Initial studies on a collimator system for Linac4

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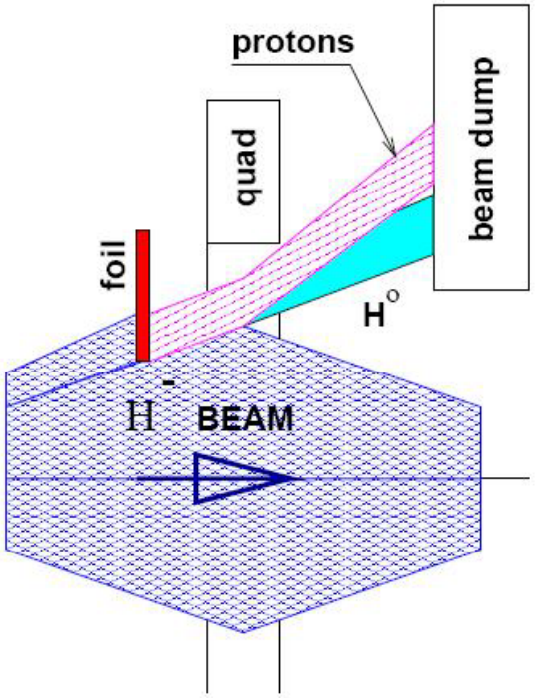
Collimation of transverse H- beam halo:



FODO cells and immediate beam dumps:

- Used in the Spallation Neutron Source (SNS).
- No need to increase quad apertures.
- more collimators needed.
- more activation.

Achromat and remote beam dumps:

- Used in European Spallation Source (ESS).
- Clean as strip particles are transported to beam dumps.
- Expensive as many beam dumps needed.

FODO cells and remote beam dump:

- Used in J-Parc.
- Stripped and un-stripped particles are transported together up to the switch magnet where the 2 beams become separated and the stripped one goes to a beam dump.
- Apertures of the magnets should e increased largely otherwise beam loss will happen.

Triplets and remote beam dump

- Option for Chinese SNS (6kW and 80MeV in the linac) (Linac4 is 5.1kW and 160MeV).
- Identical waists in both planes.
- Optics for H- is good for the protons too.

J.Y. Tang et al. / Nuclear Instruments and Methods in Physics Research A 572 (2007) 601–606

