NMIS FLOOR REFLECTION EFFECT ELIMINATION WITH A DT GENERATOR

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Floor Reflections

- Known Effects
  - Neutron Emission from Time-Tagged Cf-252 source is Isotropic
  - Results in Time Correlated Floor Reflected Contributions to NMIS Signatures
  - Floor Reflection Contributions are Mixed With the Fission Induced Signals
- Proposed Solution
  - Alpha Particle Time Tagging of DT Generator Neutrons Results in Directional Cone of Neutrons That can be Aimed at the Target Items
  - Floor Reflection is Random in Time and can be Eliminated

Simulation Geometry for Cf-252 Source

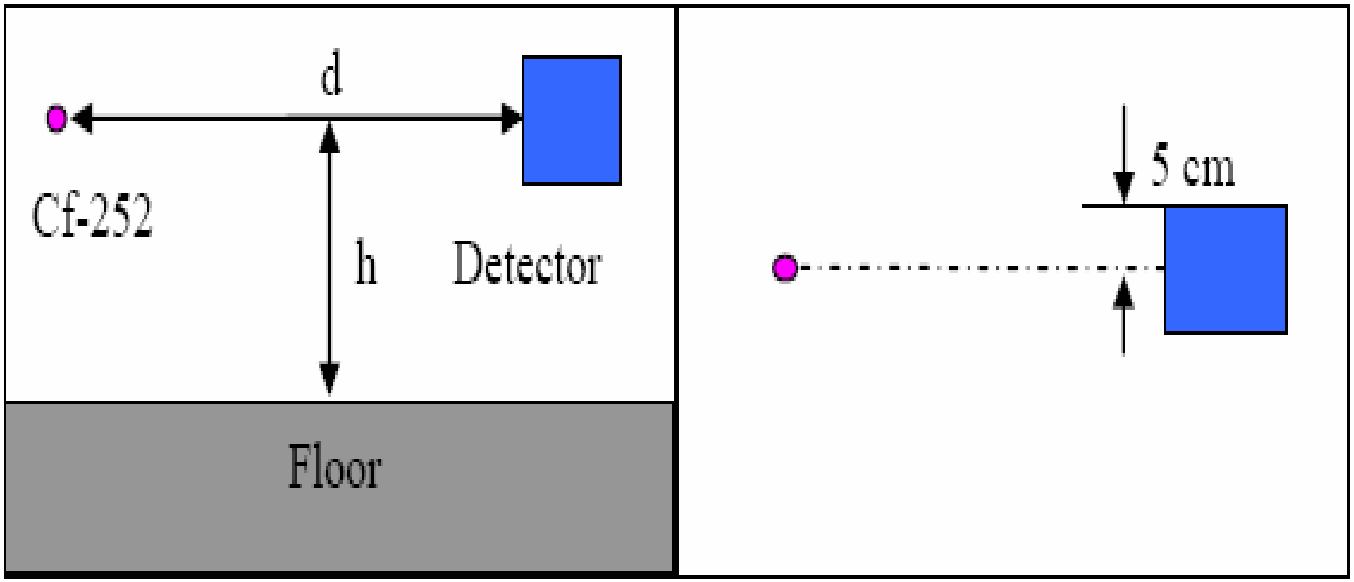


Figure 2: Sketch of geometry used in the simulations

MCNP-PoliMi Simulation

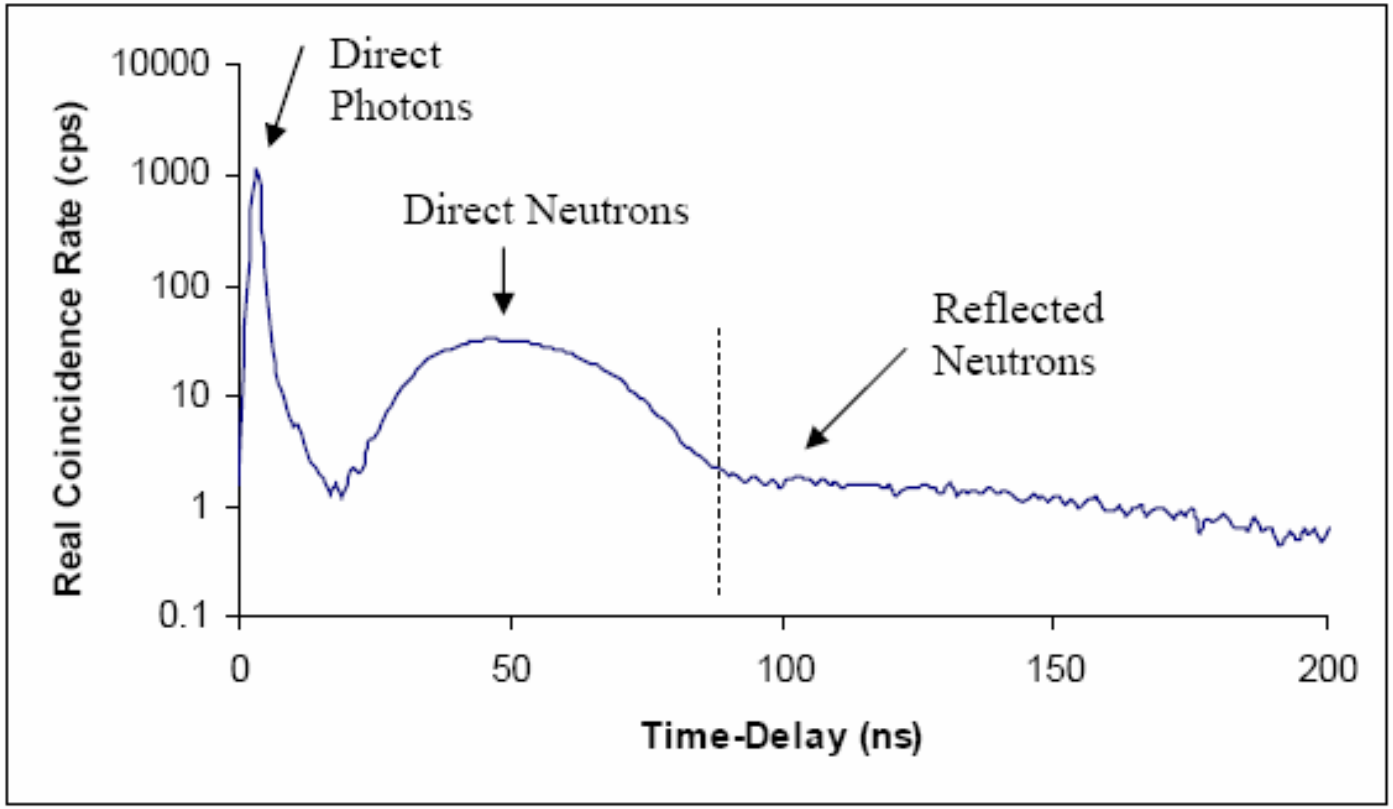


Figure 1: Example NMIS signature.

