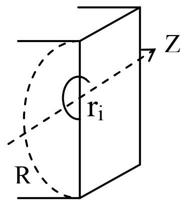
Temperatures in Short Collimators with transient and continuous proton losses

SHORT COLLIMATORS
1cm of Be or C



Line Source at $r_i \sim 0.25$ mm
Cooling at R = 15 mm

Steady state with cooling:

$$T(r_i) = \frac{dW}{dz} \frac{1}{\pi\lambda} \ln R/r_i$$

$$\ln R/r_i \sim 4.0$$

Semi-infinite body with no cooling,
only transient with uniform heating
with time over duration τ:

$$T(r_i, \tau) = \frac{dW}{dz} \frac{1}{\pi\lambda} I(x)$$

$$x = \frac{r_i}{2} \sqrt{\frac{c\rho}{\lambda\tau}}$$

	I (x)	
	τ = 1s	τ = 10s
Be	3.6	4.8
C	4.0	5.1
Al	4.2	5.3
Cu	3.8	5.0

I(x) varies only slowly with material and τ

Only Ionization: Power deposited at r_i:

$$\frac{dW}{dz} = \frac{dE}{d\xi} \bullet \rho \frac{dp}{dt} \bullet n$$

$$\frac{dE}{d\xi} \sim \frac{1.5 \text{ MeV cm}^2}{\text{gr}}$$

ρ = Density

$\frac{dp}{dt}$: N° of protons lost per time

n: No of traversals $\frac{x(abs)}{\Delta x}$

C (Be): n = 40, Δ x = 1 cm

Cu : n = 40, Δ x = 0.3 cm

C (Be) : after n=40 all protons INTERACT in Δ x. This adds only marginally (for Cu should be checked)

$\frac{dp}{dt} = 10^{11}$ per s:

$\Delta T(r_i, \tau)[K]$						
	N	Δx[cm]	dW/dz[Watt/cm]	τ =1s	τ = 10s	$\tau = \infty$ + Cool.
Be	40	1	1.73	13.2	17.6	14.7
C	40	1	1.73	18.4	23.5	18.4
Al	40	0.9	2.6	29.0	35.8	27.6
Cu	40	0.3	8.6(?)	51.7	68.0	54

CONCLUSION

One can intercept with and finally interact in "Short" collimators in C, Be about 10^{12} p/s over 10 s (or permanently). In Al, Cu(?) about 4 x 10^{11} p/s over 10 s (or permanently).

What to do with 99.999 % of the escaping power???

For similar studies with "long" collimators we need FLUKA (Vasilis, Alfredo).