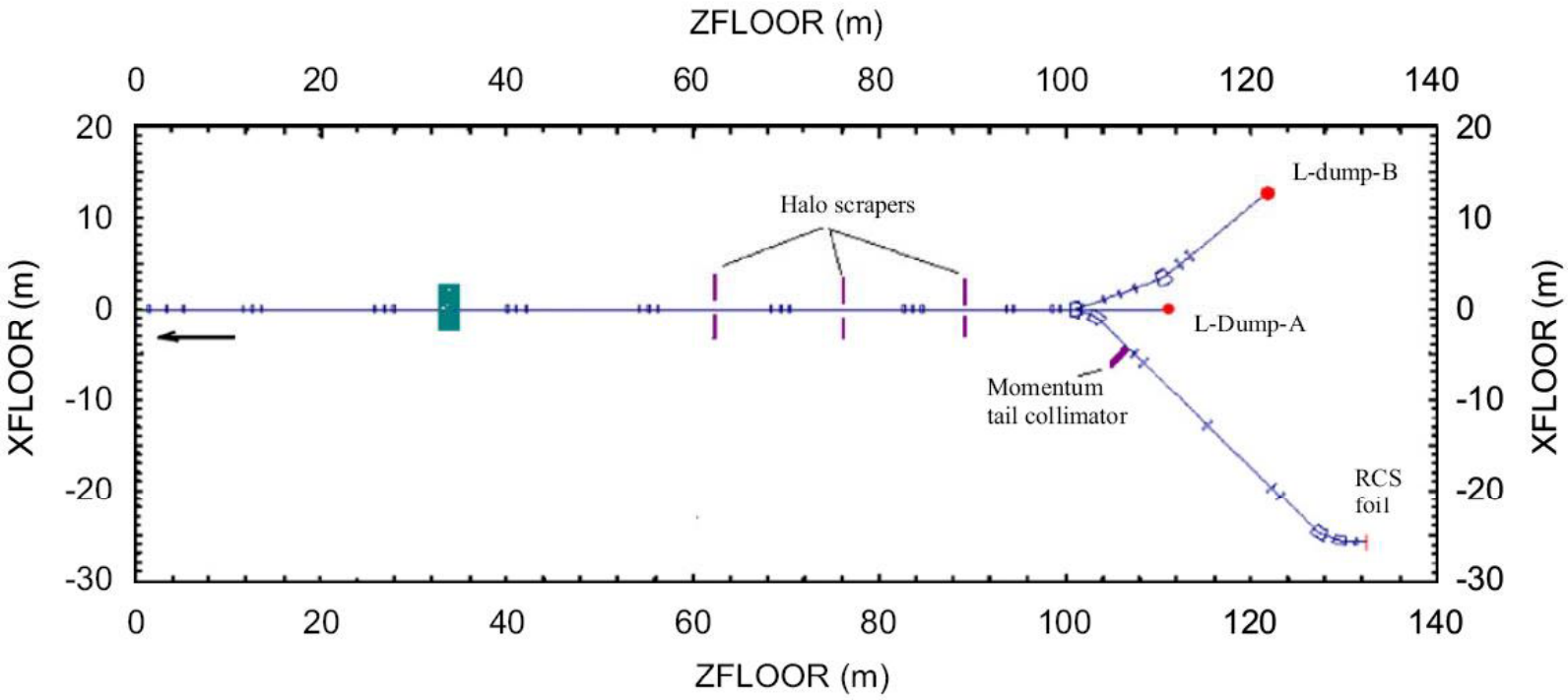
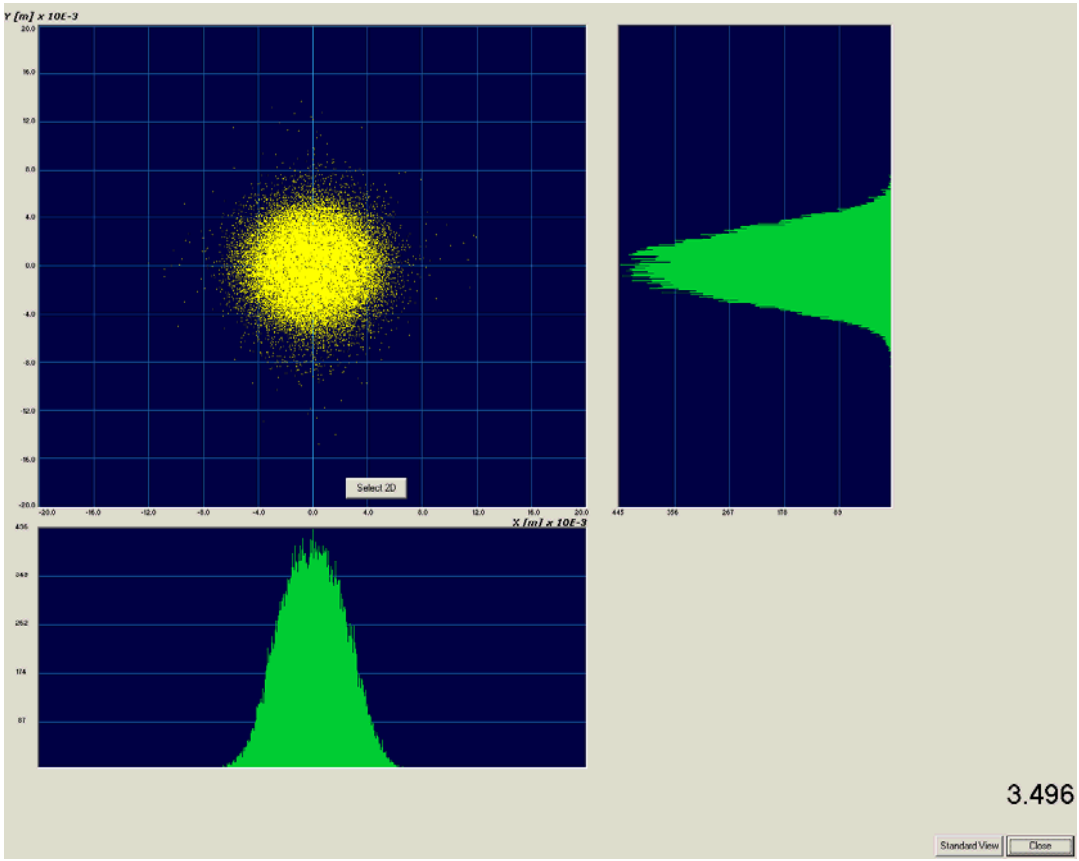


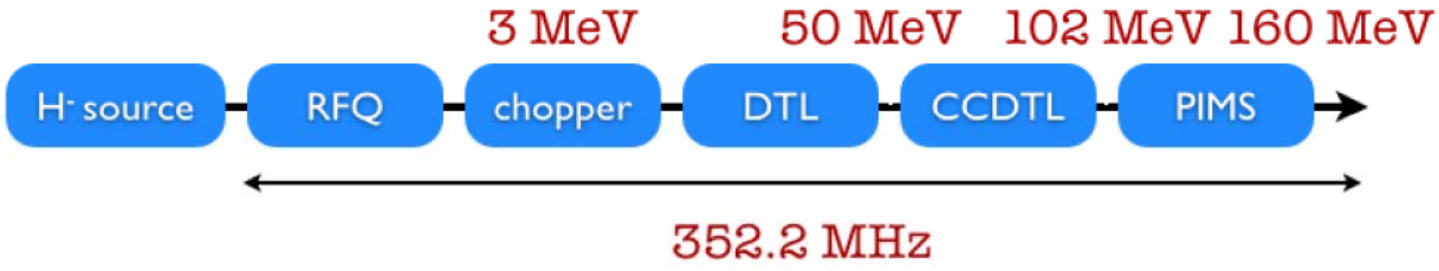
Fig. 8. Layout of CSNS/LRBT.

