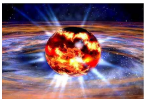


CREX Target Discussion

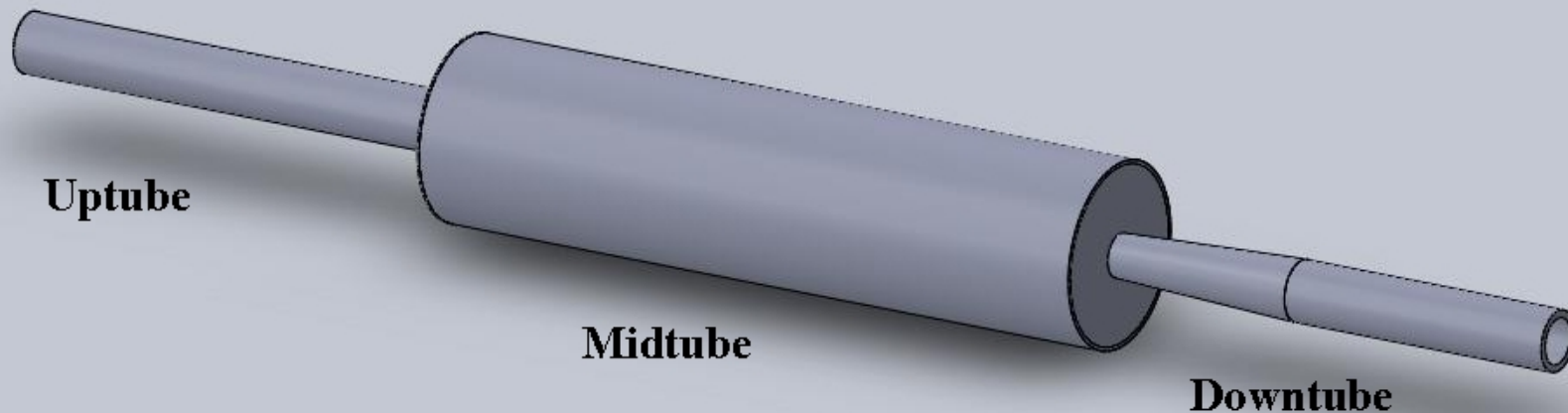
Dustin McNulty
Idaho State University
mcnulty@jlab.org

Thanks to: Brady Lowe

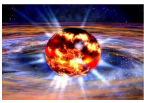
April 12, 2014



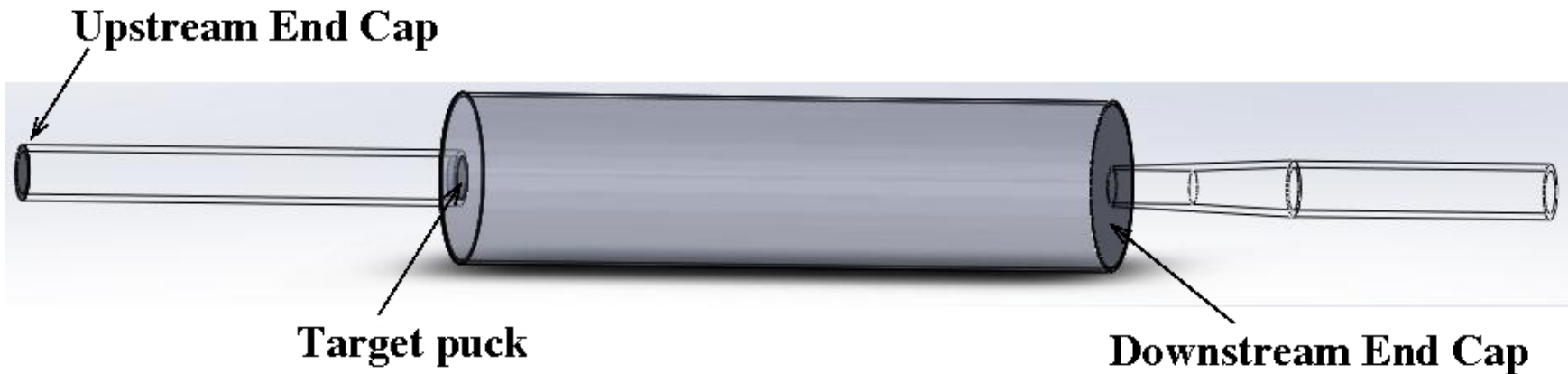
Current CREX Target Cell Design (The Rolling Pin)



