CPS Radiation Simulation Update

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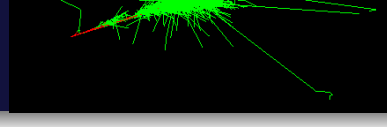
James Madison University

CPS Meeting 03/27/2020

April 17, 2020

From last time...



...

- Look at RE (BW) analysis and suggestions
- Try to implement said suggestions
- Compare. Look 4 next steps.

Disclaimer

- ...as usual!

CPS "conclusions" - March

1) the impact of W close to the source is very clear when comparing the prompt radiation for 001 and W/Pb z = 0, a drastic rise in the curves below z = 0. Since that is already reduced for russian doll 10/40 and for mkIII (f/s/w) likely a thin 10 cm of W all around ("near-skin") really helps.

2) on the other hand, I never see a reduction of the prompt radiation (or activation) between 001 and the other models in the regions where one would expect impact of an outer Pb skin should show up, which leads me to believe it is either not there or there in all cases. It is just inconsistent.

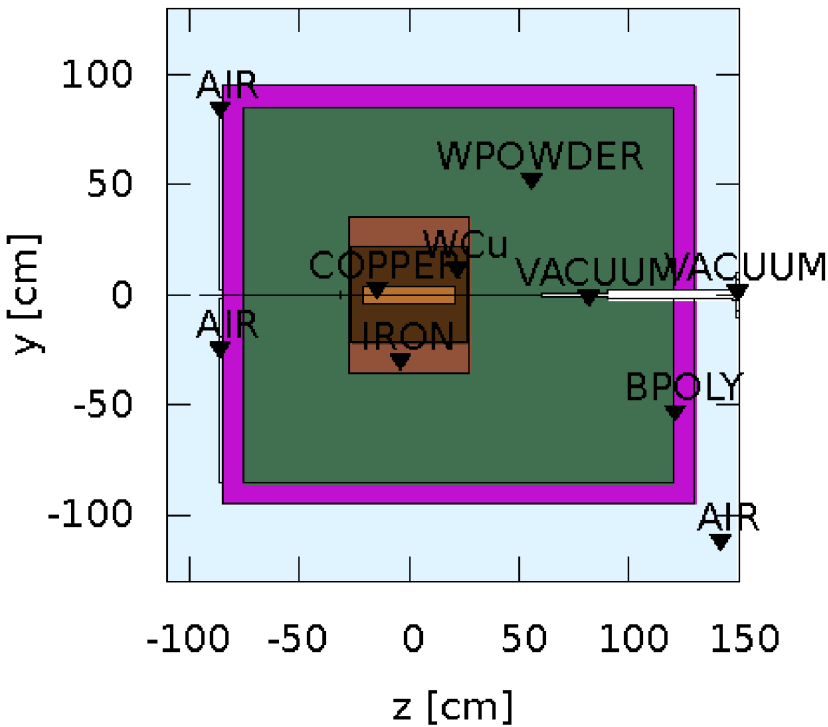
3) this is the same for the "forward" region, in the earlier February simulations we saw a clear impact of adding a 5 cm lead skin also on activation in the forward/target region (Comparisons VIII of the February slides). Now it just does not show up in the graphs and we always have the "red" cone.

Action(s):

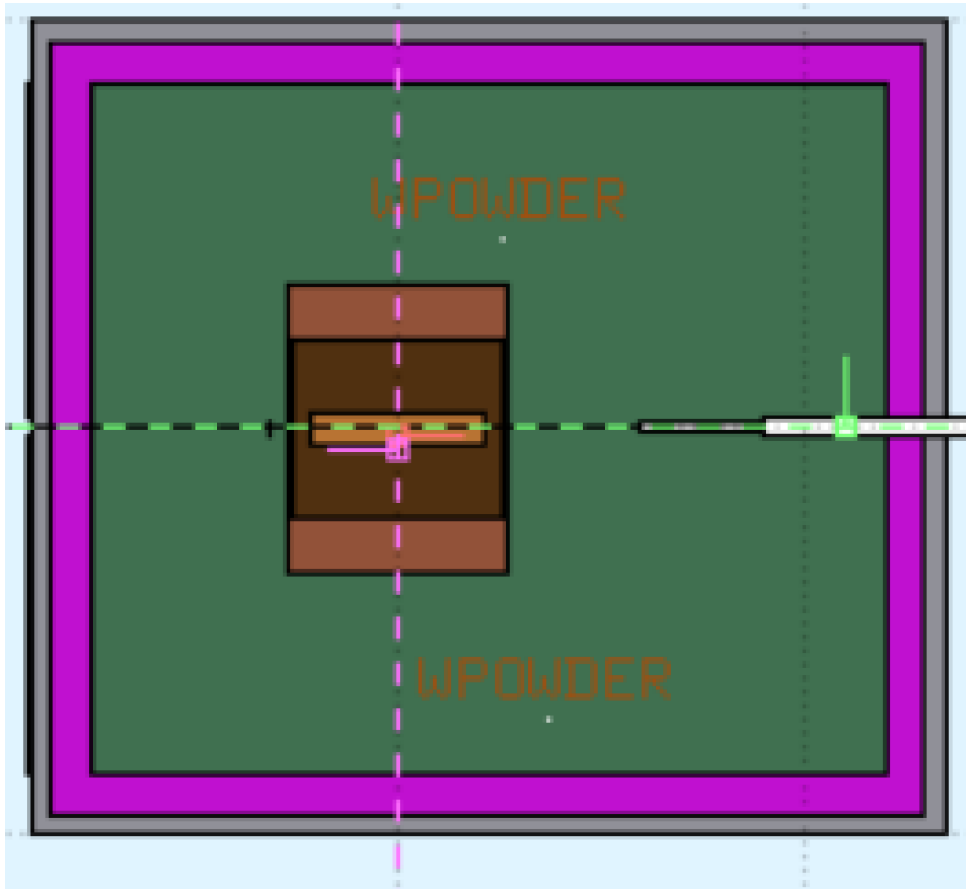
- Redo 001 setting, with and without the Pb layer skin.
- Next set of slides show results for these two geometries

