Plan for a Multi-Foil Solid Target
Hall D SRC/CT Experiment
E12-19-003

We propose a slight modification to the experiment's multi-foil target. We intend to replace four of the eight carbon foils with copper foils. Copper will provide a valuable additional data point, and the experiment will still retain adequate luminosity on carbon.

The thickness of the original carbon target (1.9 cm) was limited by the expected electromagnetic backgrounds. With this in mind, we have chosen a total copper thickness to maintain the target's electron density. The relevant parameters are in the table below.

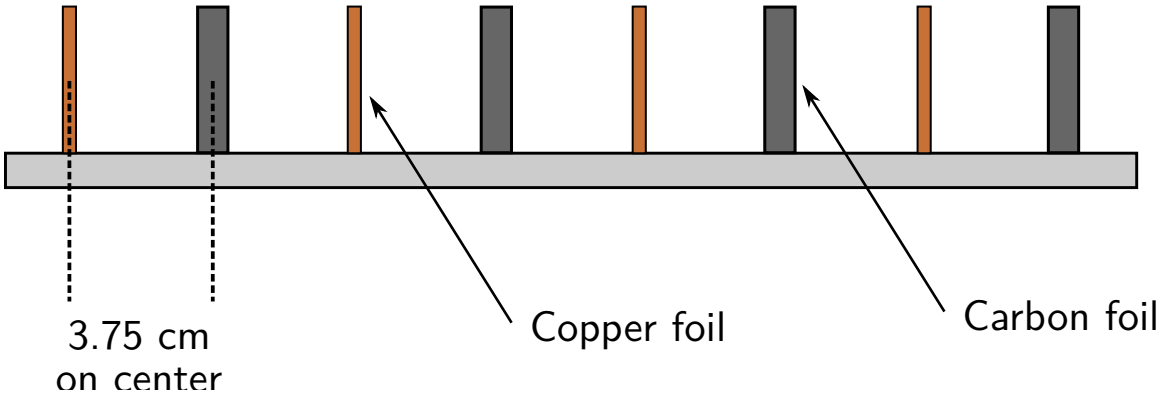
Material	**e^- Density [cm^{-3}]**	**Density [g/cm^3]**
Carbon	6.65 E23	2.21
Copper	2.46 E24	8.96

The original target's electron density budget is 1.9 cm x 6.65 E23 e^-/cm^3 = 1.26E24 e^-/cm^2.

We intend to replace 35% of our carbon target's electron density budget with copper. The total thicknesses of the two materials are:

- Carbon: 0.65 x 1.9cm = **1.235 cm** (2.73 g/cm^2)
- Copper: 0.35 x 1.26E24 e^-/cm^2 / 2.46 E24 e^-/cm^3 = **0.179 cm** (1.60 g/cm^2)

We intend to divide these total thicknesses over 4 foils per material, interleaved on a multi-foil target to match the detector acceptance as closely as possible to that when running the 30 cm cryogenic liquid target. The four carbon foils would each be 0.309 cm thick. The four copper foils would each be 0.045 cm thick. An illustration of the intended multi-foil target is shown below.



To estimate the new count rates, we have scaled our estimates from the proposal according to:

$$R_{Cu} = R_C \cdot \frac{\rho_{Cu}}{\rho_C} \cdot \frac{x_{Cu}}{x_C} \cdot \frac{T_{Cu}}{T_C}$$

where R is the count rate, ρ is the density (in g/cm^3), x is the target thickness, and T is the nuclear transparency. We assume $T_{Cu} = 0.26$ and $T_C = 0.44$. In this experiment, there is an important distinction between "Short-Range Correlations" (SRC) kinematics and "Mean-Field" (MF) kinematics. The table below lists anticipated count rates for the $n(\gamma, \pi^- p)$ reaction, which is one of the lowest cross sections among the reactions of interest.

Kinematics	**Original R_C [events/day]**	**New R_C [events/day]**	**New R_{Cu} [events/day]**
MF	740	480	170
SRC	230	150	50