An update of Energy deposition around e-driven positron source

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PosiPol2018
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CERN


6 years ago, we were,,

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- Parameters
- Geometry
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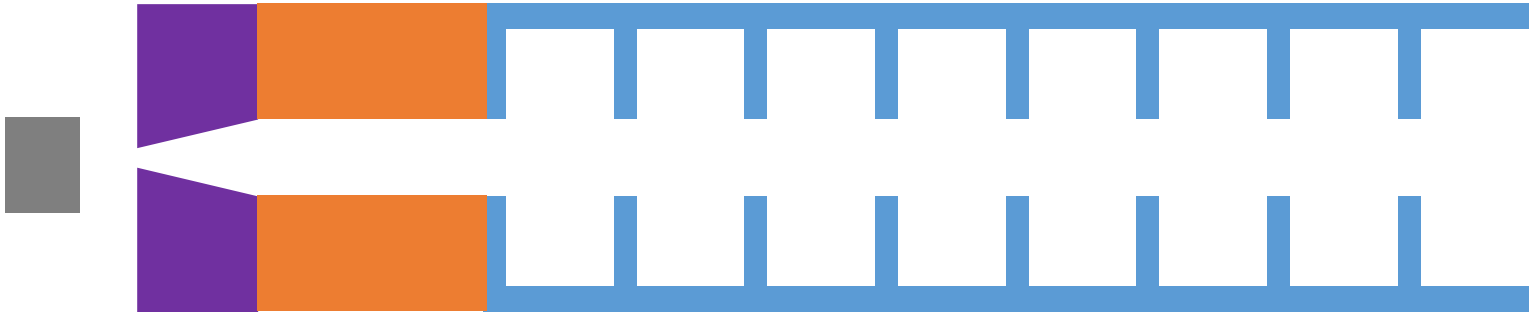
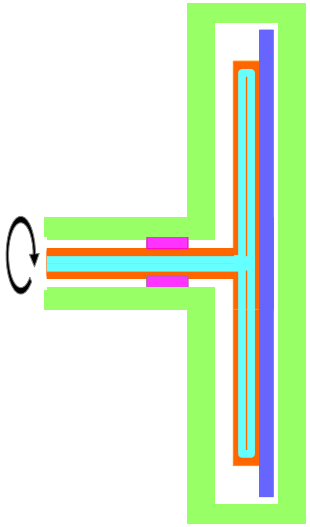
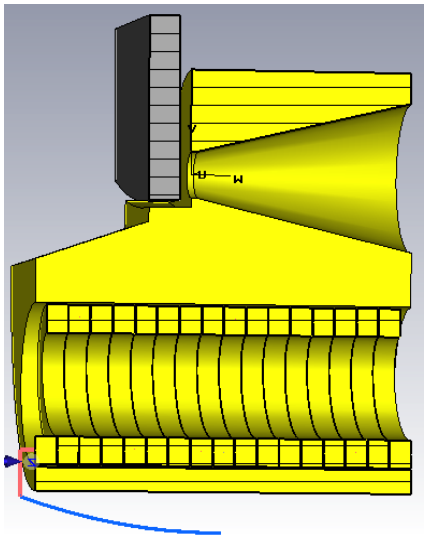
- Further issues?