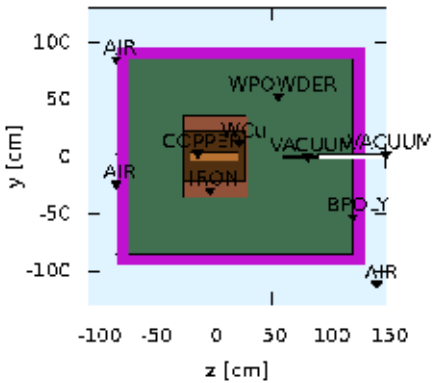
cps21_001a_geom

CPS21_001 Geometry

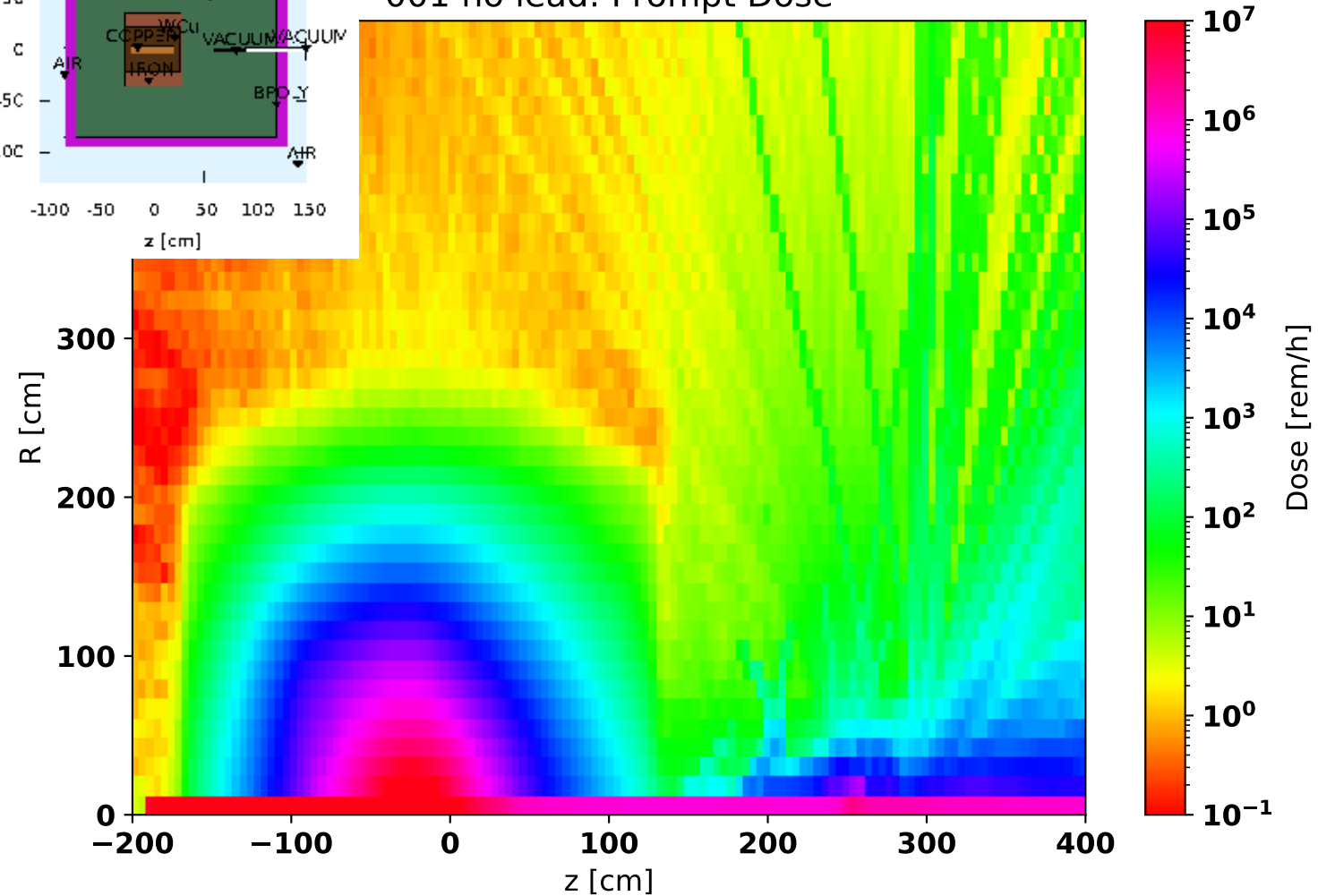


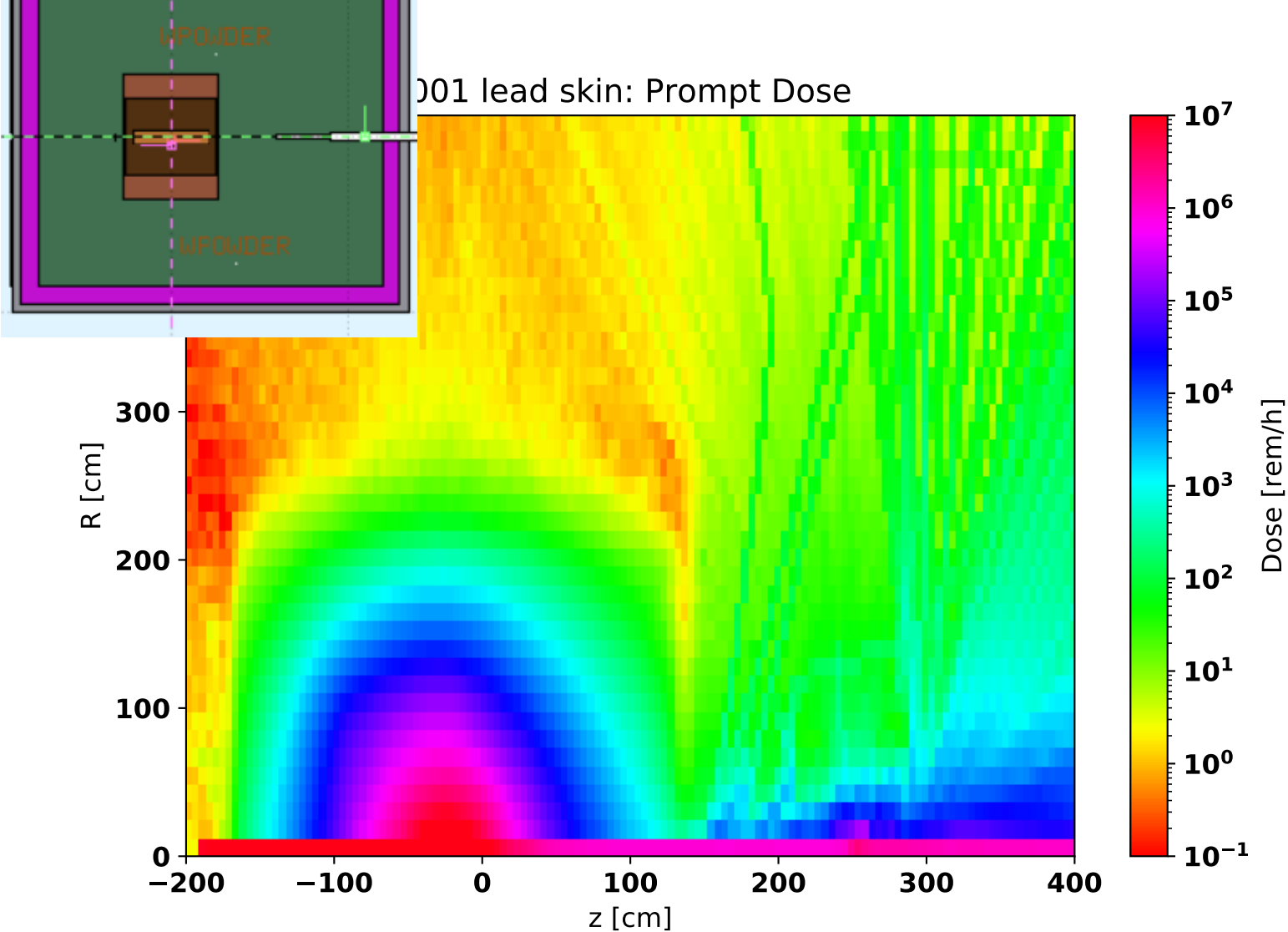
cps21_001a_geom2

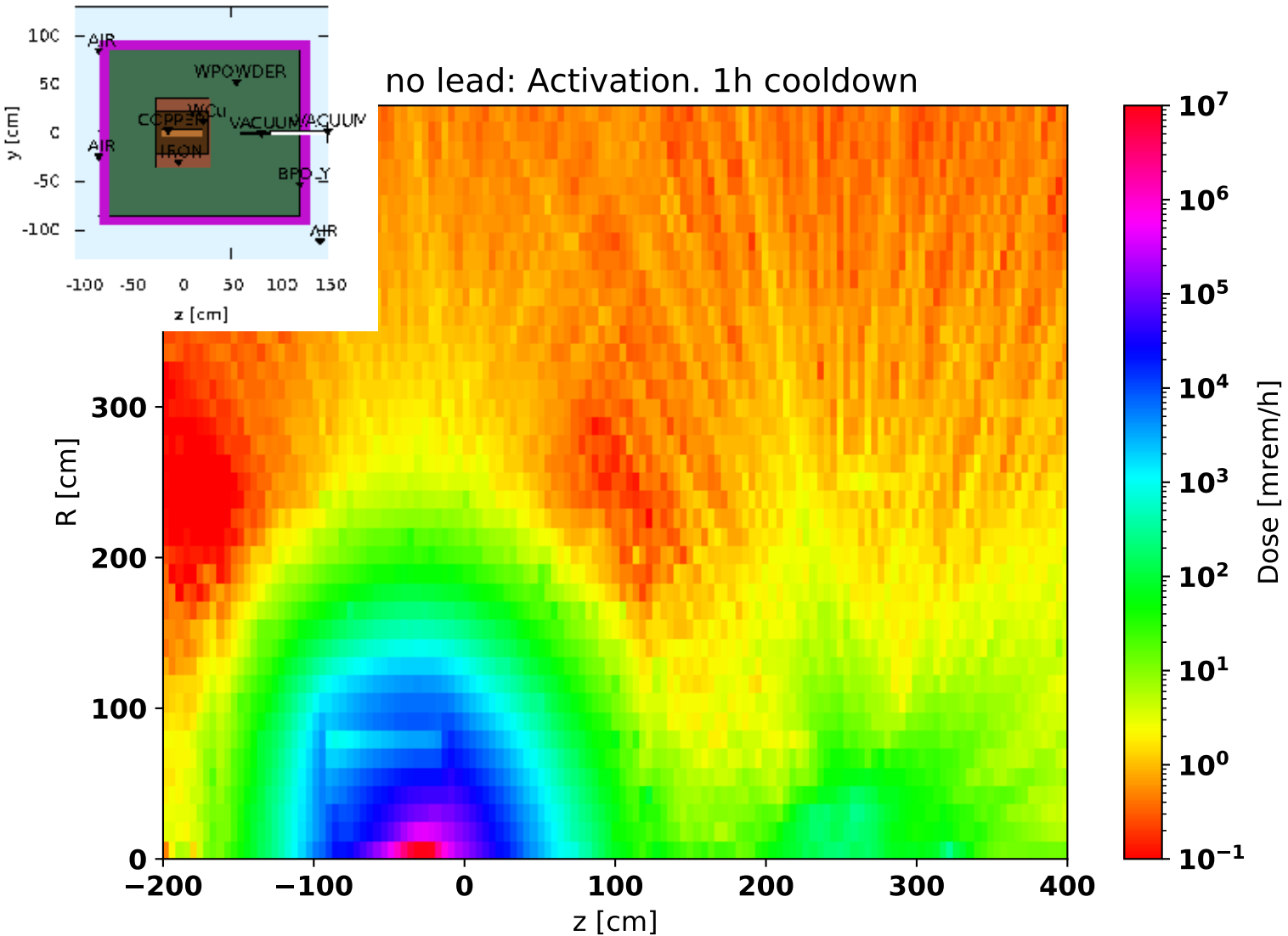


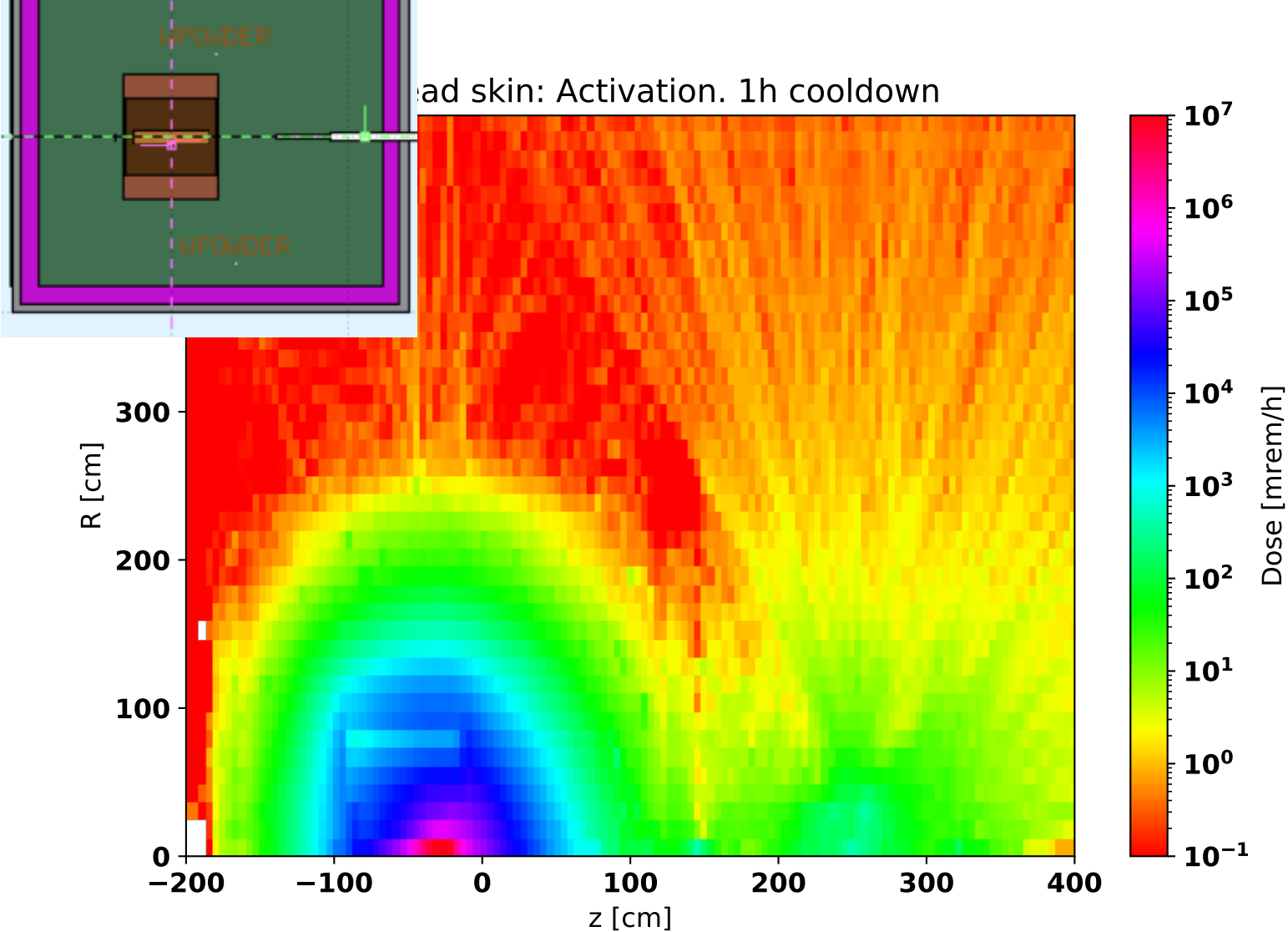


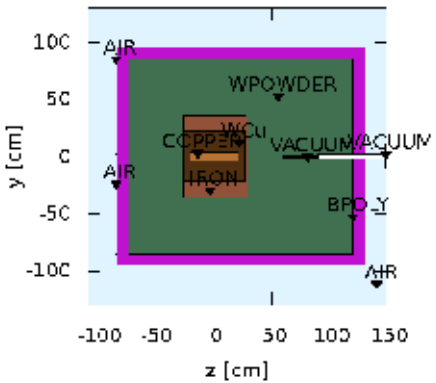
001 no lead: Prompt Dose

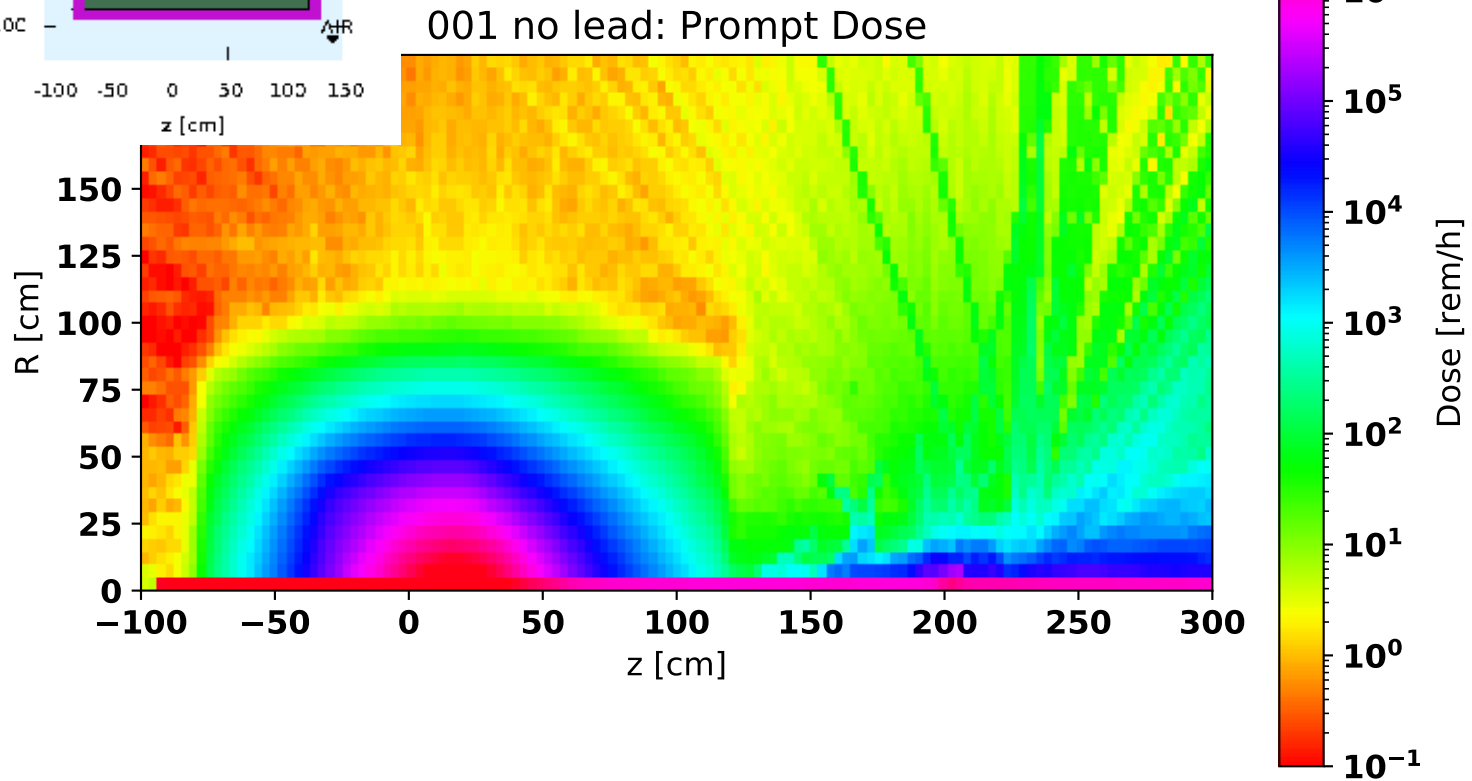


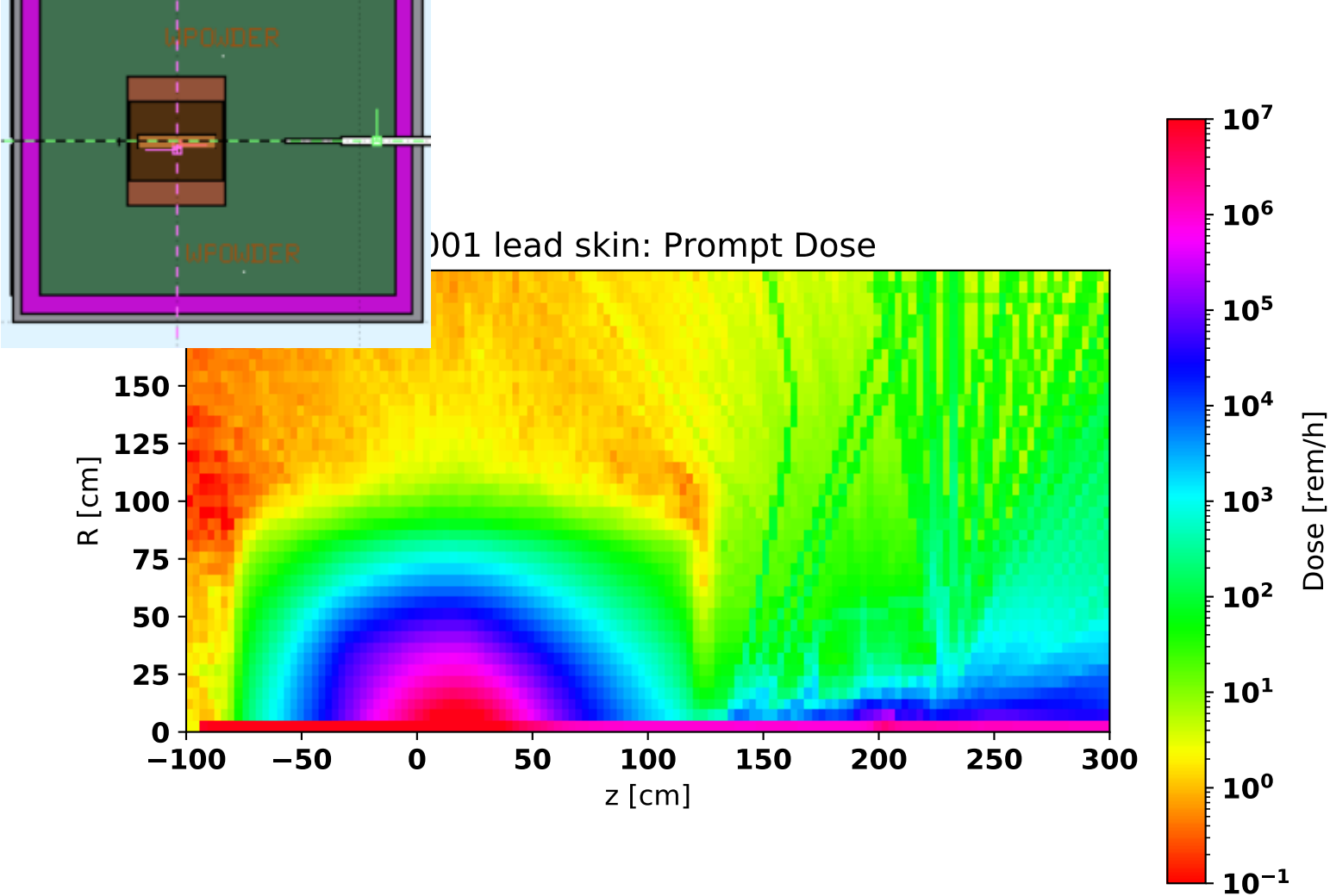

UPOWDER
WPOWDER
001 lead skin: Prompt Dose
R [cm]
z [cm]
Dose [rem/h]
0
100
200
300
−200
−100
0
100
200
300
400
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}

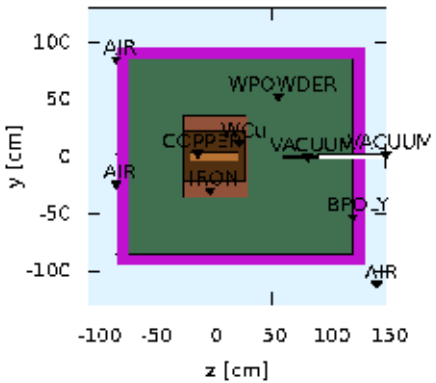

no lead: Activation. 1h cooldown
AIR
WPOWDER
WCu
COPPER
VACUUM
VACUUM
IRON
AIR
BPOLY
AIR
y [cm]
z [cm]
R [cm]
z [cm]
Dose [mrem/h]

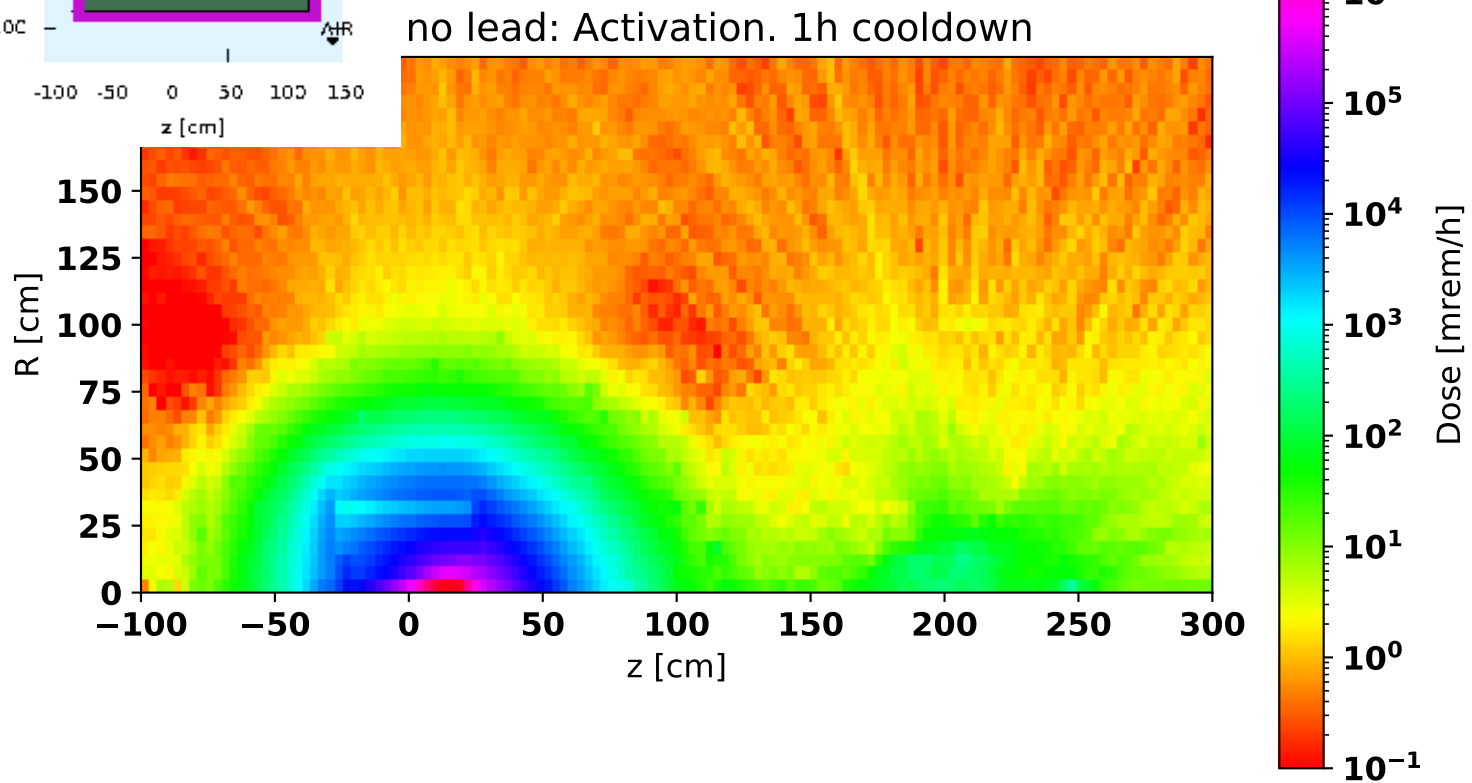

UPOWDER
WPOWDER
ad skin: Activation. 1h cooldown
R [cm]
z [cm]
Dose [mrem/h]
0
100
200
300
−200
−100
0
100
200
300
400
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}

