Exercise

Biasing

Definition of problem

Goal

Study the effect of different biasing options using the example from the activation exercise

Beam characteristics and Geometry *(identical to activation exercise)*

- 28.5 GeV electron beam with a beam power of 20W, Gaussian profile with (σ_x,σ_y) = (0.5, 1.0) mm
- cylindrical tunnel section with copper target (25cm long, 3cm in radius) and downstream stainless steel sample (2cm long, 1cm in radius)

Biasing options to be studied

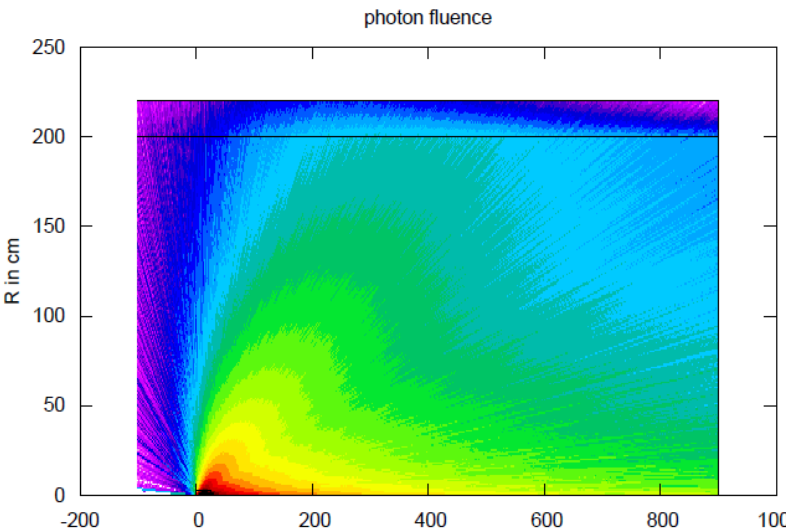
1) **Inelastic interaction length biasing for photons**
   - switch off biasing and calculate star density and fluence maps for as many primary particles as needed to obtain the same CPU time as with interaction length biasing
   - calculate star density and fluence maps and compare both cases
2) **Leading particle biasing in target**
   - calculate star density and fluence maps with and without leading particle biasing
   - choose the number of primaries such that both runs need the same CPU time
3) **Region importance biasing into the sample**
   - calculate residual dose rate around the sample with and without region importance biasing
   - choose the number of primaries such that both runs need the same CPU time
4) **Number of "replicas" in the simulation of the decay radiation**
   - calculate residual dose rate around the sample for different number of "replicas" (*e.g.,* 3 and 10)

