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Comments on Target Length

Bob Zwaska

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Beam Optimization / Interface / Simulation / etc. Meeting

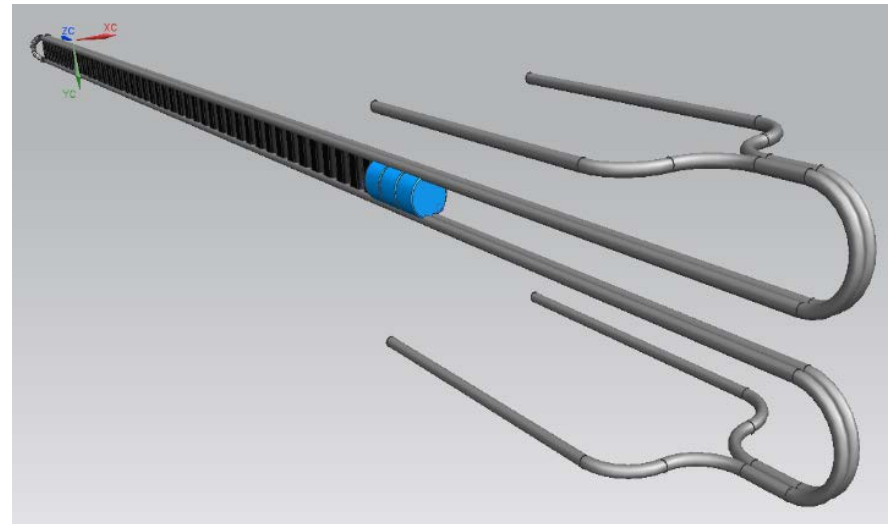


Some Fairly Obvious Concerns

- Sag (deflection) of a cantilevered target
 - Grows roughly as L^4
 - What is allowable?
 - Compensate with additional material / size?
 - Compensate with larger horn inner conductor?
- Cooling
 - Longer target will absorb appreciably more energy
 - Must be removed by coolant volume
 - Nearby horns reflects energy back into target
 - Possibly puts water cooling lines in jeopardy
- Systematics...

A Longer Target is No Surprise

- NOvA Target is 1.2 m of graphite intended for higher-energy mesons
- LBNF reasonably will desire lower-energy mesons which could result from supplemental interactions
- “Default LBNF Target is 0.94m – inherited from NuMI



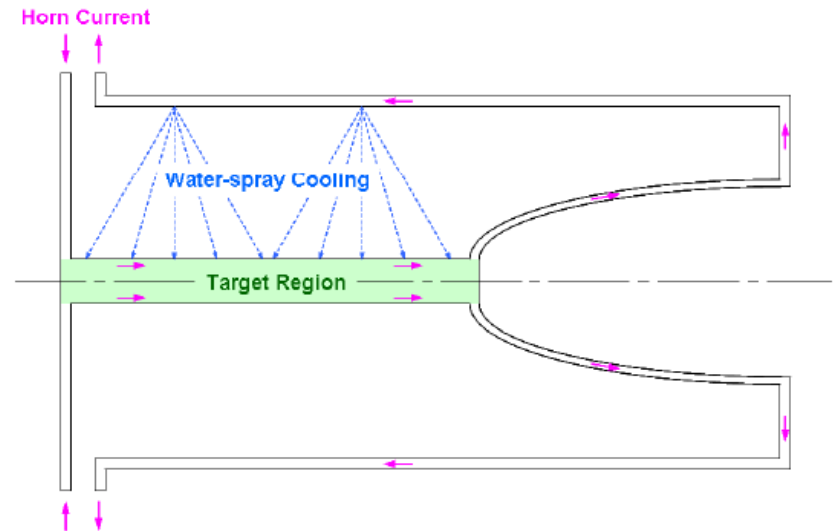
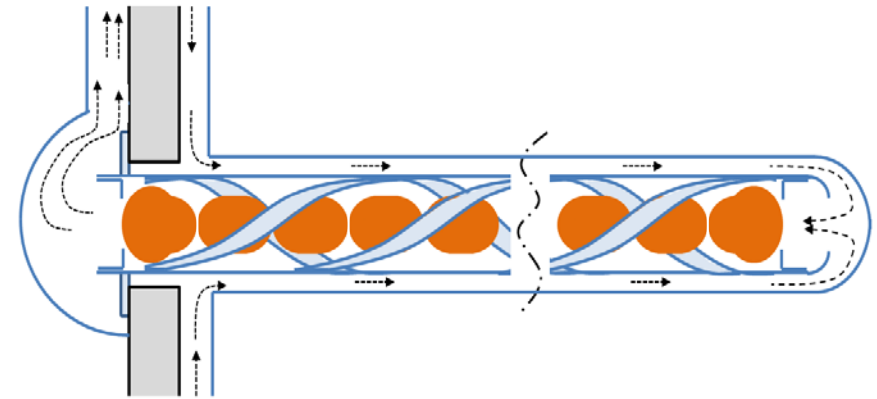
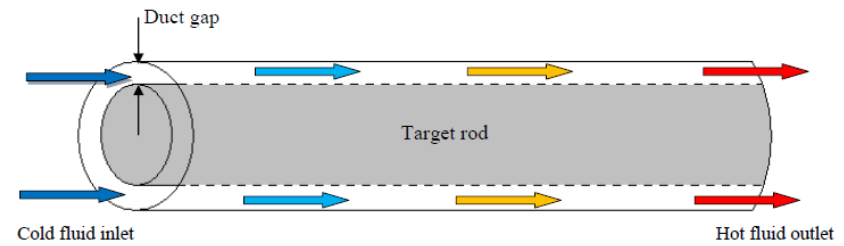
How well is the optimal length number known?