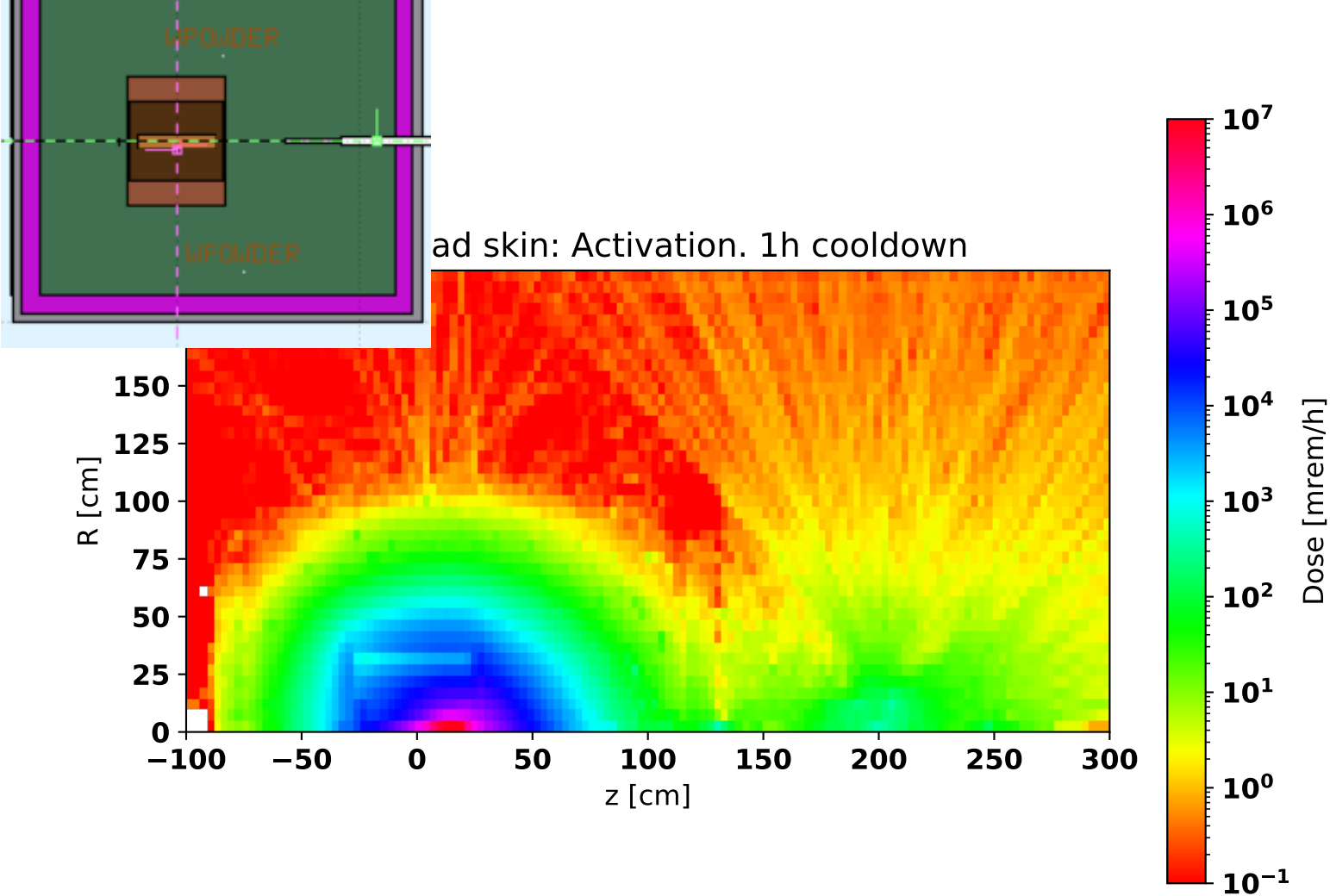

AIR
WPOWDER
WCu
COPPER
VACUUM
VACUUM
AIR
IRON
BPOLY
AIR
y [cm]
z [cm]

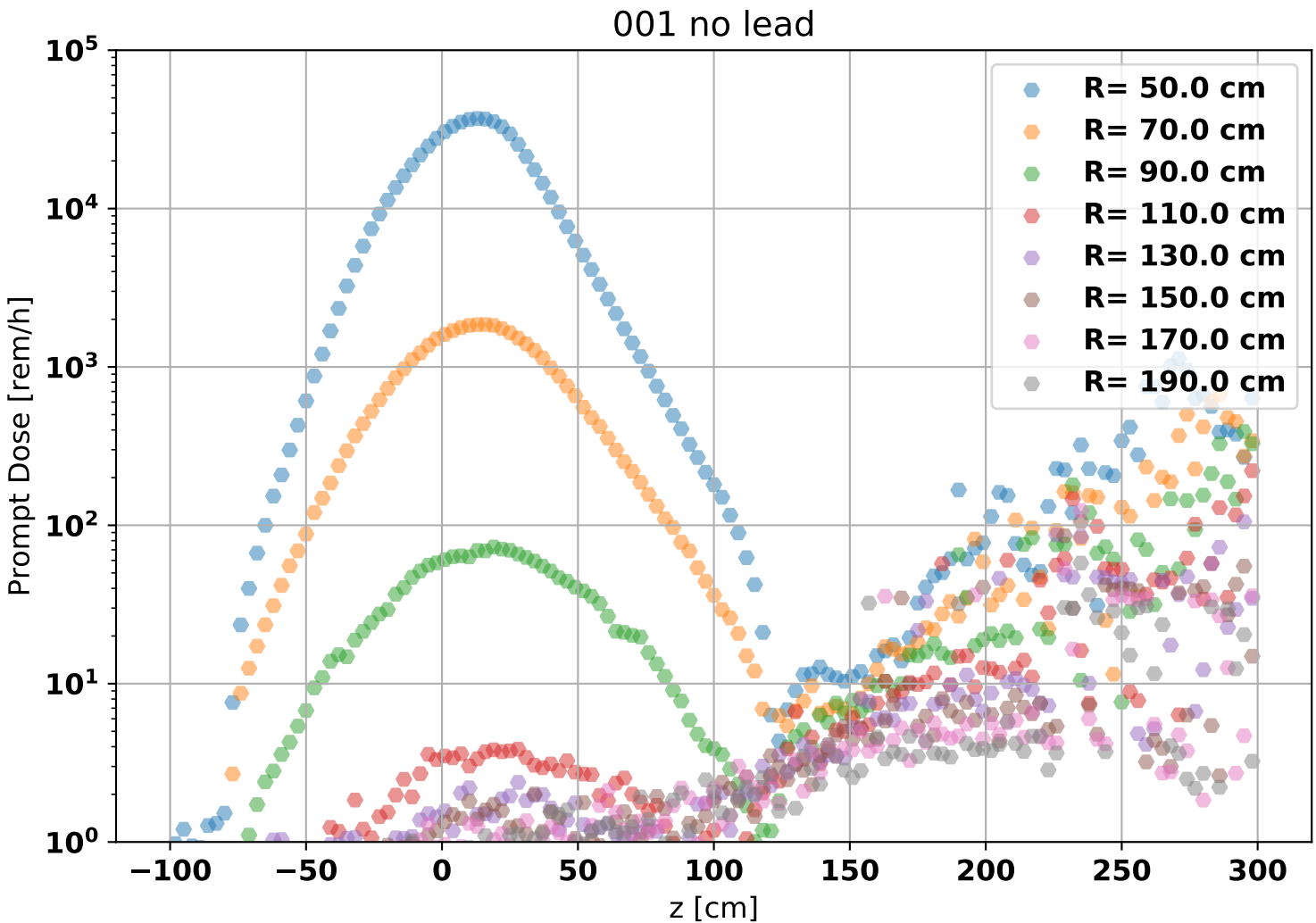

001 no lead: Prompt Dose
R [cm]
z [cm]
Dose [rem/h]

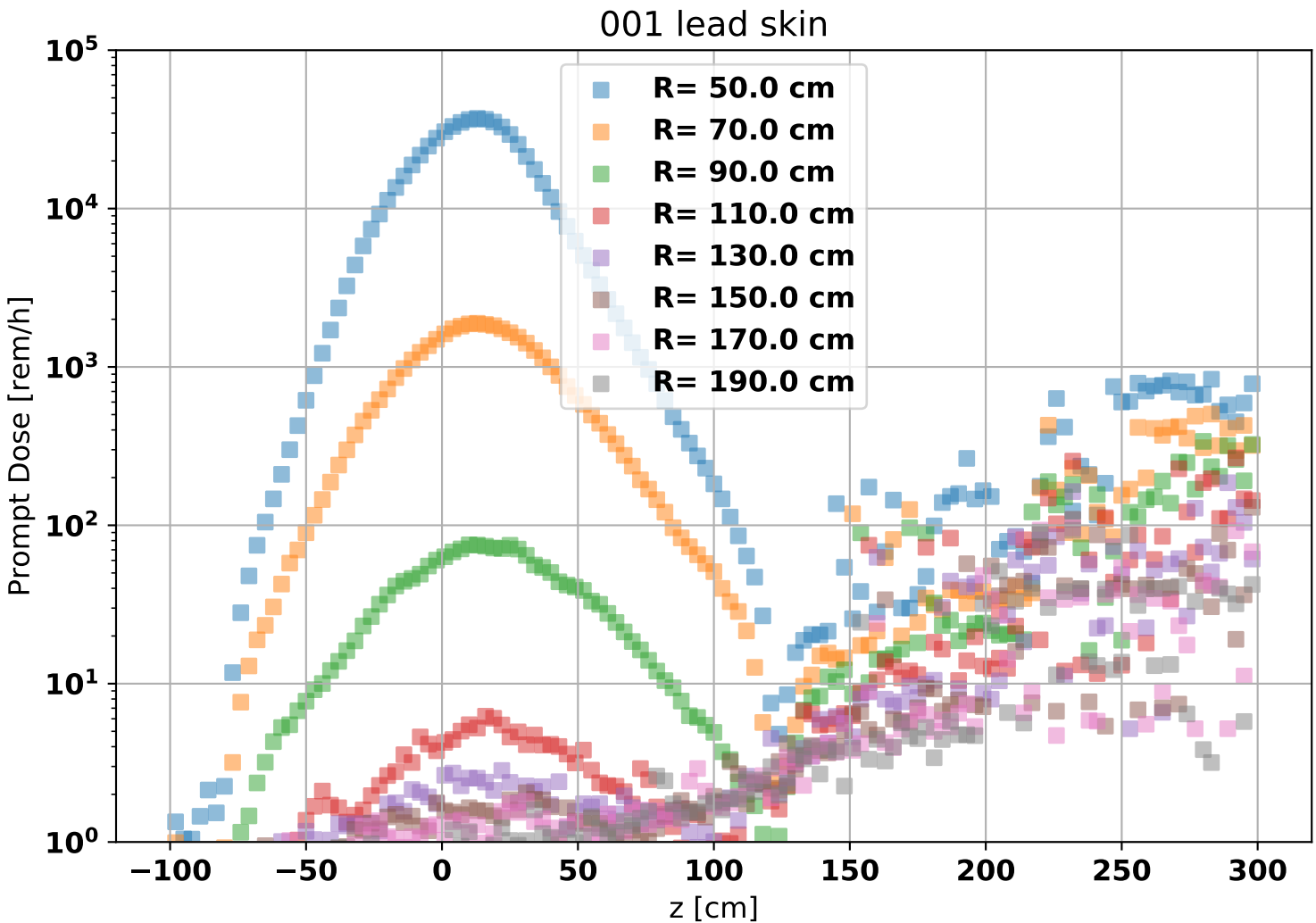

WPOWDER
WPOWDER
)01 lead skin: Prompt Dose
R [cm]
150
125
100
75
50
25
0
−100
−50
0
50
100
150
200
250
300
z [cm]
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
Dose [rem/h]

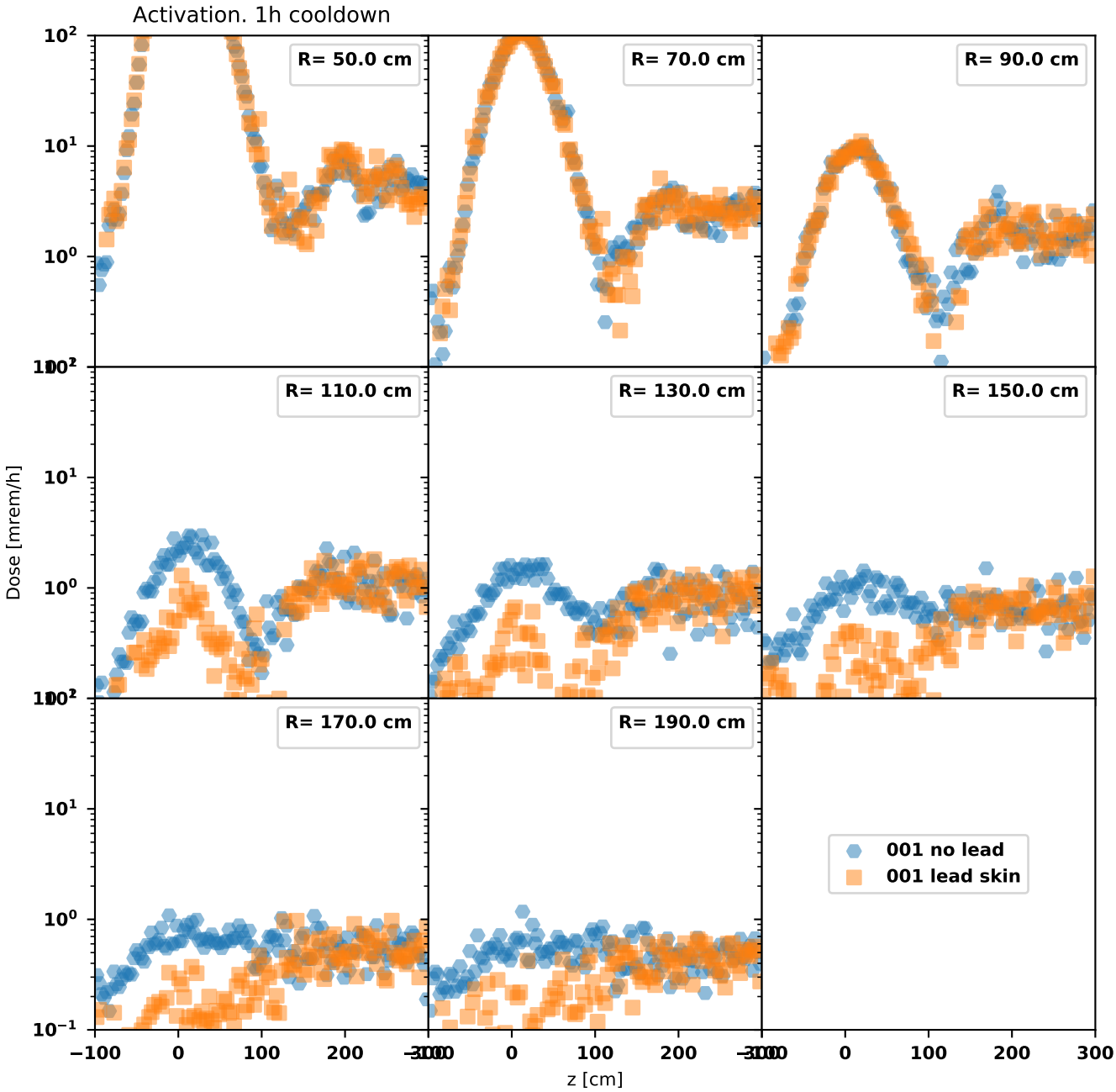

AIR
WPOWDER
COPPER
WCu
VACUUM
VACUUM
AIR
IRON
BPOLY
AIR
y [cm]
z [cm]

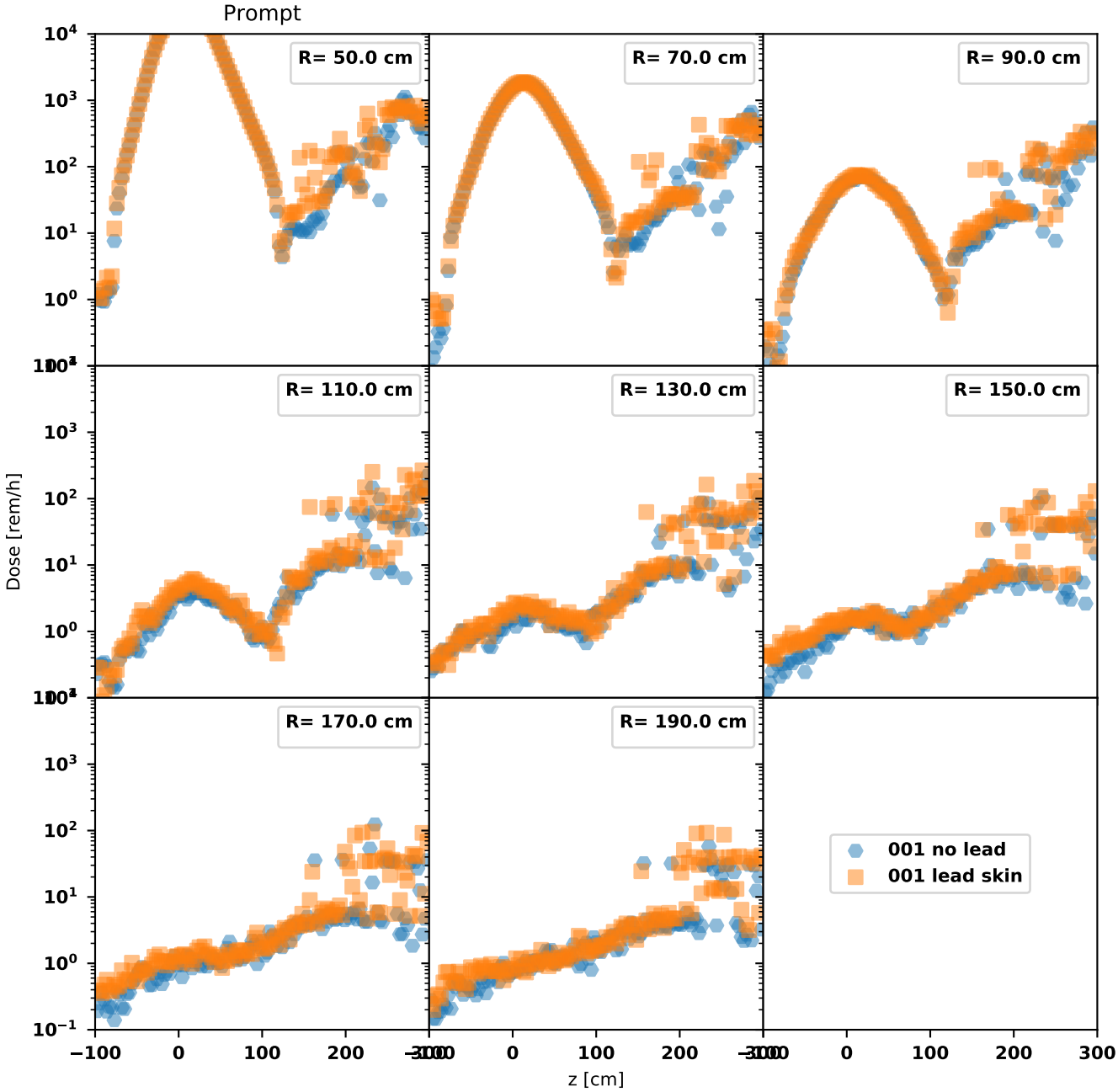

no lead: Activation. 1h cooldown
R [cm]
z [cm]
Dose [mrem/h]