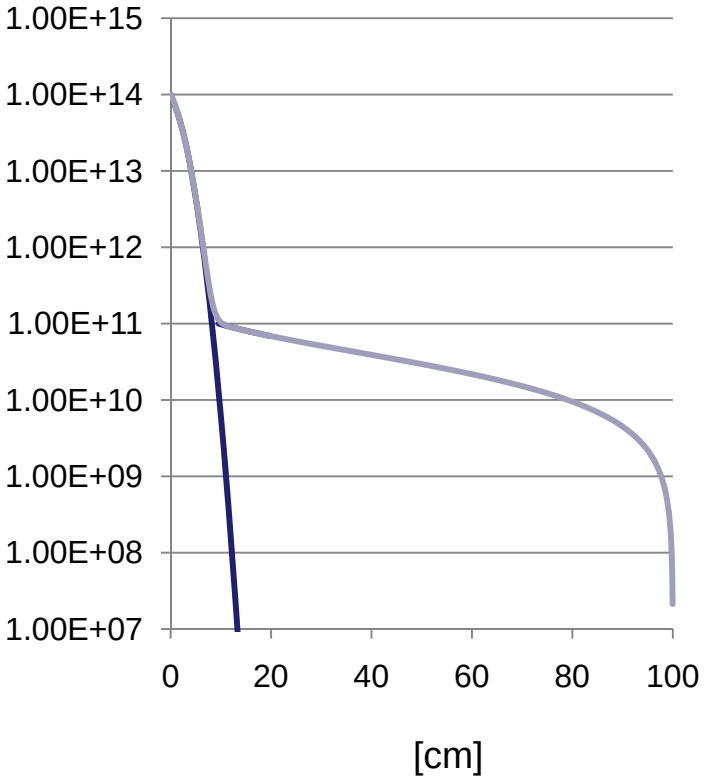


Beam and halo model for the simulations in FLUKA

x RMS [m]	2.36E-03
x' RMS [rad]	2.75E-04
y RMS [m]	2.57E-03
y' RMS [rad]	6.66E-04