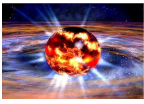
- SolidWorks CAD recently developed (based on Bob's work)
- Current geometry/design constraints:
 - Raster size 4 mm \times 4 mm plus potential beam misalignment (\lesssim 3 mm) gives overall offset of \lesssim 6 mm
 - Scattered electron acceptance $4.3^\circ \pm 1.8^\circ$
 - Any constraints on total target cell length?



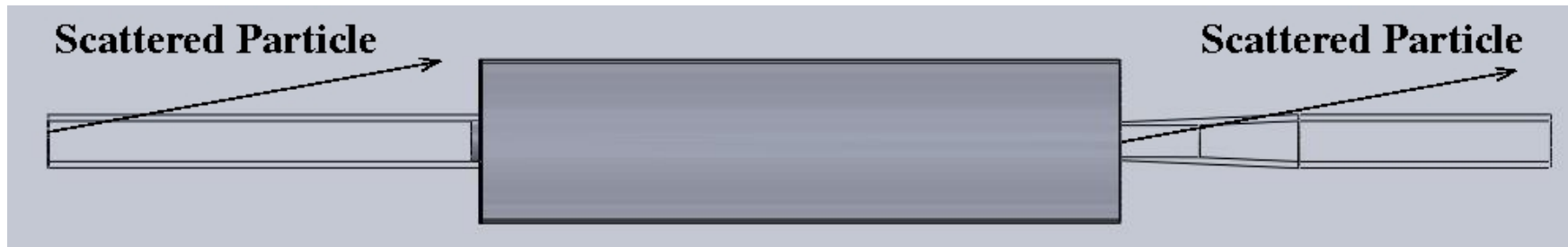
End Cap Windows



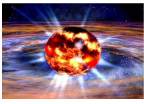
- Due to hyper-expensive isotopically pure ^{48}Ca , target cell must be self-contained in its own vacuum chamber
- Proposal mentions 0.3 mm thick stainless windows to keep background to a minimum while ensuring vacuum seal



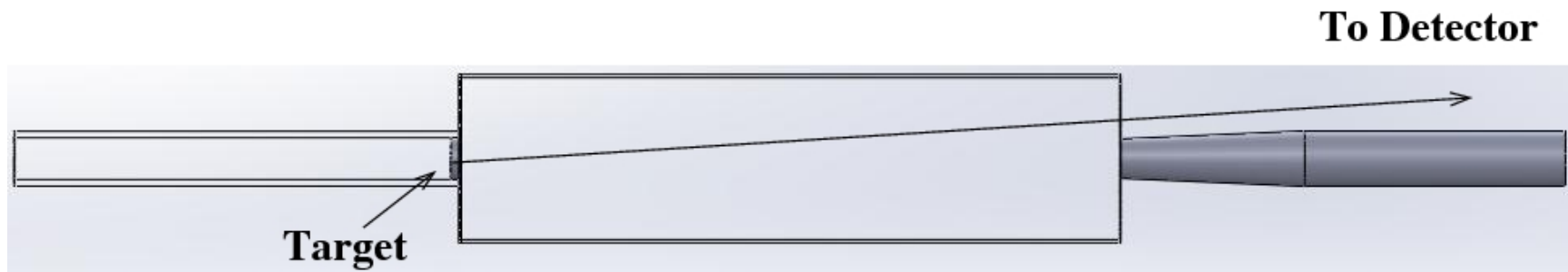
Blockers (Uptube/Downtube walls)



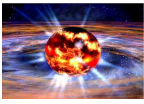
- Blockers needed to energy degrade end cap scattered electrons out of the quartz acceptance: 4mm thick uptube walls and a tapered downtube
- 4mm thick stainless walls will energy degrade electrons by $\gtrsim 20$ MeV which pushes them $\gtrsim 12$ cm away from elastic peak assuming $12.5\text{cm} / \% \text{mom}$ dispersion constant
- Blockers could also carry cryogenic cooling to target puck and end caps (if needed)