WPOWDER
WPOWDER
ad skin: Activation. 1h cooldown
R [cm]
150
125
100
75
50
25
0
−100
−50
0
50
100
150
200
250
300
z [cm]
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}
Dose [mrem/h]

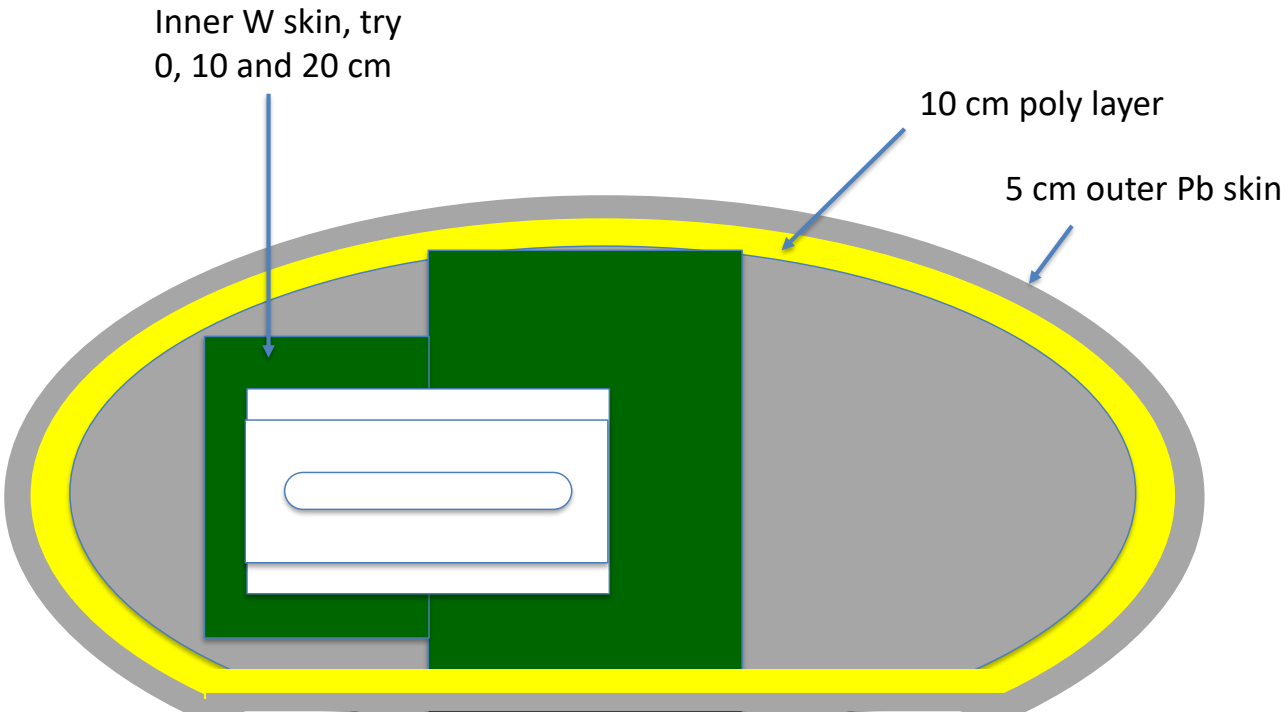

001 no lead
Prompt Dose [rem/h]
z [cm]
R= 50.0 cm
R= 70.0 cm
R= 90.0 cm
R= 110.0 cm
R= 130.0 cm
R= 150.0 cm
R= 170.0 cm
R= 190.0 cm
10^5
10^4
10^3
10^2
10^1
10^0
−100
−50
0
50
100
150
200
250
300


001 lead skin
R= 50.0 cm
R= 70.0 cm
R= 90.0 cm
R= 110.0 cm
R= 130.0 cm
R= 150.0 cm
R= 170.0 cm
R= 190.0 cm
Prompt Dose [rem/h]
z [cm]
10^5
10^4
10^3
10^2
10^1
10^0
−100
−50
0
50
100
150
200
250
300


Activation. 1h cooldown
R= 50.0 cm
R= 70.0 cm
R= 90.0 cm
R= 110.0 cm
R= 130.0 cm
R= 150.0 cm
R= 170.0 cm
R= 190.0 cm
001 no lead
001 lead skin
Dose [mrem/h]
z [cm]


Prompt
R= 50.0 cm
R= 70.0 cm
R= 90.0 cm
R= 110.0 cm
R= 130.0 cm
R= 150.0 cm
R= 170.0 cm
R= 190.0 cm
001 no lead
001 lead skin
Dose [rem/h]
z [cm]

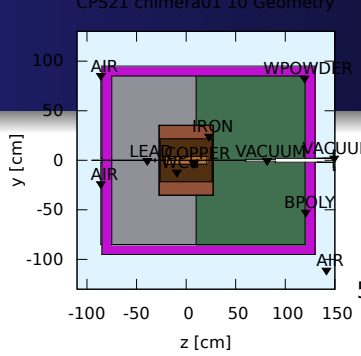
From "CPS_next_steps" - page 3 (RE)

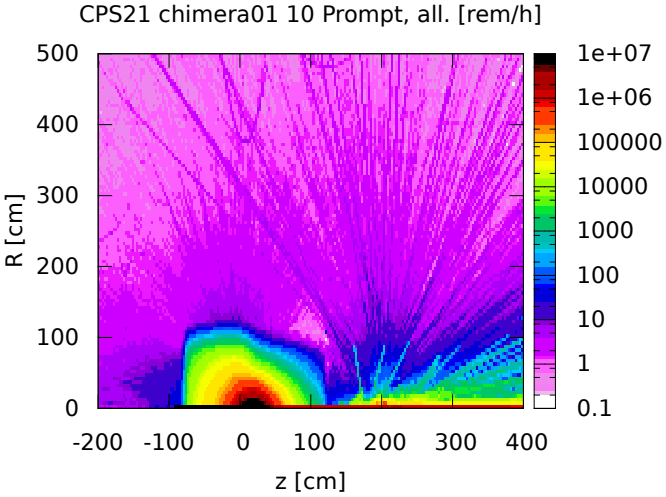


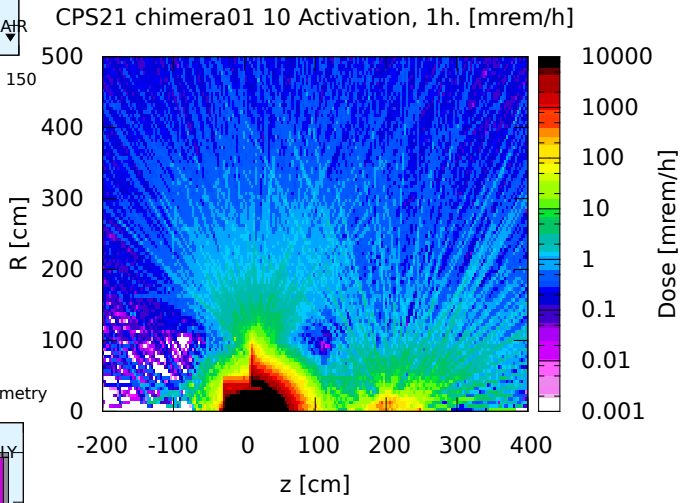
Action(s):

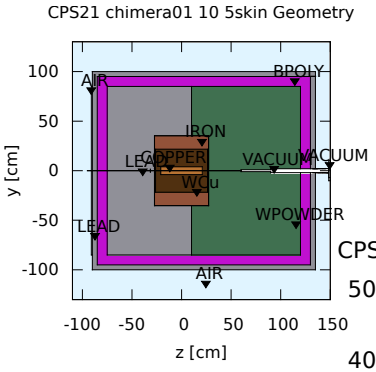
- Try the three proposed configurations.
- Next set of slides show results for these results

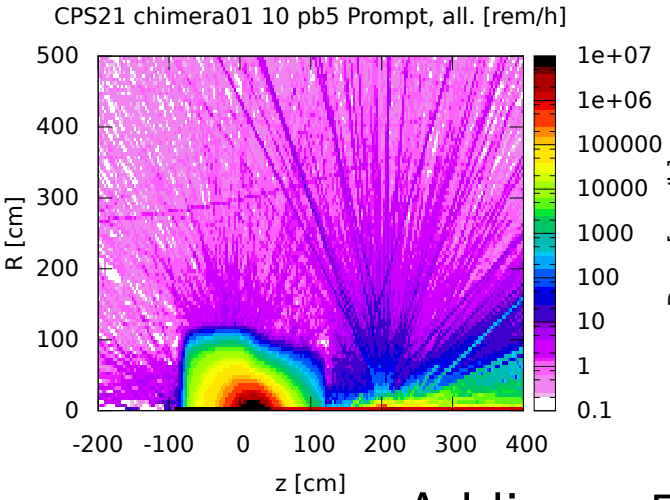
Comparisons (VIII)

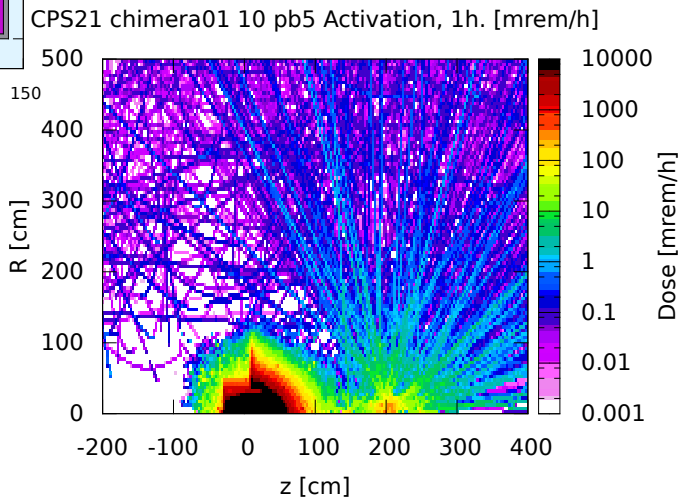






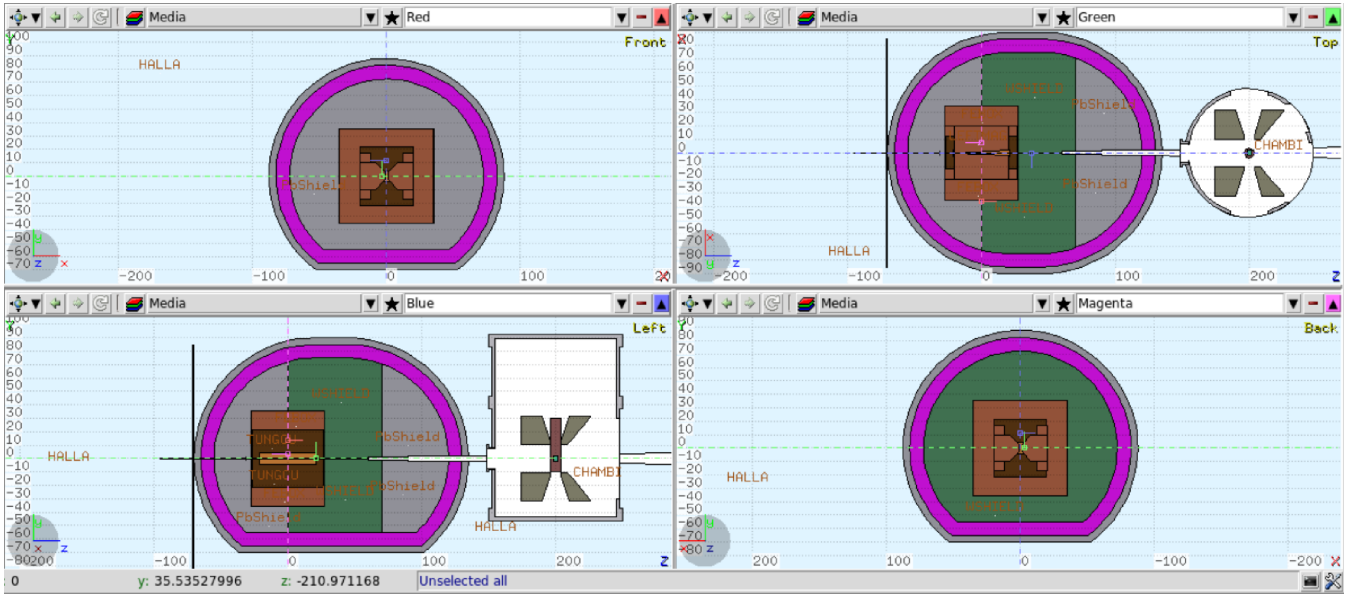




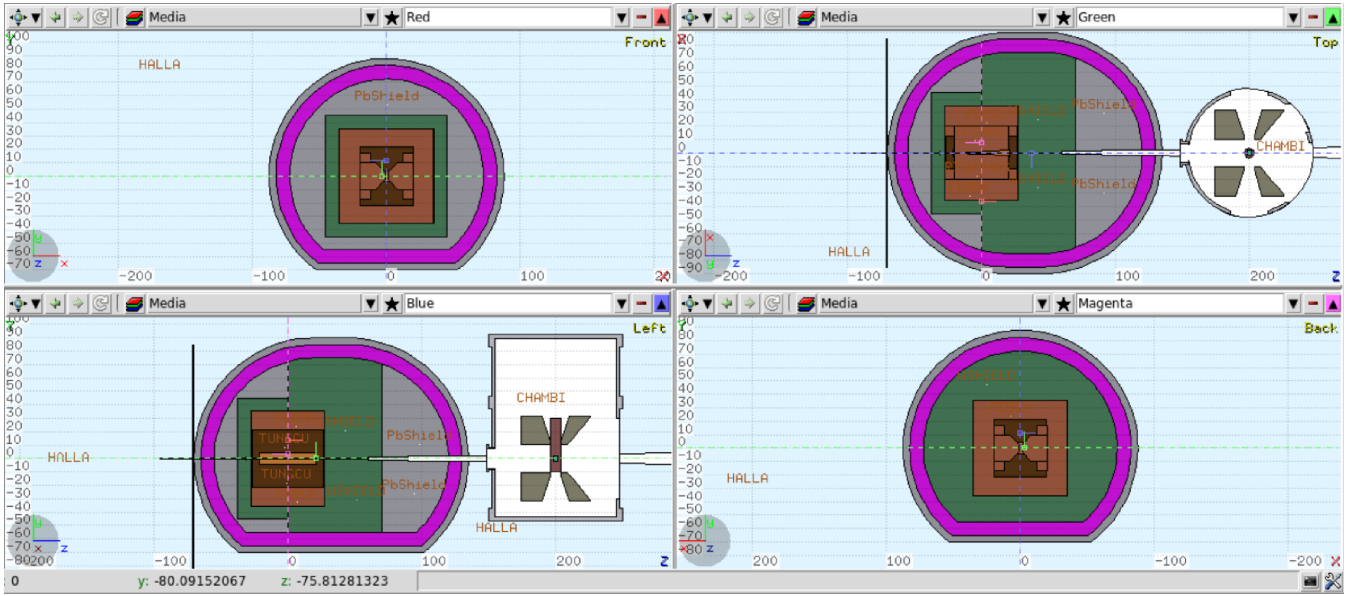


Back to square geom. Adding a 5 cm Pb skin.