Beam 3.5 meters after the PIMS

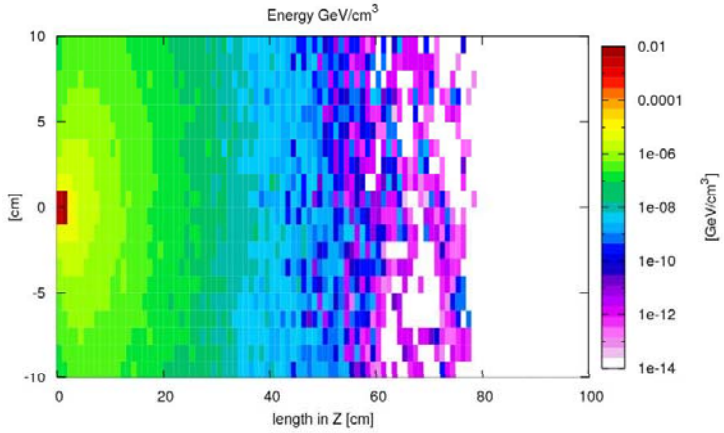




particles in the bunch

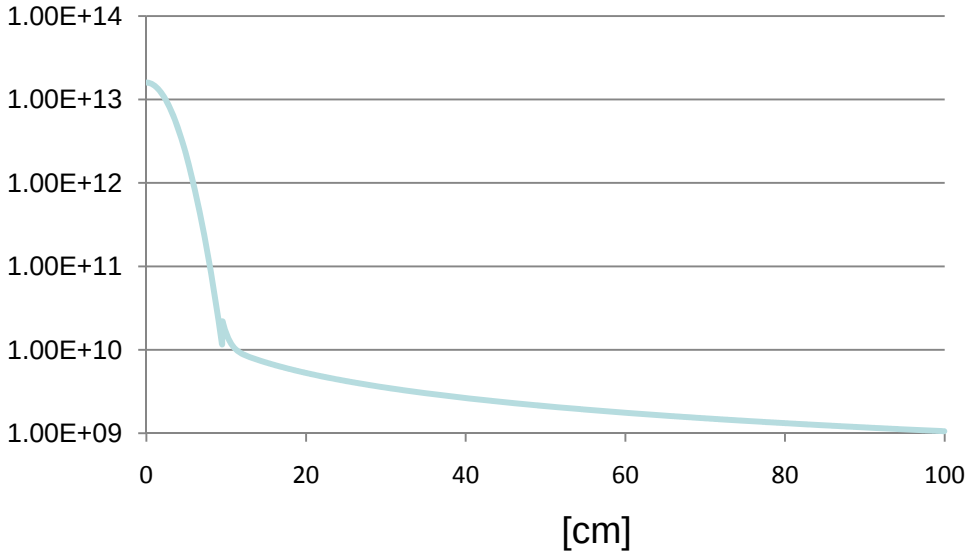
particles in the halo

total particles beam + halo



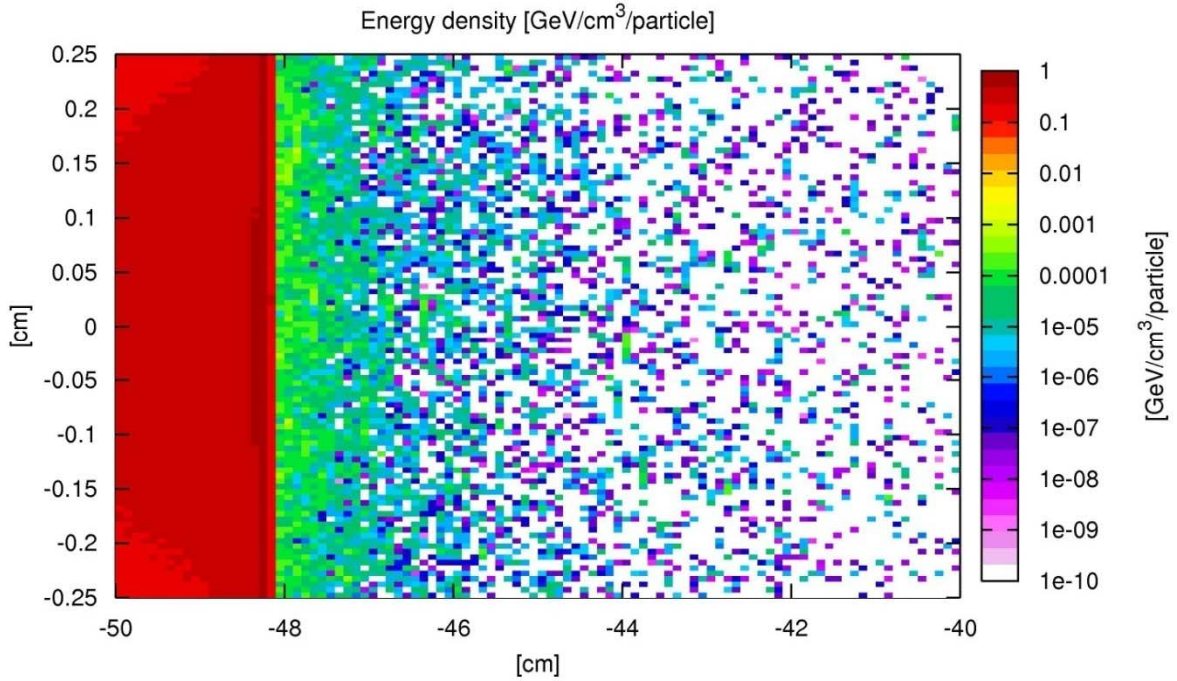
At the end of the linac energy is 160MeV

For this kind of model 10W absorption per pulse corresponds to a radial aperture of 83.3mm; 25W to 63.2mm and 50W to 39.9mm.



