Comments to the video. What is the wedge effect?

1) Consider e-**beam as a cylinder diameter D** with uniform density of beam particles; $\mathbf{n_b}=(0,\sin(\alpha),\cos(\alpha))$.

2) For a **squared or wedge-like** channels the **hot spot is a cross section of a cylinder with a plane**. Plane orientations: $\mathbf{n_1}=(0,1,0)$ -for **squared** channel, or $\mathbf{n_2}=(\pm\cos(\varphi),\sin(\varphi),0)$ - for **wedge** planes. Impact angle is determined by $(\mathbf{n_b}, \mathbf{n_1}) = \sin(\alpha)$ or $(\mathbf{n_b}, \mathbf{n_2}) = \sin(\alpha)\sin(\varphi) = \sin(\vartheta)$ - pitch to wedge plane.

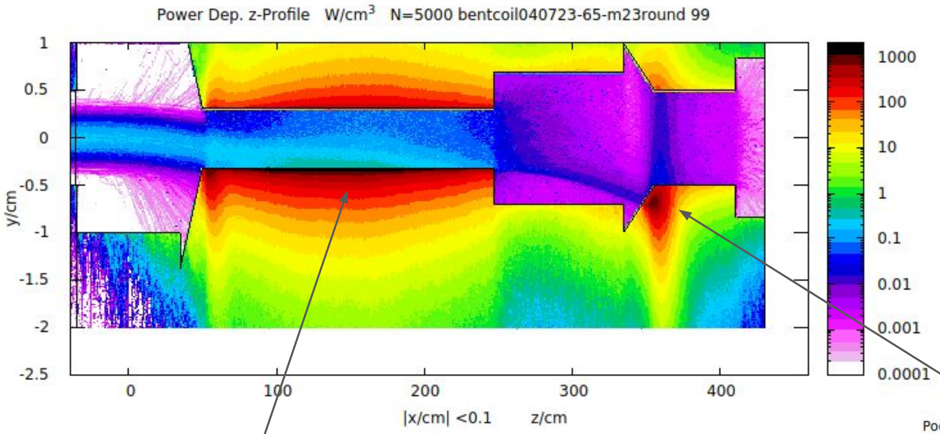
3) But in both cases the **intersection is an ellipse** with the area $S = \pi D \times L$, where L - ellipse large axis.

4) Pitch angle $\vartheta \sim D/L$.

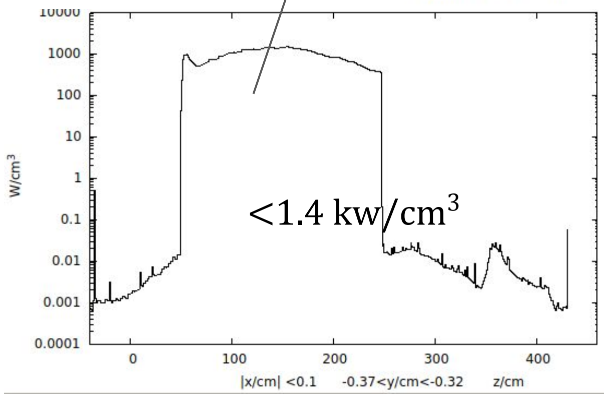
5) Maximum **L is constrained by the length** of the **beam channel** ($L<L_c\sim 2$ m), or the **wedge** ($L<L_w\sim 0.5$ m).

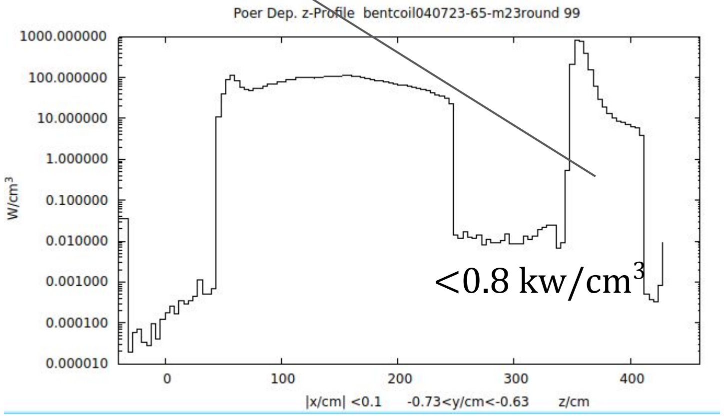
- Therefore max $dP/dS \propto L^{-1}$ for the wedge is ~4 times higher.