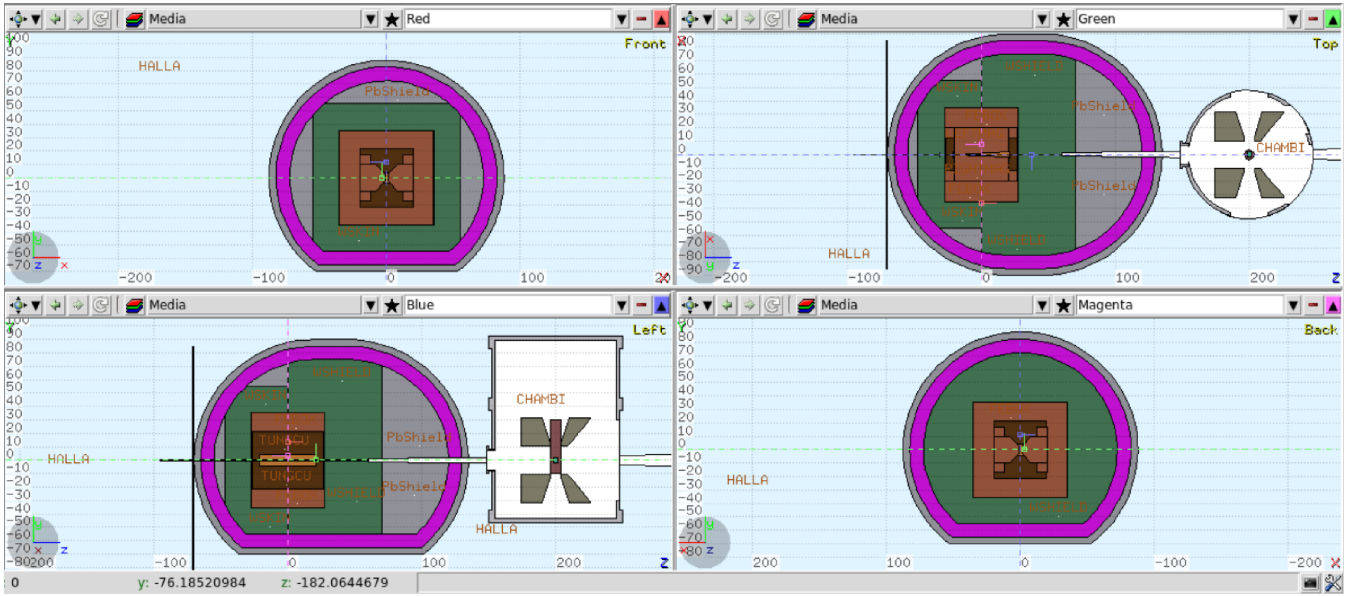
mkV_geometry

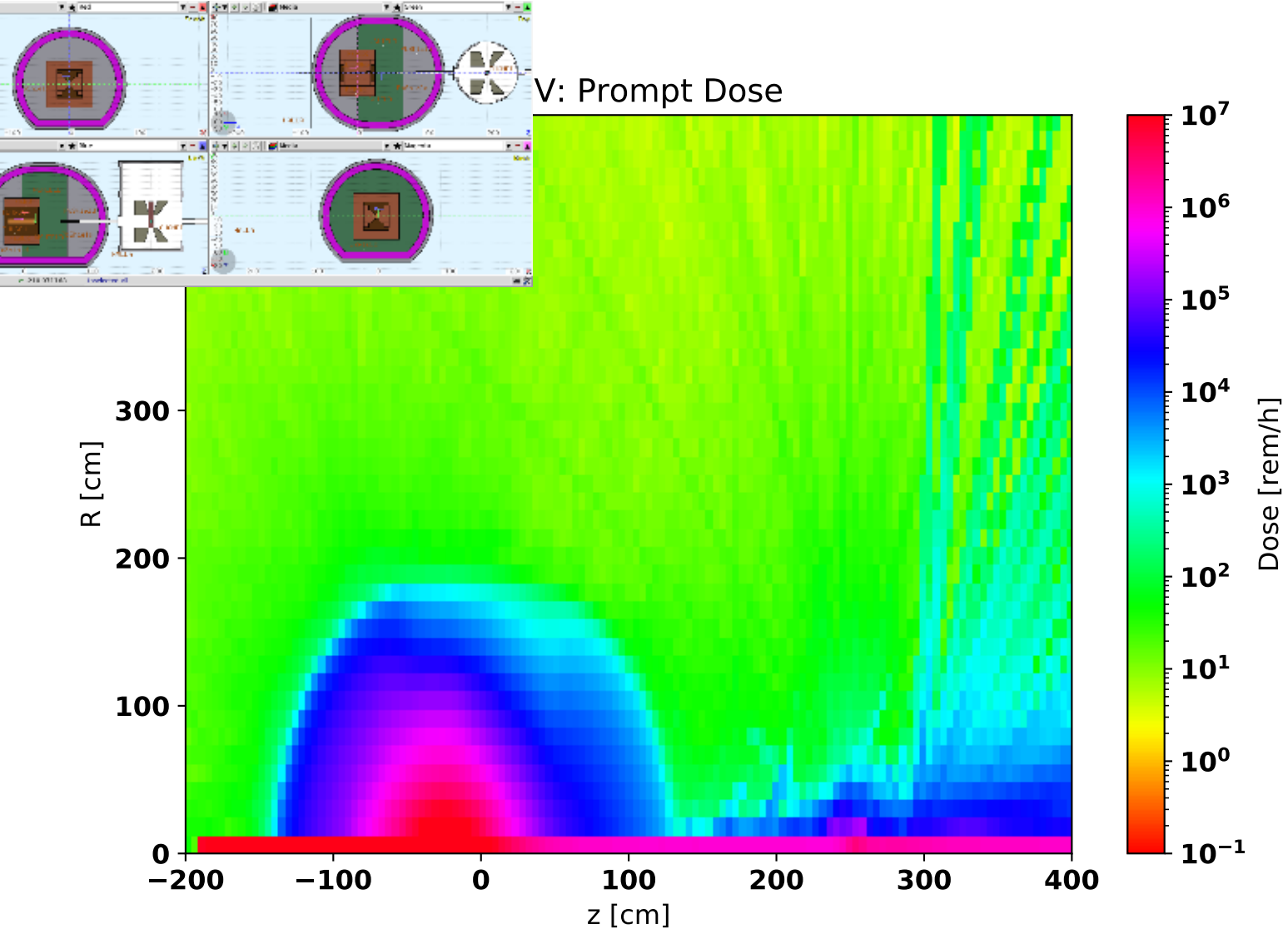


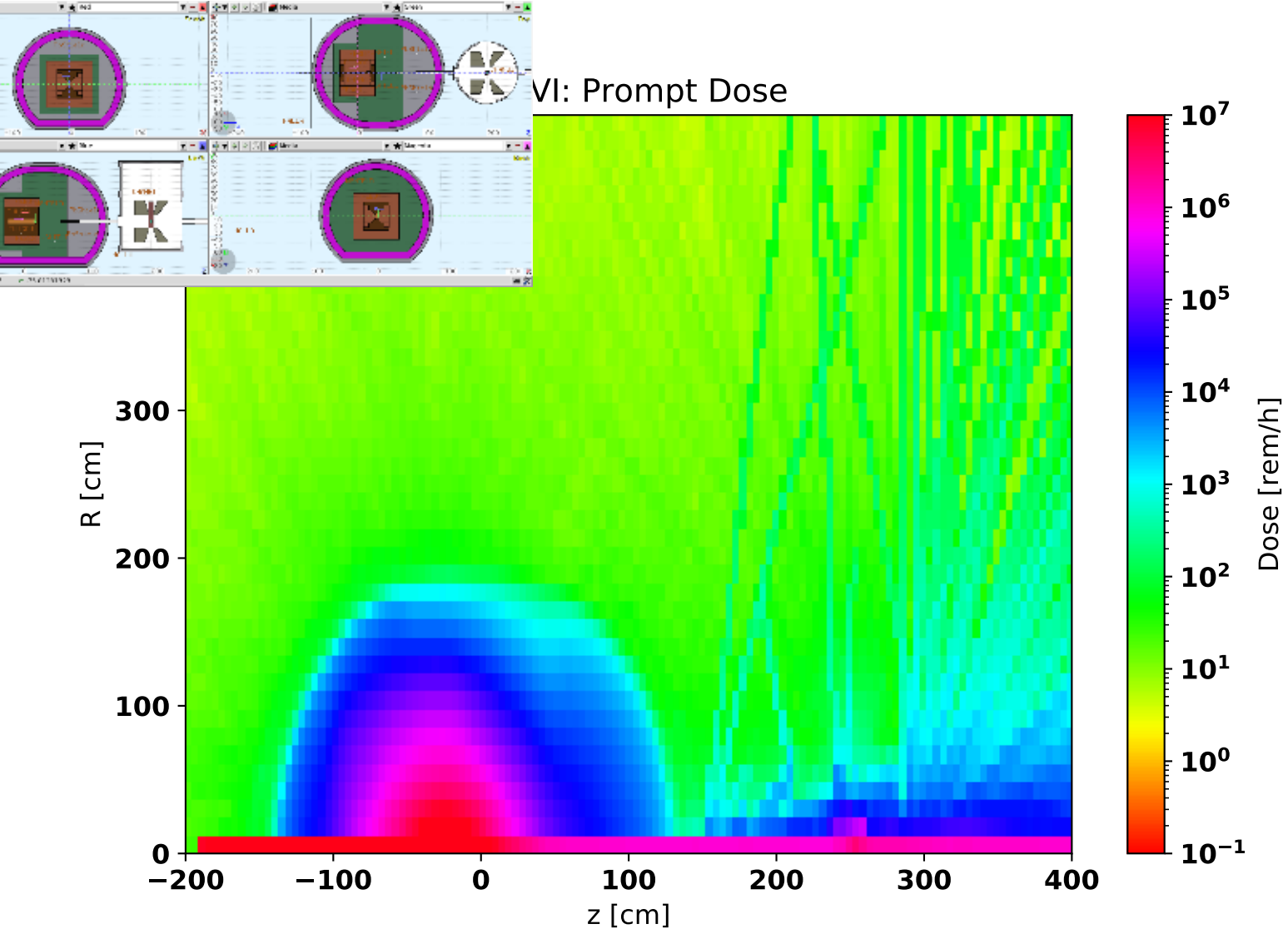
mkVI_geometry

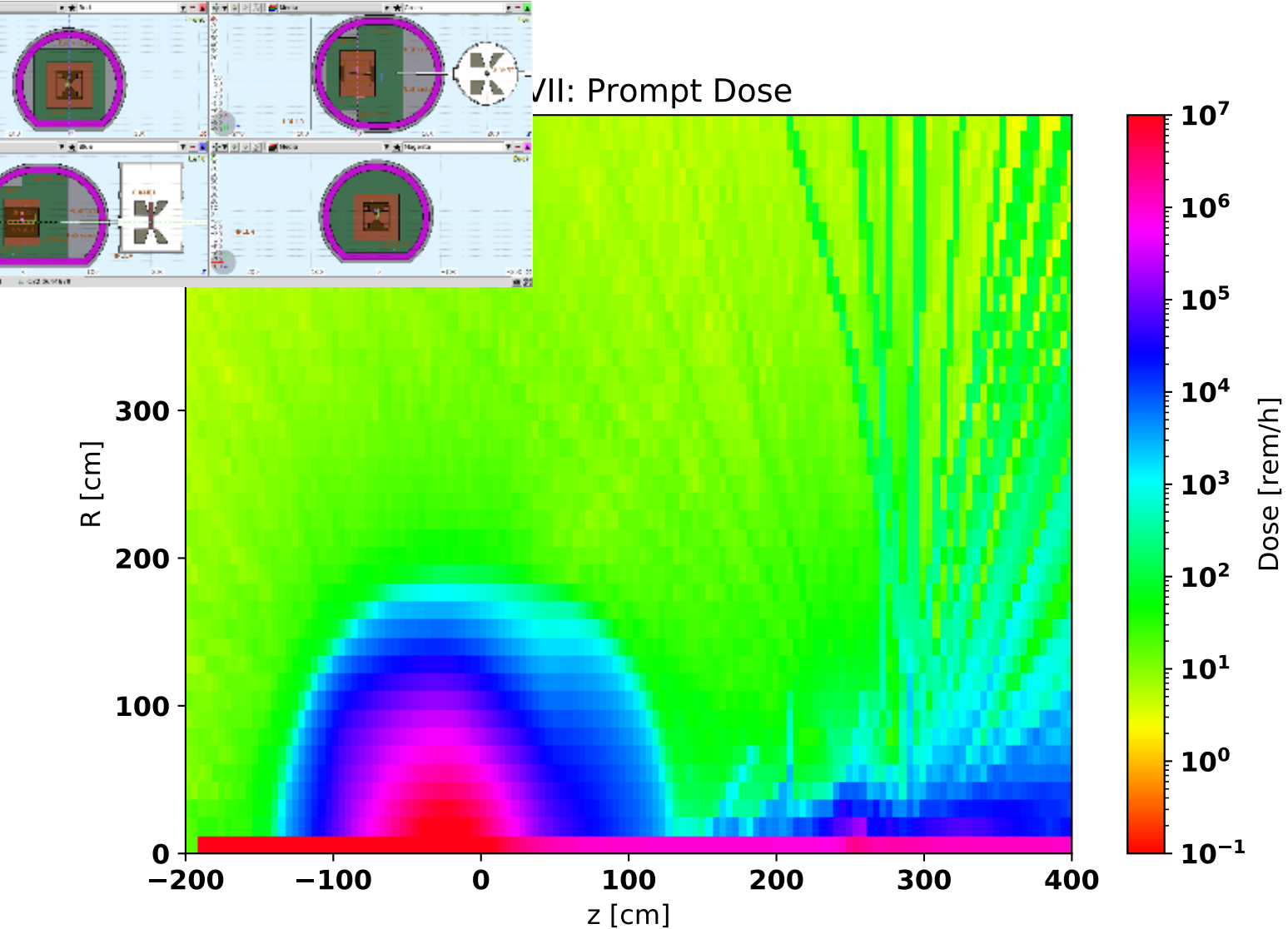


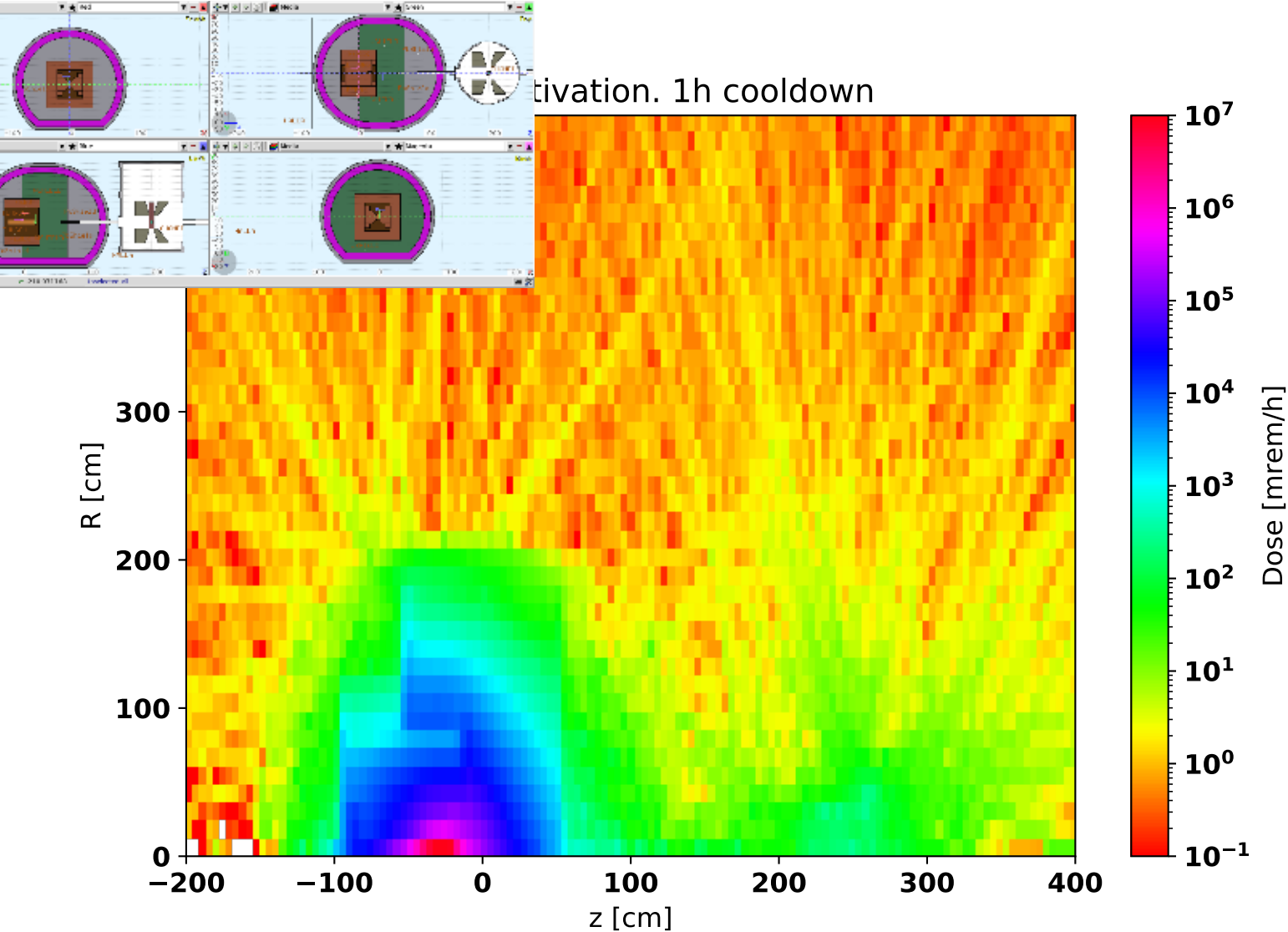
mkVII_geometry

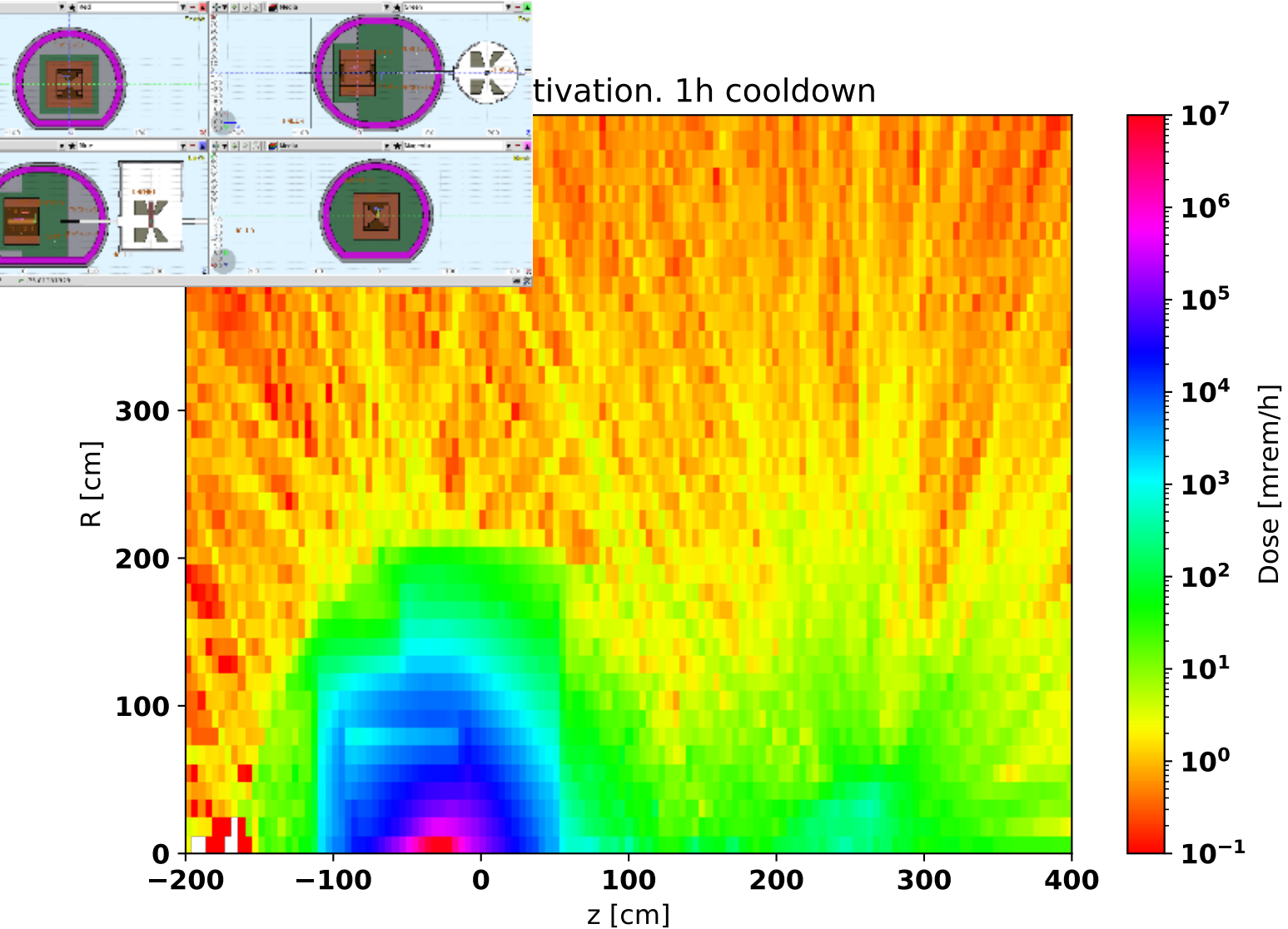


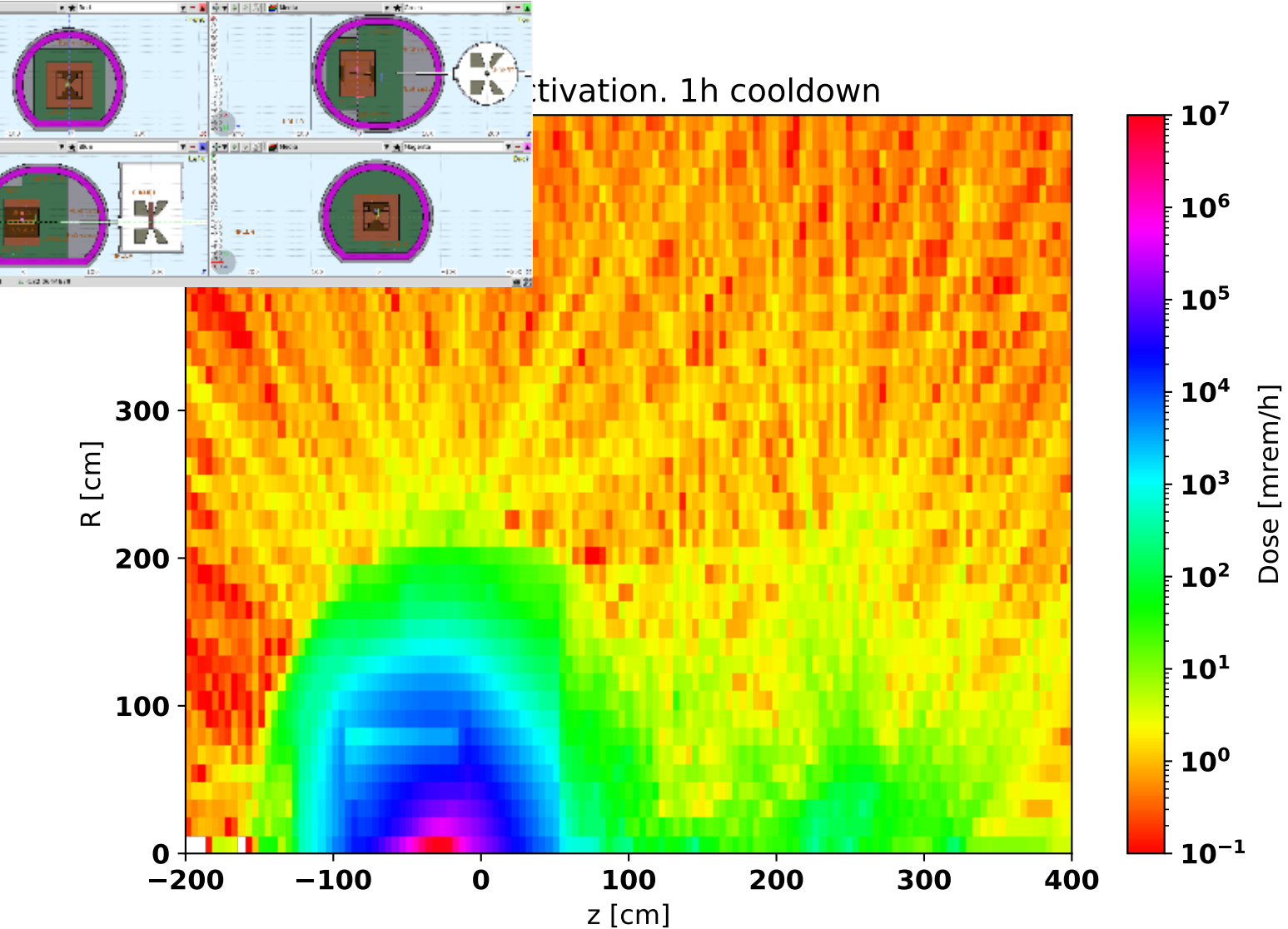

V: Prompt Dose
R [cm]
300
200
100
0
−200
−100
0
100
200
300
400
z [cm]
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
10^{-1}
Dose [rem/h]

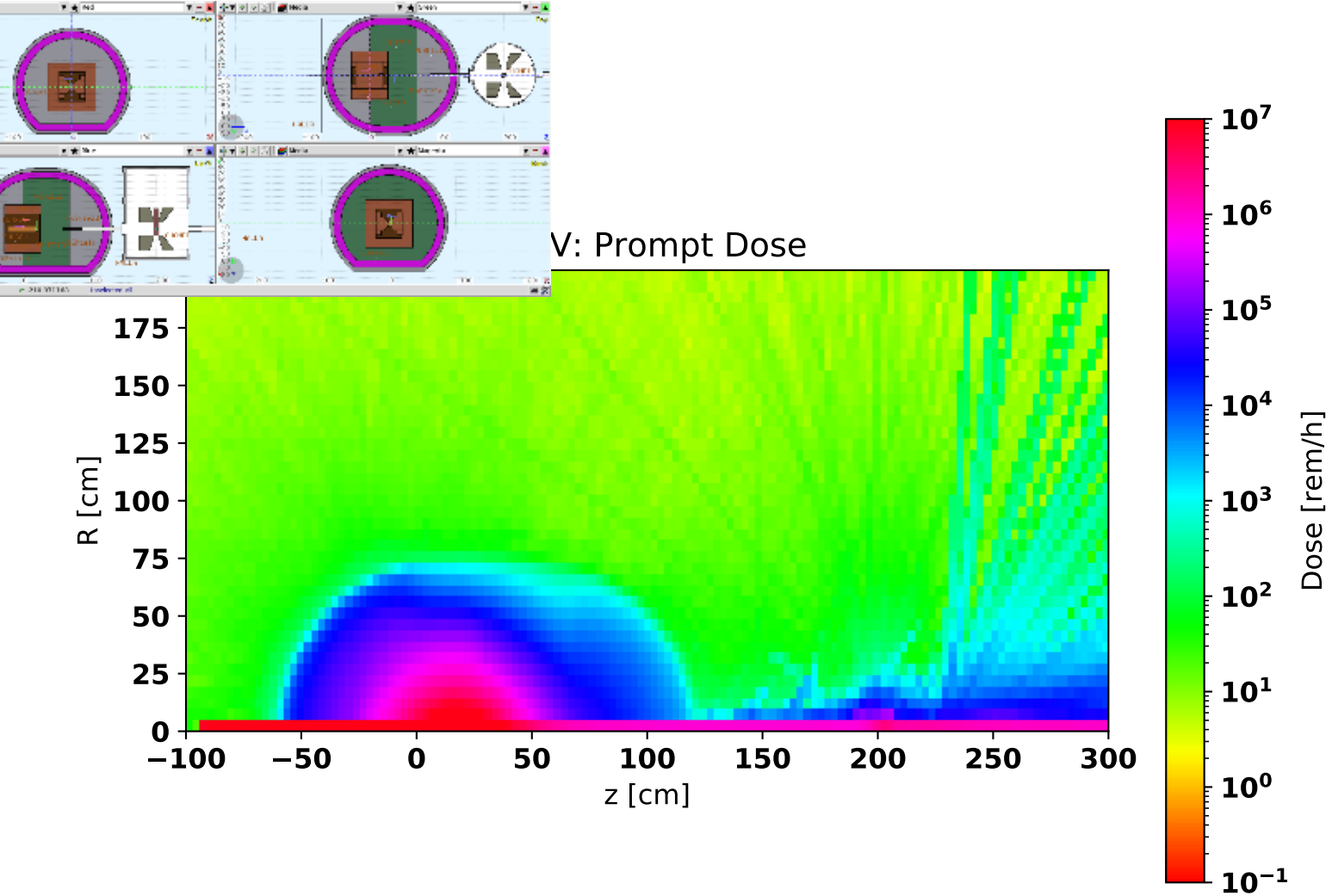