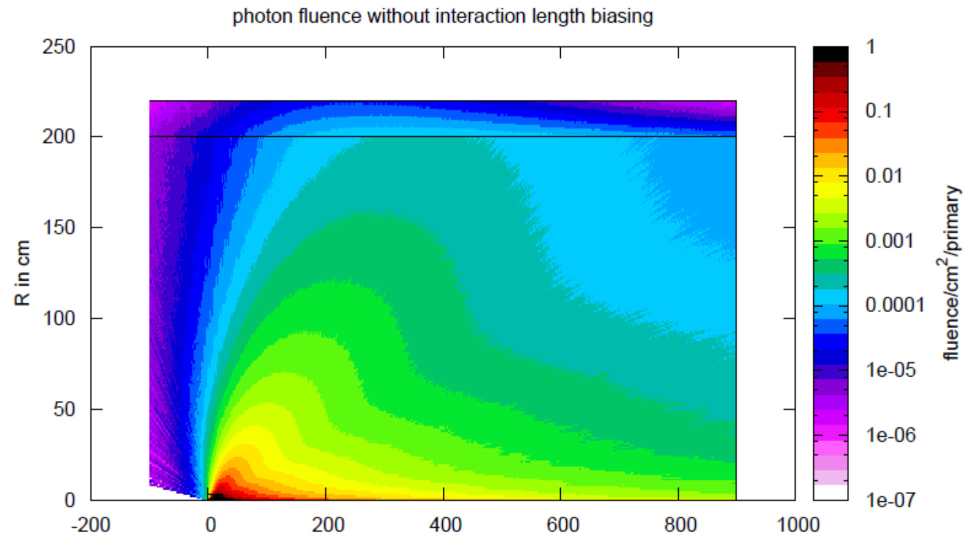
Interaction length biasing

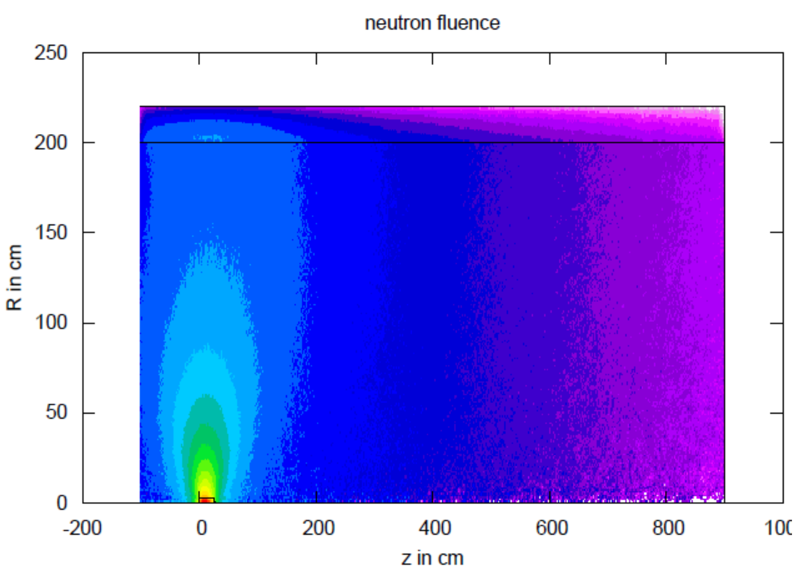
500 primaries
w ilb

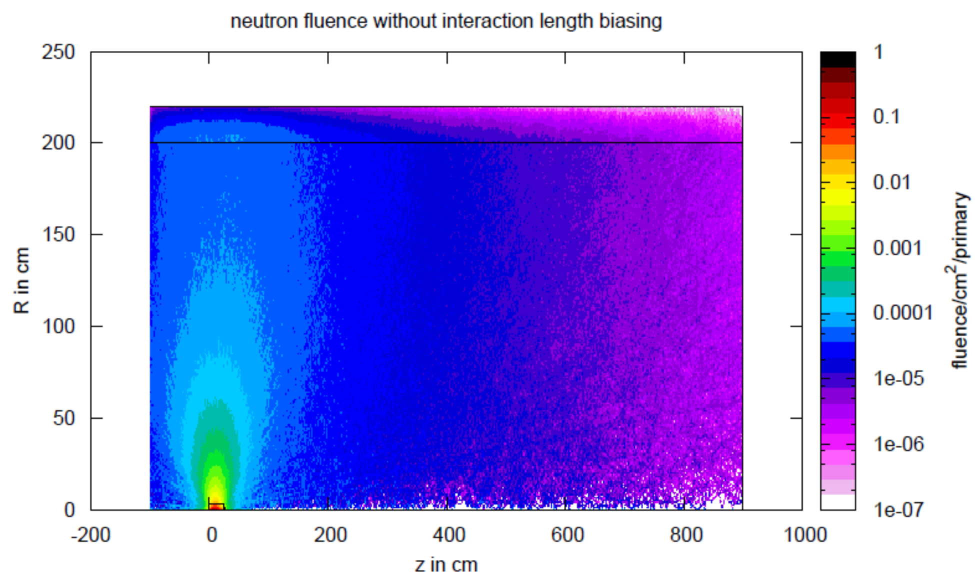
(same total CPU time!)