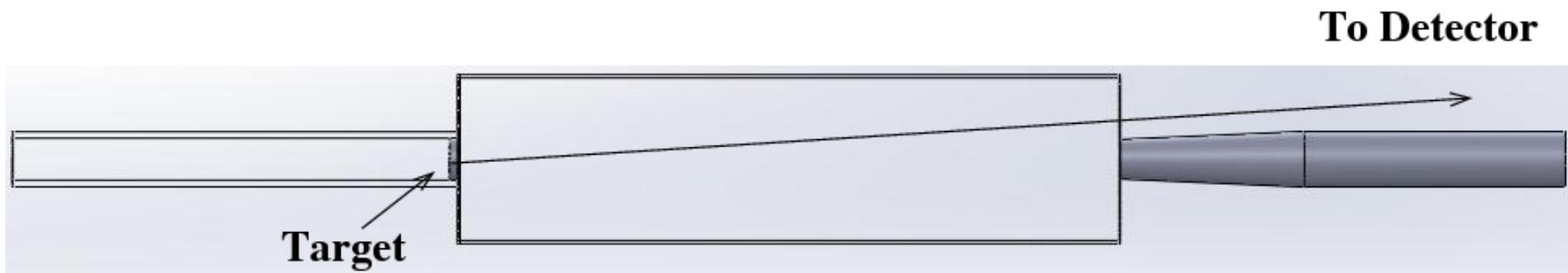
Midtube



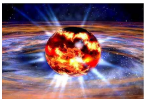
- Target puck is located right inside uptube, just before midtube
- Midtube length must be long enough to allow minimum desired angles to miss the downtube
- Midtube radius must be large enough to allow maximum desired angles to exit through end cap windows (and not midtube walls)



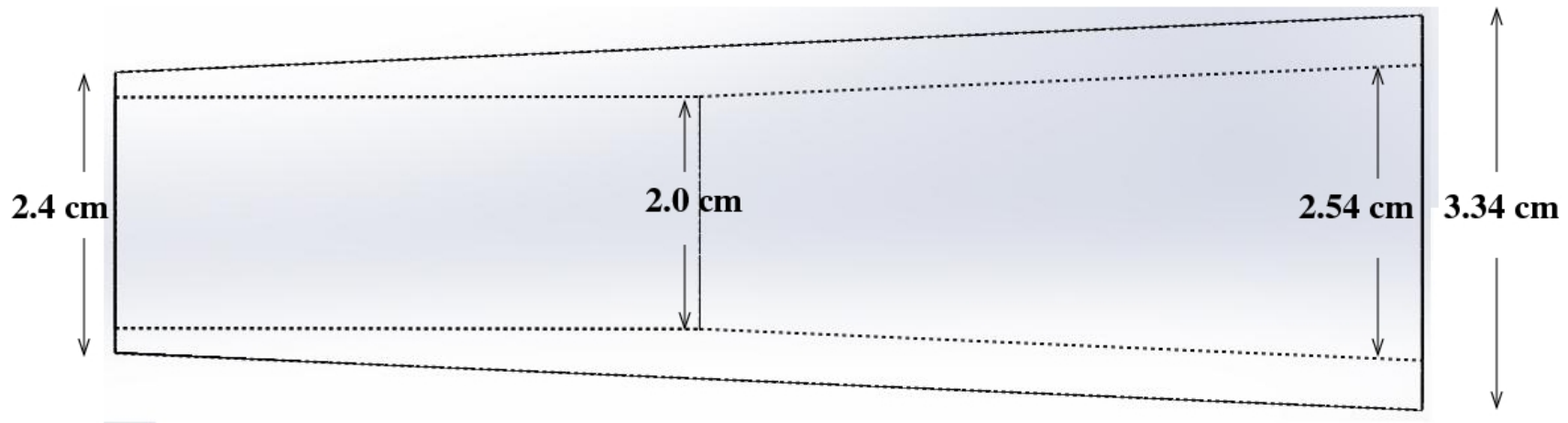
Midtube continued



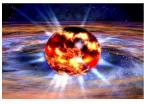
- Using Bob's 40 cm midtube length (from haplog 2866), a 2.5° target scatter from the extreme beam offset position demands a maximum OD of ~ 2.4 cm at the start of the downtube taper
- A 6.1° target scatter from the extreme beam offset position demands a minimum inner midtube radius of ~ 4.9 cm



