Shielding of Radioactive Materials

Issues and Ideas

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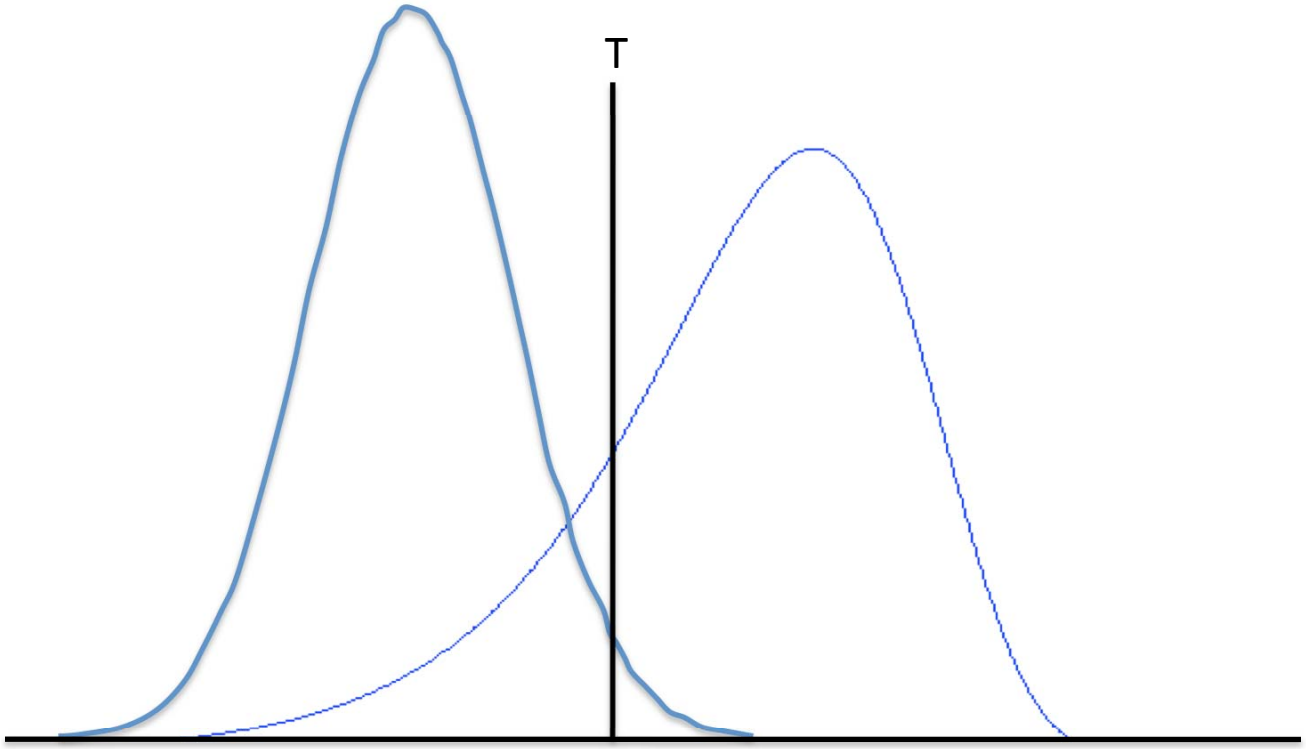
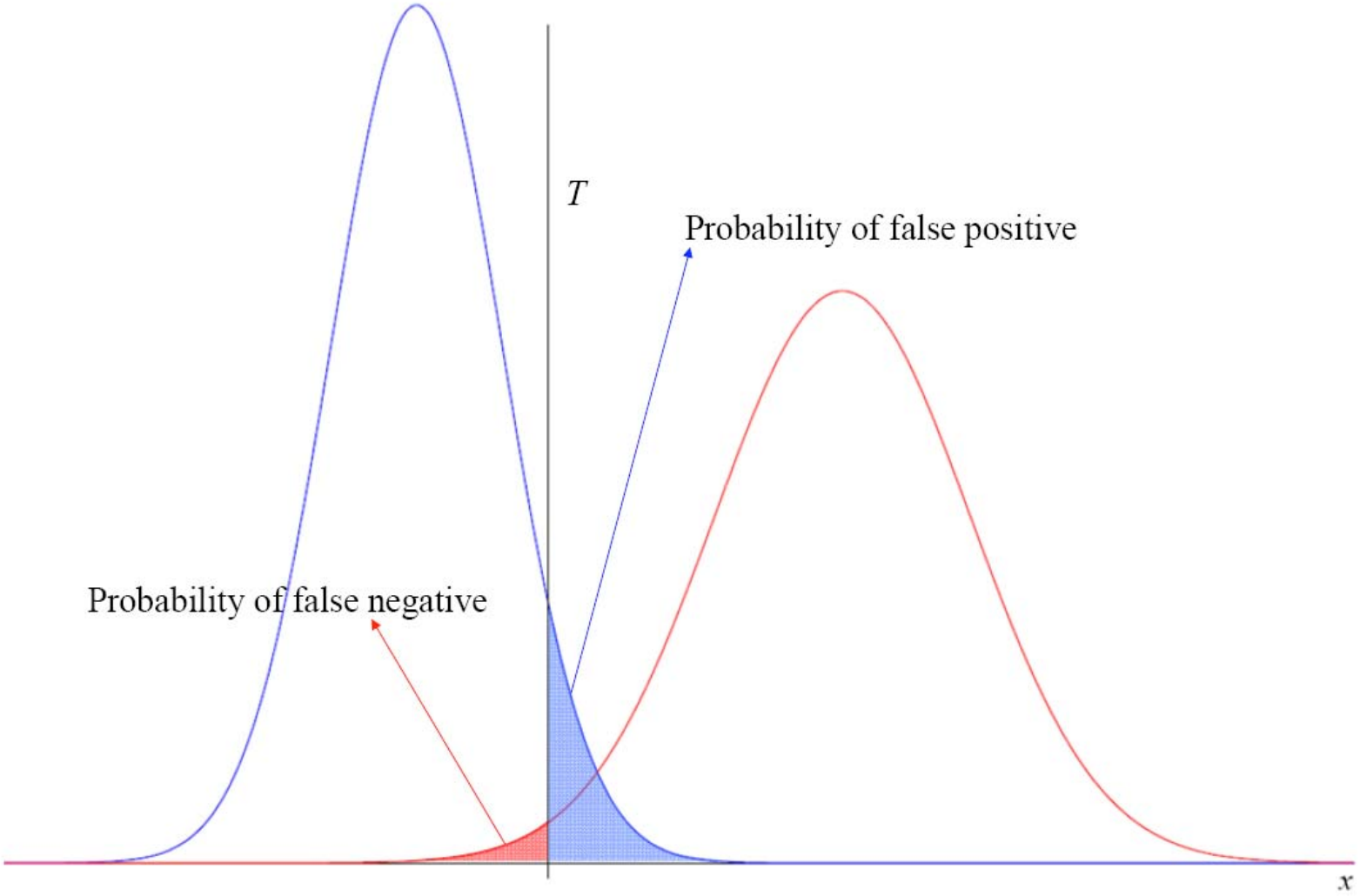


