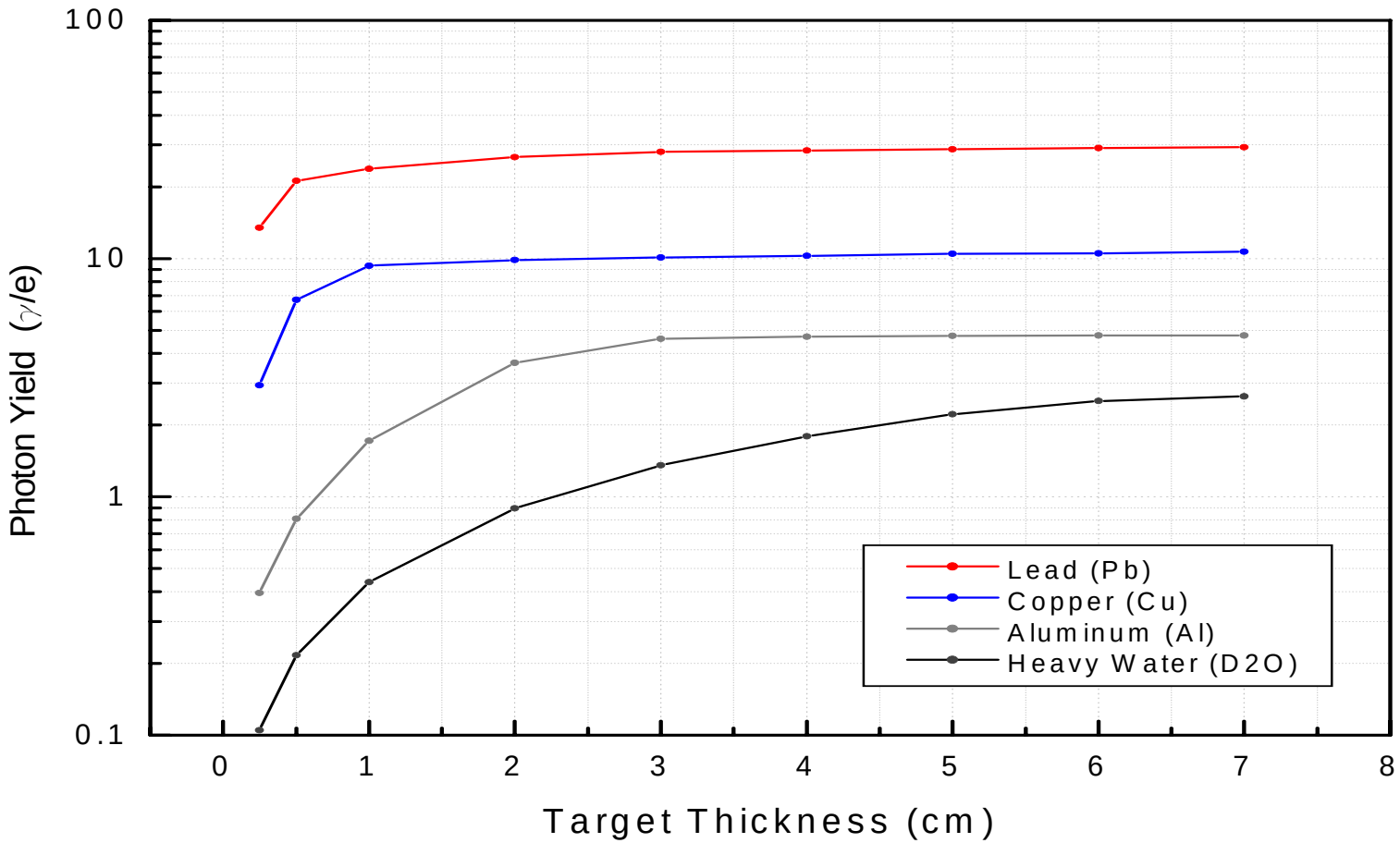
Bremsstrahlung Spectra