- Why is 5 interaction lengths advantageous?
- What is the range of near-identical values?
 - Re-optimize at smaller values?
- What if we had to compensate with more material?

(Also, curious that target width seems so insensitive)

Alternative approaches

- Multiply support target
 - “catcher” mounted to front of horn
 - Contact inside horn
 - Single or multiple points
- Integrate / Embed to horn inner conductor
- Issues:
 - Coolant flow (single pass?)
 - Vibration / stresses
 - Current flow
 - Damage multiple components
- Some of these issues have been investigated over the years (much by RAL) for LBNx and other purposes.



Systematic Issues

- 5 interaction lengths implies that a large fraction of the resultant mesons will be from re-interactions, including reactions like n - p , π - p , π - n , K - p , K - n , etc.
 - These interactions are even less well known
 - Need to get a feeling for impact
- Alignment of target? Is sag an effect.
- Current flow on internally supported targets
 - Magnetic field less-well defined

Questions / Actions Needed (Summary)

- What is bound on optimized target length?
 - Have some information, but down to 1.7 m? 0.7 m?
- What are the bounds on horn inner conductor size?
- What are the bounds on target width/height? (as a proxy for cooling and support system)

- How much energy is deposited in the target?
 - Scaling with length and material?
 - Including horn energy reflection

- What is the allowable sag of the target from a systematics point of view?

- What would be the systematic effect of poorly-controlled current short-circuits into target material?

- How does the uncertainty on the flux change with greater re-interactions? (e.g. less well known π -p cross-sections)

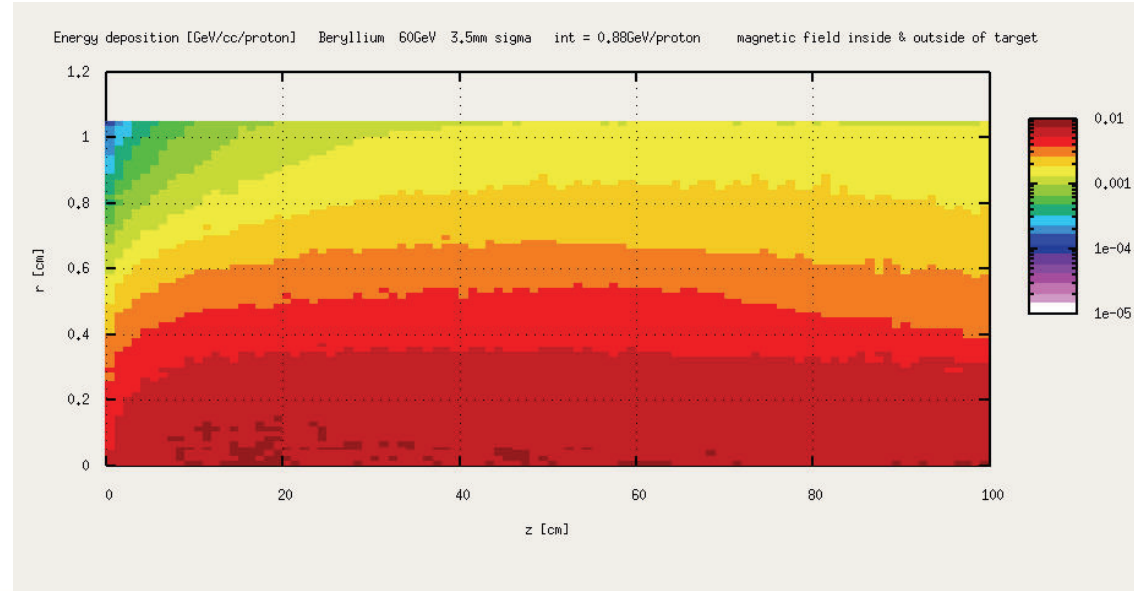
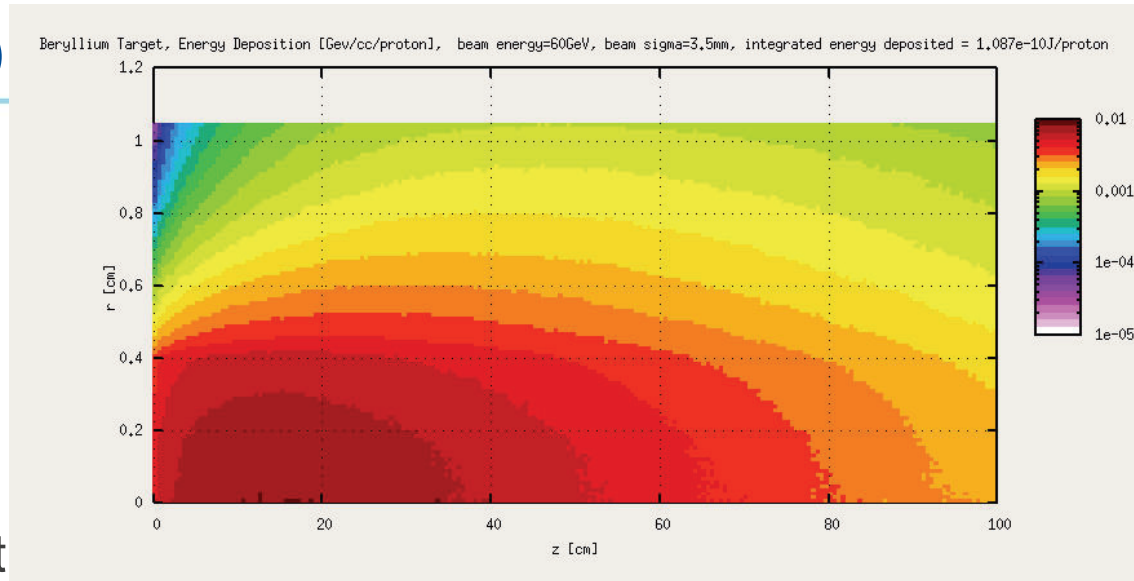


