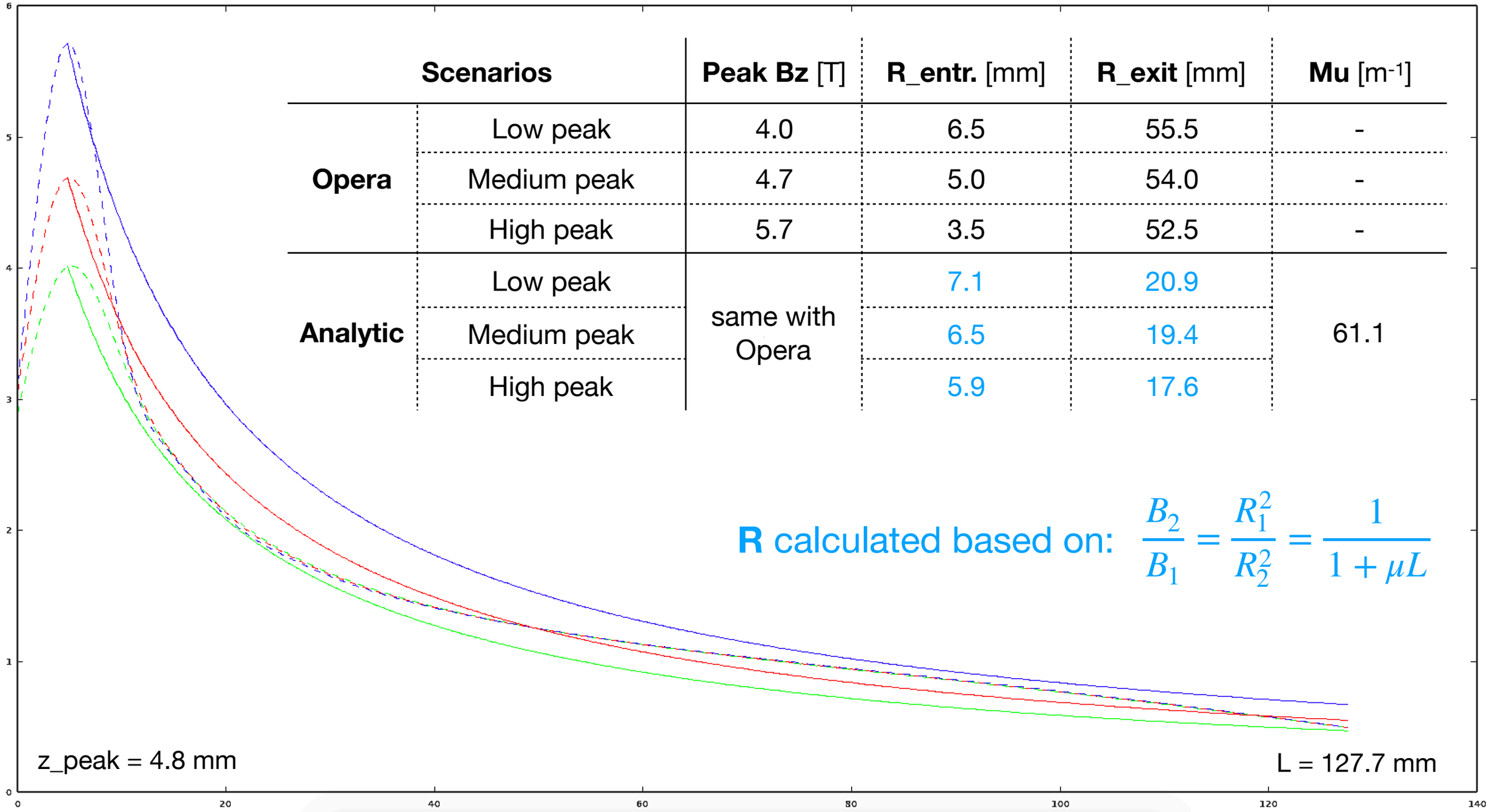
Positron source discussion

Yongke

Field map comparison

Opera v.s. analytic Bz (fixed peak)