Optimisation of Tim Whitlatch design at 75% B-field. Channel d=6.4 mm
Power Deposition and Temperature.

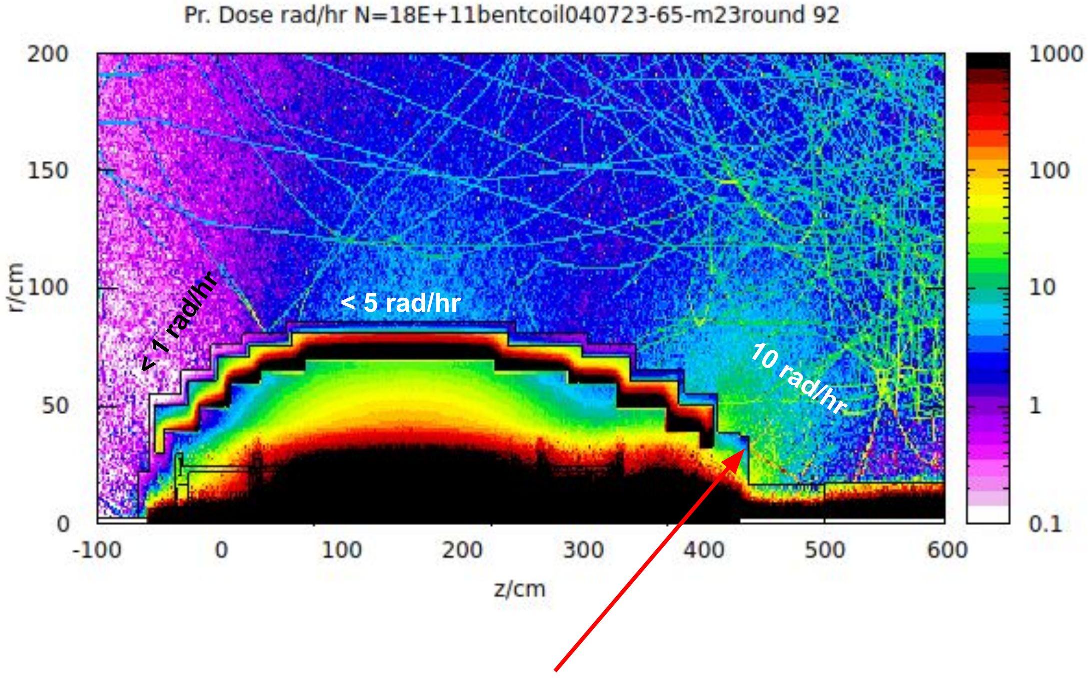


Expected temperature in hot spots <200° C

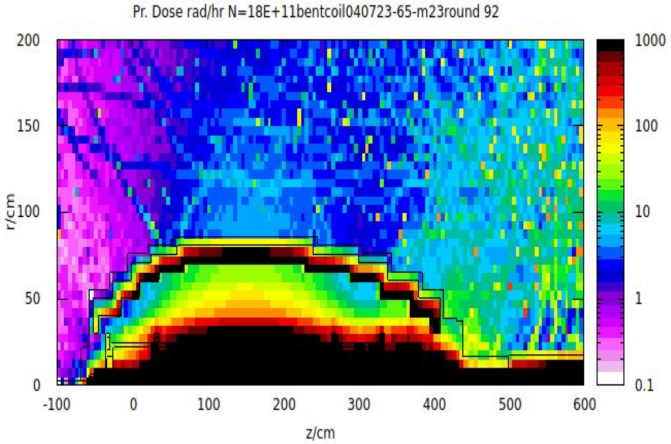




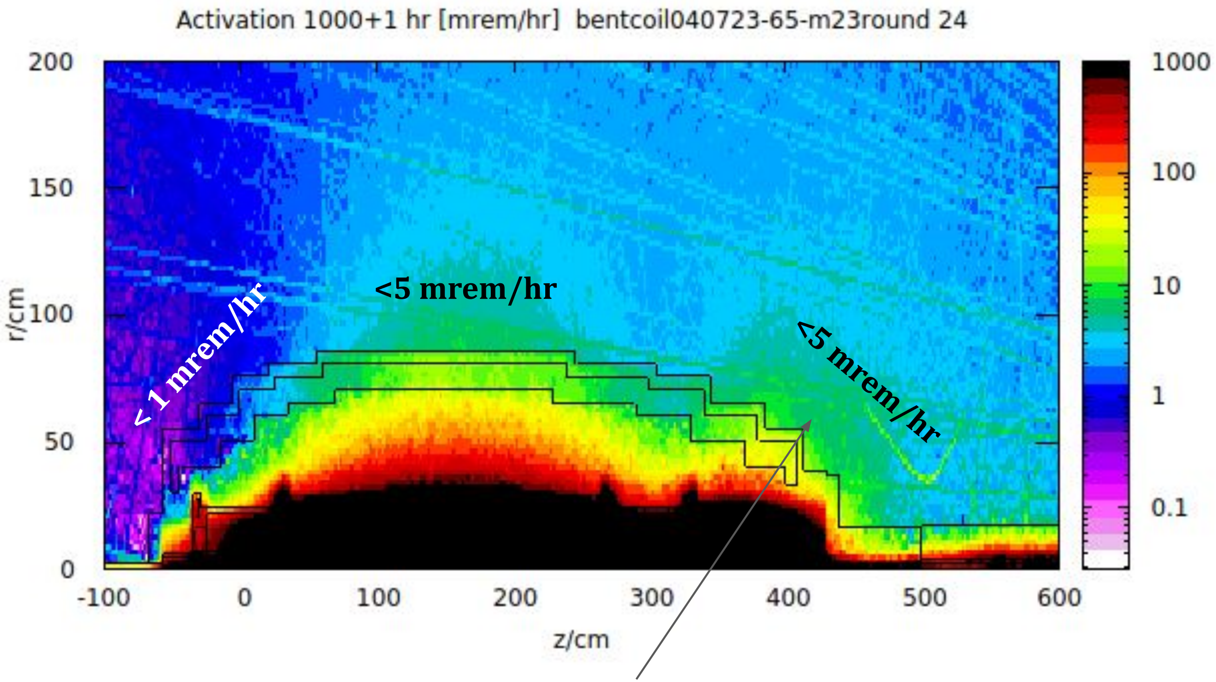
Optimisation of Tim Whitlatch design at 75% B-field. Channel d=6.4 mm
Prompt Dose at 1' distance.



May be reduced in this area using borated PE in this direction



Optimisation of Tim Whitlatch design at 75% B-field. Channel d=6.4 mm
Activation at 1' distance.



- Finer granularity of lead and borated polyethylene is required.
- 75% of B-field works good.

Critical parameters of two CPS models.

CPS param.	P.D.	V.B.	Comment
Dipoles	2 (coil+perm.)	2 (2 coils)	
B_x	0.44/0.22 T	0.22/0.22 T	
CPS Length	4.8 m	4.8 m	
CPS Width	3.0 m	1.6 m	
CPS Weight	? T	60 tonn	metric
Absorb. T°	$< 200^o\ C$	$< 200^o\ C$	Hot spot
Max. Power dep.	$7\ kW/cm^3$	$< 1.7\ kW/cm^3$	
Activation	<20 mrem/h	<10 mrem/h	after 1,000+1 h
Coil lifetime	?	> 150 years	Continuous oper.

TABLE VIII. fff344 Comparison of critical parameters of two designs of Hall D CPS.

New research program for 26 (!) simulations to be done in June. Can it be be optimized?