A pulse made of 10E14 H- with a radial beam size of around 2.5 mm and an energy of 160MeV impacting at the same point of a tungsten absorber will suppose a maximum temperature increment of around 2264K (<Tmelt=3695K).

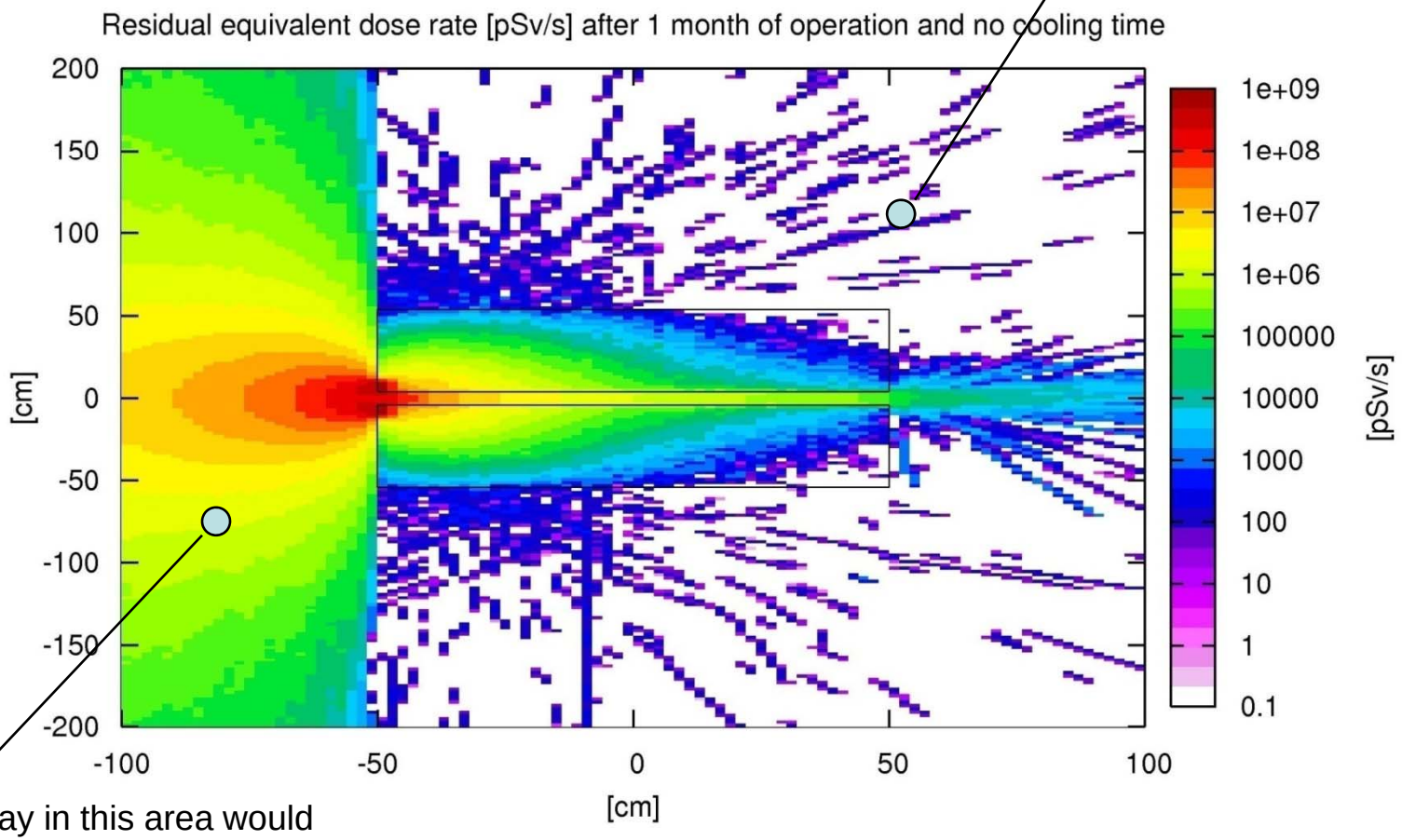
Most of the energy is absorbed in the first 2 cm of material.