Geometry

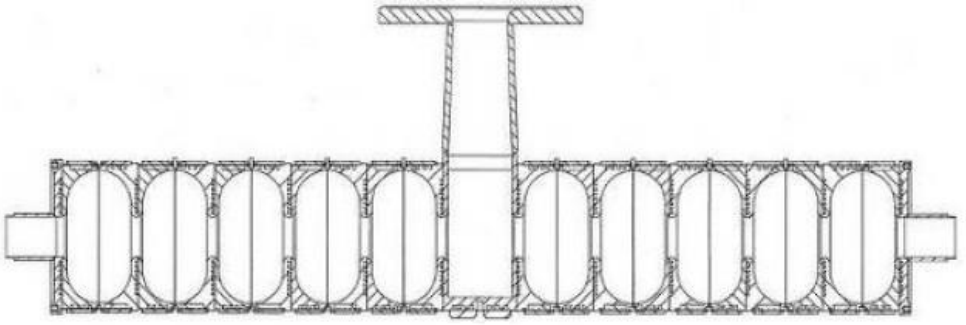




Rotating Target



Flux Concentrator

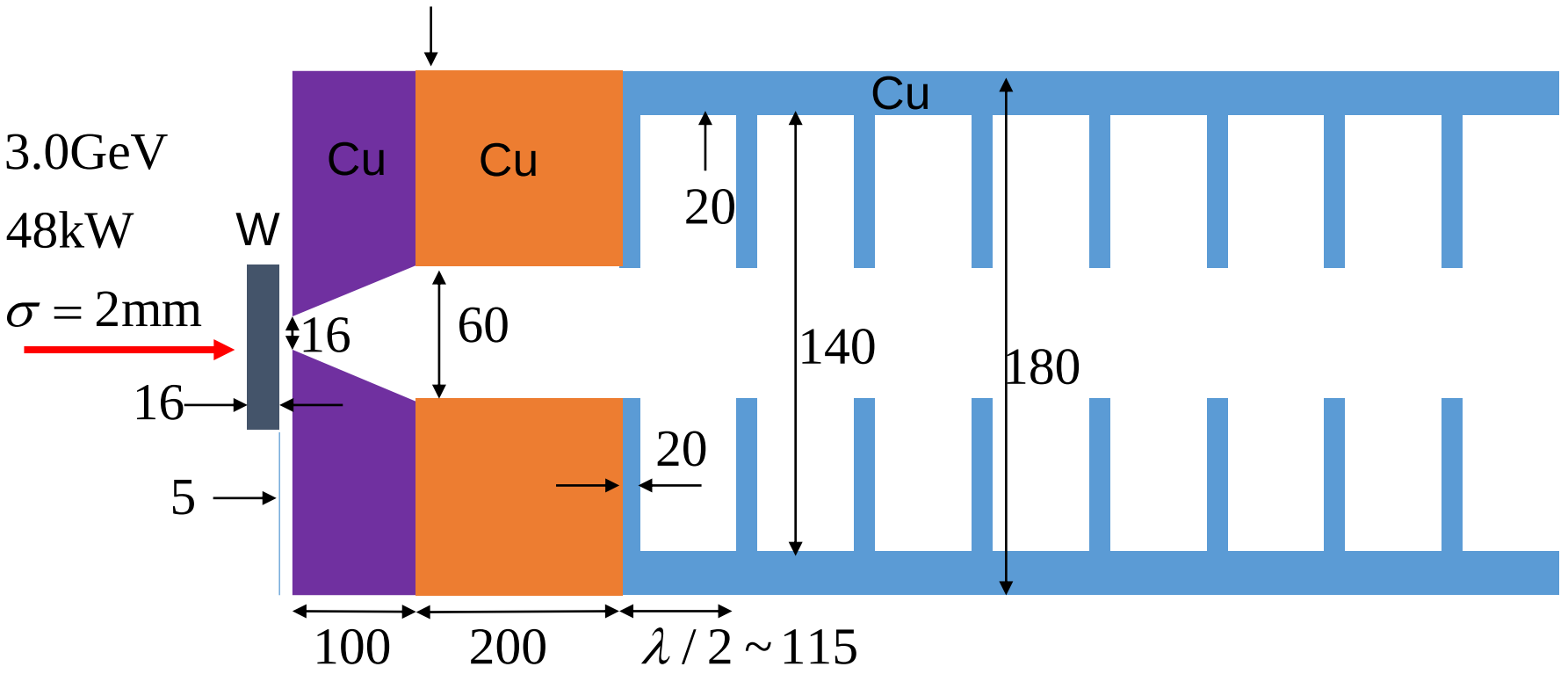


capture linac

Parameters and geometry in Geant4

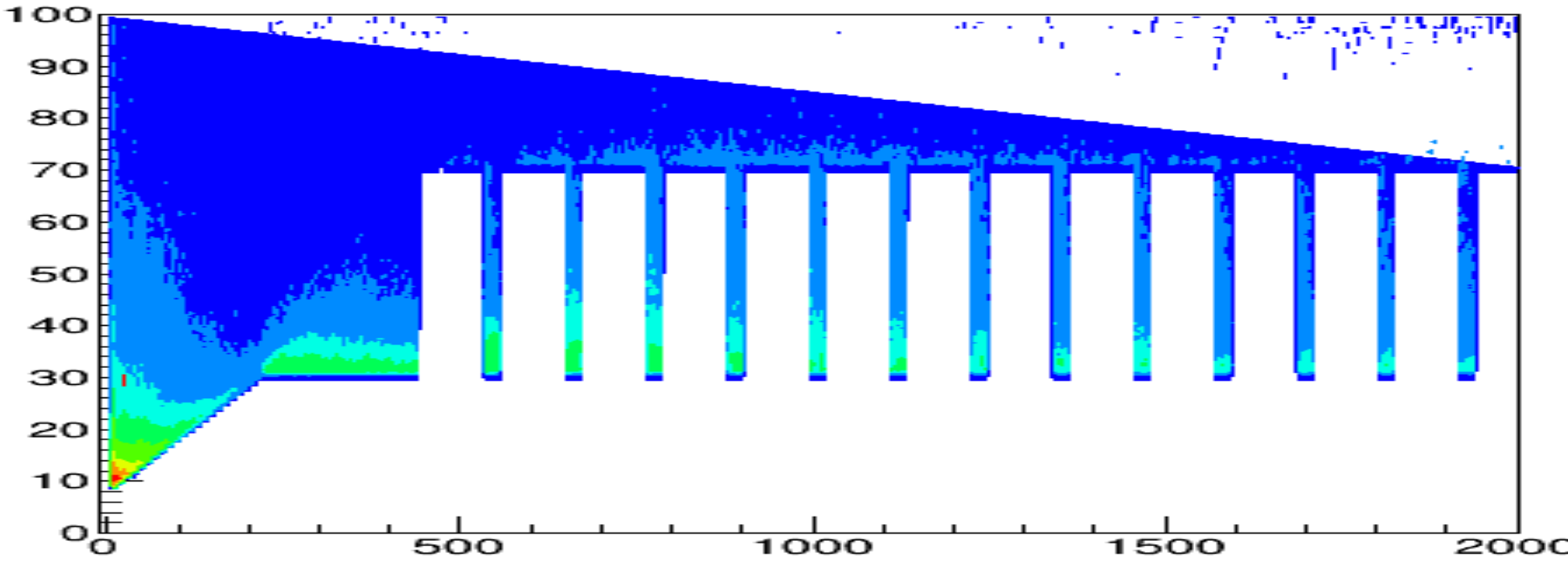
1320 bunches

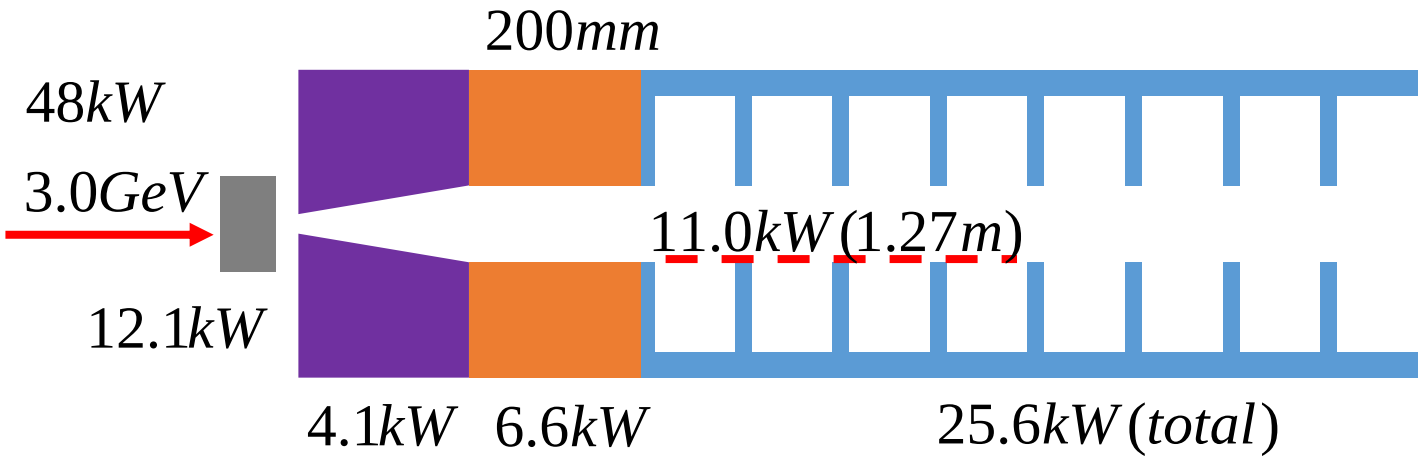
Ee	σe-	e-/bunch	Beam Power	Total thickness
GeV	mm	nC	kW	mm
3.0	2	2.4	48	16