Current Model



Current Model

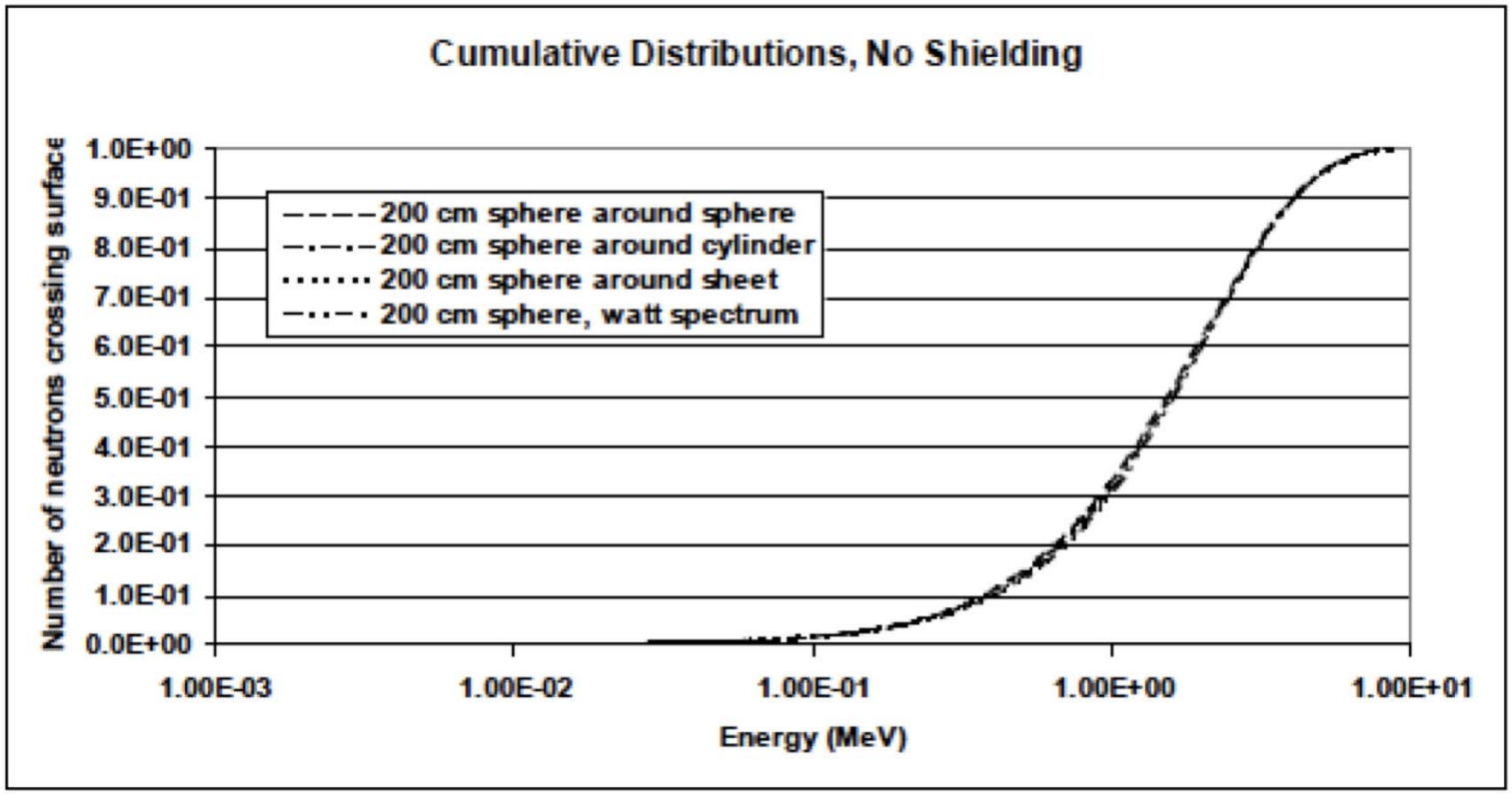