VI: Prompt Dose
R [cm]
z [cm]
Dose [rem/h]
0
100
200
300
−200
−100
0
100
200
300
400
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}

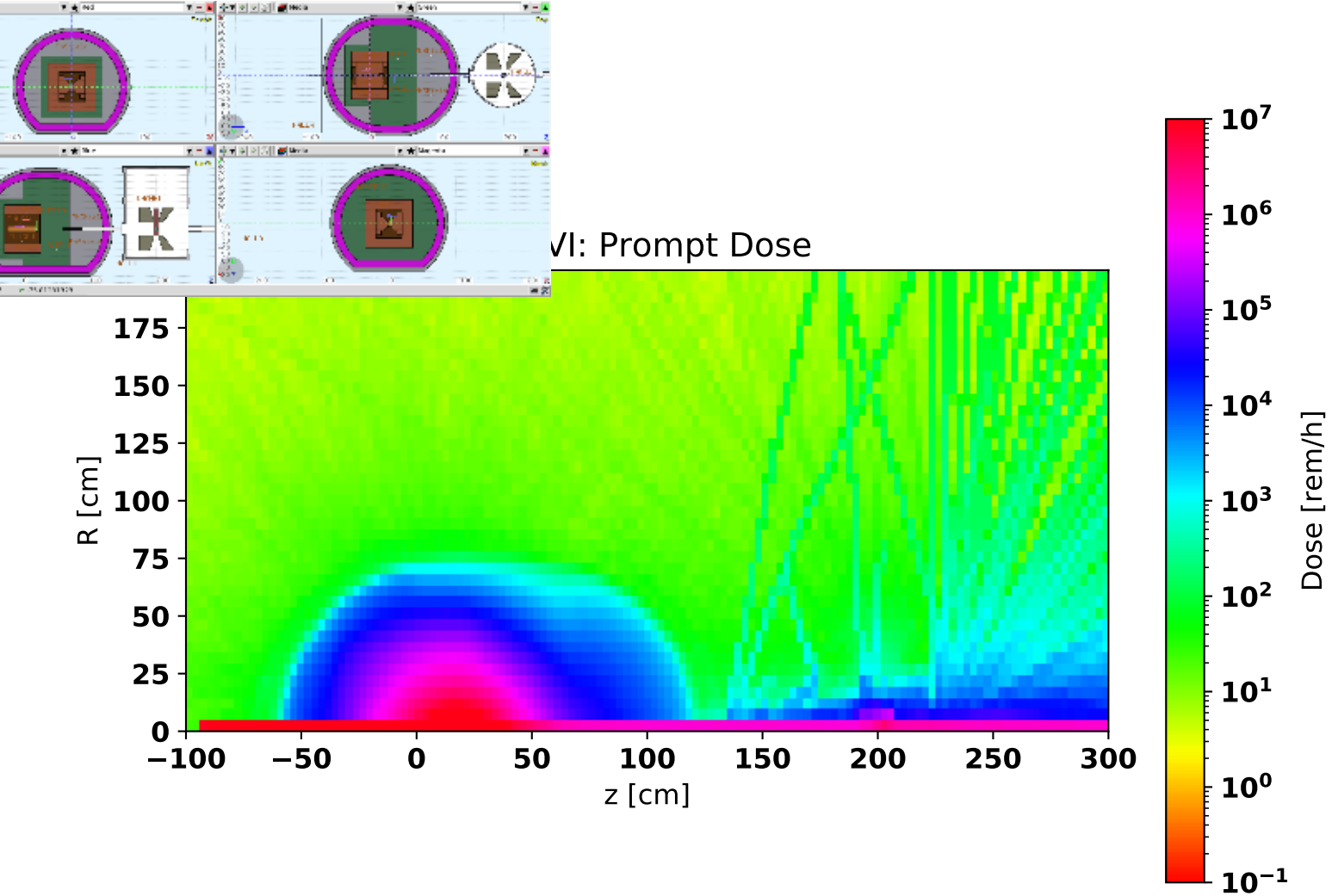

VII: Prompt Dose
R [cm]
z [cm]
Dose [rem/h]
0
100
200
300
−200
−100
0
100
200
300
400
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}

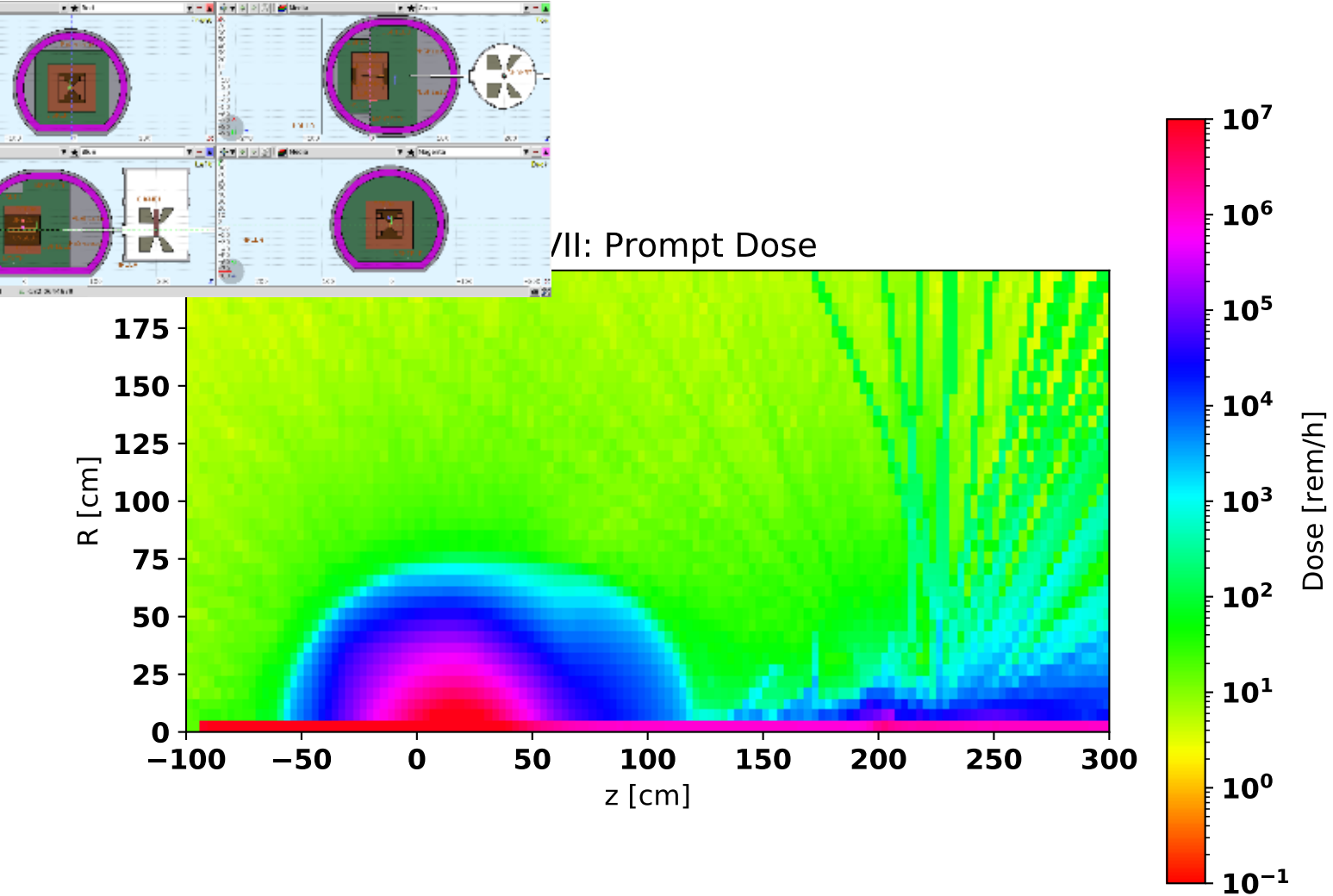

tivation. 1h cooldown
R [cm]
z [cm]
Dose [mrem/h]
0
100
200
300
−200
−100
0
100
200
300
400
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}