6500 primaries
w/o ilb



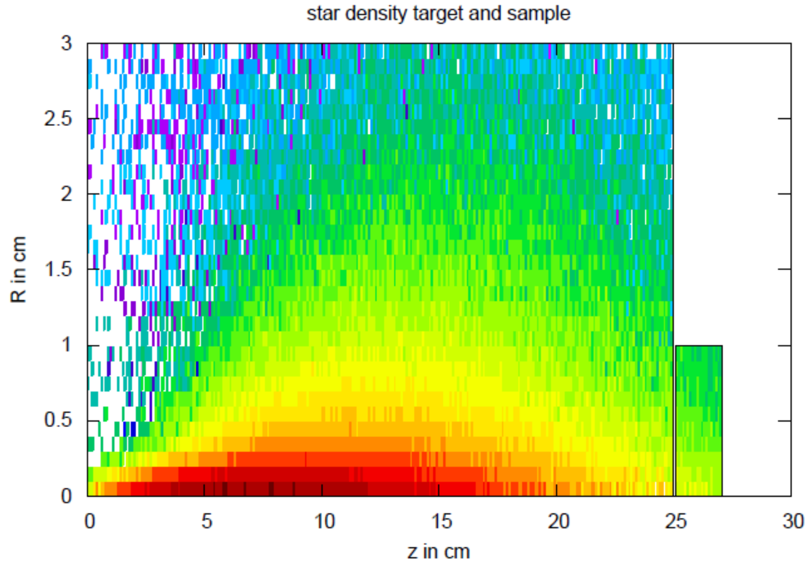


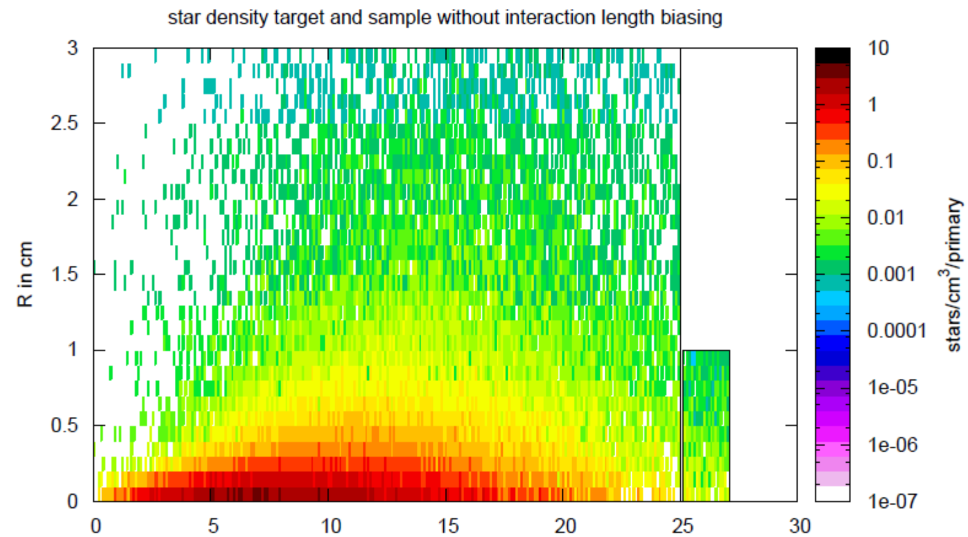


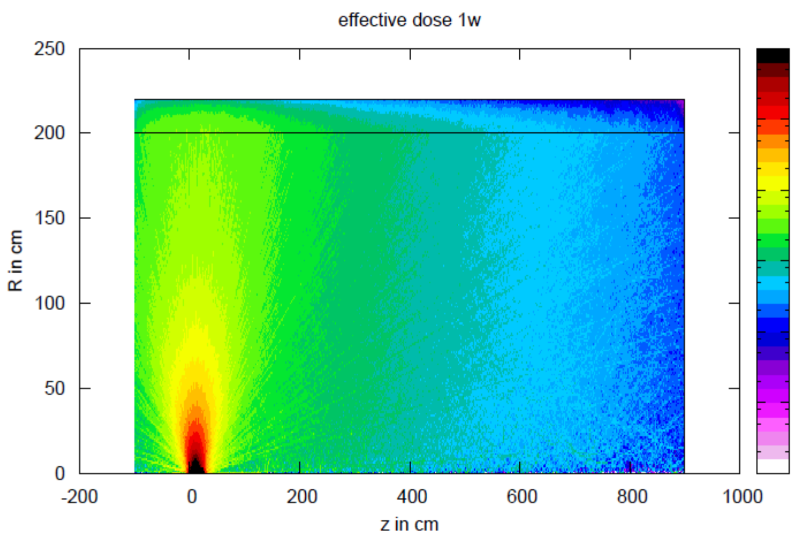