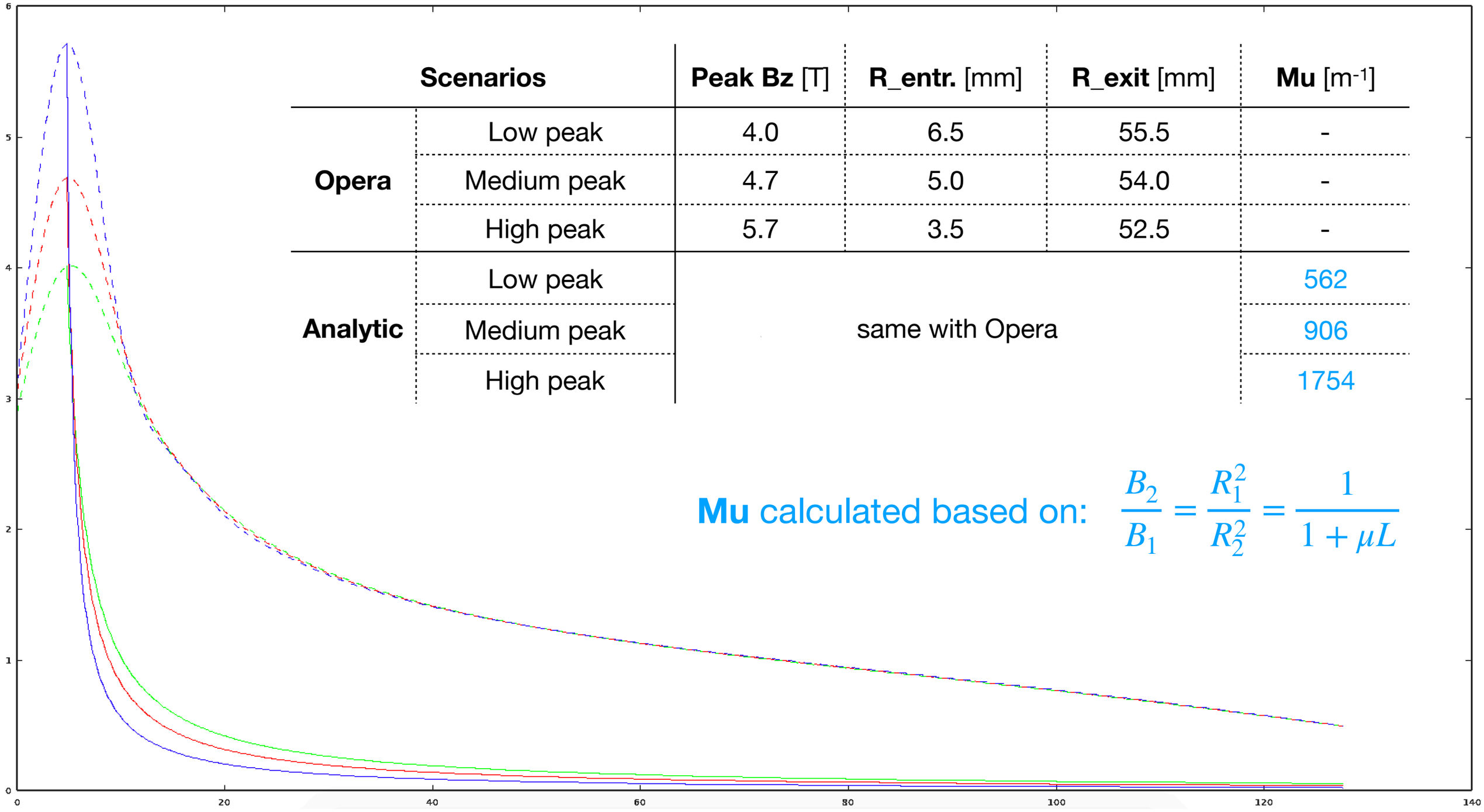
Scenarios		Peak Bz [T]	R_entr. [mm]	R_exit [mm]	Mu [m^{-1}]
Opera	Low peak	4.0	6.5	55.5	-
	Medium peak	4.7	5.0	54.0	-
	High peak	5.7	3.5	52.5	-
Analytic	Low peak	same with Opera	7.1	20.9	61.1
	Medium peak		6.5	19.4	
	High peak		5.9	17.6	



R calculated based on: $\frac{B_2}{B_1} = \frac{R_1^2}{R_2^2} = \frac{1}{1+\mu L}$

Analytic mu (61.1 m^{-1}) corresponds to optimisation results (B0=6 T, L=180 mm, B_exit=0.5 T, R_exit=20 mm)

Opera v.s. analytic Bz (fixed peak and R)



Scenarios		Peak Bz [T]	R_entr. [mm]	R_exit [mm]	Mu [m^{-1}]
Opera	Low peak	4.0	6.5	55.5	-
	Medium peak	4.7	5.0	54.0	-
	High peak	5.7	3.5	52.5	-
Analytic	Low peak	same with Opera			562
	Medium peak				906
	High peak				1754