Dose limit for radiation workers is
20 mSv during a working year

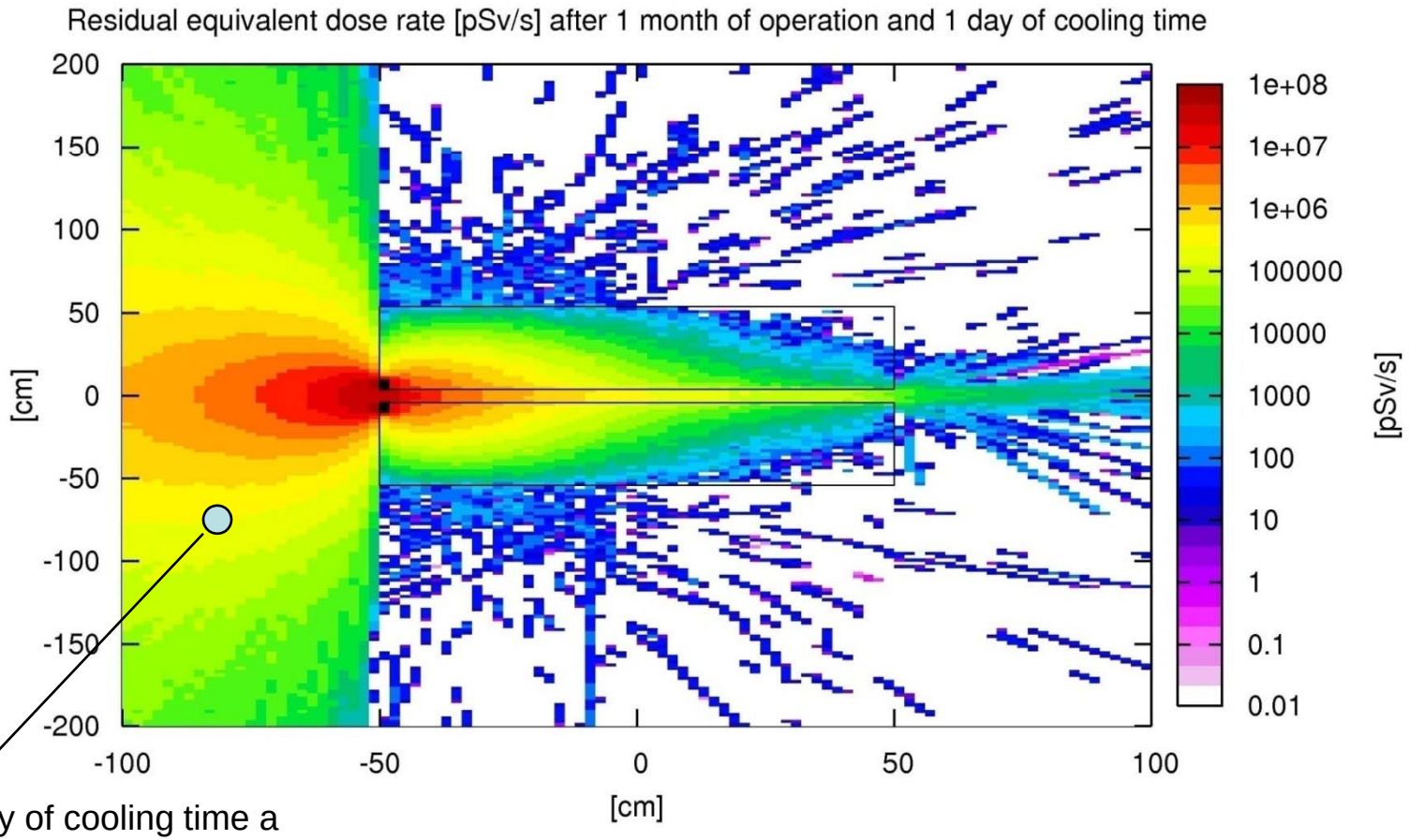
50W 50Hz

No problem in this area after just 1 month of operation



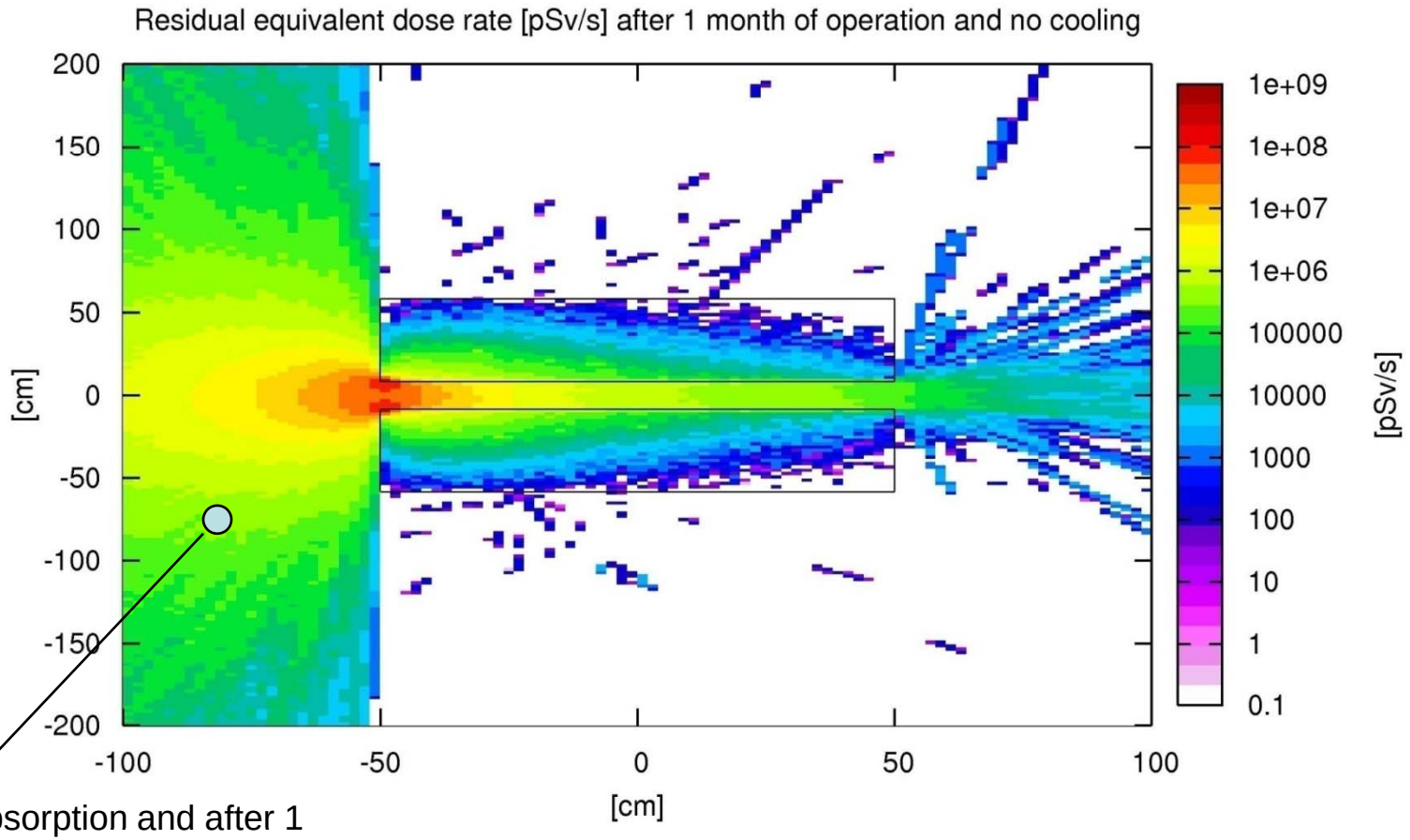
Maximum stay in this area would be reduced to 2.5 hours