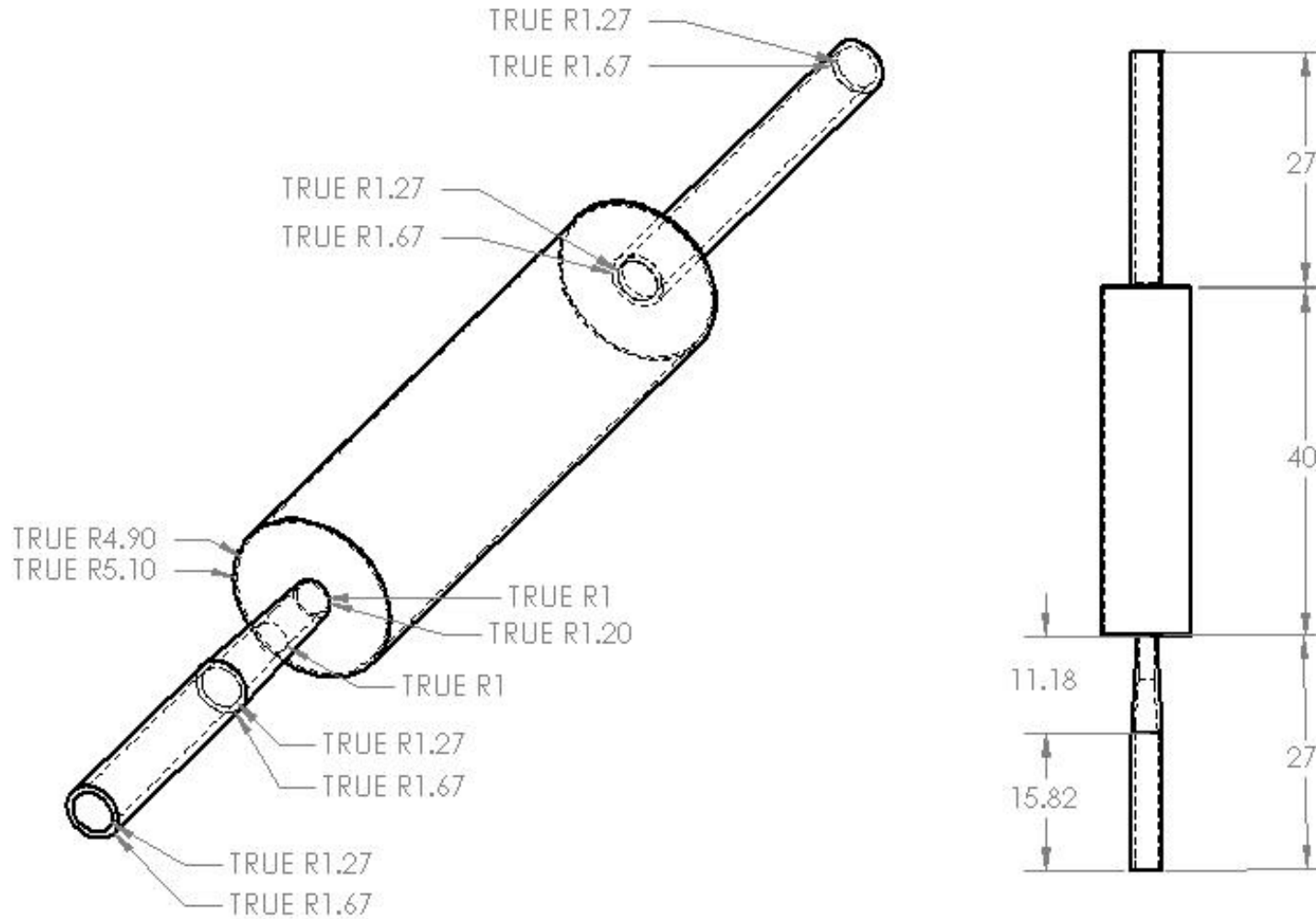
Downtube (Taper)

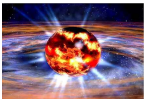


- The outer surface of taper has a constant angle of 2.5°
- The inner radius stays constant while the outer radius increases until the thickness of the blocker reaches 4 mm (starts out at 2mm); then the blocker thickness remains constant.