Mu calculated based on: $\frac{B_2}{B_1} = \frac{R_1^2}{R_2^2} = \frac{1}{1+\mu L}$

z_peak = 4.8 mm

L = 127.7 mm

Opera field 2D vs 1D

- Fringe field in target: not considered
- Distance between target and AMD: 0

- TW parameters: not reoptimised

High peak scenario	Yiled at target exit	Yield at AMD exit	Yield at TW exit	Yield at IL exit	Final yield
2D B	11.9	8.51	2.71	2.35	2.17
1D Bz		7.32	2.41	2.16	2.01

7% difference

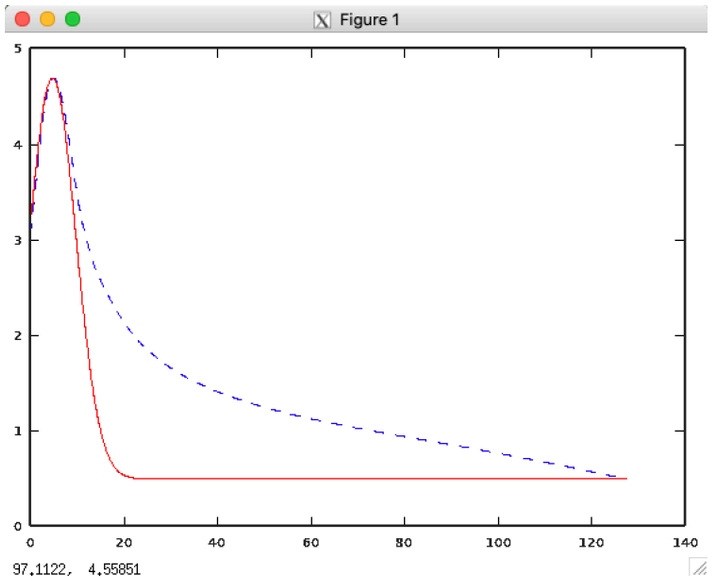
- TW parameters: reoptimised

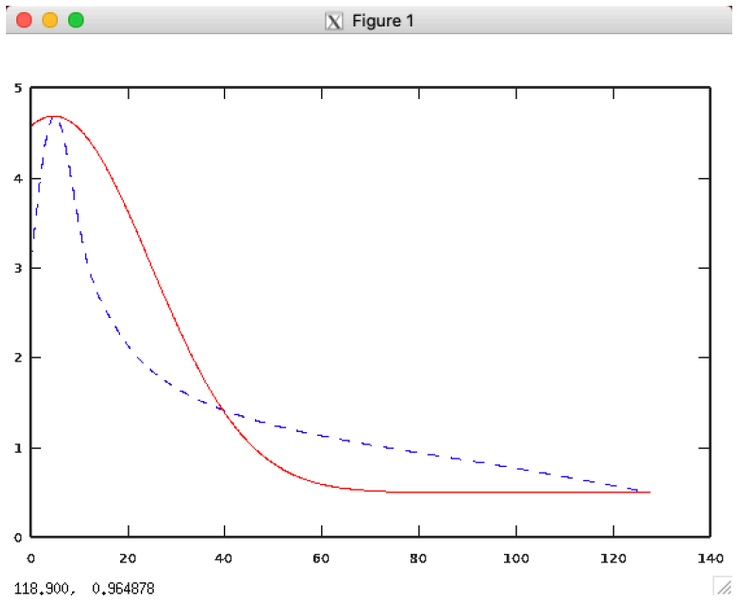
High peak scenario	Yiled at target exit	Yield at AMD exit	Yield at TW exit	Yield at IL exit	Final yield
2D B	11.9	8.51	2.71	2.58	2.39
1D Bz		7.32	2.41	2.24	2.08

