

Relevant numbers

Solid target	Rad. Length [cm]	Int. Length [cm]	e ⁻ Density [cm ⁻³]	Density [g/cm ³]	Transparency	a2
Carbon	19.32	38.83	6.65 E23	2.21	0.44	4.5
Calcium	10.42	77.31	4.67 E23	1.55	0.29	4.7
Iron	1.76	16.77	2.20 E24	7.87	0.26	4.8
Lead	0.56	17.59	2.69 E24	11.35	0.17	4.8

Our originally proposed carbon target was:

- 0.07 radiation lengths
- 1.9 cm thick
- Divided into 8 foils, each 2.4 mm thick
- $1.45E23 \text{ cm}^{-2}$

Expected $p\pi^-$ yield:

- 740 MF events/PAC day
- 230 SRC events/PAC day

Scenario 1: Replace 1/8th Total X0 with Fe

Iron Target Thickness:

$$0.875\% X_0 \cdot 1.76 \text{ cm} = 154 \text{ } \mu\text{m}$$

$$154 \text{ } \mu\text{m} \cdot 7.87 \frac{\text{g}}{\text{cm}^3} \cdot \frac{\text{mole}}{56 \text{ g}} \cdot \frac{6E23}{\text{mole}} = 1.3E21 \text{ cm}^{-2}$$

Our multi-foil would be:

- $1.3E21 \text{ cm}^{-2}$ Iron

- $1.3E23 \text{ cm}^{-2}$ Carbon

648 MF/day, 201 SRC/day

Scenario 1: Replace 1/8th Total X0 with Fe

What rates do we expect? Scale from Carbon:

$$R_{Fe} = R_C \cdot \frac{\rho_{Fe}}{\rho_C} \cdot \frac{N_{Fe}}{N_C} \cdot \frac{T_{Fe}}{T_C}$$

I'm ignoring a2 for the moment.

- $R_{Fe}^{MF} = \frac{740}{\text{day}} \cdot \frac{1.3E21}{1.45E23} \cdot \frac{30}{6} \cdot \frac{0.26}{0.44} = 20/\text{day}$
- $R_{Fe}^{SRC} = \frac{230}{\text{day}} \cdot \frac{1.3E21}{1.45E23} \cdot \frac{30}{6} \cdot \frac{0.26}{0.44} = 6/\text{day}$

Summary of Iron Scenarios

Events per day

Event Type	0/8 th X0 Fe	1/8 th X0 Fe	2/8 th X0 Fe	3/8 th X0 Fe
C MF	740	648	555	463
C SRC	230	201	173	144
Fe MF	0	20	40	60
Fe SRC	0	6	12	18

Scenario 2: Replace 1/8th Total X0 with Pb

Lead Target Thickness:

$$0.875\% X_0 \cdot 0.56 \text{ cm} = 49 \mu\text{m}$$

$$49 \mu\text{m} \cdot 11.35 \frac{\text{g}}{\text{cm}^3} \cdot \frac{\text{mole}}{208 \text{ g}} \cdot \frac{6E23}{\text{mole}} = 1.6E20 \text{ cm}^{-2}$$

- $R_{Pb}^{MF} = \frac{740}{\text{day}} \cdot \frac{1.6E20}{1.45E23} \cdot \frac{126}{6} \cdot \frac{0.17}{0.44} = 7/\text{day}$
- $R_{Pb}^{SRC} = \frac{230}{\text{day}} \cdot \frac{1.6E20}{1.45E23} \cdot \frac{126}{6} \cdot \frac{0.17}{0.44} = 2/\text{day}$

Summary of Lead Scenarios

Events per day

Event Type	0/8 th X0 Pb	1/8 th X0 Pb	2/8 th X0 Pb	3/8 th X0 Pb
C MF	740	648	555	463
C SRC	230	201	173	144
Fe MF	0	7	14	21
Fe SRC	0	2	4	6

Conclusions

- If we must scale target thickness based on EM backgrounds, it will be hard to include a heavy target.
 - Is DC occupancy primary concern?
- We proposed gathering 1600 He events.
 - A similar number in Fe or Pb would not be possible without replacing half of the target, running > 10 days.