All parameters are consistent with Kuriki's tracking simulation

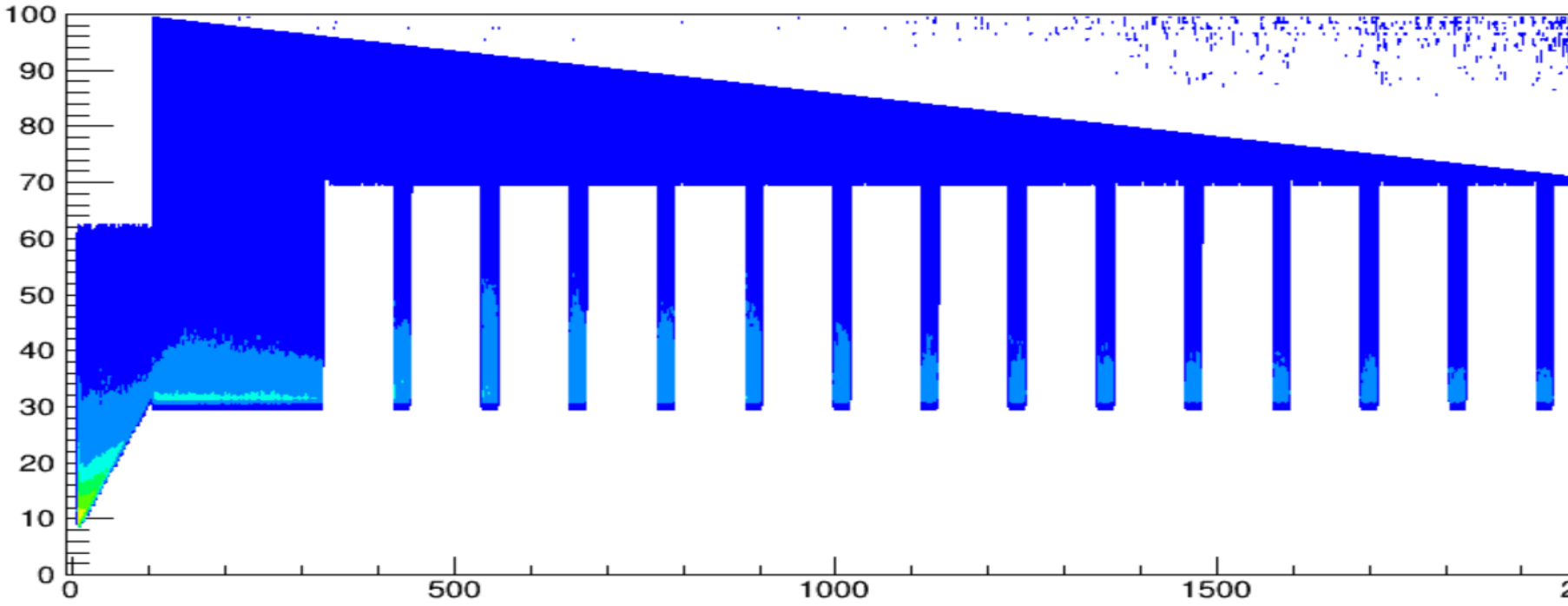
Summary of the calculation

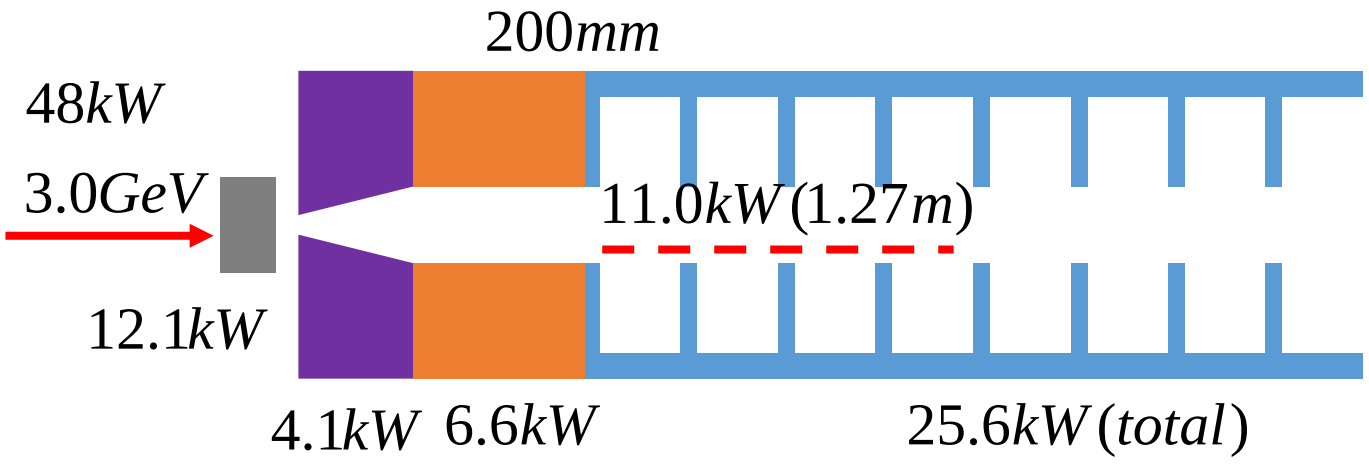




$\sum loss = 48.4kW$

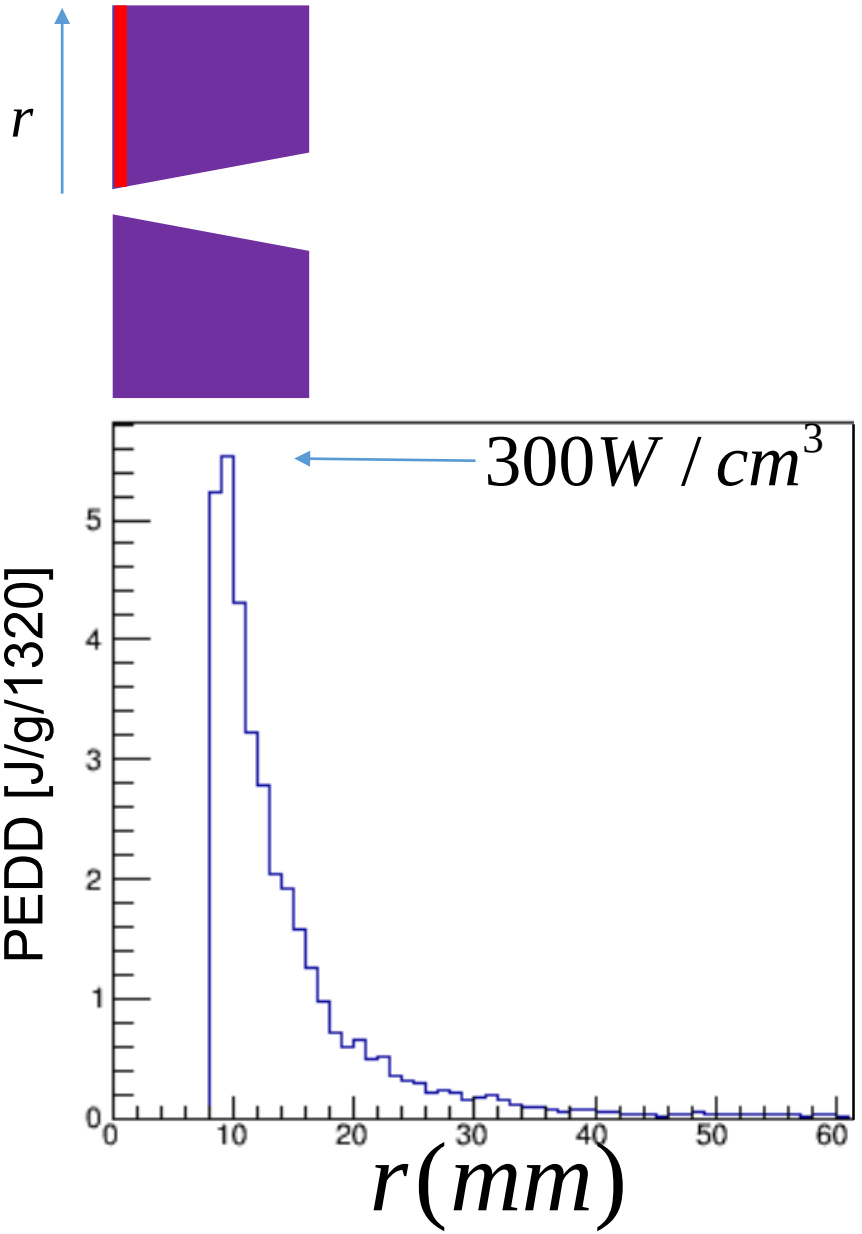