13% difference

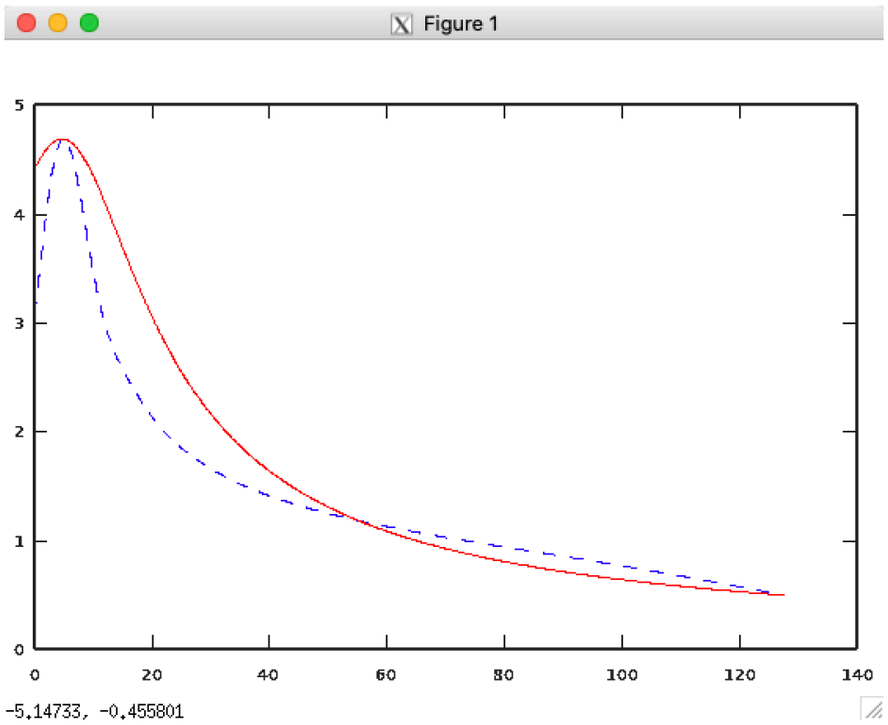
Theoretical description of 1D Bz

- Gaussian





- Modified analytic formula



$$\frac{B_0}{\sqrt{1+\mu\,(z-z_0)^2}}$$

$\mu = 76\ m^{-1}$ (calculated automatically)