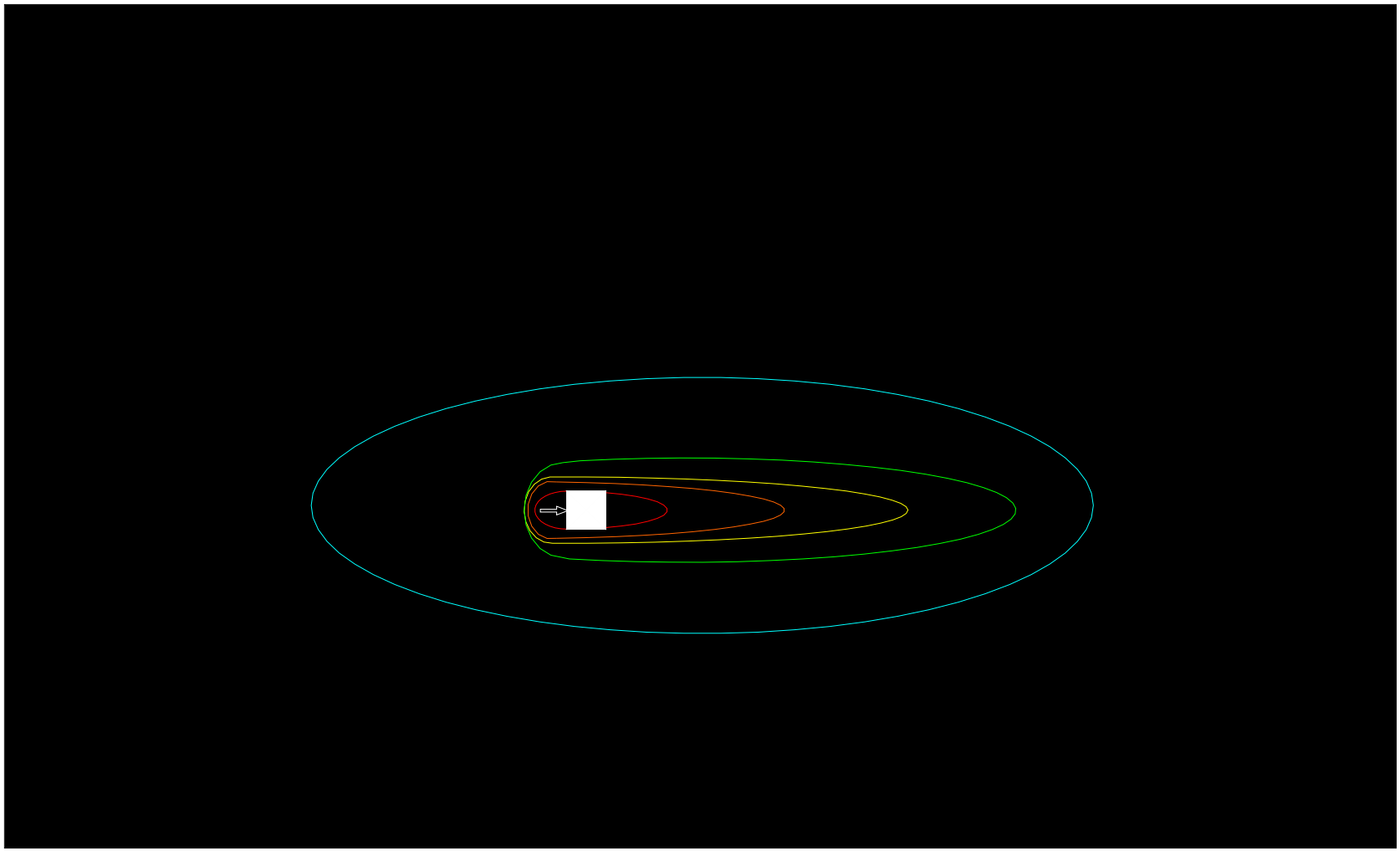
Photonuclear Giant Resonance Cross Section for Lead