Modeling Efforts to Estimate Effects of Floor Reflections

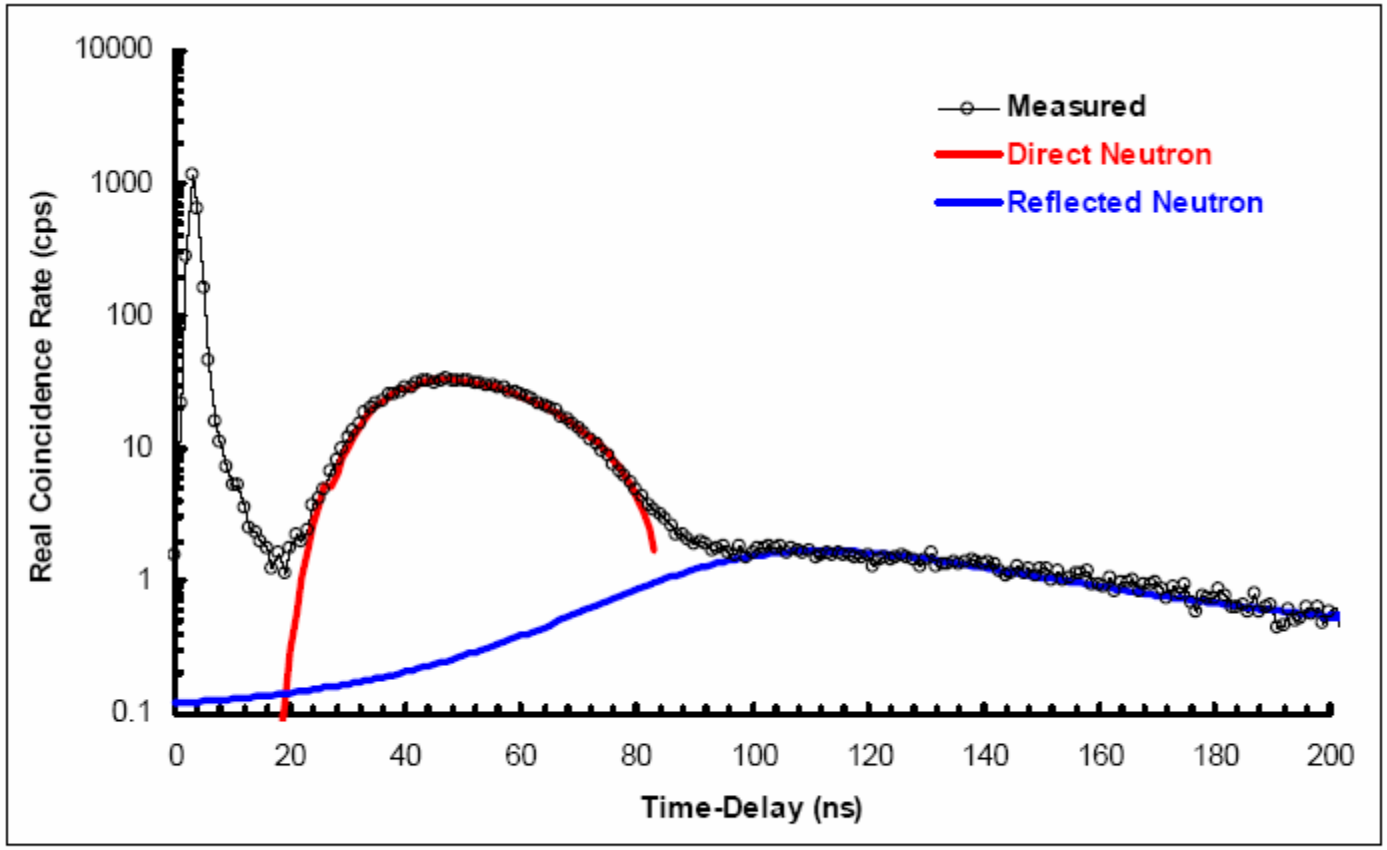


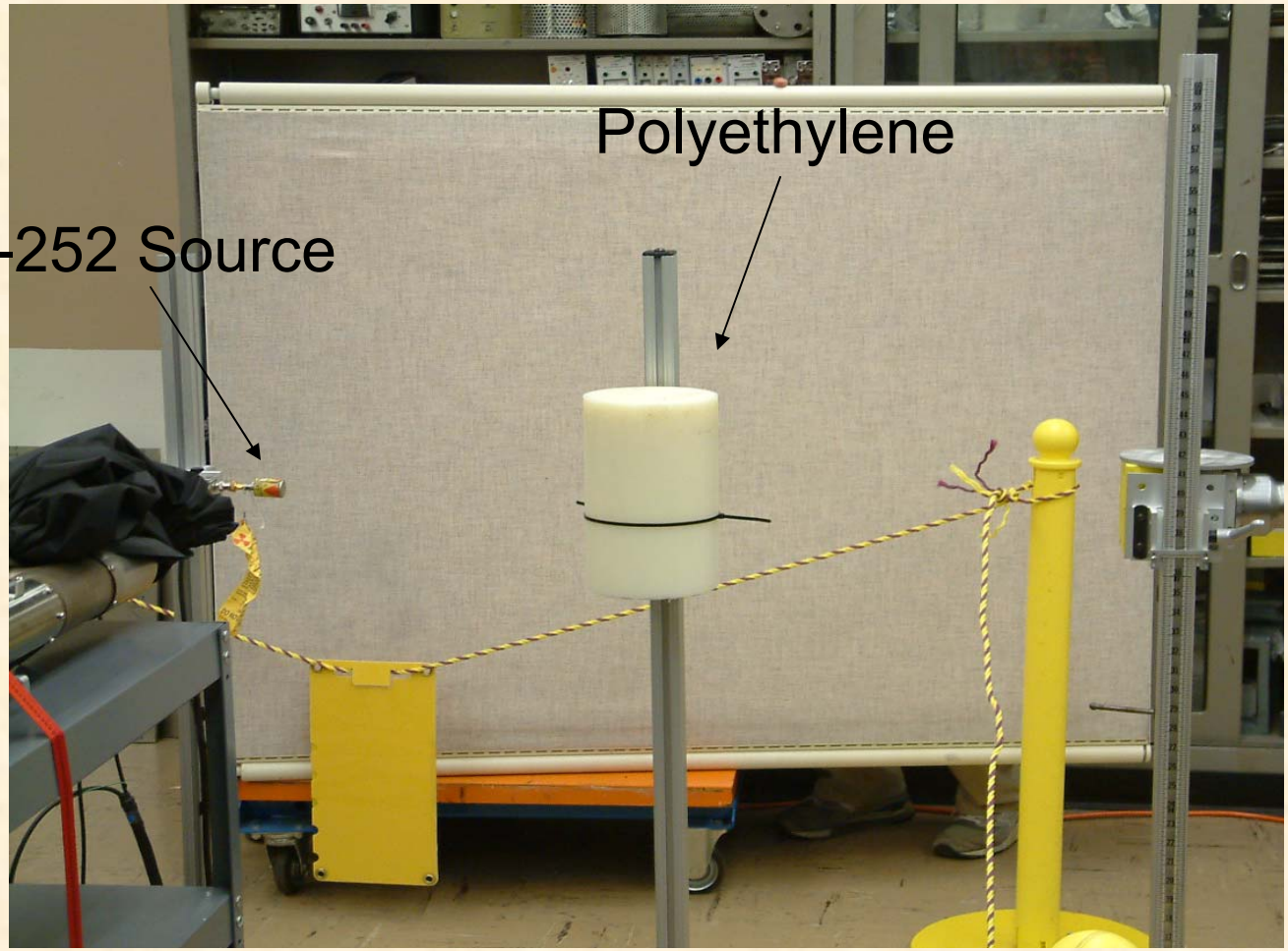
Figure 5: Comparison of model with NMIS laboratory measurement

Floor reflection models can estimate reflection effects ….