50W 50Hz



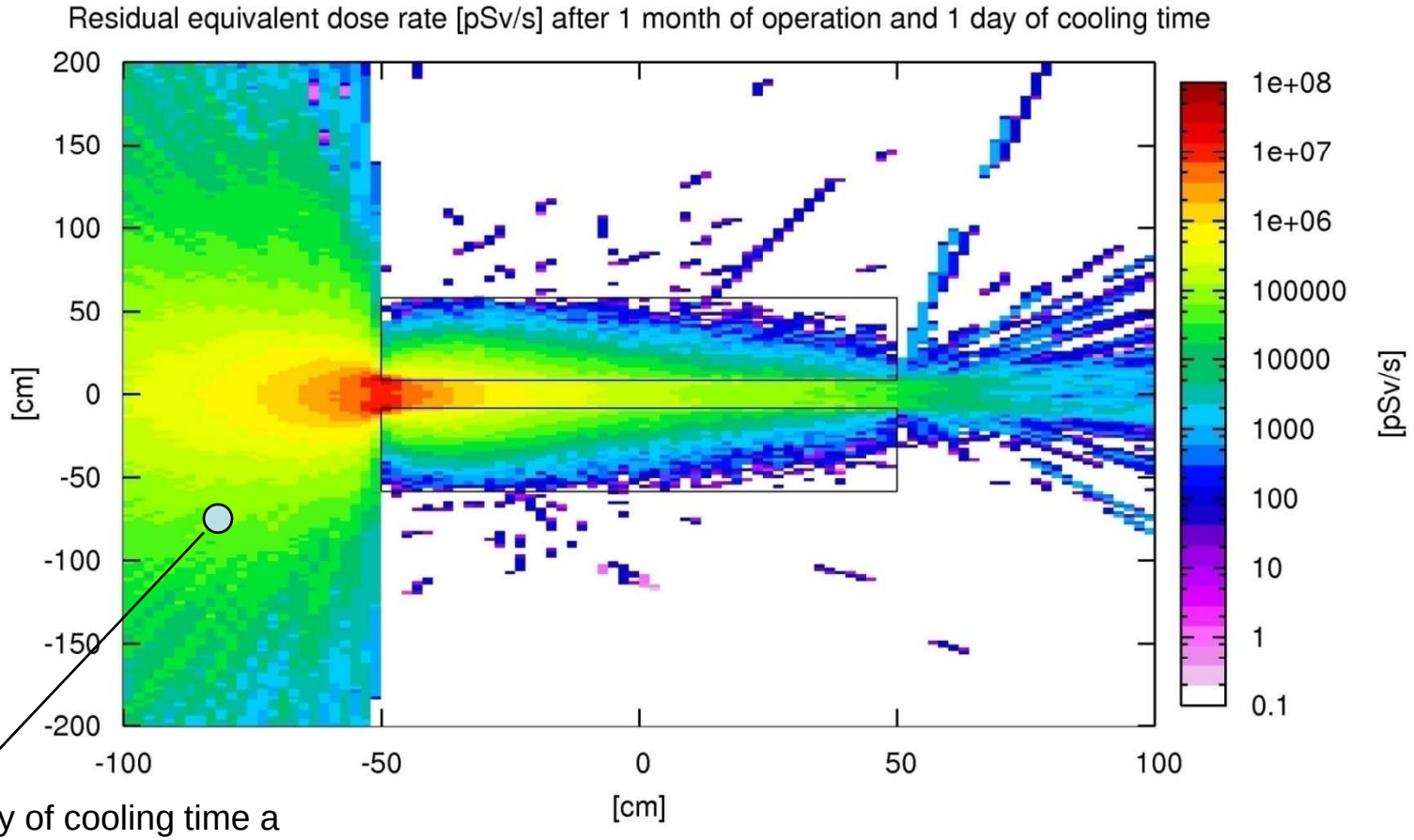
After 1 day of cooling time a worker could stay here for as long as 27 hours (after just 1 month of operation in the machine)

10W 50Hz



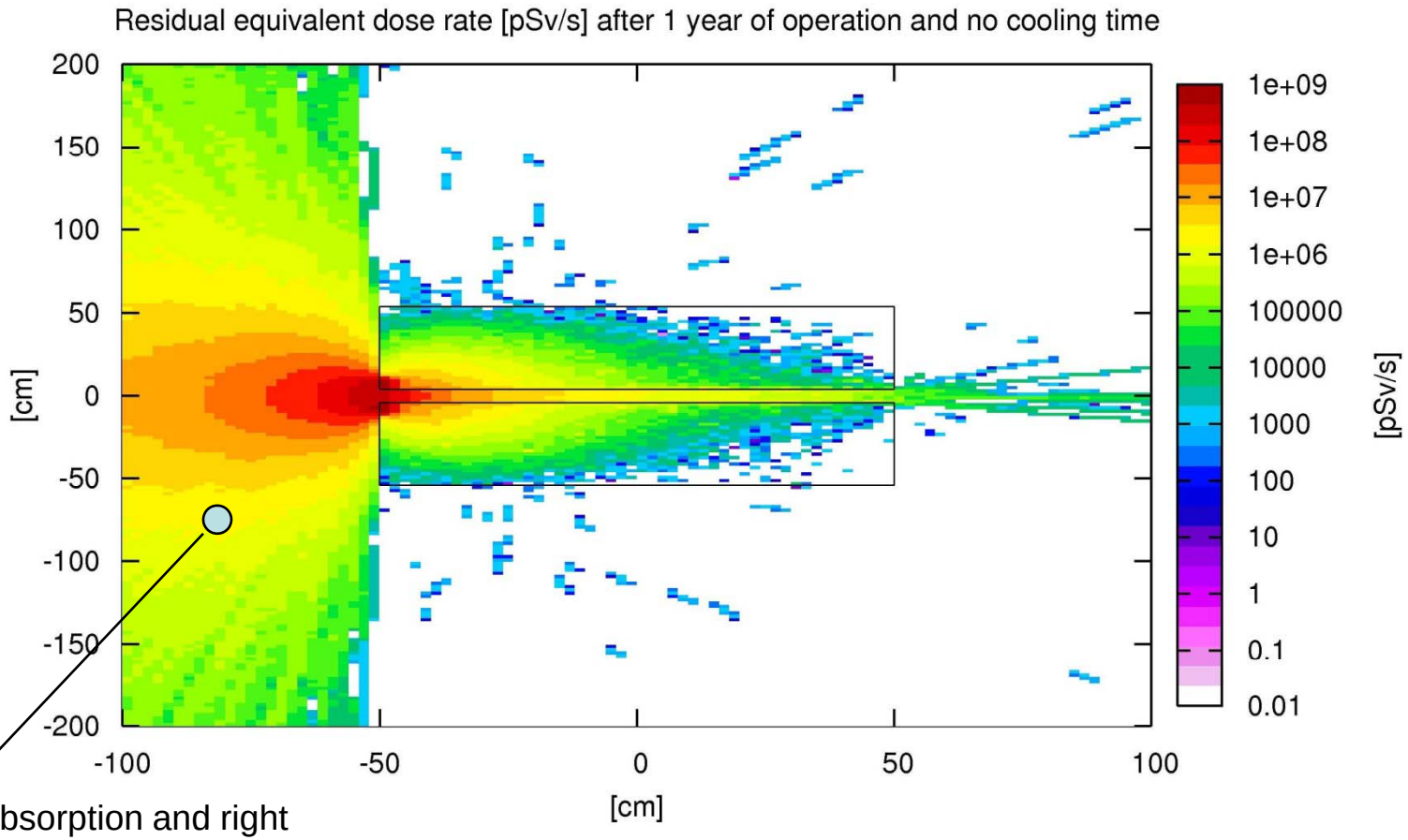
For 10W absorption and after 1 month of operation of the machine a worker can stand here for 5 hours.