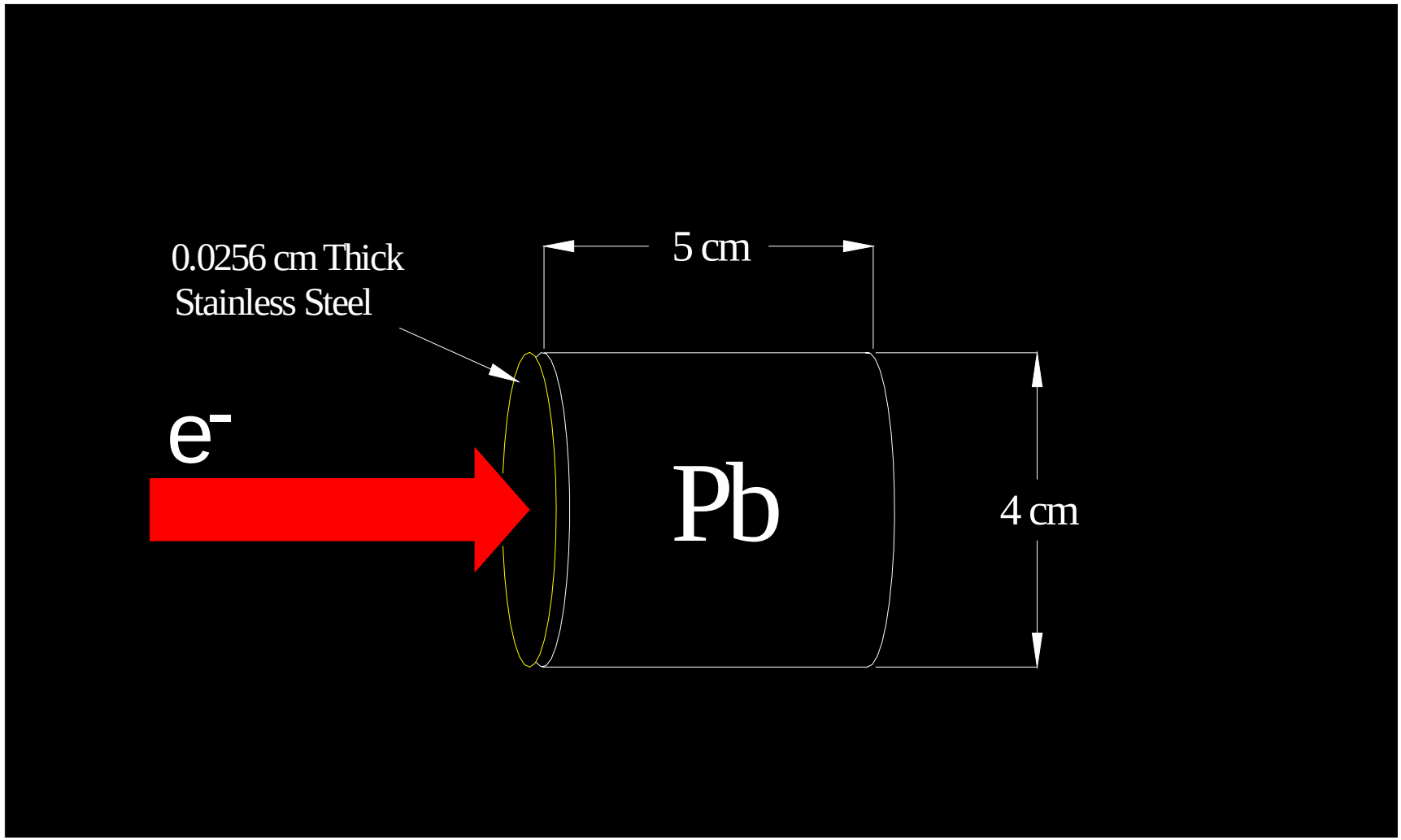
Photon Yield as Function of Target Thickness