Fringe field effect in target

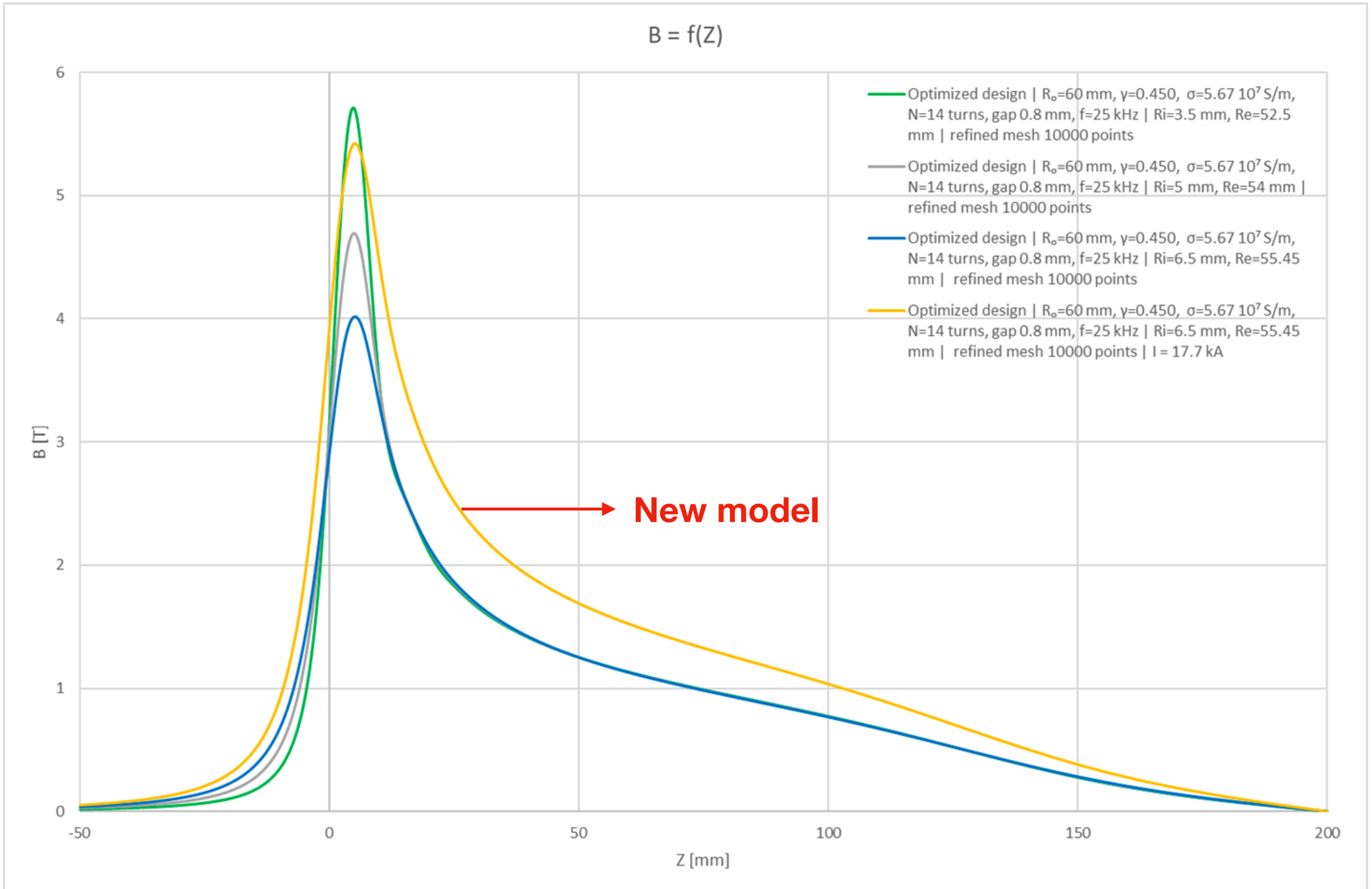
Distance between target and AMD

Medium scenario	e+ yield at Target exit	e+ yield at AMD exit	e+ yield at TW exit	e+ yield at IL exit	Effective e+ yield	Norm. PEDD
Without fringe field	11.9	8.45	2.67	2.54	**2.35**	**28.81 J/g**
With fringe field 0 mm distance	11.2	7.20	2.41	2.22	2.11	45.57 J/g
1 mm distance	11.3	7.02	2.30	2.01	1.94	47.54 J/g
2 mm	11.4	7.03	2.28	2.18	1.88	47.13 J/g
5 mm	11.6	7.42	2.47	2.30	2.03	43.00 J/g
10 m	11.6	7.86	2.59	2.41	2.09	38.00 J/g
15 mm	11.8	8.15	2.63	2.37	2.06	36.07 J/g
20 mm	11.8	8.05	2.65	2.32	**2.05**	**34.23 J/g**
25 mm	11.9	7.80	2.64	2.29	**1.98**	**33.90 J/g**
30 mm	12.00	4.93	1.28	1.10	1.01	67.56 J/g
35 mm	11.86	3.00	0.65	0.51	0.48	140.8 J/g
40 mm	11.90	2.18	0.37	0.30	0.28	247.7 J/g

Some results are not full reoptimised, but it's not necessary for the moment (since the difference should be small)