Summary of the calculation





$$\sum loss = 48.4kW$$

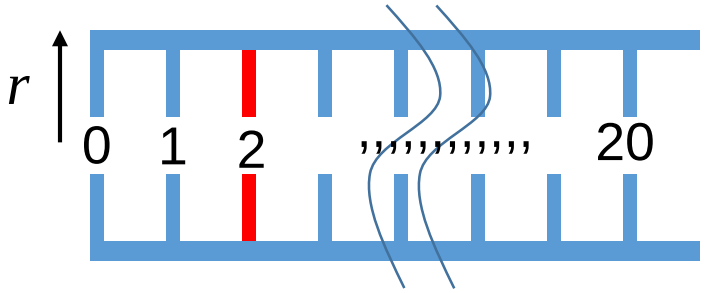
PEDD(1320 bunches) in FC

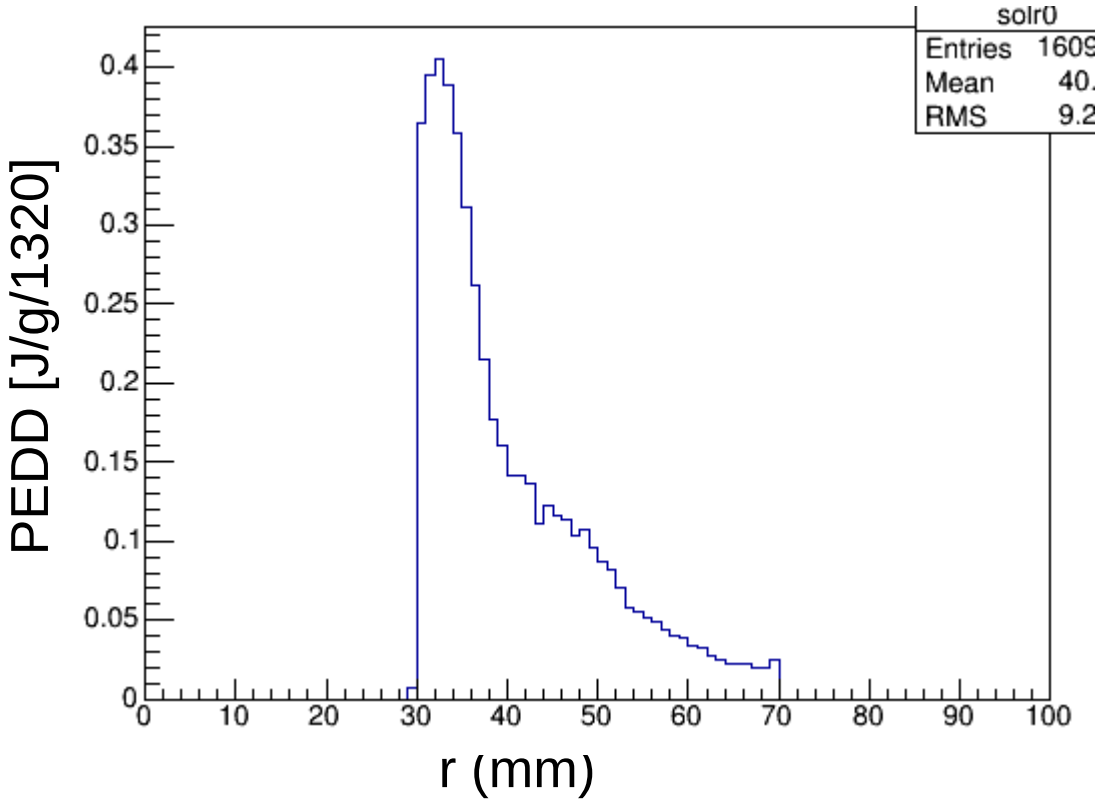


Less than the limit for Cu (7~12 J/g)* with 1320 bunches (~ 64ms).