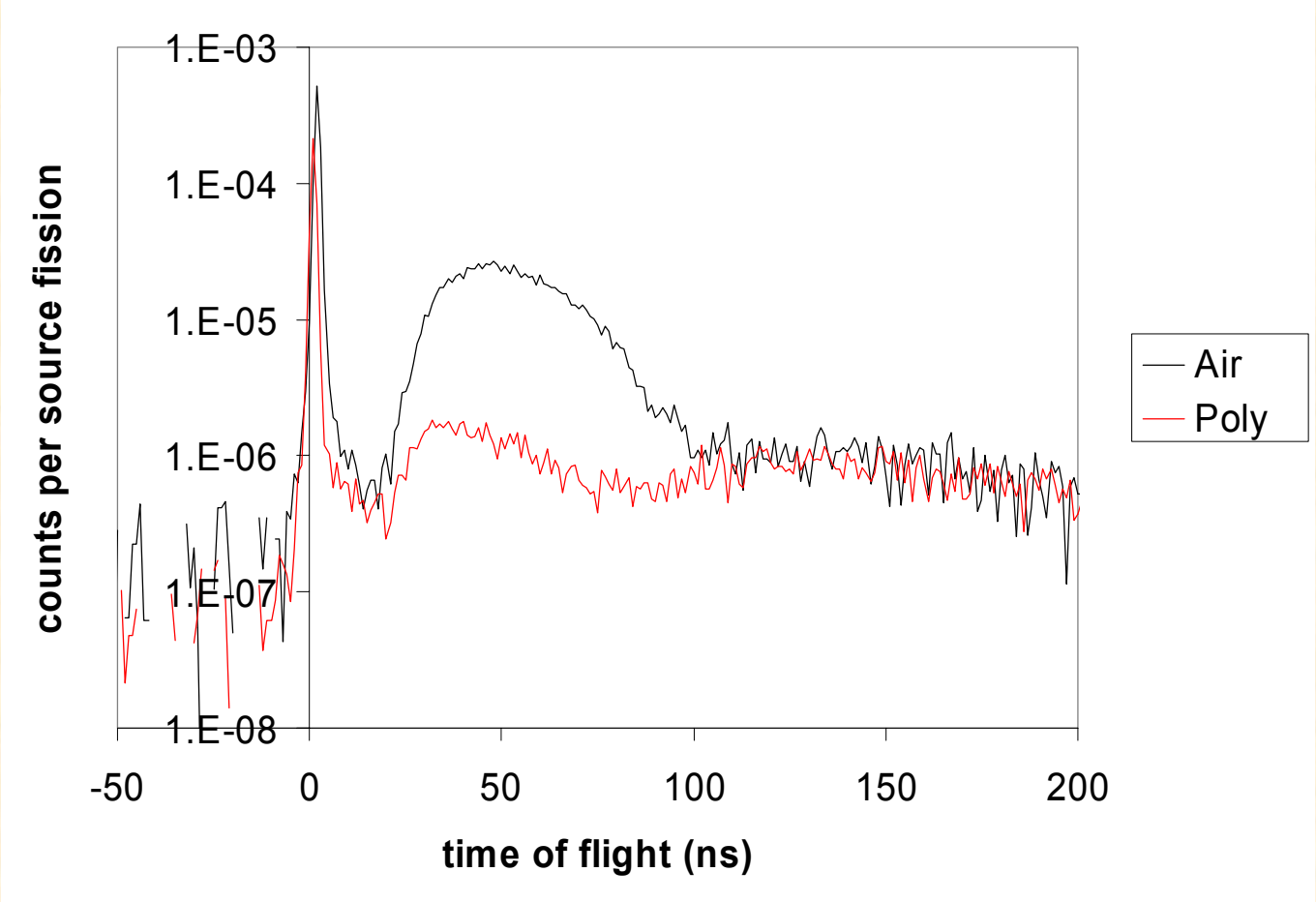
Better solution is to eliminate reflection effects from the measurement

Measurements Performed to Demonstrate This Elimination of Floor Reflection

- Time of Flight in Air with Cf Source
- Time of Flight with Cf with Polyethylene Between Source and Detector
- Time of Flight in Air with DT Generator
- Time of Flight with Polyethylene Between DT Generator and Detector