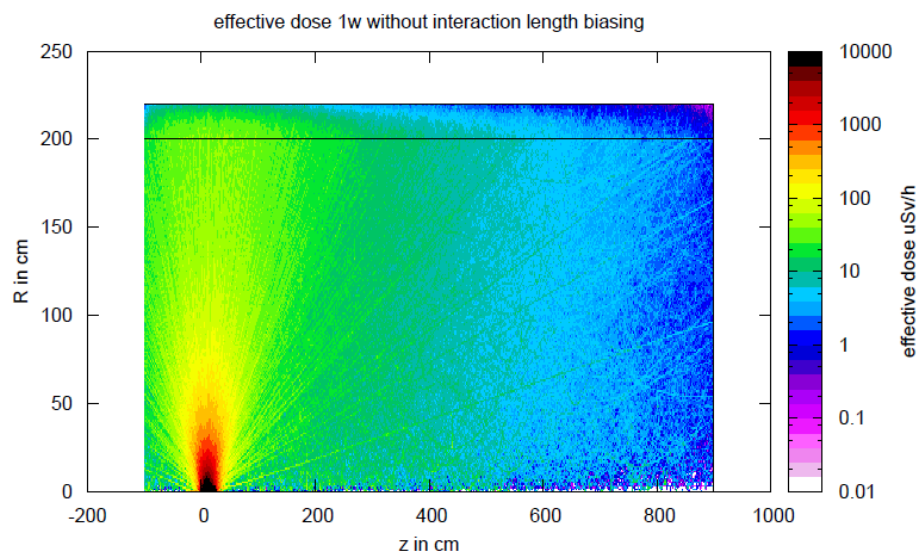
Interaction length biasing

500 primaries (same total CPU time!) 6500 primaries
w/ ilb w/o ilb