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Supplemental Material

Reentrant Heating (RAL)

- Magnetic field bends secondaries back into target
 - Proportionally larger effect in target exterior
- Not a limiting effect, but something that needs to be considered for target and inner conductor cooling



NOvA Fin Test

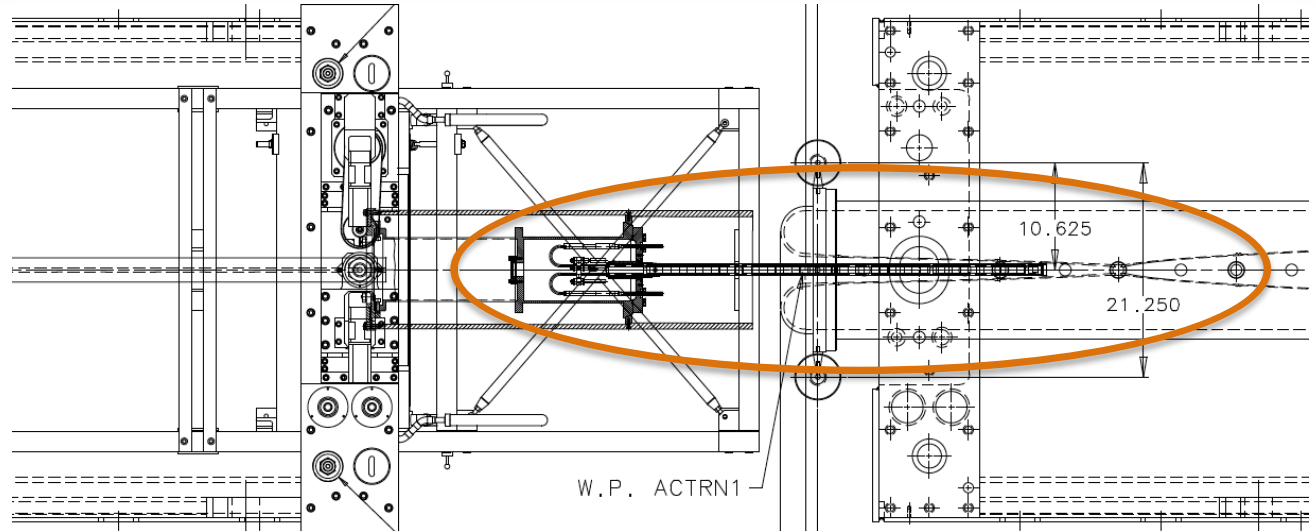


Beryllium Fins

NuMI versus NOvA

NuMI- Low Energy Configuration

- Target inserted into Horn 1 Inner Conductor



NOvA- Medium Energy Configuration

- Target well US of Horn 1