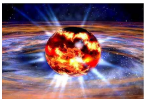
Technical Drawings of basic target cell (all units in cm)





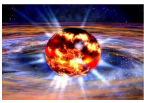
Comments

- Using the PREX septum in its nominal position, the target puck must be 136.1 cm upstream of old pivot to get 4.3° .
- This design is 94 cm long! How can we shorten it?
- All things constant, a thicker blocker wall can reduce the length of the uptube.
- It seems the target puck could be located further upstream (5 - 10 cm) in the uptube. This would allow for both a shorter midtube and installing target chamber closer to the old pivot.
- If we increased our minimum accepted angle, the midtube could be made shorter, or the downtube wall could be thicker allowing for a shorter downtube and/or better blocking.
- Any changes need careful simulation: HRSMC, HAMC



More Comments

- Proposed $150\mu\text{A}$ on Ca target; simple thermal conductivity calculations indicate this should not be a problem.
- Should test this with ^{40}Ca target during PREX II – Also need a custom cell design for this? Would the E08014 target cell design work?
- Stainless steel cell? Sounds risky for a parity experiment. What other material could we use? Tungsten up- and down-tubes and Al midtube?
-



PREX/C-REX Sieve, HRS, and Septum Geometry

R. Michaels, Feb, 2013

Survey Data (cm) Ref. A1277, A1279

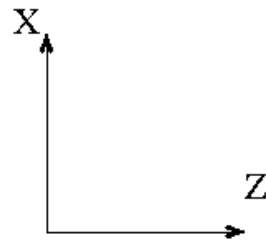
Target (by my def'n) Z, X = 0, 0

Sieve Left Z, X = 79.8, 7.0 Sieve Right Z, X = 79.7, -6.9

Septum (center) Z = 175.3 (ideal + DZ in survey)