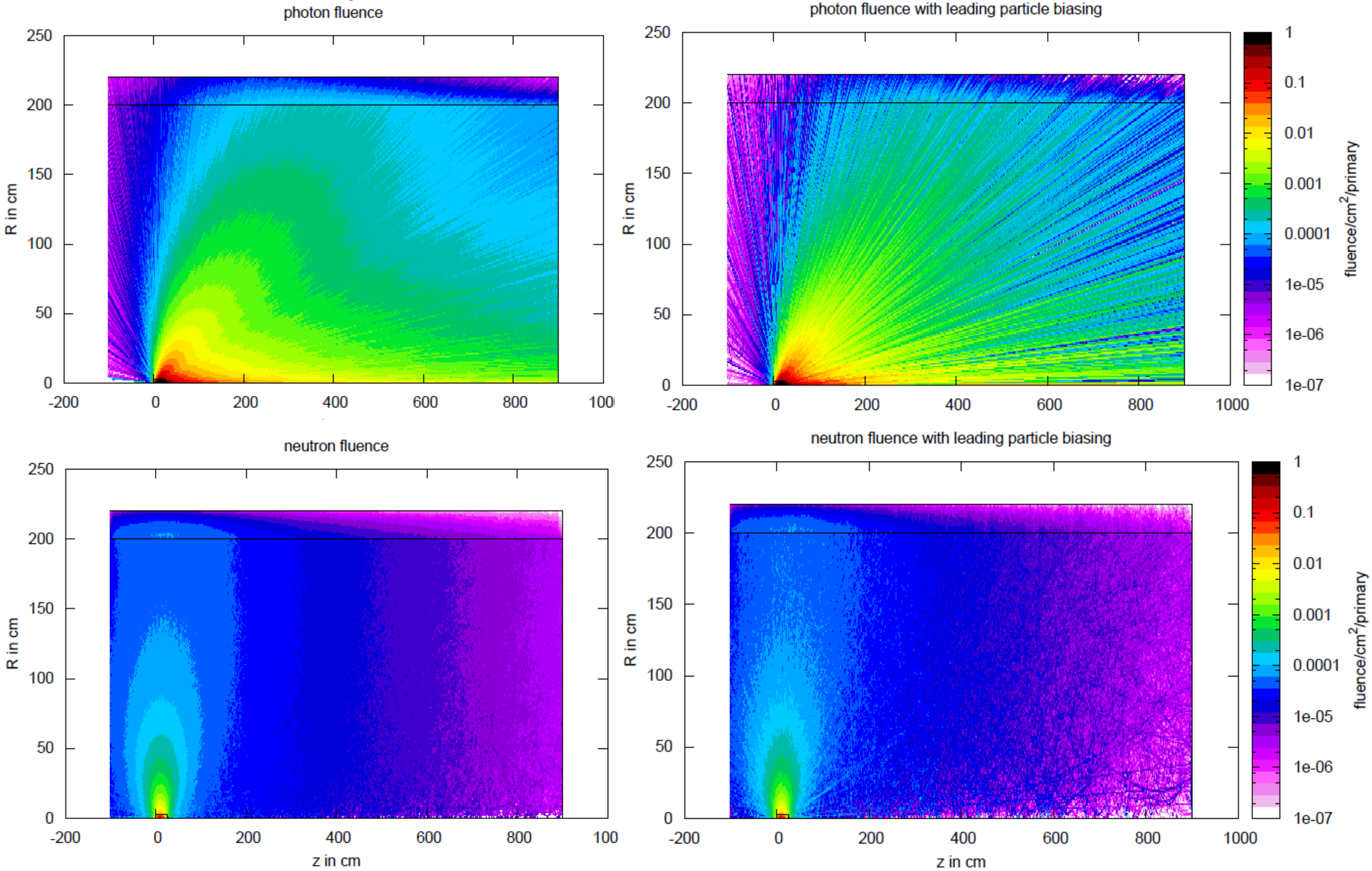


Leading particle biasing

500 primaries
w/o lpb

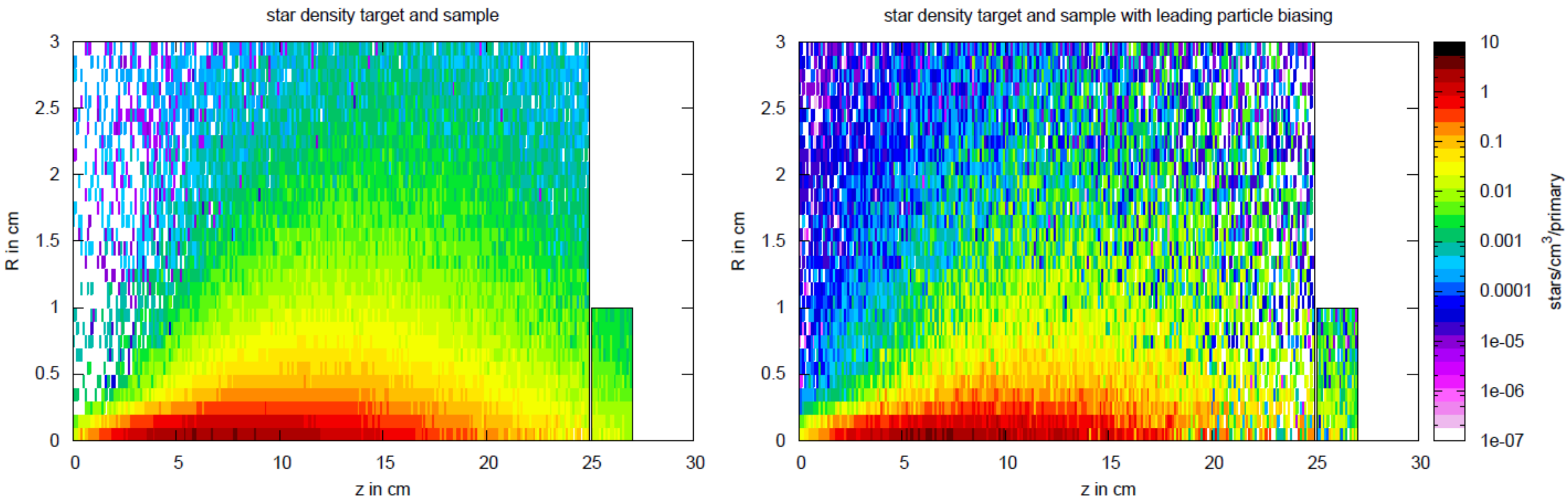
(same total CPU time!)