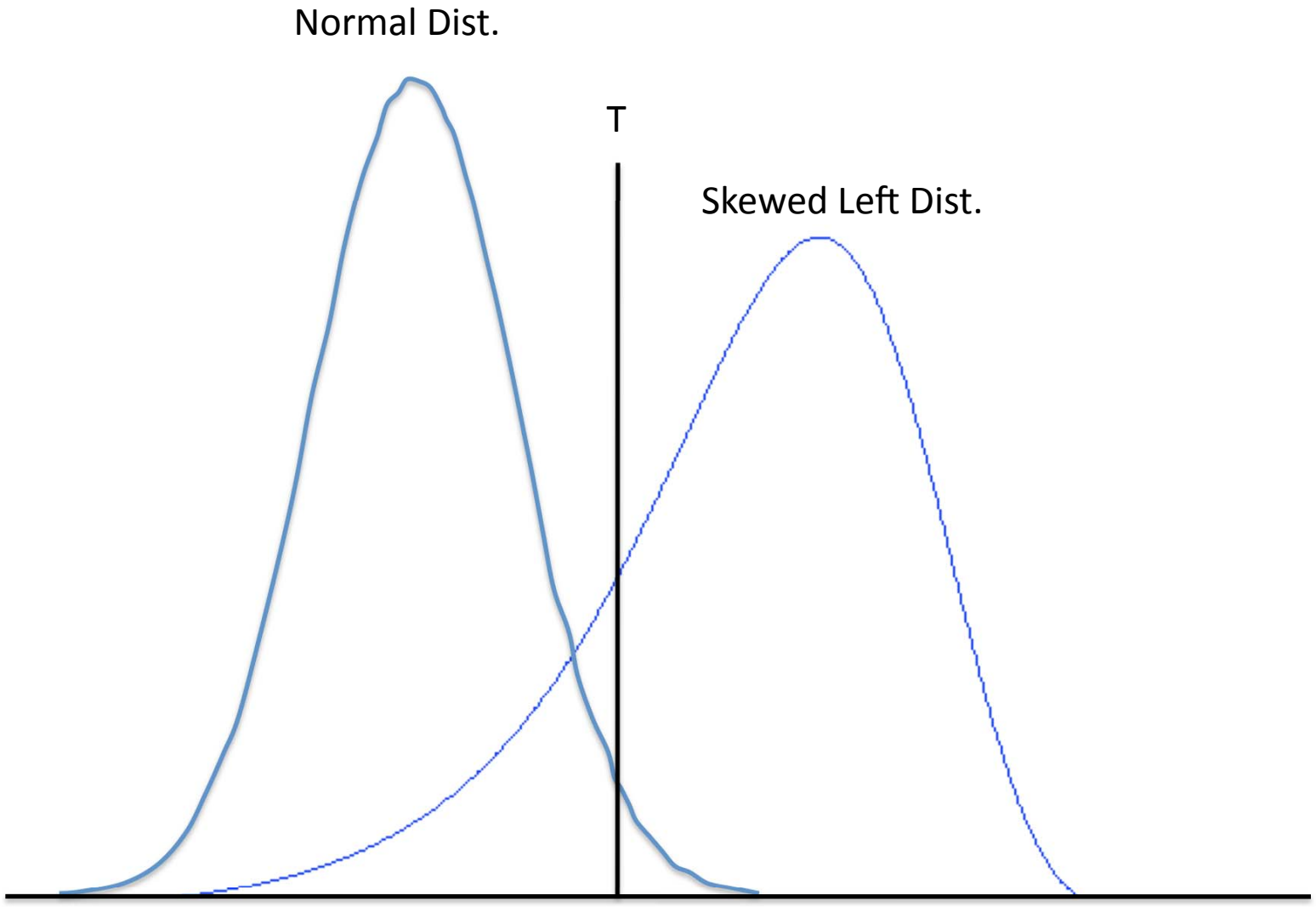