AMD model optimisation

Enlarged entrance aperture

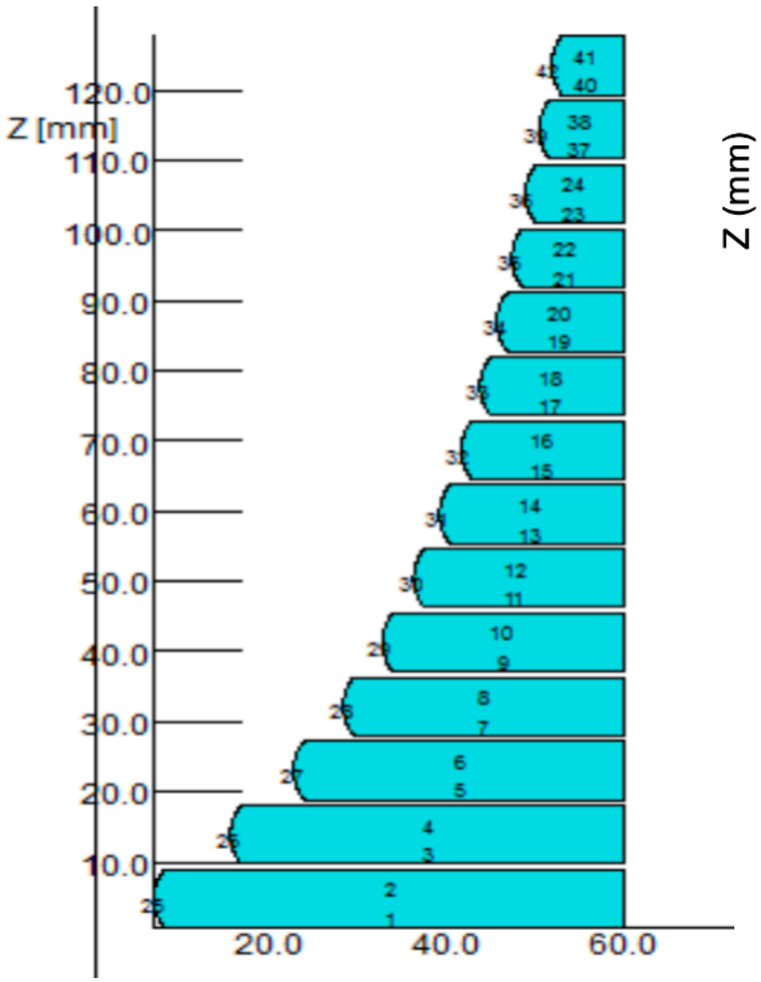


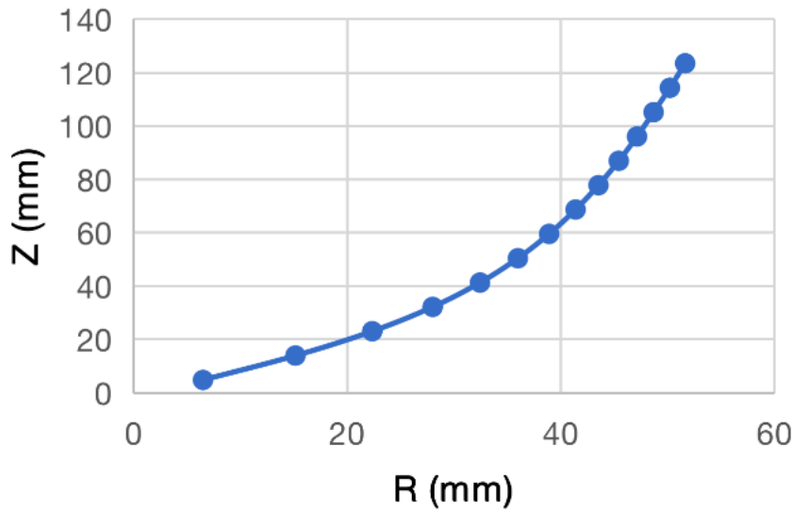
Comparison with old models

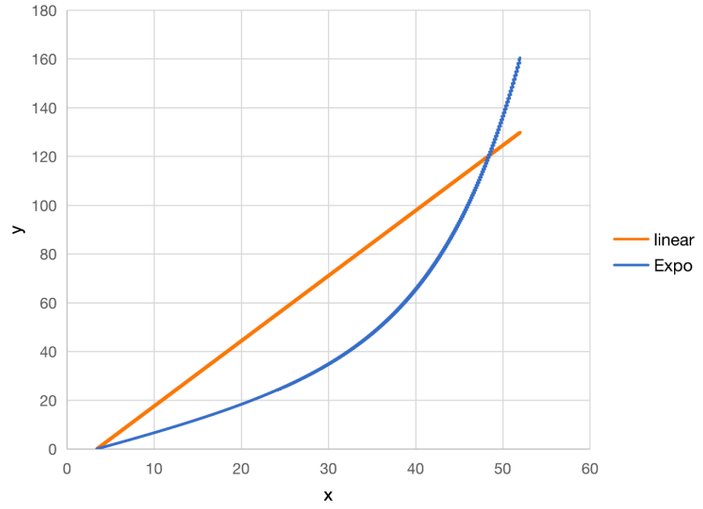
- For simplification, in the table below:
  - Fringe field and distance (Target—AMD) NOT considered