10000 primaries
w/ lpb



Leading particle biasing

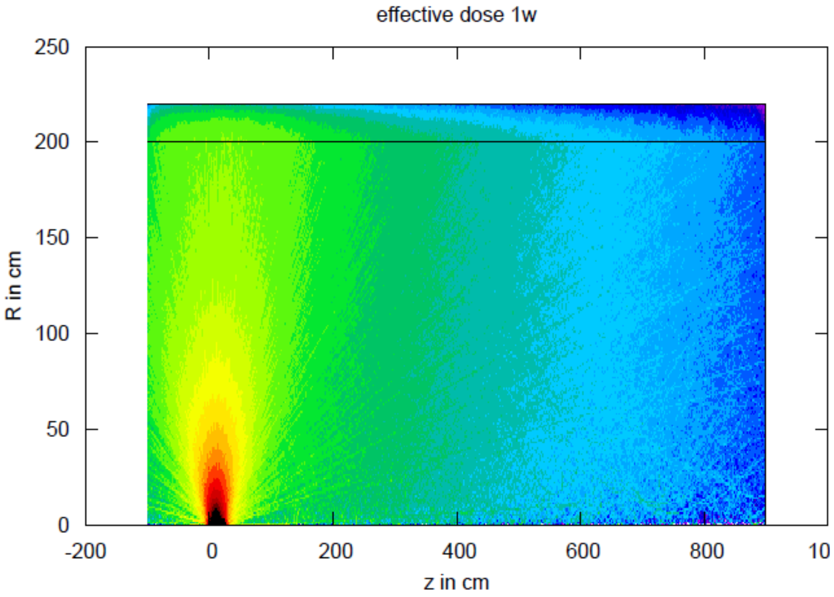
500 primaries w/o lpb (same total CPU time!) 10000 primaries w/ lpb