Q1 Col. Left Z, X = 239.6, 29.8 Q1 Col. Right Z, X = 239.7, -29.7

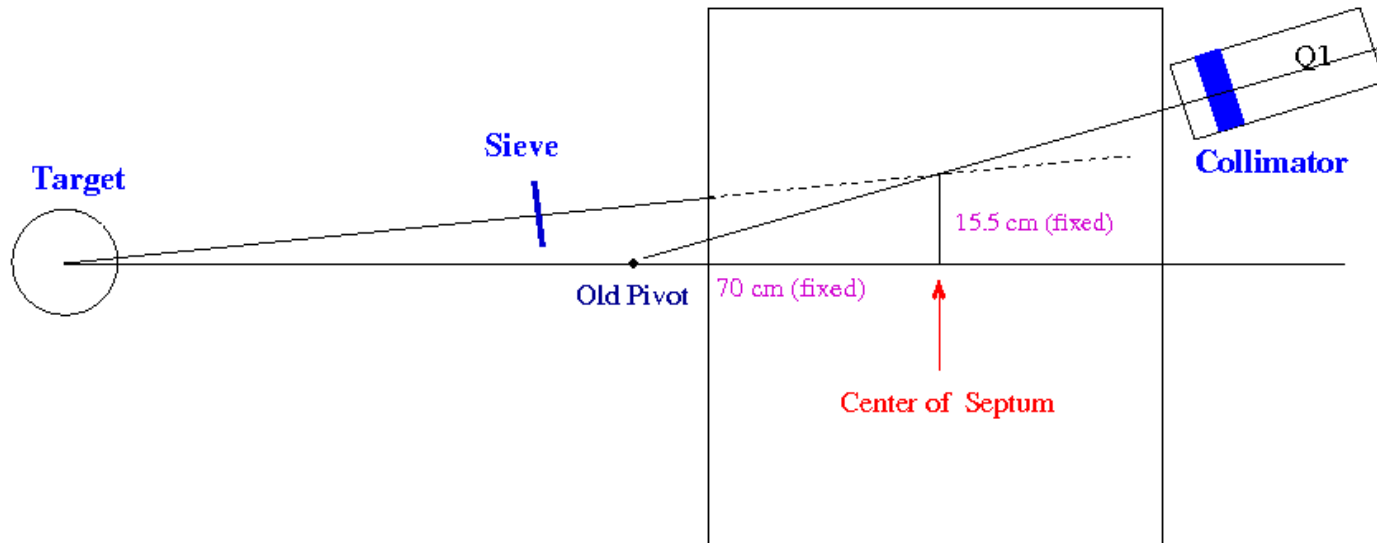
Old Pivot Point Z, X = 105.4, 0

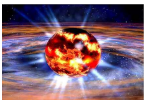


This was for 5 degrees. Assume for C-REX we want 4.3 degrees.

Move target back to 136.1 cm upstream of old pivot

Septum is the same, so the center to the old pivot is fixed at 70 cm (see fig)





C-REX Target Geometry Parameters

R. Michaels

Feb 1, 2013

not drawn to scale!

L1 = length of upstream blocker = 27 cm

L2 = middle thin-wall chamber = 40 cm

Vac. windows are 0.3 mm SS foils

L3 = length of downstream blocker = 27 cm

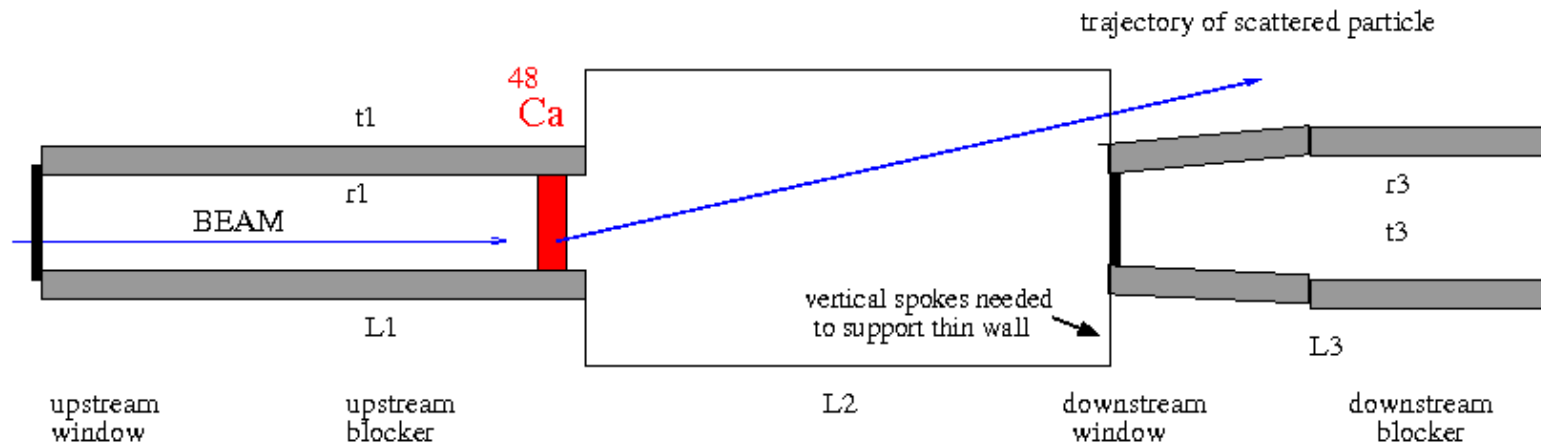
r1 = inner radius of upstream vacuum = 1.27 cm

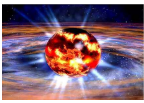
r3 = inner radius of downstream vacuum = 1 cm

x_{max} = max excursion of beam = assumed 6 mm (mis-align + raster)

t1 = thickness of upstream blocker = 4 mm

t3 = thickness of downstream blocker (2 mm, then tapers to 4 mm after 5 cm)





Rel. Rates from Ca Target and Al Foils