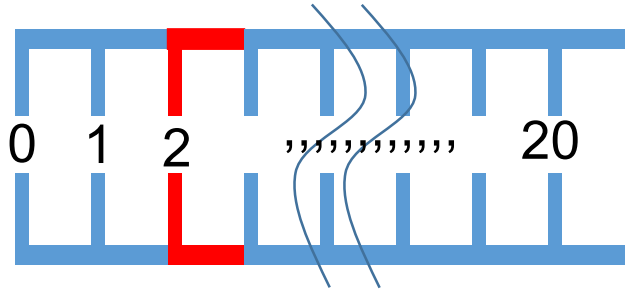
*TESLA-FEL-2006-05

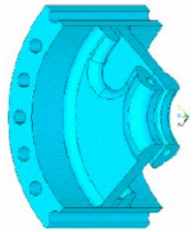
PEDD in irises the capture linac

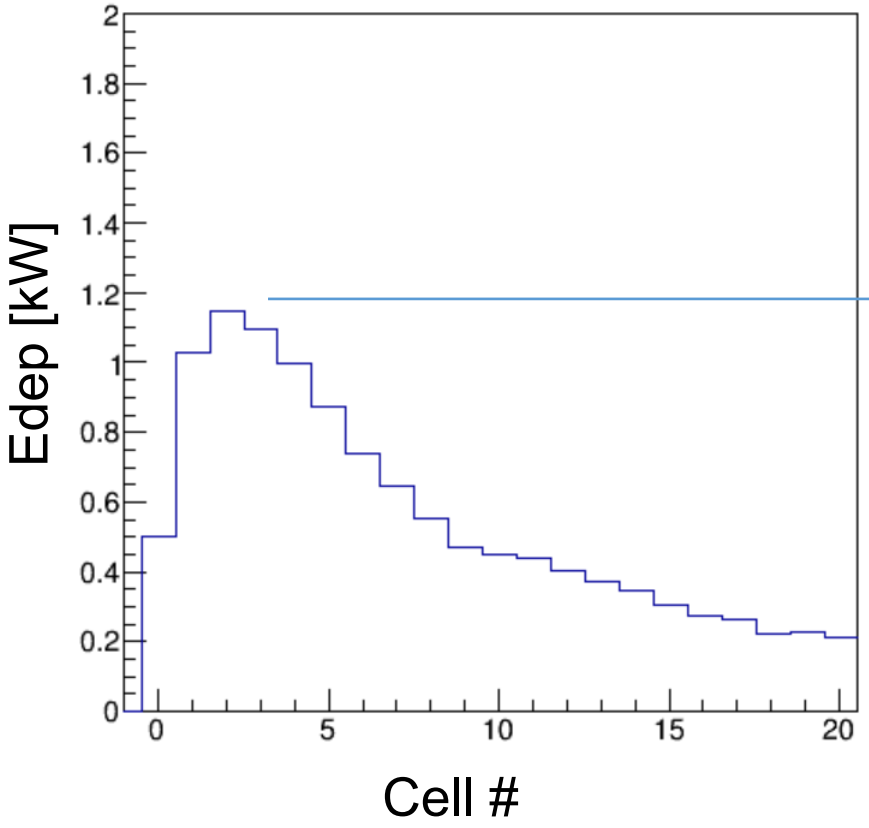




Energy deposit in cells the capture linac

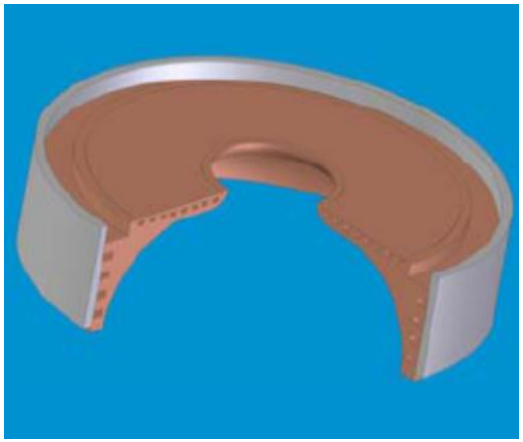


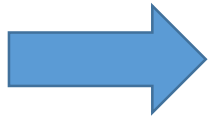


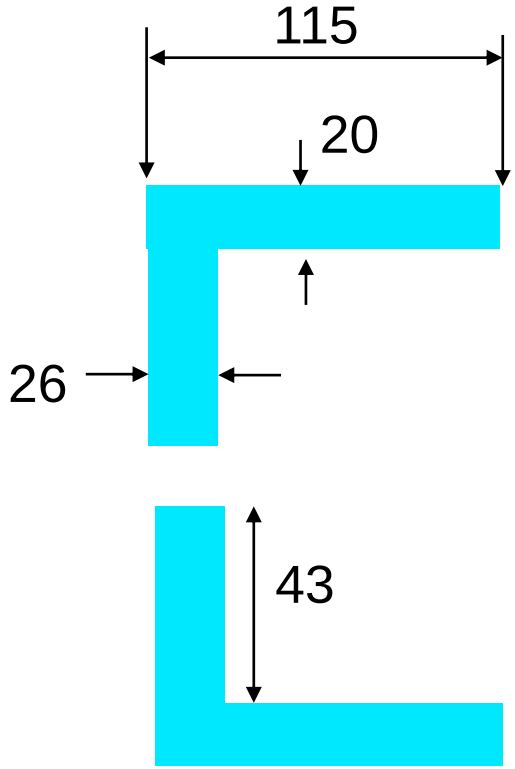


1.2 kW
at the worst point

SLAC-PUB-11767





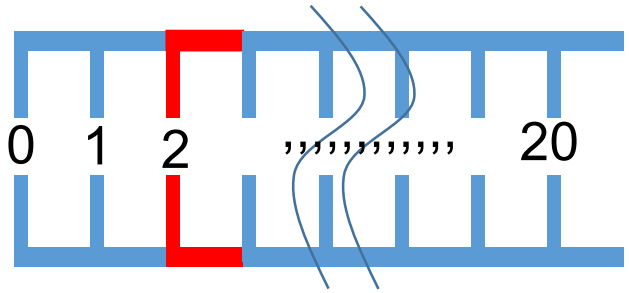


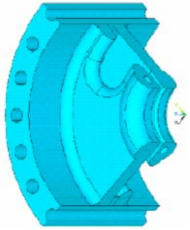
$$\Delta f = 38.2\,kHz$$

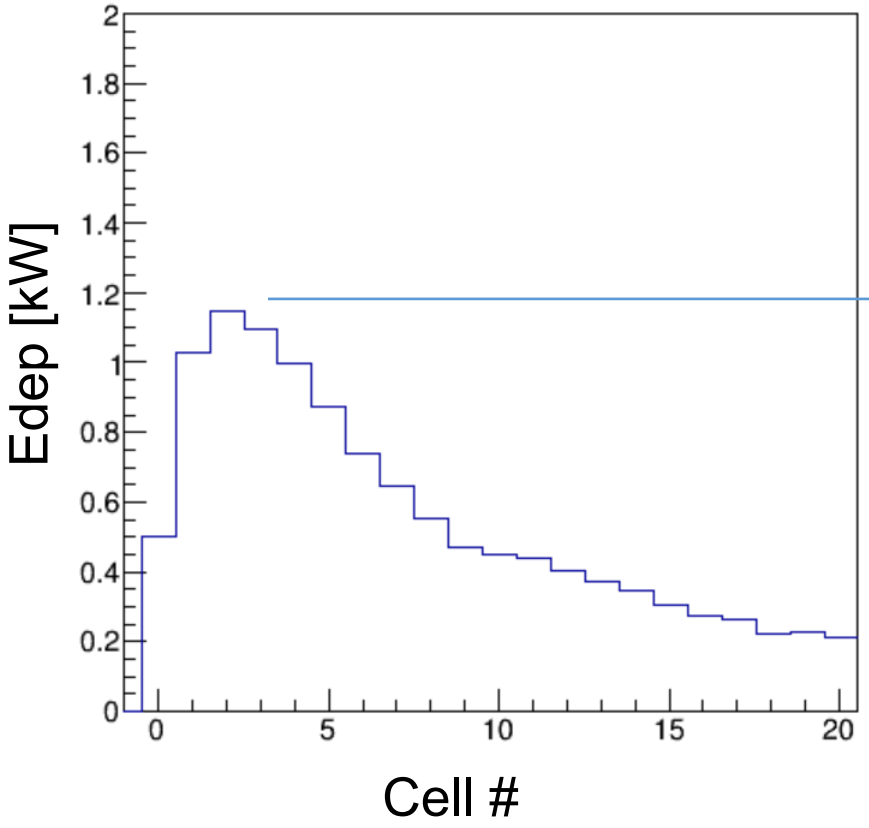
$$H(r) = e^{((3-r)/1.5)}\,(w/cm^3)$$

$$W(cell) = \int_{vol} H(r)\,dv \approx 16.7kW$$