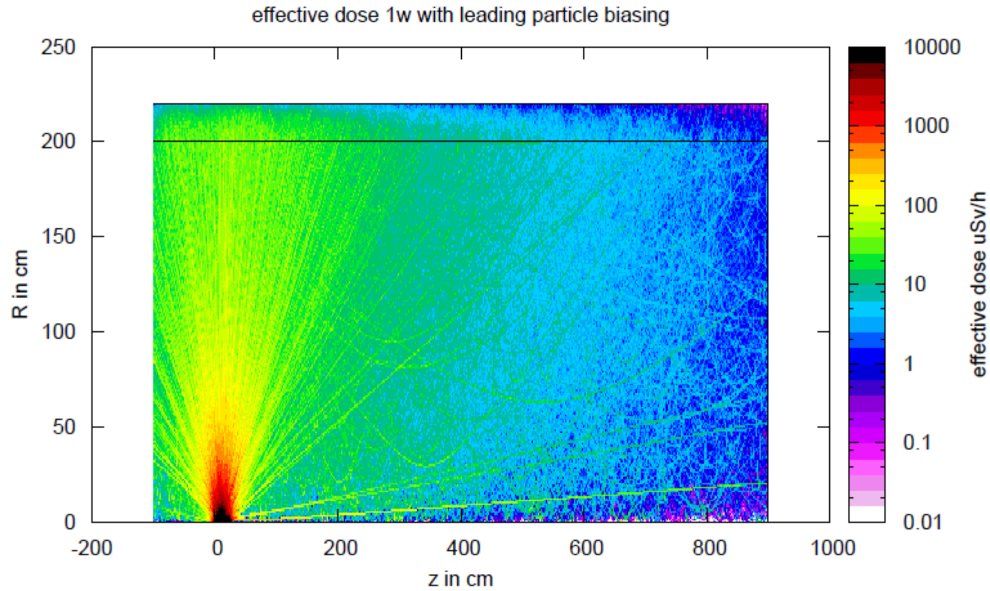


- Leading particle biasing introduces significant weight fluctuations
- Weight windows could be defined to reduce them
- In the present example, leading particle biasing introduces a bias towards high energy photonuclear interactions that have lower cross sections than GDR interactions. In addition the latter contribute significantly to the nuclide yield.
- Thus, better not use leading particle biasing in the present example...

