Simulations of Protons in Beam Lifetime 3 experiment

OBJECTIVE:

Characterize protons reaching the detector and determine how gold metallization on silicon affects **detection parameters.**

BACKGROUND:

The world average of neutron lifetime is approximately 15 minutes. However, the beam method and the ultracold neutron storage method gave the average value that currently differs by 8.7 seconds (4 standard deviations). The BL3 experiment at the NIST aims to improve the precision of one of the beam-type measurements to resolve this discrepancy. The present goal is to decrease uncertainty in the experiment to 3 seconds.

METHODS:

Compare simulation tools Kassiopeia, SRIM, PySrim to assess **performance of protons** in trap area in **meter scale for Kassiopeia** and **nano scale for SRIM.**

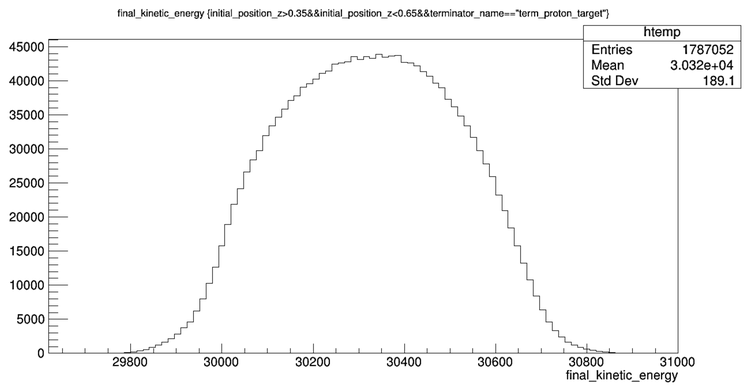
1. **Kassiopeia-based**: Simulate 35keV protons in a quasi-Penning trap of mirror electrodes at +800V, central trap electrodes at 0V, and door electrodes at +800V to determine distribution, trap efficiency. The length of trap is 2m.

2. **SRIM-based**: Simulate 35keV Hydrogen atom to 5000A target layer with different material to determine energy deposition, dead layer effects, and charge sharing in the proton detector. The thickness of detector is 5000A.

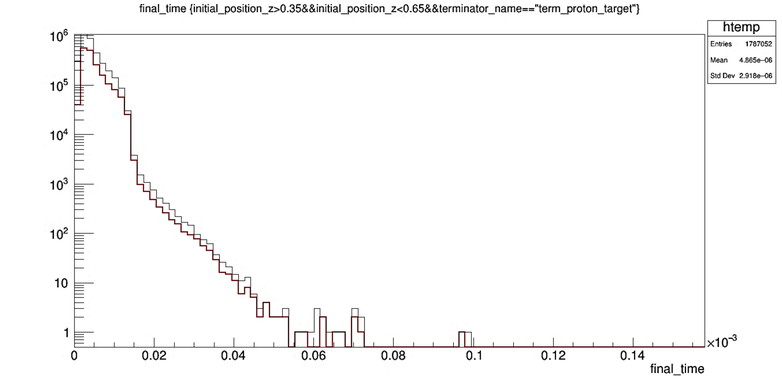
FIGURES

Simulations in Kassiopeia

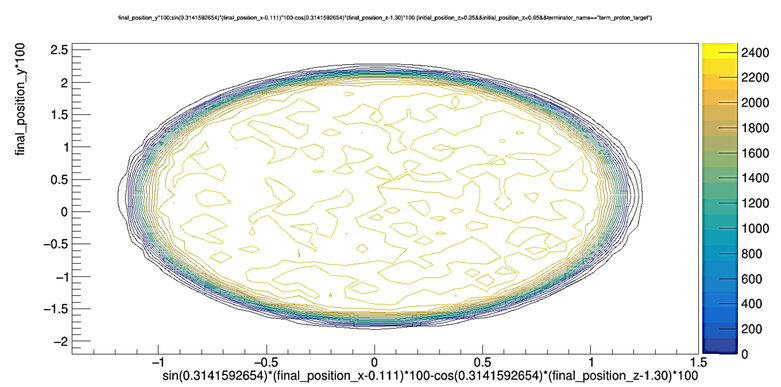
3 Millions events



Histogram of Final kinetic energy of events reached the detector



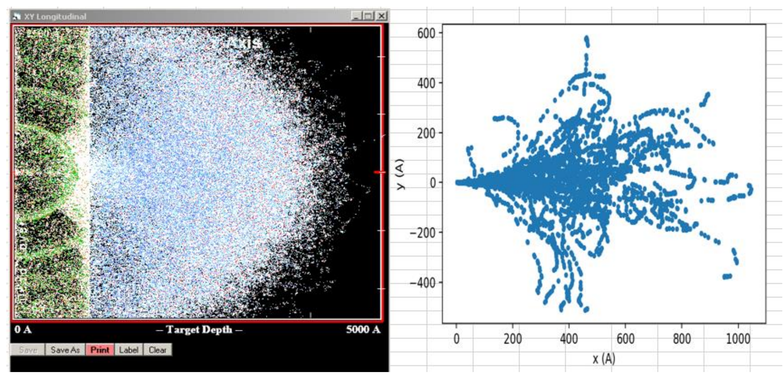
Histogram of Final time of events reached the detector



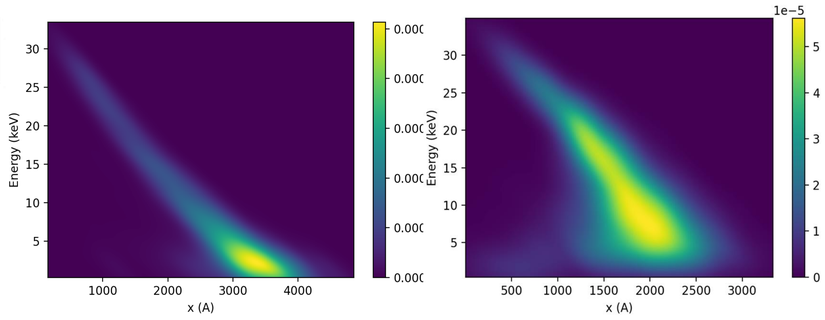
Distribution of events on detector on detector plane

Simulations in SRIM and PySrim

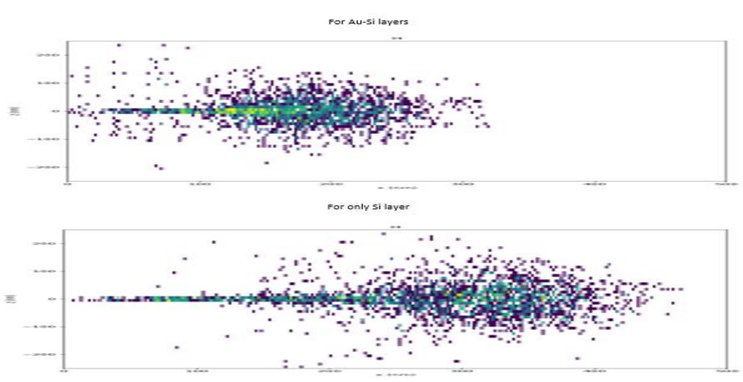
10000 events



Comparison between SRIM and PySrim model



Comparison between Silicone and Gold in distribution of Energy vs depth into the detector



Comparison between Silicone and Gold in collision map into the detector