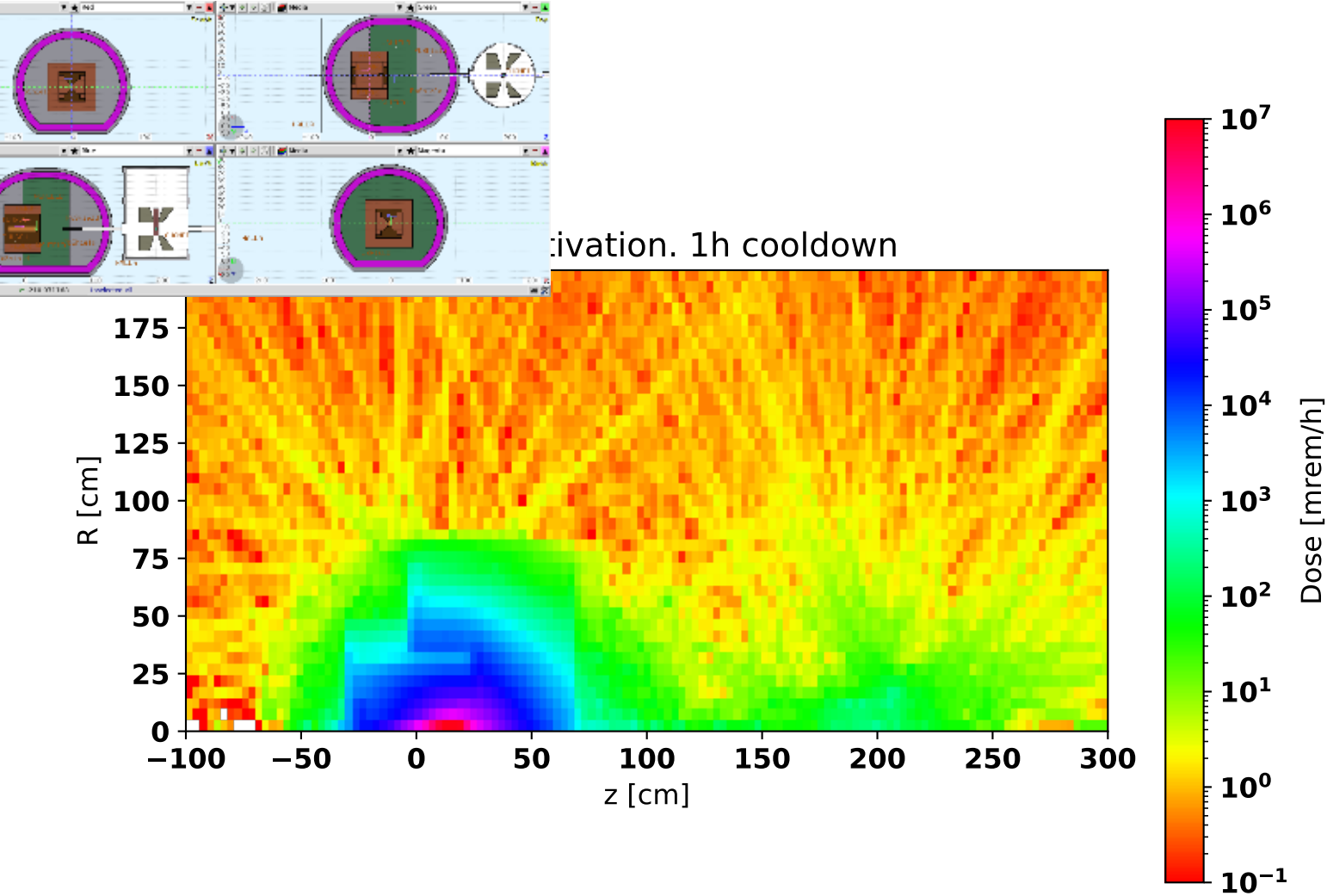

tivation. 1h cooldown
R [cm]
z [cm]
Dose [mrem/h]
0
100
200
300
−200
−100
0
100
200
300
400
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}

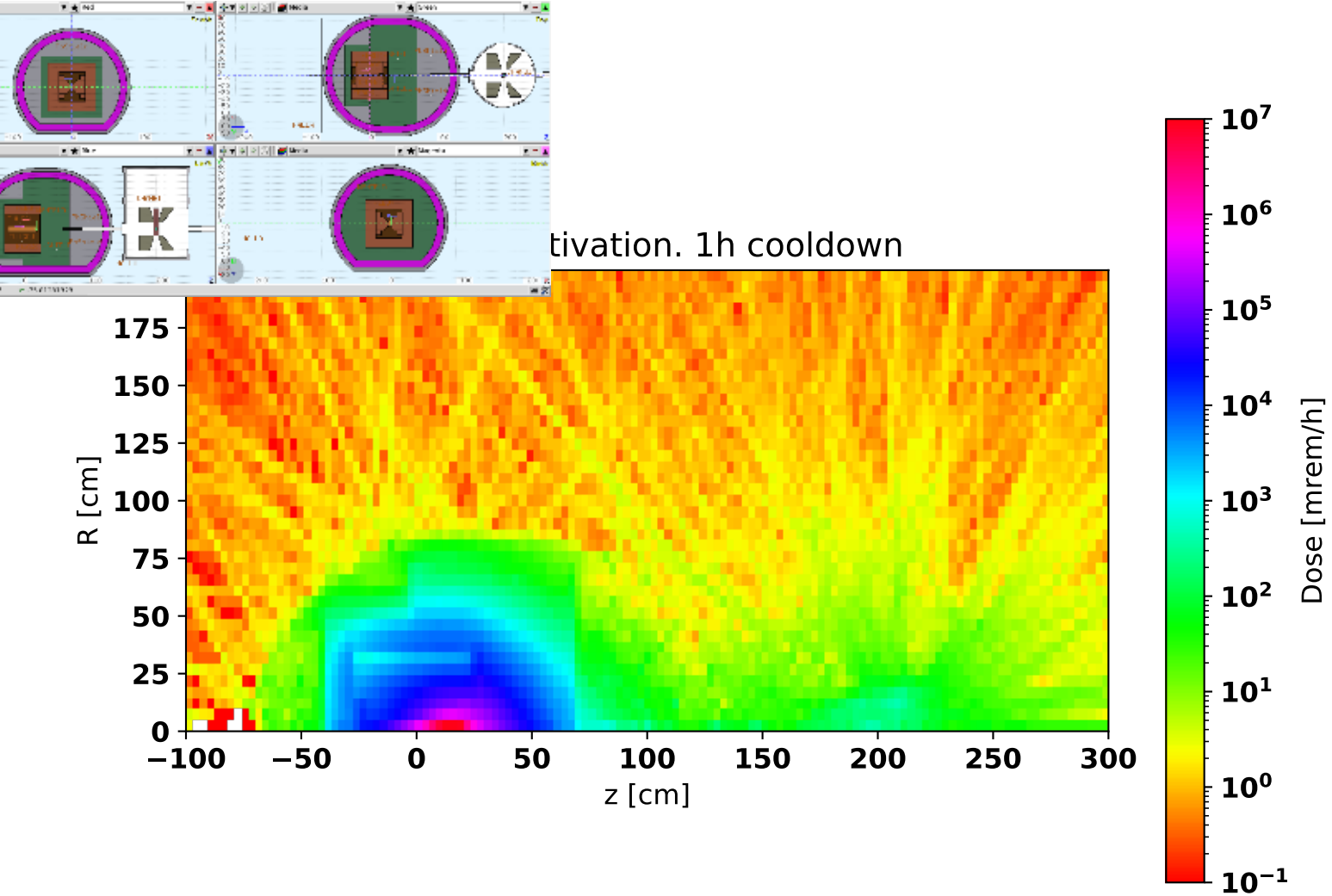

tivation. 1h cooldown
R [cm]
z [cm]
Dose [mrem/h]
0
100
200
300
−200
−100
0
100
200
300
400
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}

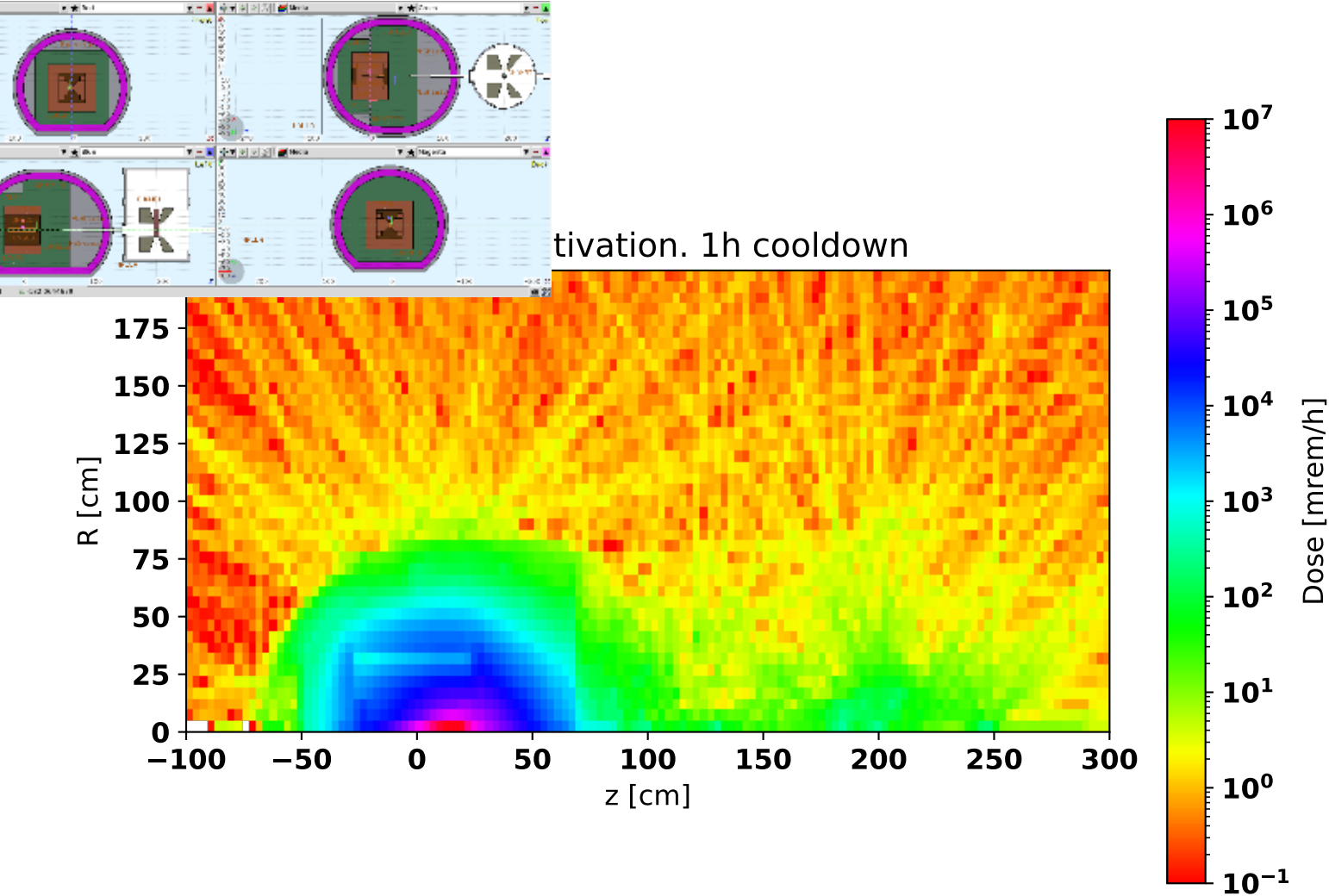

V: Prompt Dose
R [cm]
175
150
125
100
75
50
25
0
−100
−50
0
50
100
150
200
250
300
z [cm]
Dose [rem/h]
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}

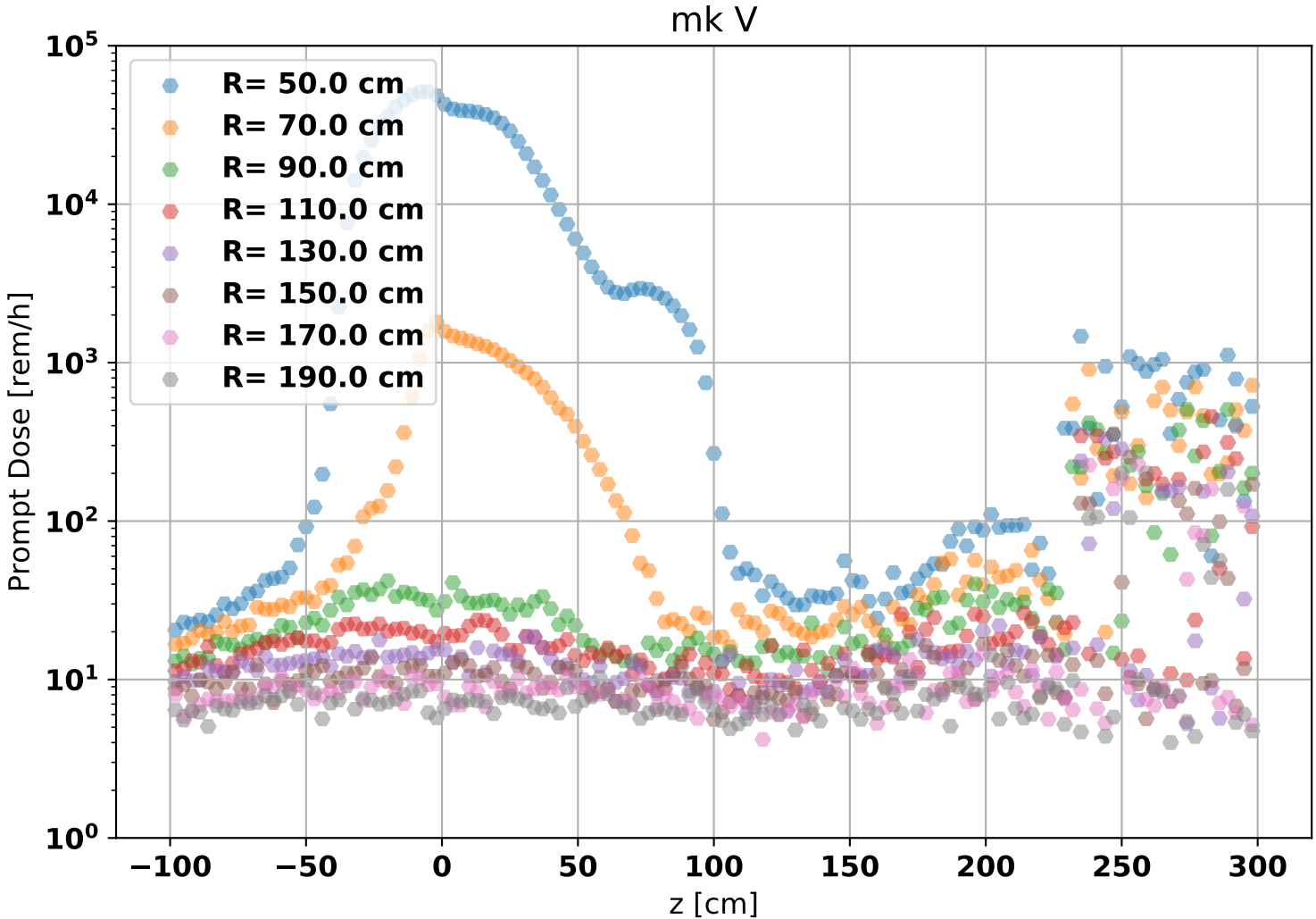

VI: Prompt Dose
R [cm]
175
150
125
100
75
50
25
0
−100
−50
0
50
100
150
200
250
300
z [cm]
Dose [rem/h]
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}

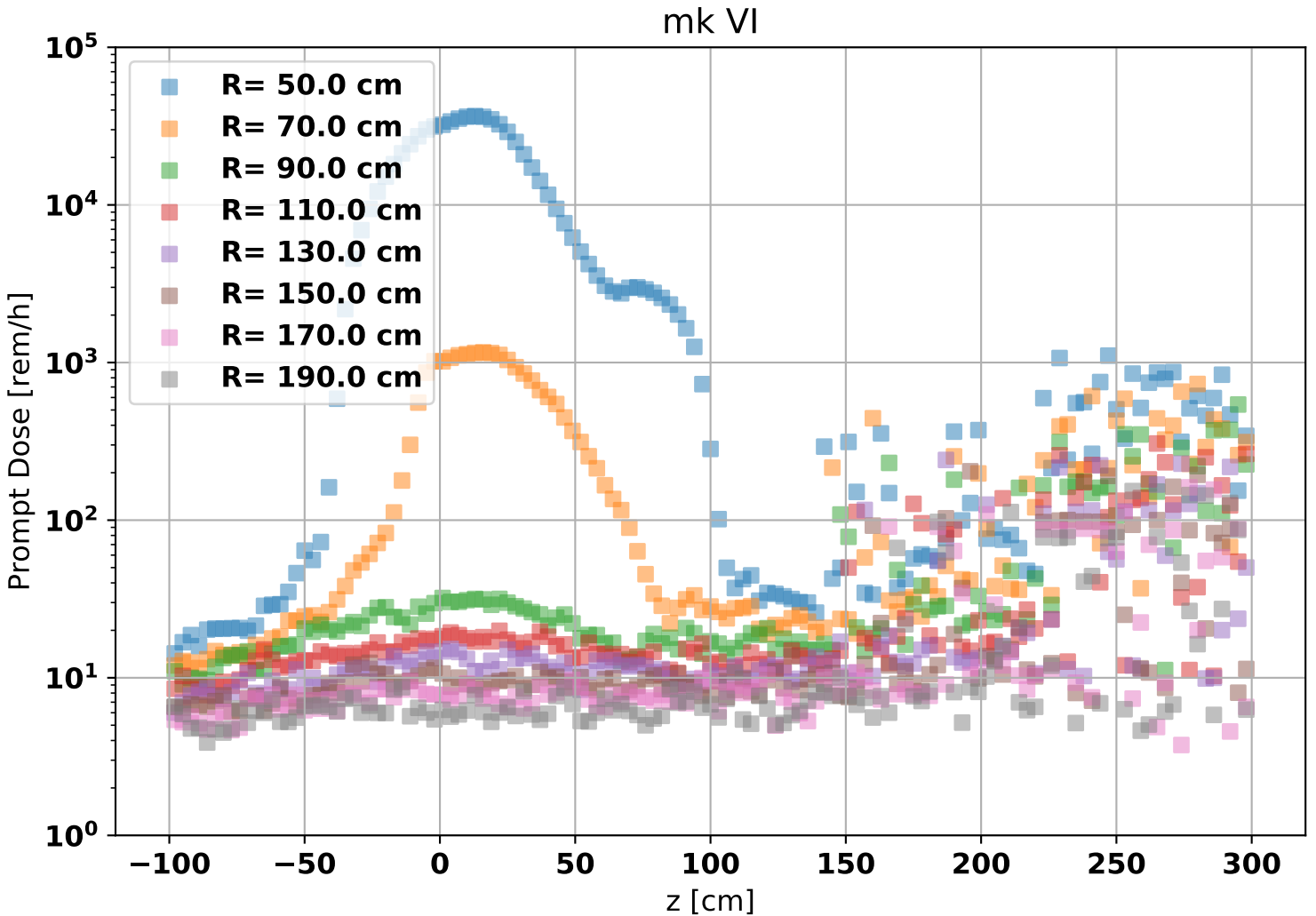

/II: Prompt Dose
R [cm]
175
150
125
100
75
50
25
0
−100
−50
0
50
100
150
200
250
300
z [cm]
Dose [rem/h]
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}