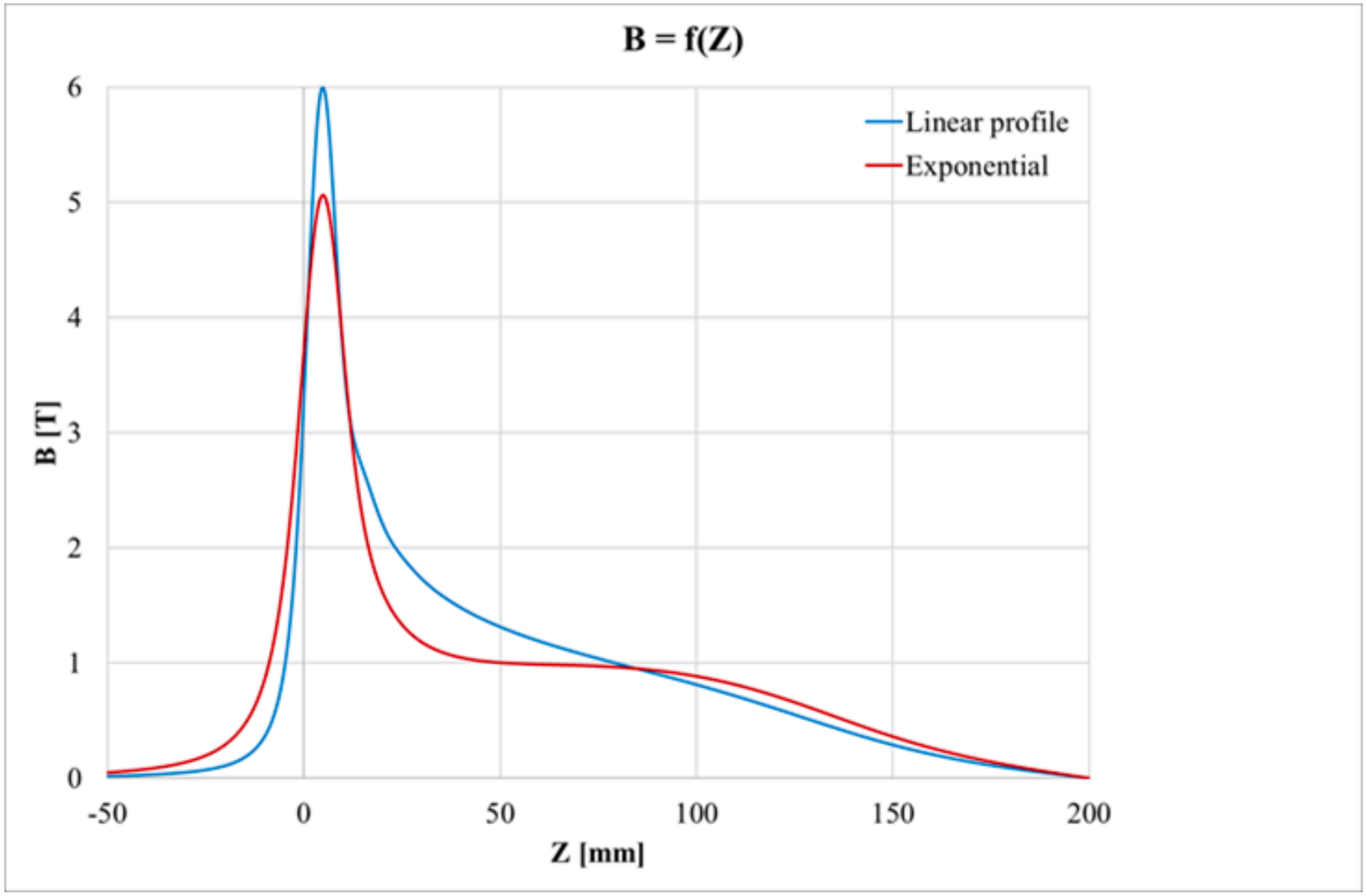
	Scenario	Yield at target exit	Yield at AMD exit	Yield at TW exit	Effective Yield
Opera (Old)	High peak	11.9	6.81	2.05	1.90
	Medium peak		8.51	2.58	2.39
	Low peak		9.29	2.53	2.37
Opera (**New**)	Large aperture		9.38	3.15	**2.59**
Analytic			4.49	2.64	2.22