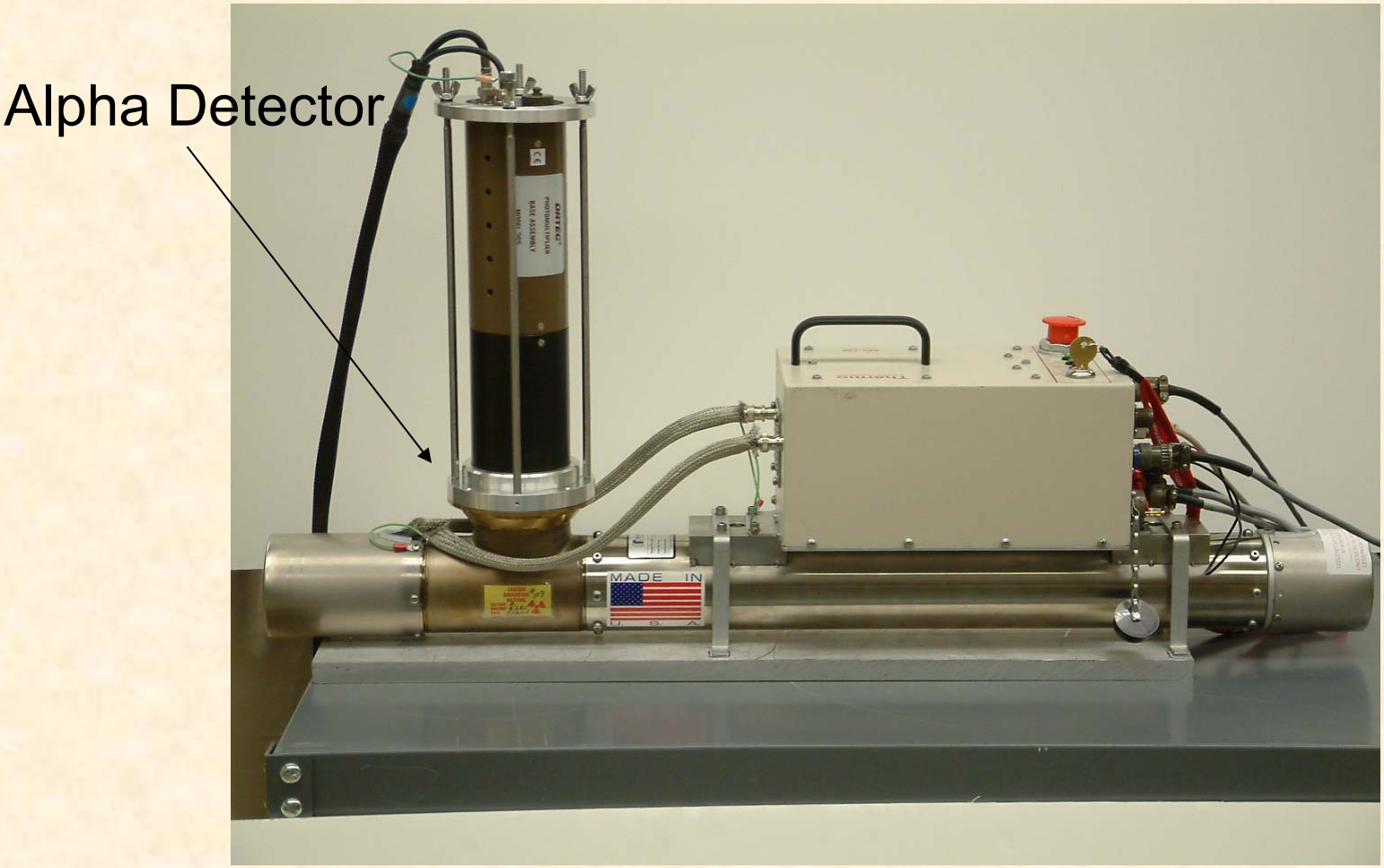


Cf Source-Sample-Detector Configuration for a Time of Flight Transmission Measurement Through Polyethylene

