CARBON AND MERCURY TARGET SYSTEMS FOR MUON COLLIDERS AND NEUTRINO FACTORIES

(TUPMY044, IPAC16, May 10, 2016)

K.T. McDonald,[2] J.S. Berg,[1] X. Ding,[3] H.G. Kirk,[1] D. Stratakis[1]

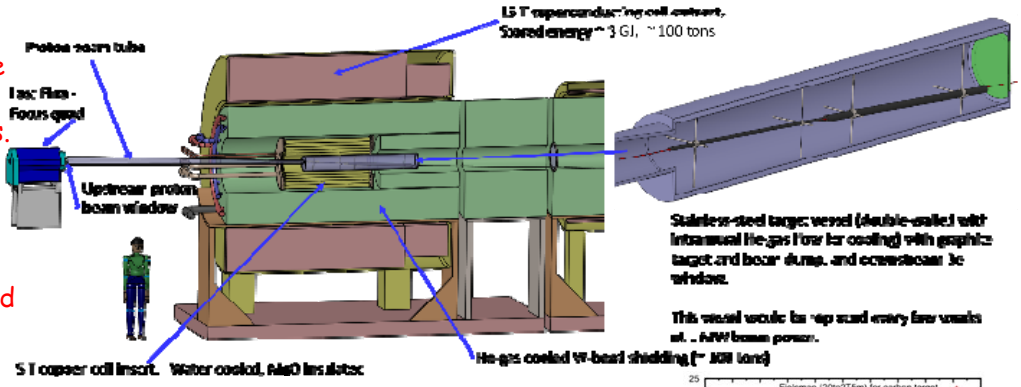
[1]BNL, Upton, NY 11973, USA [2]Princeton University, Princeton, NJ 08544, USA

[3]University of California at Los Angeles, Los Angeles, CA 90095, USA

The **Target System** for a Muon Collider or Neutrino Factory is designed to produce ~ 10^{14} μ/s (both μ+ and μ-) via decay of pions from 1-4 MW of 6.75-GeV protons.

The system is inside a 15-20-T solenoid magnet whose field tapers down over 5 m to 2 T in the subsequent Front End. We also consider a final field of 4 T.

The superconducting coils must be protected from radiation damage by massive shielding: W beads cooled by He gas.

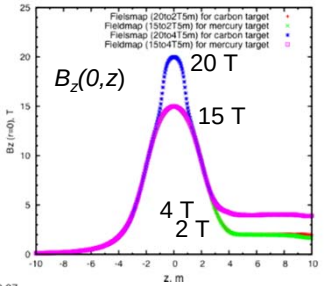


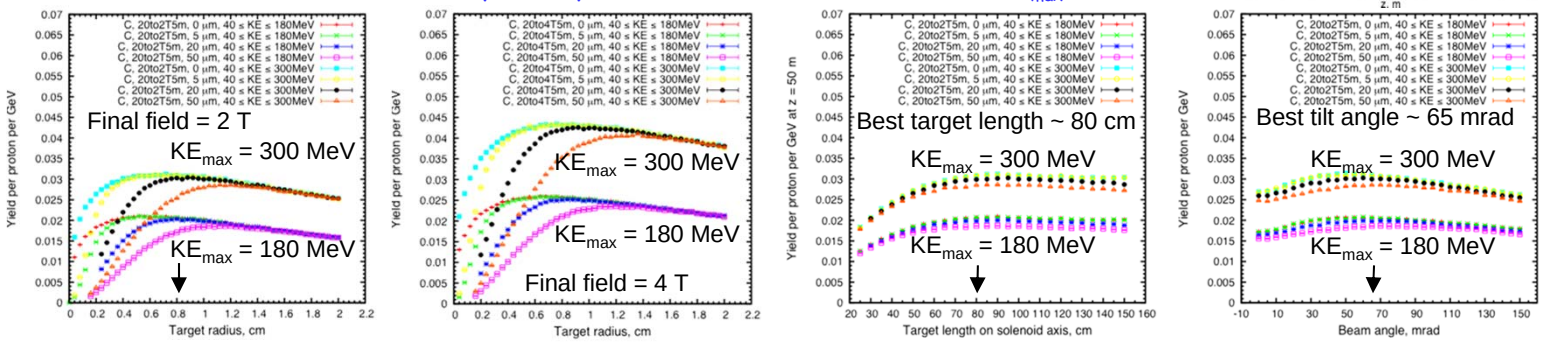
Carbon Target Optimization in a Peak Field of 20 T, Final Fields of 2 & 4 T, for "good" muons with 40 < KE < 180 MEV, using the MARS15(2014) Code

Target length = 80 cm. Target rod radius = 0.8 cm.

Beam radius = ¼ target radius. Beam/target tilt = 65-mrad to the solenoid axis.

Particle production decreases slowly with increasing beam transverse emittances from 5 to 50 mm-mrad. Muon yield improved if final field = 4 T, and/or KE_{max} = 300 MeV.





The beam dump must be inside the target system.

The beam dump for the graphite target can consist of 2 additional graphite rods, 55-cm long, with radii of 3 and 4 cm.

This beam dump intercepts about 2/3 of the unscattered proton beam while causing only 8% decrease in the yield.

Mercury Target Optimization in a Peak Field of 15 T

In a possible upgrade to 2-4 MW beam power it may be favorable to use a liquid metal target, such as mercury.

[Graphite target at ≈ 2000 C may have long enough life against radiation damage to be viable.]

A flowing mercury jet target is not mechanically compatible with the 5-T insert, ⇒ use peak field of 15 T.

Target radius ≈ 0.5 cm. Beam radius = 0.3 target radius.

Beam angle ≈ 65 mrad (same as for C target). Beam/Hg jet crossing angle ≈ 24 mrad.

The beam dump is a pool of mercury.

The mercury target at 15 T has about 10% more yield than a carbon target at 20 T.

Muon yield improved if can use 4-T field throughout the Front End, and/or KE_{max} = 300 MeV.