"In order to **evaluate the CPS model** that you propose for KLF, I would like to see the results of simulations with various test configurations. For each configuration I would like to have the files for the **power depositions** **(~4+ weeks, "fast" model, mesh-statistics)** to estimate the **temperatures** just in the absorber, and I also would like you to present the **prompt and residual dose** environment in the **tagger hall** for **each of them** **(~13 weeks of calculations, "slow" model)**. The test configurations would be the following:"

1. Nominal configuration with FWHM=2.5mm in both x and y of the gaussian beam, and 10% radiator, and nominal magnetic field.
2. Beam transverse FWHM=0.8mm in both x and y direction. (?) Temperature is obviously higher.
3. 90% nominal magnetic field. (!) **Linear dependence-nominal conf. as a 2nd point**- of max energy deposition => ±10% change in max. temperature)
4. 110% nominal magnetic field (?) Linear dependence of max energy deposition => ±10% change in max. temperature
5. +1mm parallel shift in y for the beam transverse position. (!) Linear dependence. Criterion for a beam interlock system?
6. -1mm parallel shift in y for the beam transverse position.
7. Either +1mm or -1mm shift in x for the beam transverse position. (!) Not prevented by a beam trip system?
8. +0.5 mrad angle with respect to the nominal direction in Y (either just before or after the corrector magnet is fine). (?) similar to +25% B-field change.
9. -0.5 mrad angle with respect to the nominal direction in Y (either just before or after the corrector magnet is fine). (?) similar to - 25% B-field change.
10. Either +0.5 mrad or -0.5 mrad angle with respect to the nominal direction in X (either just before or after the corrector magnet is fine).(!)
11. Beam transverse FWHM=3.5mm in both x and y. (?) obviously lower temperature, (!) higher background at the CPSentry
12. Beam halo as a flat background distribution under the main gaussian peak of the beam extending radially 0.5cm from the center of the beam at the relative level of 10^-4 with respect to the gaussian peak height with FWHM=2.5mm in both x and y . (!)
13. 20% radiation length for the copper radiator before CPS. (!) (Lower temperature, higher photon beam intensity, same background).

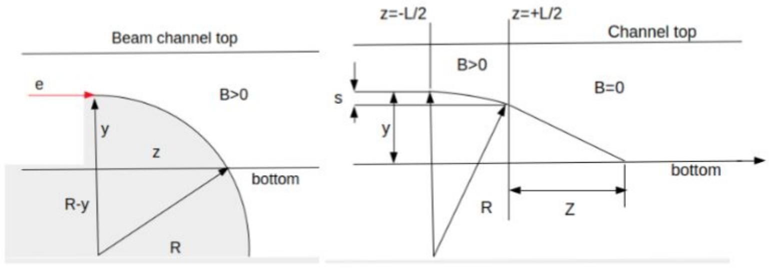


FIG. 2. ffffffinimag Particle trajectories and hit coordinates at the bottom of the beam channel. y – beam particle impact coordinate relative the bottom of the beam channel; R – trajectory radius in uniform magnetic field; z – coordinate along the beam line; s – trajectory sag; L – magnetic field area size along the beam channel; B – magnetic field.

$$
\begin{aligned}
(R-s)^2 + L^2 = R^2, \quad => \quad s \approx \frac{L^2}{2R}, \\
\frac{L}{R-y} = \frac{y-s}{z}, \\
z \approx \frac{R}{L}(y-s) = \frac{R}{L}y - \frac{L}{2}, \\
< z' > \approx < y > \frac{R}{L}, \\
rms(z') \approx rms(y)\frac{R}{L} = < z' > \frac{rms(y)}{< y >}.
\end{aligned} \qquad (2)
$$

B-field is constrained to hit the CPS middle, => <z'>=Z/2 , where Z is CPS length

=> bending power R/L = is constrained by Z.

rms(z')=(rms(y)/d)*Z,

where d-diameter of the beam channel

Overheating risk due to beam walk or B-field off, etc.
What time is required to melt copper in the beam channel?

From FLUKA I estimate the maximum beam power in the channel : $P=\sim 20\ kW/cm^3$
Assuming no hit sink, the energy accumulated in 1 cm^3 during time dt relates to the temperature change dT as:

$$P[J/s]dt[s]=C_v\ [J/(kgK)]\ \varrho\ [kg/cm^3]\ dT\ [K]$$

Where ϱ-copper density =9.E-3 [kg/cm^3], C_v -it's specific heat capacity =400 [J/(kgK)].
Hence dt =

$$=400\ [J/kgK]\ 9.E\text{-}3\ [kg/cm^3]\ 1.E{+}3\ [K]/20.E{+}3\ [J/cm^3 s]$$
$$= \sim 0.2\ [s].$$

- This time is sufficient to make a decision turn off the beam.