Leading particle biasing

500 primaries w/o lpb (same total CPU time!) 10000 primaries w/ lpb

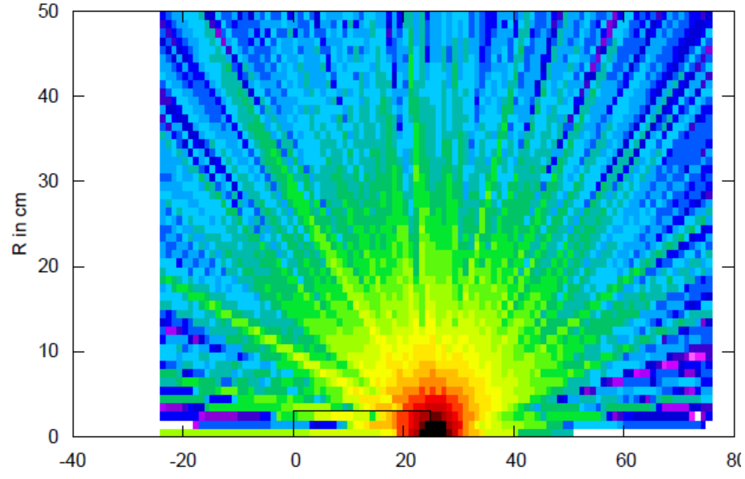




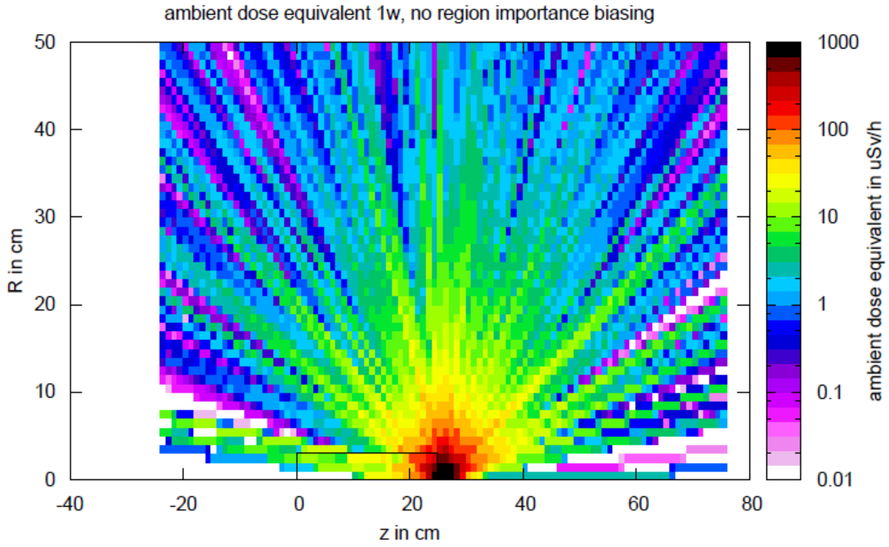
Region importance biasing

1000 primaries (same total CPU time!) 2000 primaries

With region importance biasing

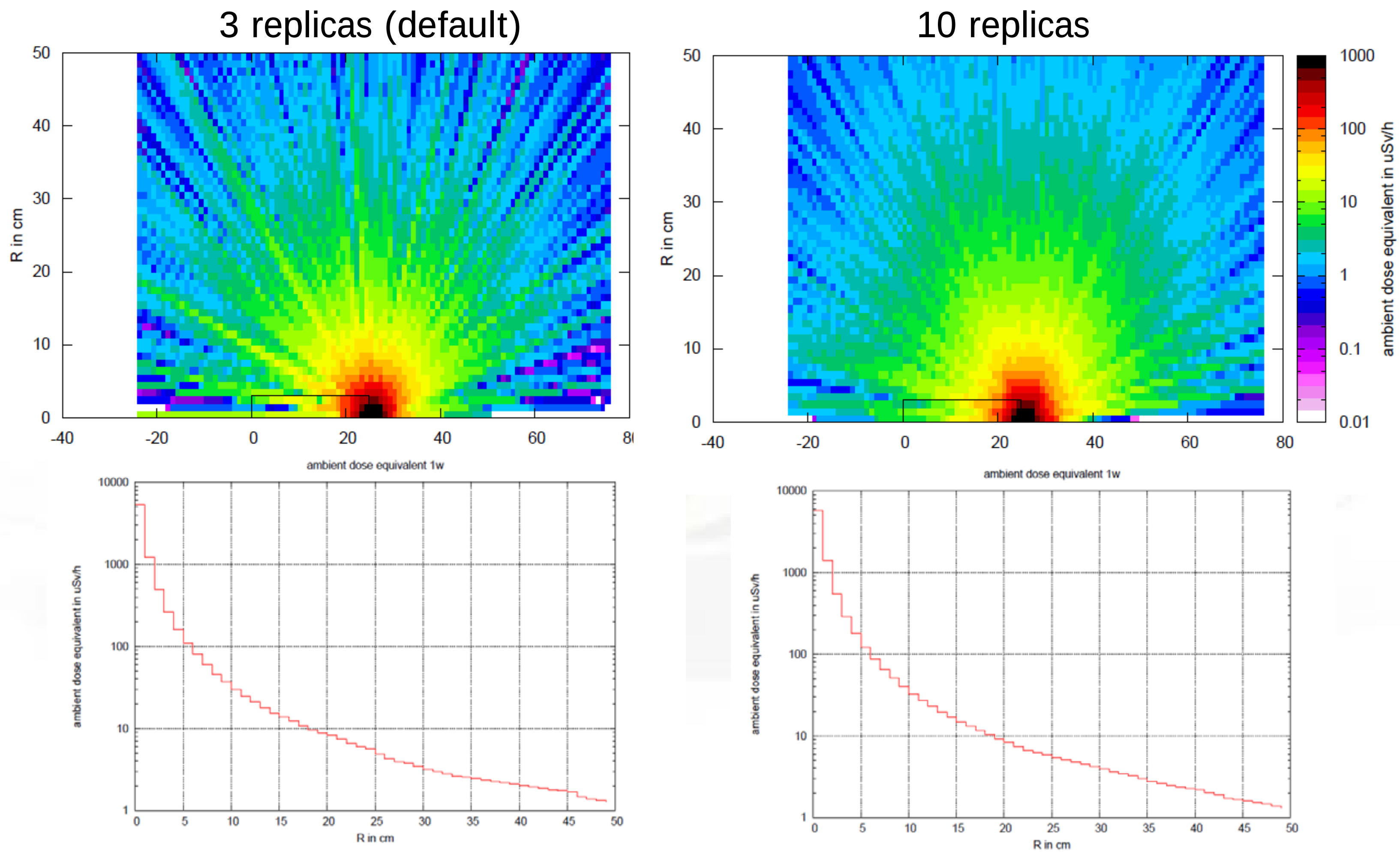


Without region importance biasing



- Here: region importance in sample set equal to 5 (the maximum relative value possible) , all other regions =1
- It requires sufficient statistics in the particle fluence entering the sample.

Number of “replicas”



- Increasing the number of requires sufficient statistics in the production of nuclides (check, e.g., star density or activity maps!)
- In any case, don’t overdo it…