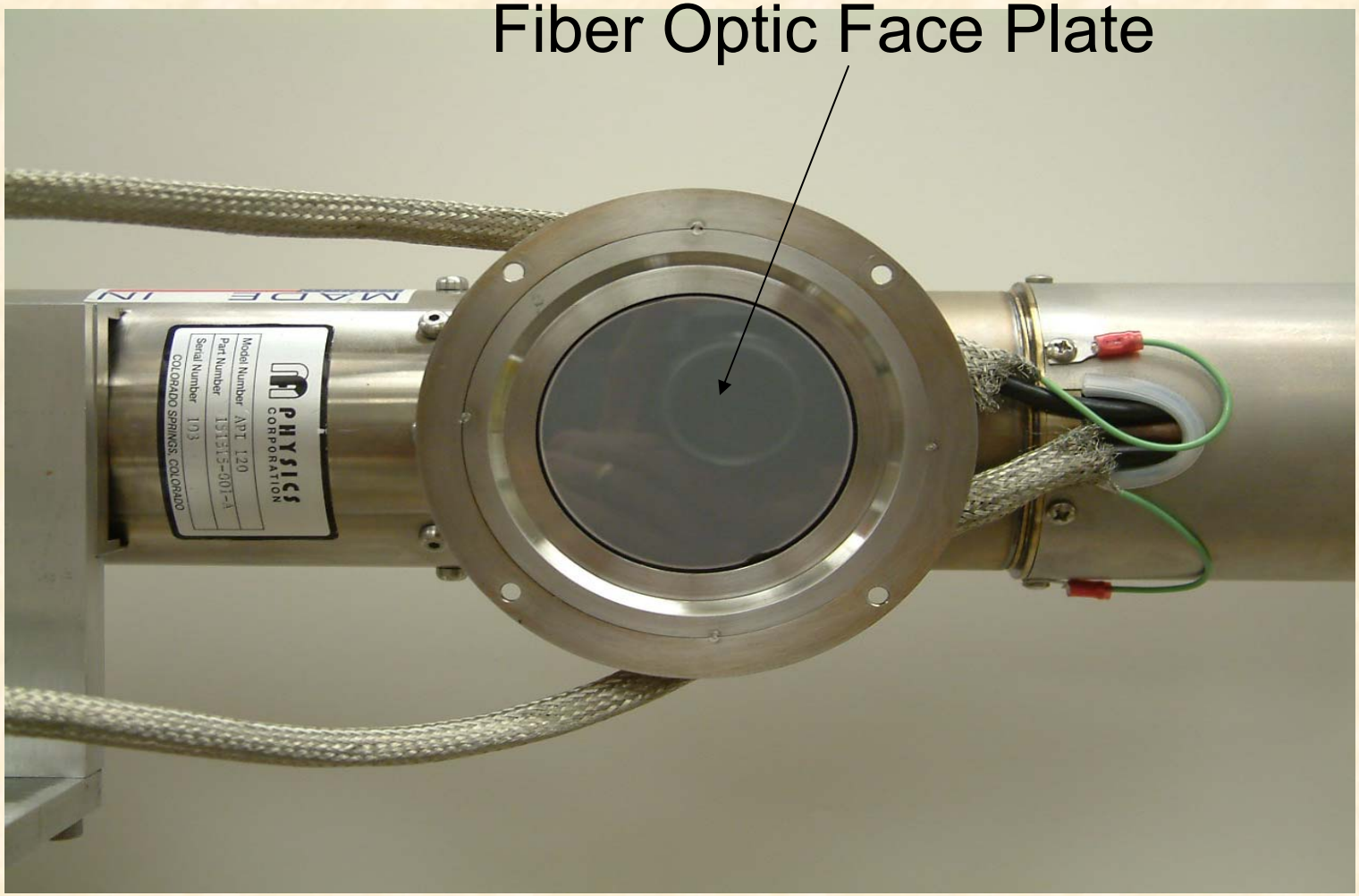


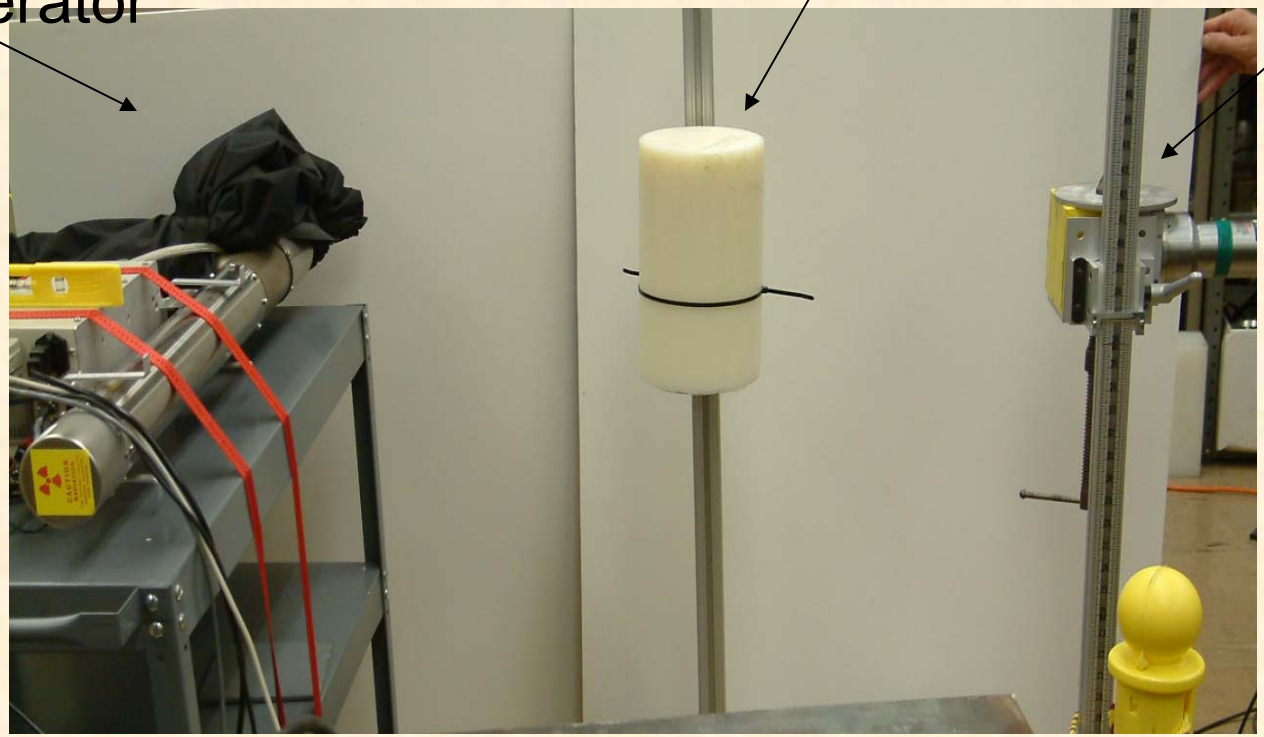
Comparison of Time-of-Flight Transmission Data with a Cf Source for the Polyethylene Cylinder to Measurements in Air