Energy deposit in irises the capture linac



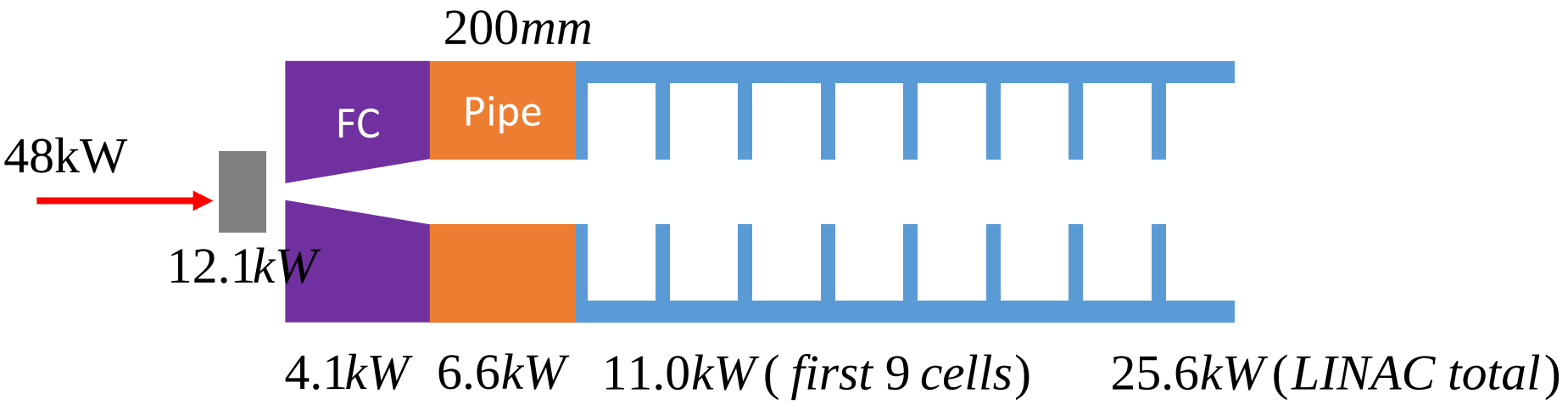




Detuning -38.2kHz/16.7kW in an iris
(an estimate from SLAC-PUB-11767)

38.2 x 1.2/16.7 =2.7 kHz
at the worst point
is less than the bandwidth of 44 kHz

Summary of the energy deposition



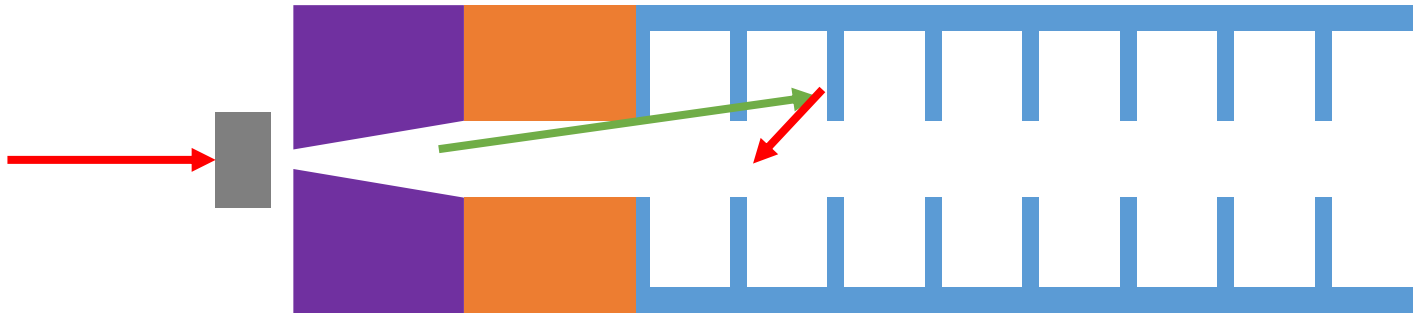
Target	$12.1kW$
Pipe	$6.6kW$
Flux Concentrator	$4.1kW(beam)+14kW(ohmic)$ PEDD=6J/g(1320bunch)=0.3kW/cm^3
Capture Linac	$11.0kW(beam)+3.32kW(RF)\ in\ first\ 9Cell$ $25.6kW(total)$

Prospects

- Energy deposition themselves does not seem to be serious issues for e-driven target now, while engineering design of the cooling system is necessary.