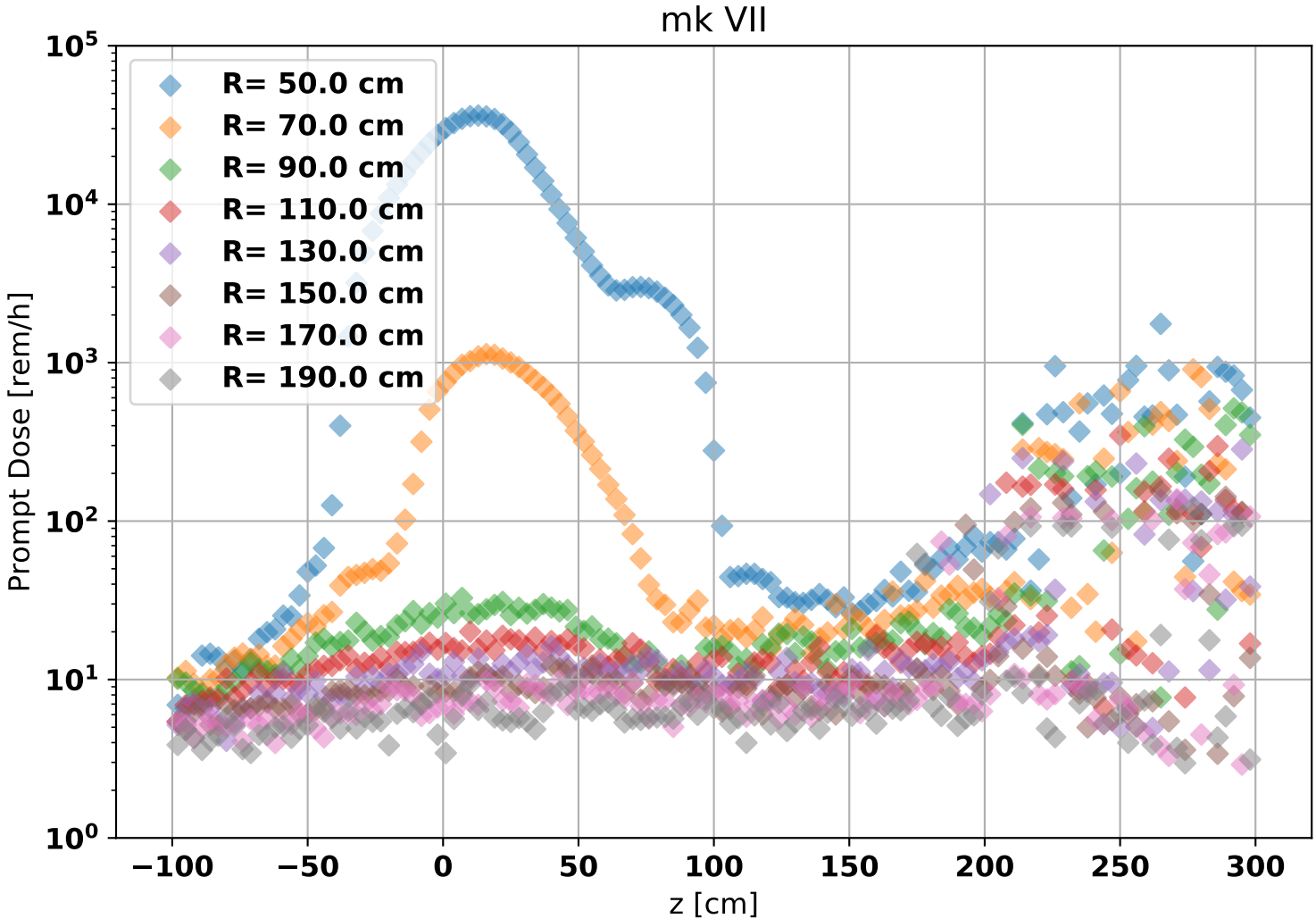

tivation. 1h cooldown
R [cm]
175
150
125
100
75
50
25
0
−100
−50
0
50
100
150
200
250
300
z [cm]
Dose [mrem/h]
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}

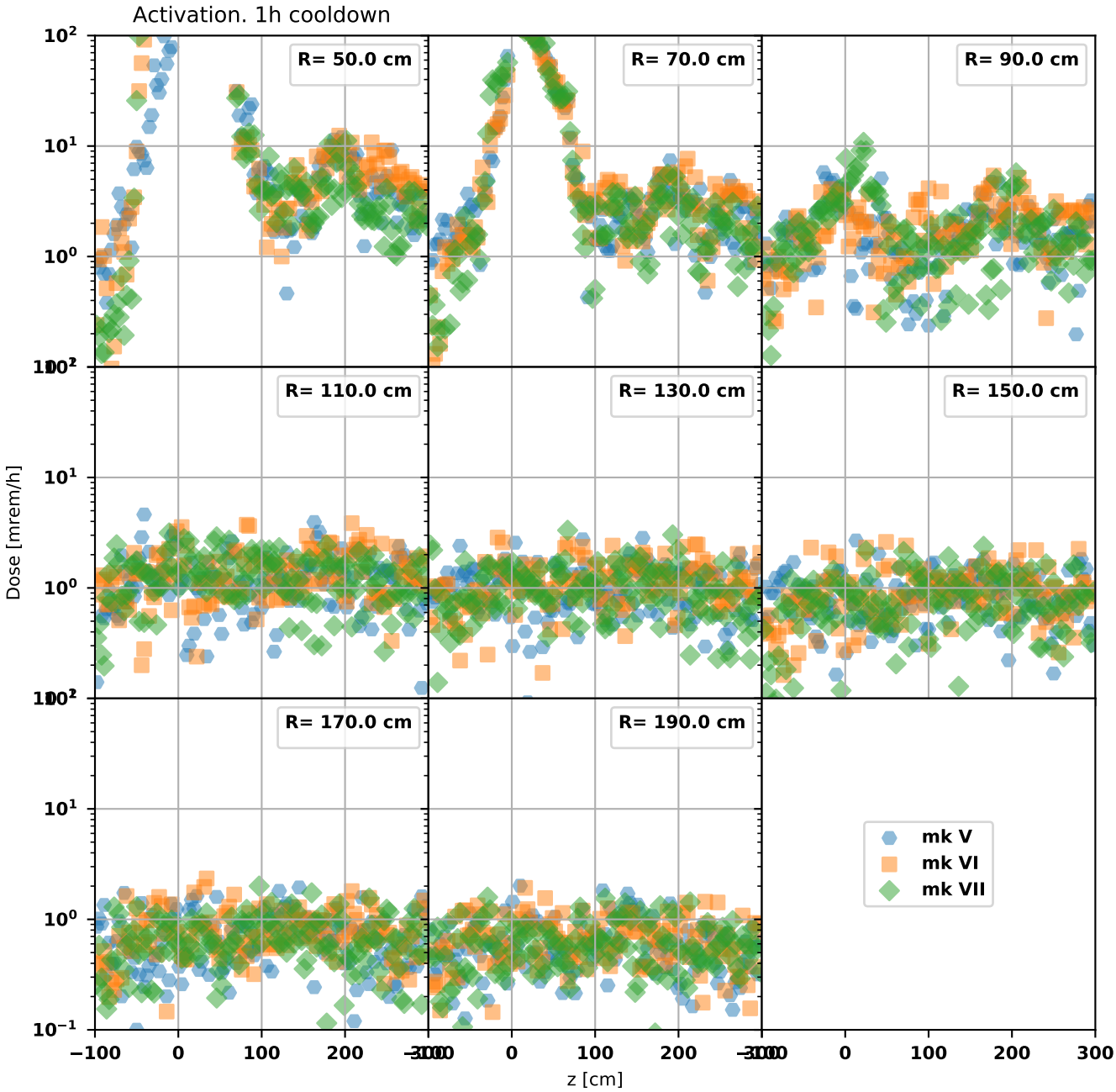

tivation. 1h cooldown
R [cm]
175
150
125
100
75
50
25
0
−100
−50
0
50
100
150
200
250
300
z [cm]
Dose [mrem/h]
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}

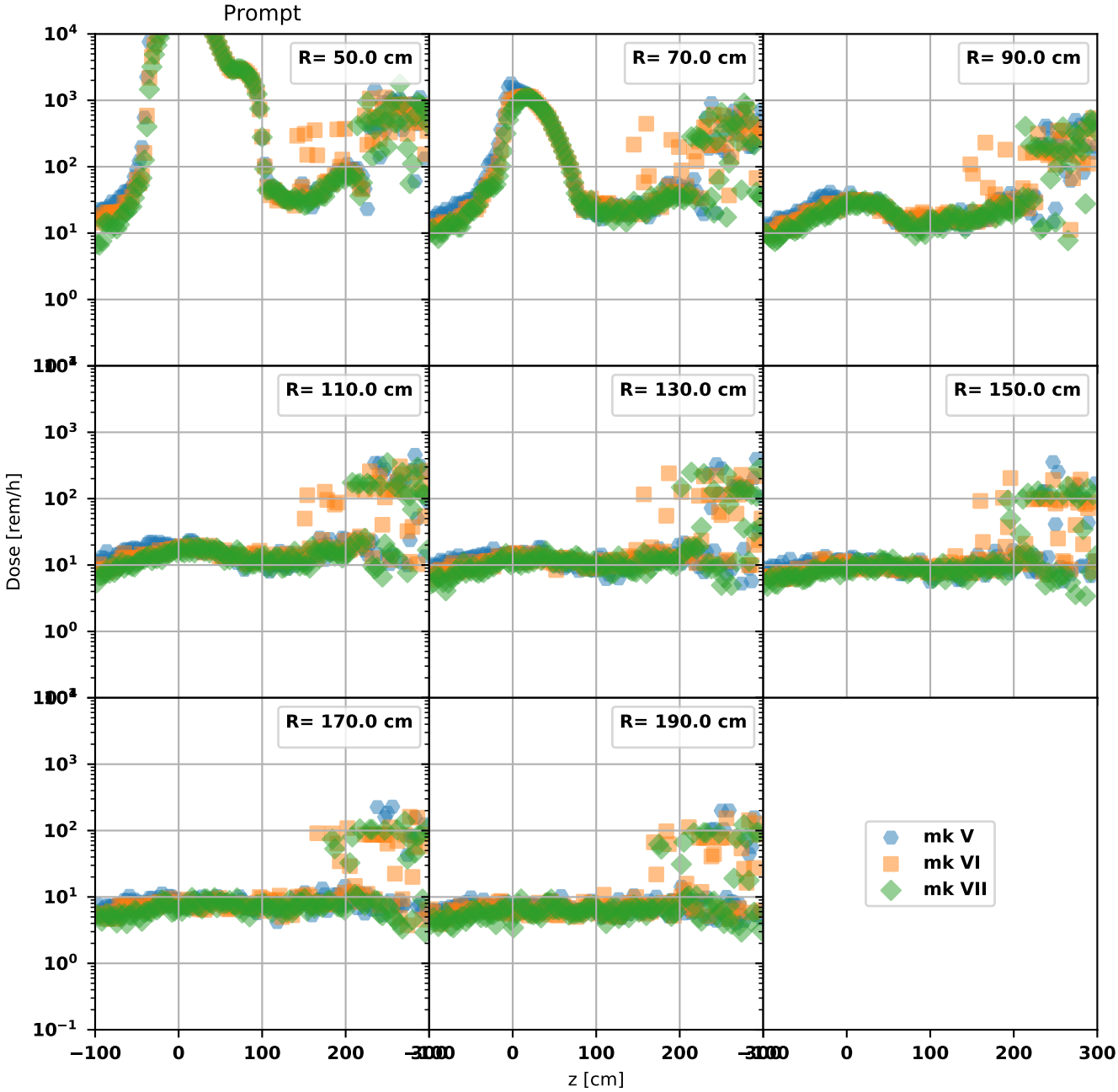

tivation. 1h cooldown
R [cm]
z [cm]
Dose [mrem/h]
175
150
125
100
75
50
25
0
−100
−50
0
50
100
150
200
250
300
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10^{1}
10^{0}
10^{-1}


mk V
R= 50.0 cm
R= 70.0 cm
R= 90.0 cm
R= 110.0 cm
R= 130.0 cm
R= 150.0 cm
R= 170.0 cm
R= 190.0 cm
Prompt Dose [rem/h]
z [cm]
10^5
10^4
10^3
10^2
10^1
10^0
−100
−50
0
50
100
150
200
250
300

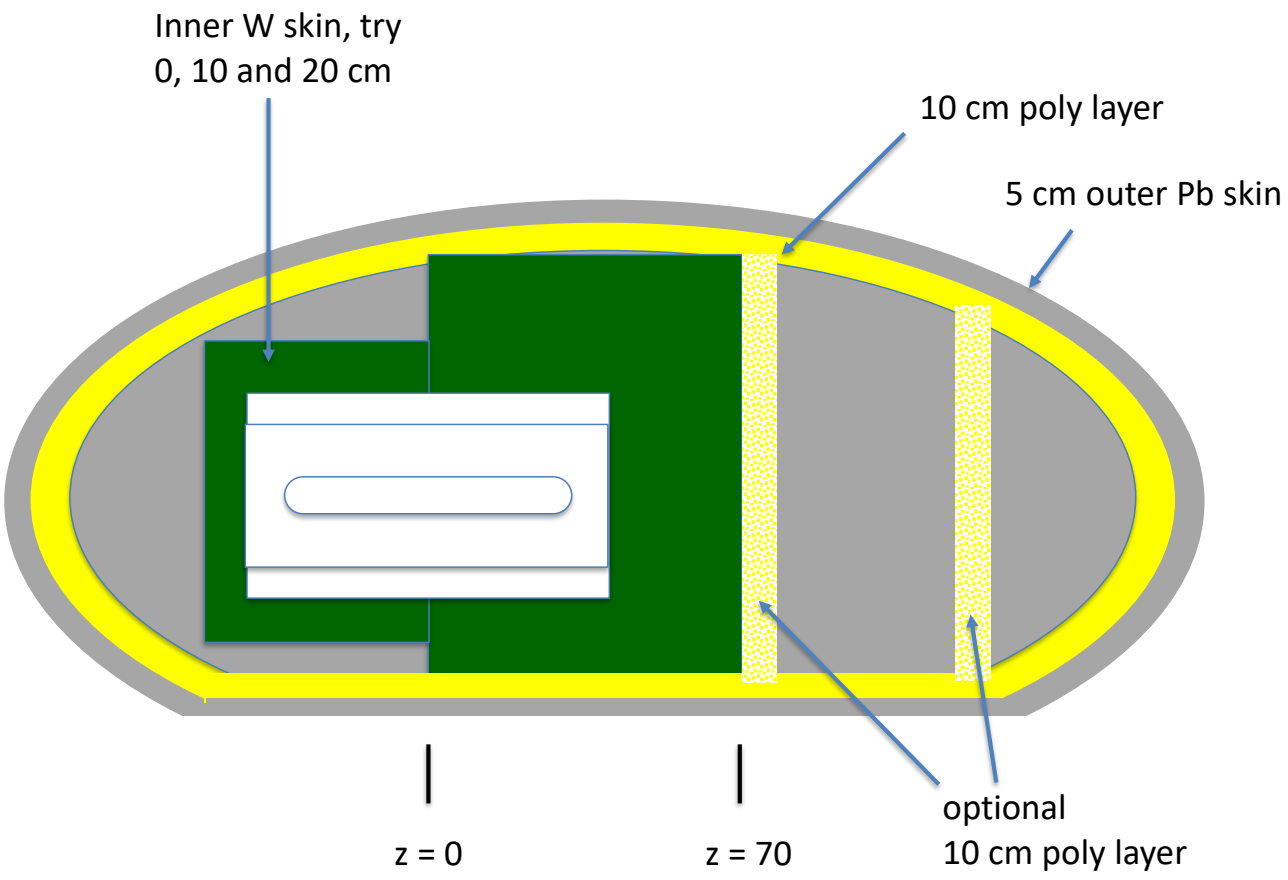

mk VI
R= 50.0 cm
R= 70.0 cm
R= 90.0 cm
R= 110.0 cm
R= 130.0 cm
R= 150.0 cm
R= 170.0 cm
R= 190.0 cm
Prompt Dose [rem/h]
z [cm]
10^5
10^4
10^3
10^2
10^1
10^0
−100
−50
0
50
100
150
200
250
300


mk VII
R= 50.0 cm
R= 70.0 cm
R= 90.0 cm
R= 110.0 cm
R= 130.0 cm
R= 150.0 cm
R= 170.0 cm
R= 190.0 cm
Prompt Dose [rem/h]
z [cm]
10^5
10^4
10^3
10^2
10^1
10^0
−100
−50
0
50
100
150
200
250
300


Activation. 1h cooldown
R= 50.0 cm
R= 70.0 cm
R= 90.0 cm
R= 110.0 cm
R= 130.0 cm
R= 150.0 cm
R= 170.0 cm
R= 190.0 cm
mk V
mk VI
mk VII
Dose [mrem/h]
z [cm]


Prompt
R= 50.0 cm
R= 70.0 cm
R= 90.0 cm
R= 110.0 cm
R= 130.0 cm
R= 150.0 cm
R= 170.0 cm
R= 190.0 cm
mk V
mk VI
mk VII
Dose [rem/h]
z [cm]

From "CPS_next_steps" - page 4 (RE)



Action(s):

- I did not do these yet. On my "To-do" list.

Summary & Outlook

GN's $0.02 worth...

- Solid Wpowder plug in the front seems to do an OK job.
- 10-20 cm W layer around magnet - optional.
- Will add plastic layers in the fwd region as suggested.
- Any other suggestions we might think of.

Thank you!