DT Neutron Generator

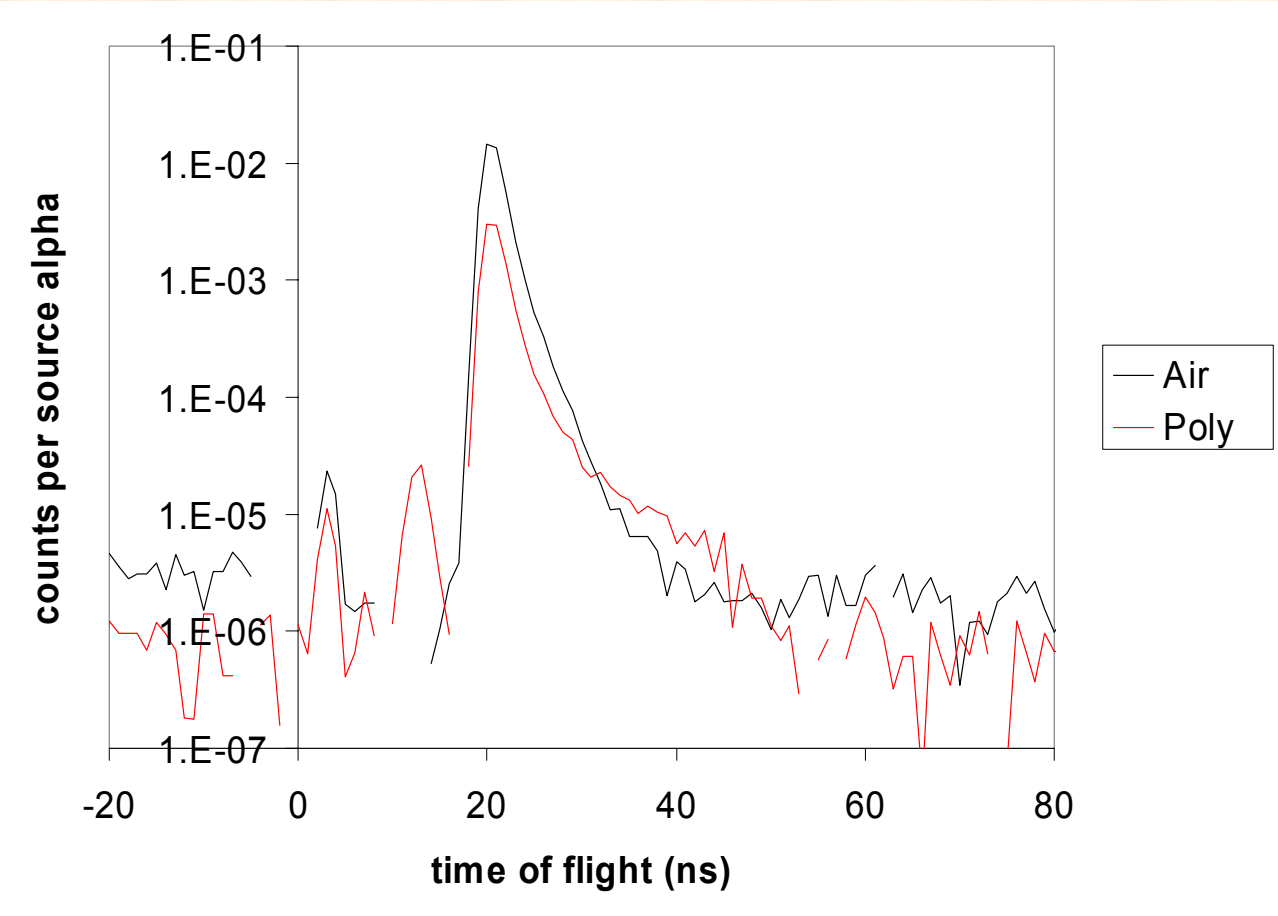


Close-up of DT Generator Alpha Detector



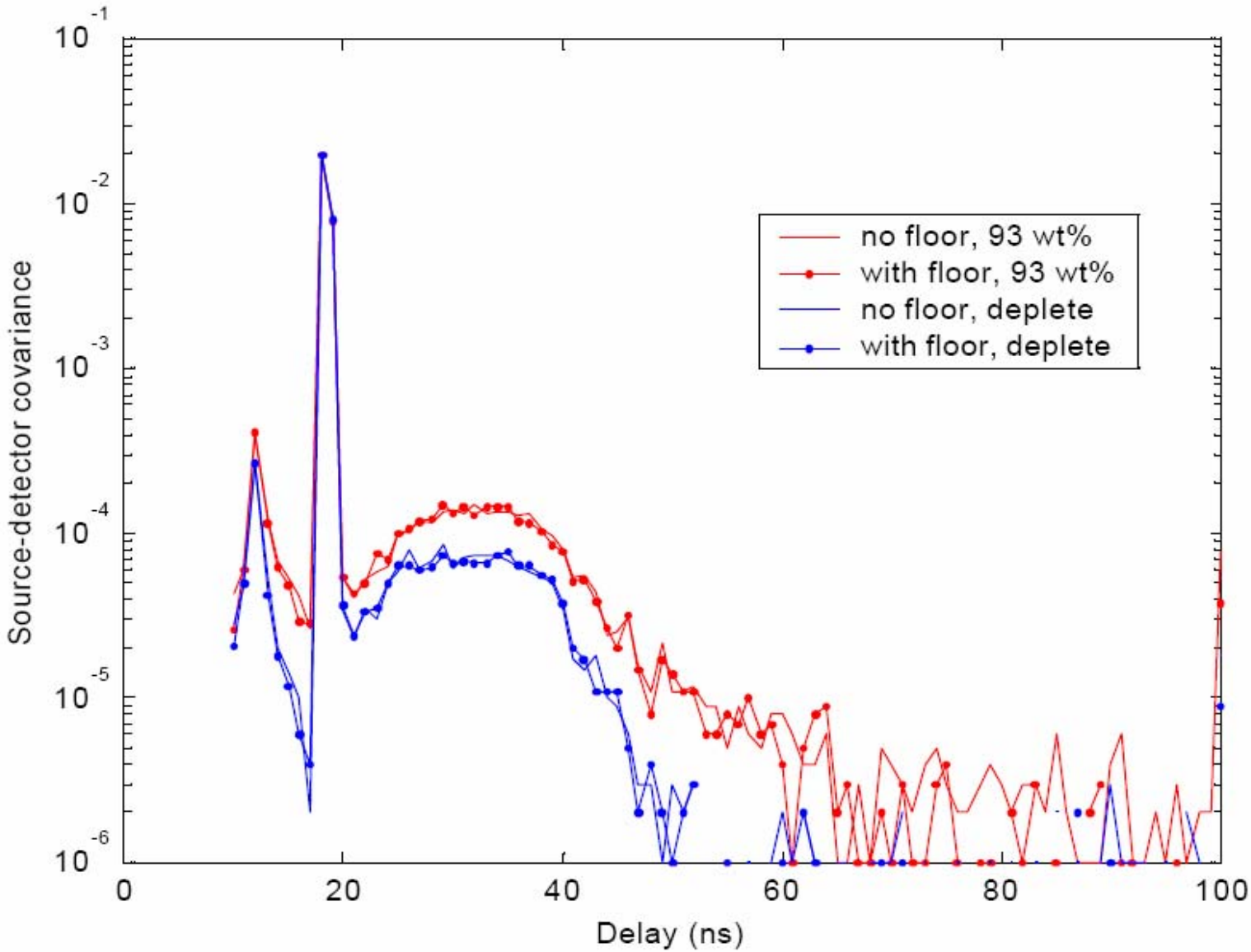


DT Generator Source-Sample-Detector Configuration for a Time of Flight Transmission Measurement Through Polyethylene



Comparison of Time-of-Flight Transmission Data with the DT Generator

Simulations for Metal Castings



Conclusions

- Time of flight transmission Measurements with a DT generator using directional time-tagging of the associated alpha that defines a cone of neutrons aimed at the target is not affected by floor reflection
- Neutrons scattered from the floor are randomly distributed in time since they are not time-tagged by the alpha detector and can easily be subtracted
- Thus, the alpha-tagged DT generator is more useful than a time-tagged Cf source since there will be no mixing of fission response with floor reflection
- In addition, there are many other advantages that have previously been reported