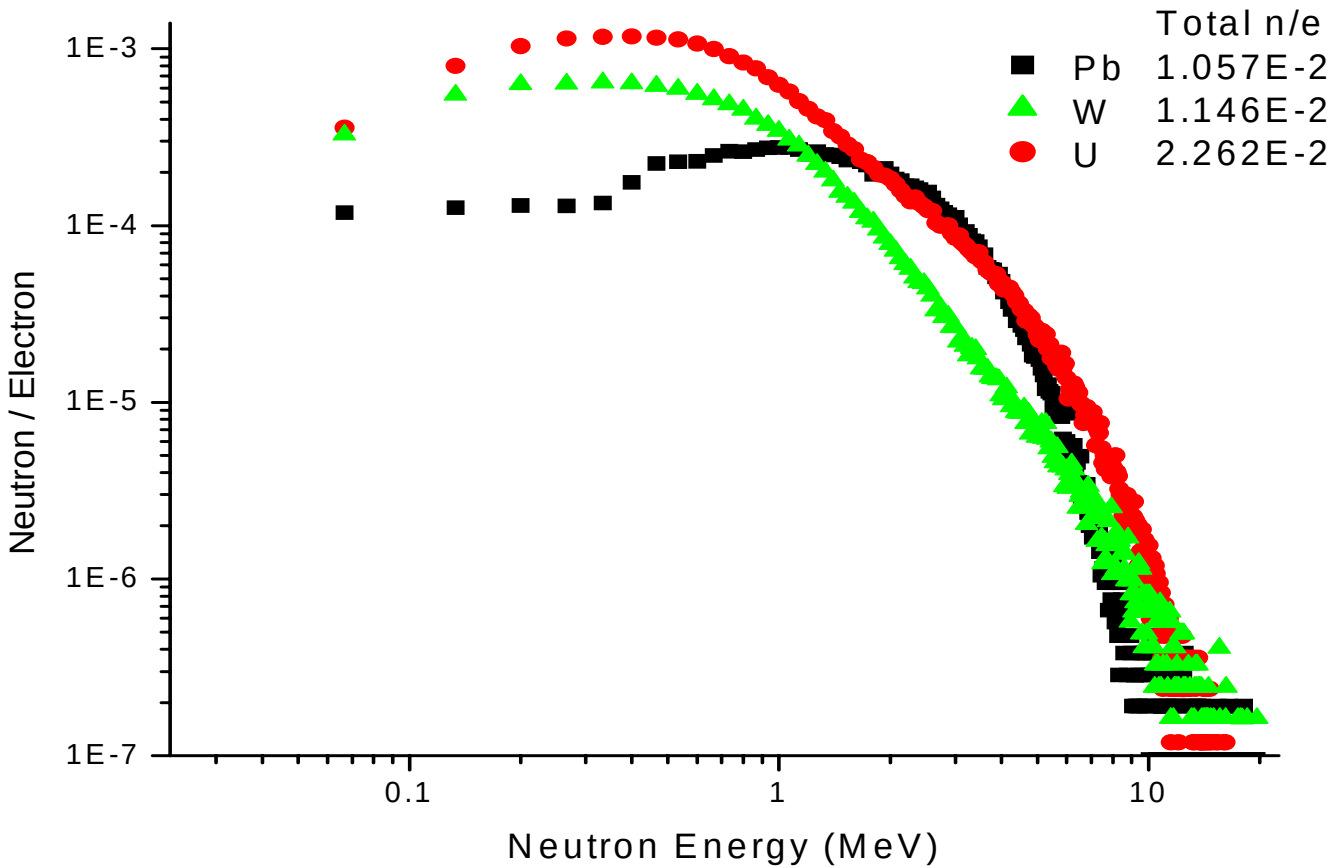
Photon Distribution



Neutron Producing Target



Spectra 40 MeV Electrons



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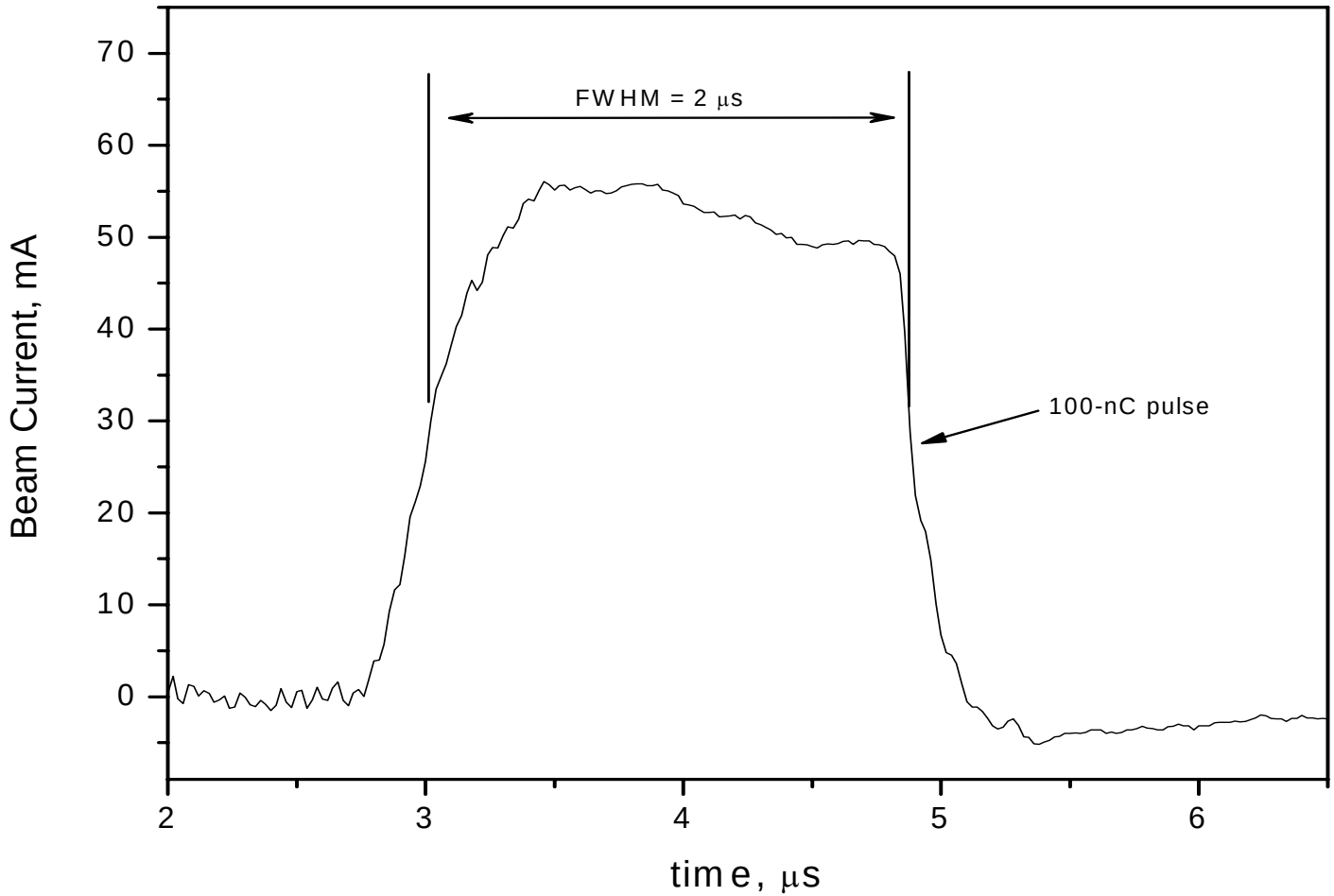
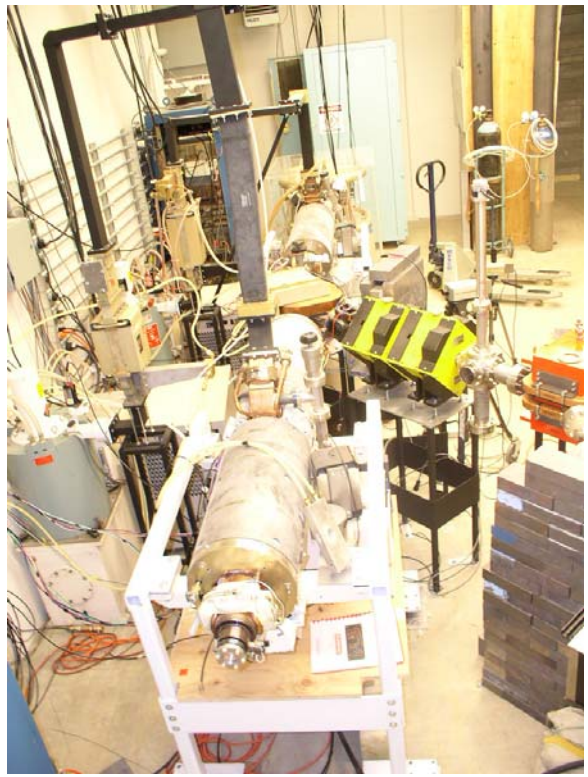
Electron Burst History, 18-MeV LINAC



Prototype 40 MeV Accelerator at IAC

- ~ 3 kW beam power
- Relatively compact
- Reliable off the shelf components
- Easy to operate
- Flexible output characteristics



Conclusion

Thanks to Linda Egli, Jennifer Farley, Anja Folkman, and Harmony Williams for the planning, travel, presentations, and clerical work. Thanks to Brian Oborn for his web page and computer expertise.

Thanks to Kevin Folkman, Brett King, Dugan Mabe, Chad O'Neill, Mark Paulson, Randy Spaulding, who have calculated, machined, welded, bolted and swore to make the 40 MeV linac work.