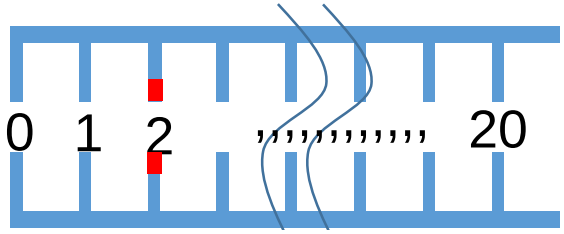
- Further considerations are needed
  - Ohomic Loss
    - spatial profile -> time evolution
  - Secondary particles
    - SuperKEKB may a good experience
  - Radiation dose estimate
  - （Neutron Flux on FerroFuild)

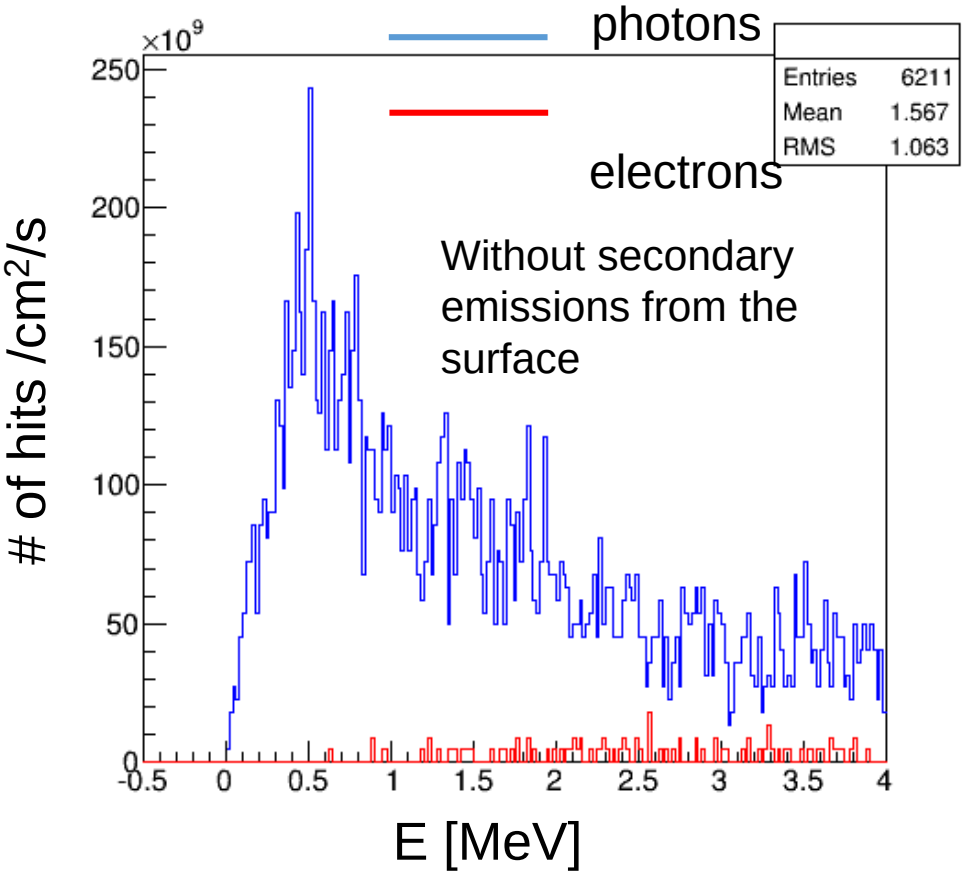
Further issues

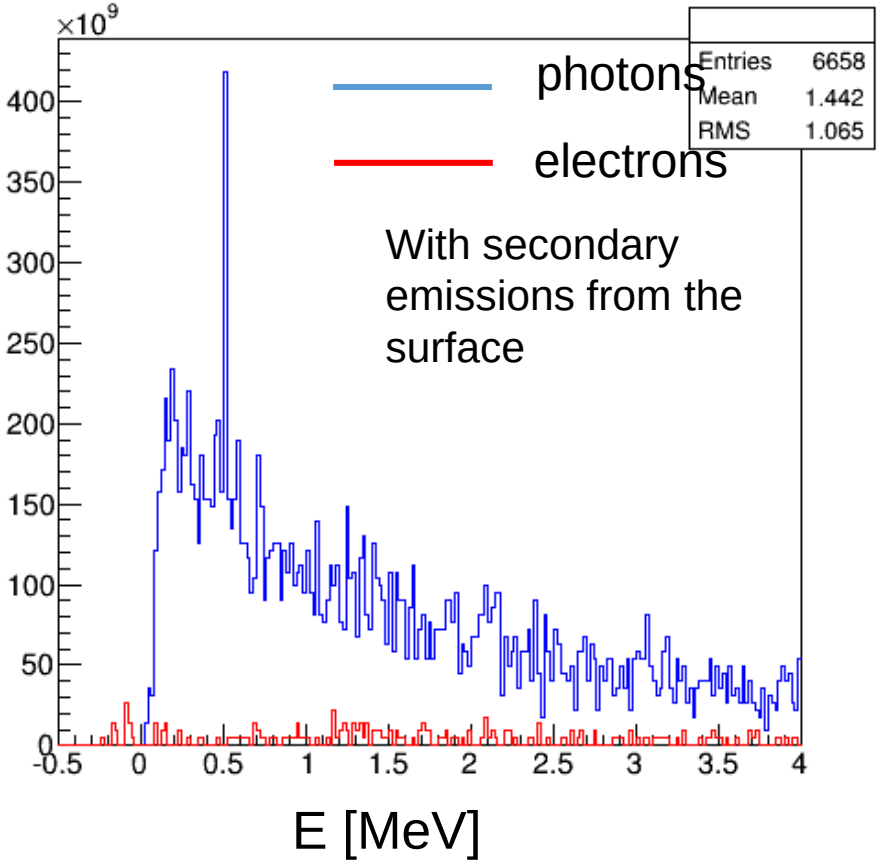


- Secondary emissions from the RF structure
  - Could be a source of discharge?
- Radiation dose
  - for shielding/handling desigen

