A Geometry for a Rotating Solid Target for a Neutrino Factory

K. McDonald, *Princeton U.* (Nov 3, 2009)

Total length of W target, $A + B$, should be so long that unspent proton beam hitting the magnet has flux comparable to that of the secondary pions.

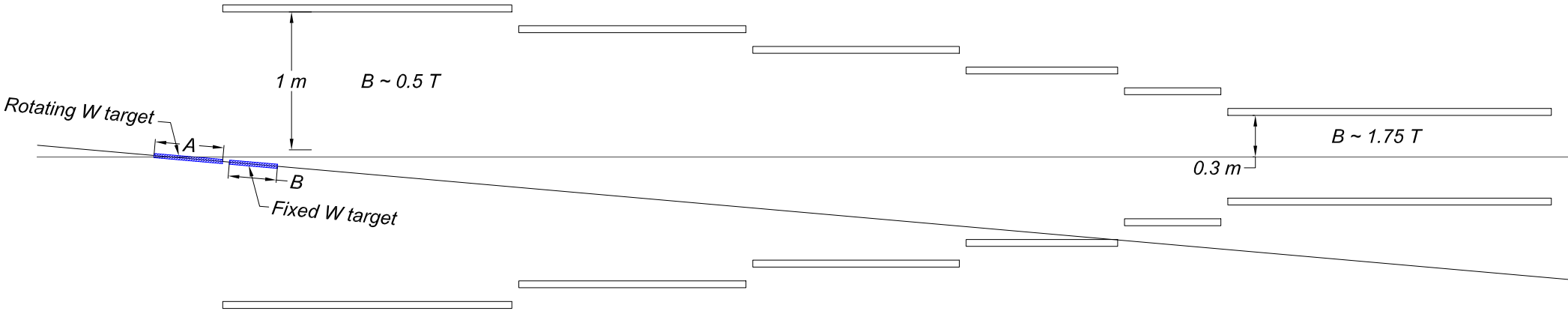
If need, say, $N = 200$ targets on the rotating wheel (axis parallel to the magnetic axis) to limit the radiation damage, then $A \approx 10\,\mathrm{cm} \cdot \ln(N) \approx 50\,\mathrm{cm}$.

Proton beam coaxial with target, and both tilted so the proton beam does not hit downstream beam window.

Target should be in magnetic field for good capture, but the field can be weak, say 0.5 T.

- Taper magnetic field from 0.5 T to nominal 1.75 T of pion transport solenoid.
- Rotating target can be upstream of first magnet
- Low field $\Rightarrow$ long period for pion helices $\Rightarrow$ reabsorption a minor issue.
- Target diameter can perhaps be larger than 2 cm

Serious flaw: For a pion transport channel of given B and r, the longitudinal-transverse momentum exchange due to the adiabatic invariant $r\,p_\perp$ implies that $p_\perp/p_{\perp 0} = (B/B_0)^{1/2}$ strongly favors use of B_0 much larger (not smaller) than B for maximal capture of pions.



Rotating Target Wheel Should Have an Air Bearing

CNGS rotating target failed due to radiation damage to lubrication of the bearings.

⇒ Use an air bearing for the rotating target wheel.