Figure 9. Cumulative distribution of neutron current at 200 cm empty sphere surface for basic source configurations with no shielding. The cylinder, sheet, and sphere each represent a 500 g HEU source with a uniform distribution. The Watt spectrum was run as a point source.

>Closely corresponds to a normal distribution for *d*=1 containers

Intuitively: Skewed-left Distribution



Intuitively: Skewed-left Distribution

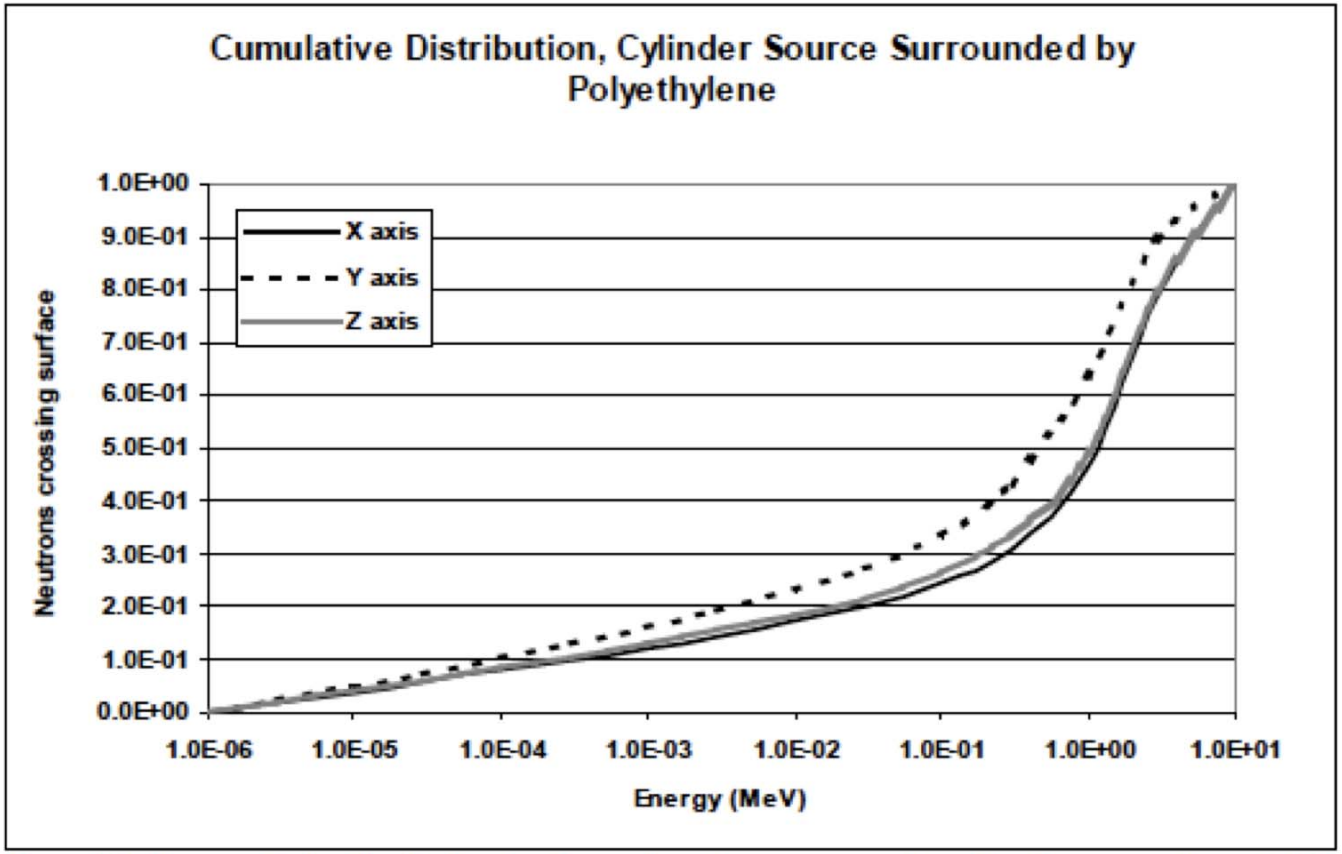


Figure 19. The cumulative distribution for the number of neutrons crossing a flat detector surface of 2500 cm^2 at a distance of 100 cm from the center of the source along the X, Y and Z axes. The neutrons originate from a 500 g cylinder source of uniformly distributed HEU. The source is surrounded by polyethylene with dimensions of 24 x 7 x 28 cm. All data is normalized to 1 neutron particle.

>Closely corresponds to a skewed-left distribution for shielded, *d*=1 containers

Modeling Ideas

>Model emissions as a Poisson process (justifiable from physics)

>>Because the number of emissions is so large, we can use the normal approximation

$$N \sim Poisson(\lambda) \qquad p(x)N \sim Poisson(p(x)\lambda)$$

$$\begin{cases} x = f(t) \\ m = g(t) \end{cases} \qquad \iint p(x)N \cdot f(t) \cdot g(t)\, dxdt$$

>Separate illicit containers into two groups: shielded and unshielded

>>Using shielded radiation data, construct a "Shielded distribution"

>>Model unshielded container as normal distribution (as before)

>Combine the distributions to make a composite, skewed-left distribution

Issues & Possible Solutions

>Shielding thickness

>tradeoff between more shielding and less

>model shielding thickness as a random variable

>little data

>How to decide which shielding material and geometry to focus on

IDEAS?