Particles hitting the RF surface

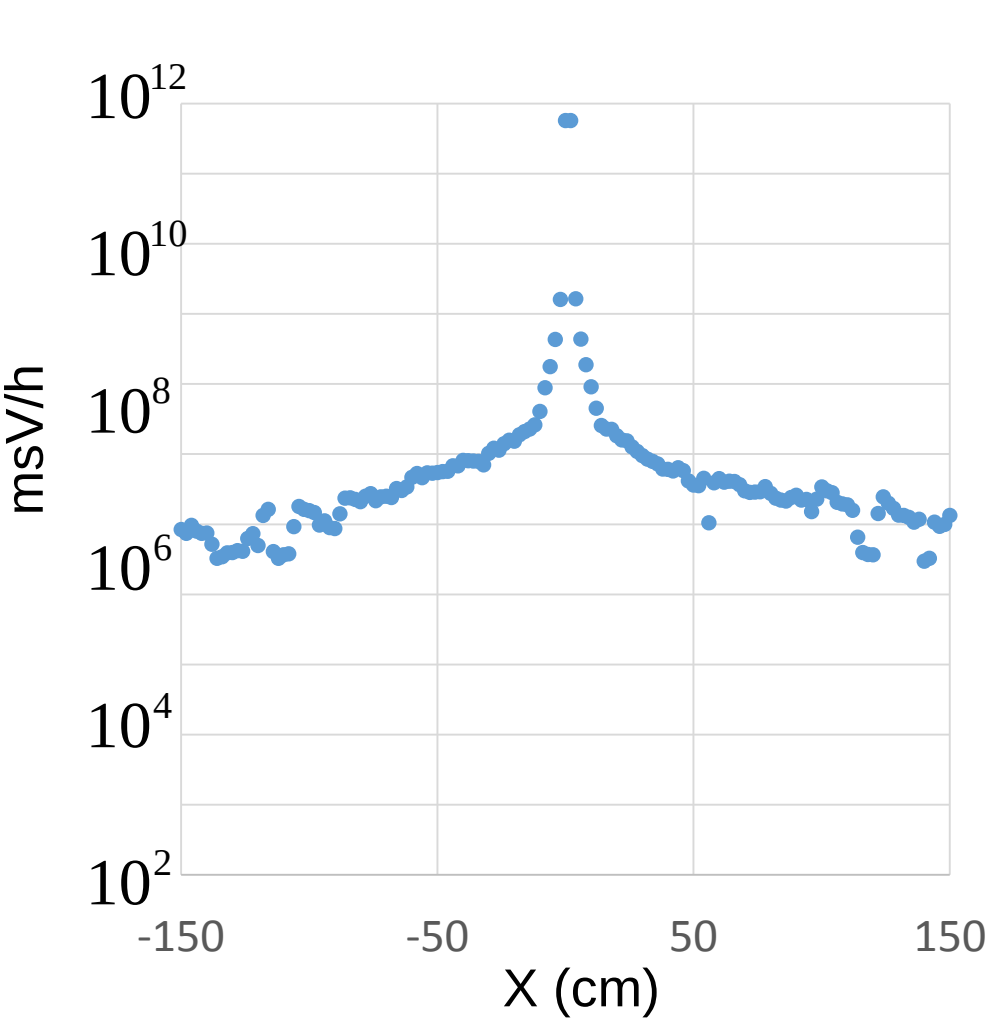




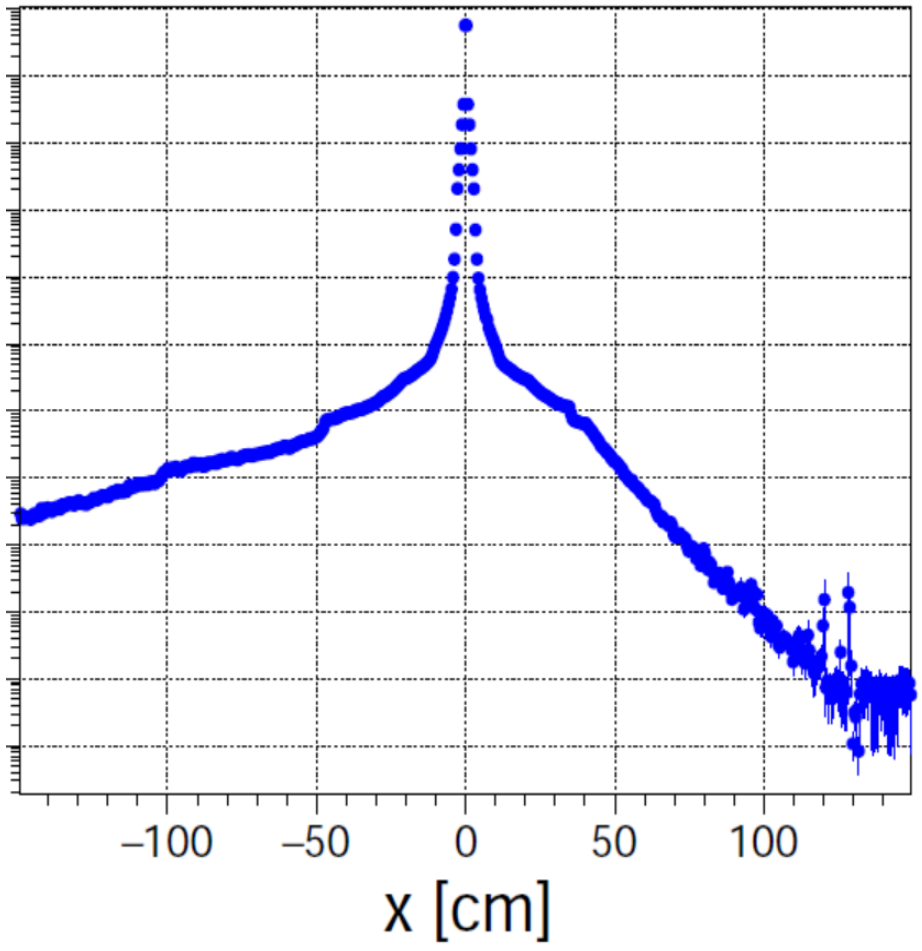


Simulation of low enegy particles is tricky

Effetive Dose(2600 bunch at LCWS2015)



Ushakov LCWS2015



Electron driven and undualtor: radiation levels are more or less the same
Deference at x > 50 cm due to difference of materials around the target

Effetive Dose (2600 bunches at LCWS2015)