10W 50Hz



After 1 day of cooling time a worker could stay here for as long as 55 hours (after just 1 month of operation in the machine)

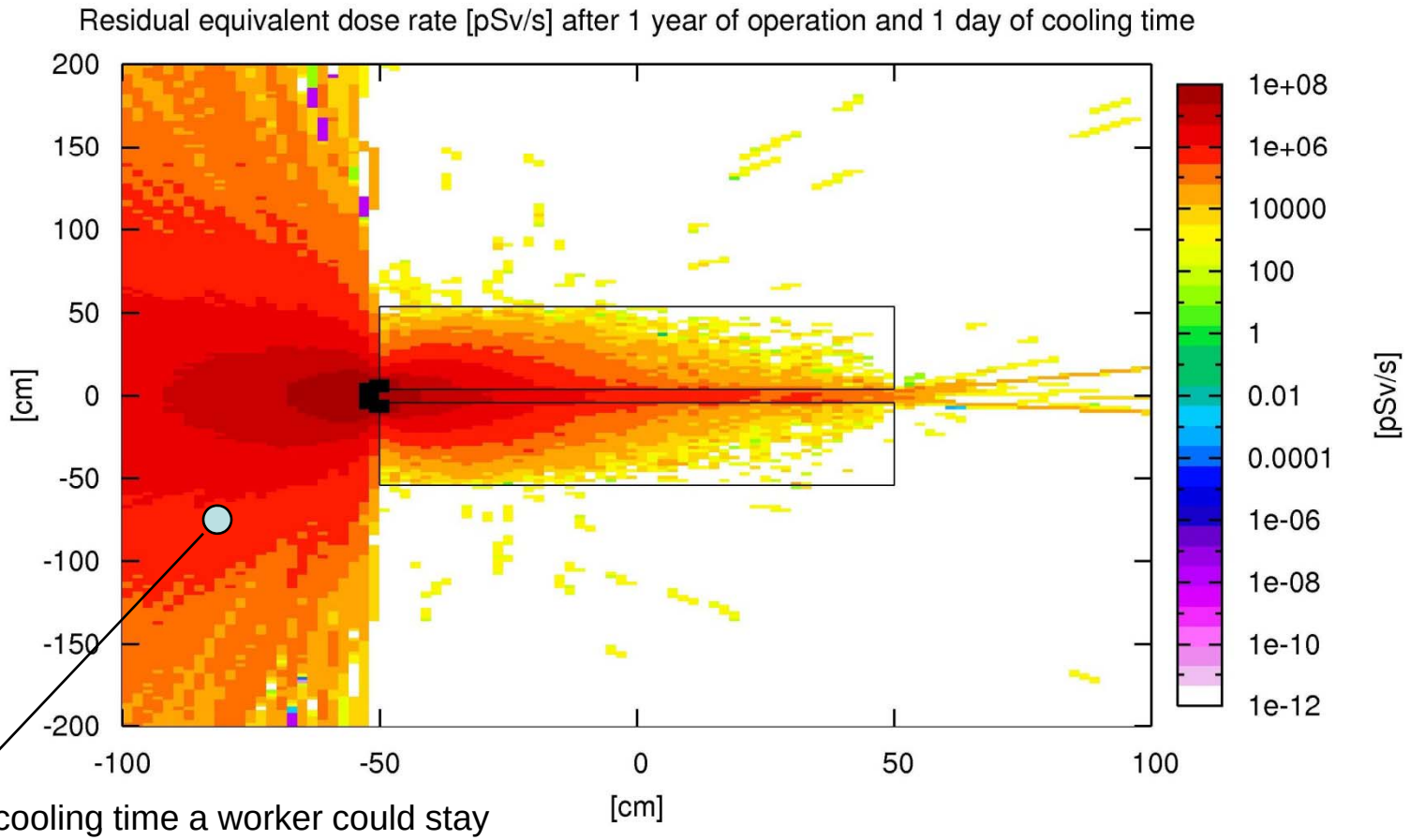
50W 50Hz



For 50W absorption and right after 1 year of continuous operation a worker can stand here for a maximum of 2.5 hours

Low statistics run

50W 50Hz



After 1 day of cooling time a worker could stay here for as long as 5 hours (after 1 year of operation in the machine)

Low statistics run

OUTLOOK

- Transverse beam halo – collimation required at different phases.
- Is longitudinal collimation required?
- Shorter collimators located in different positions of the beam line will serve to avoid having absorbers too hot due to activation.
- Option with foil scrappers and modified optics? Just simple absorbers along the line?
- Study of shielding and activation once these questions been resolved.