Exponential / logarithmic shape



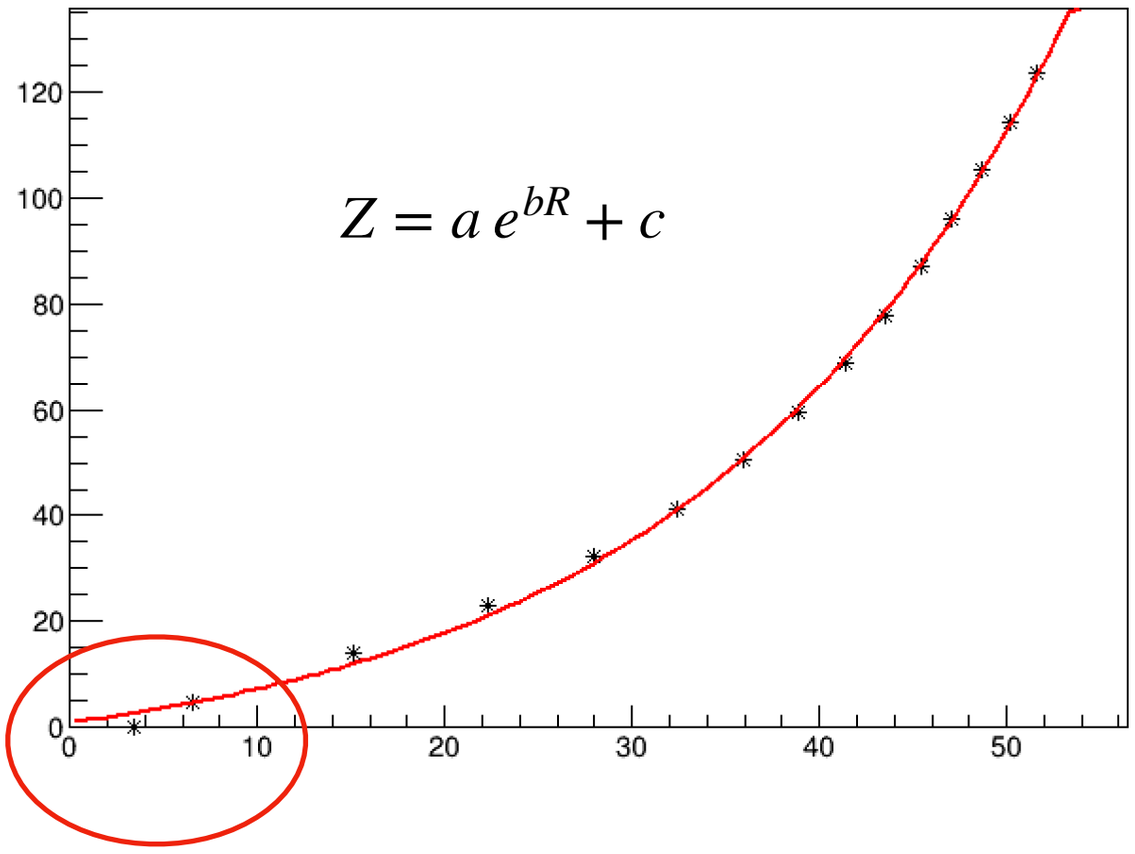




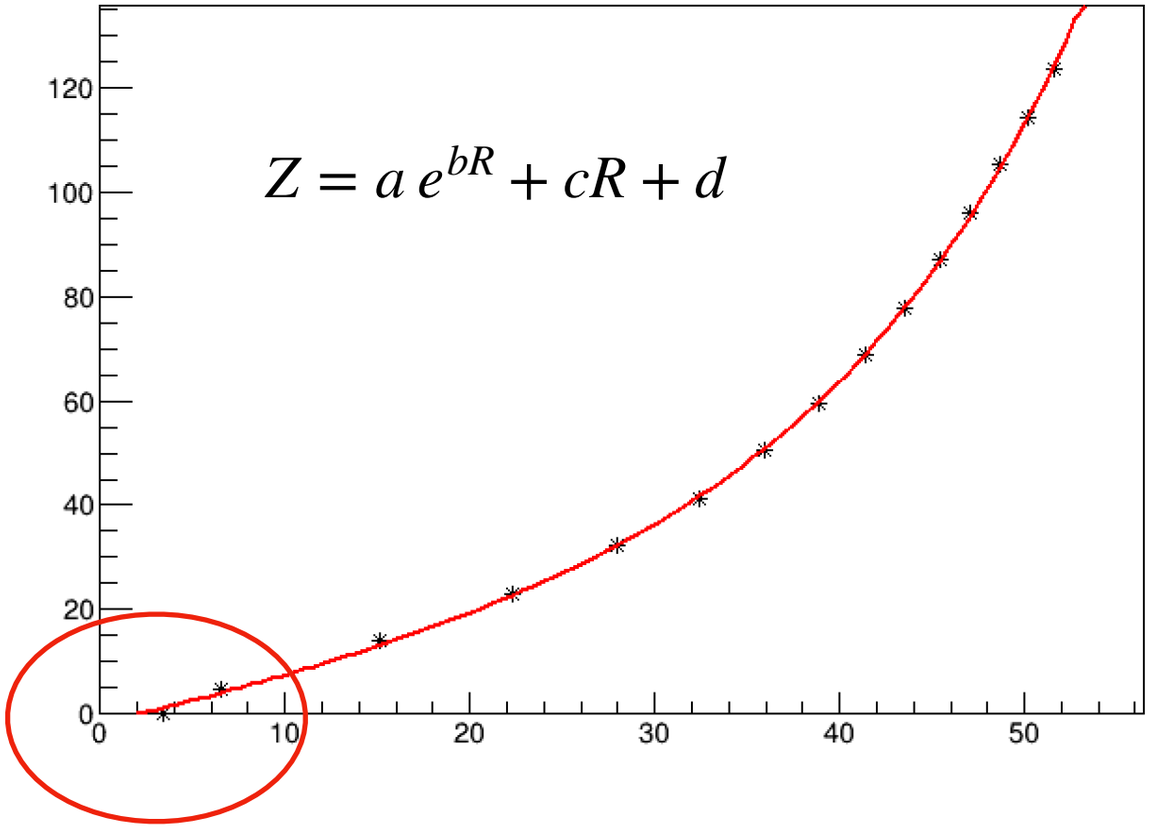


Exponential / logarithmic shape

- Study in progress
  - Trying to do a fit to get the exp. / log. formula, which is necessary in the RF_Track to construct the shape of AMD



Bad fit at Z=0



Fit at Z=0 not good, which gives a smaller entrance aperture that would affect the yield. Trying to solve this.

Exponential / logarithmic shape

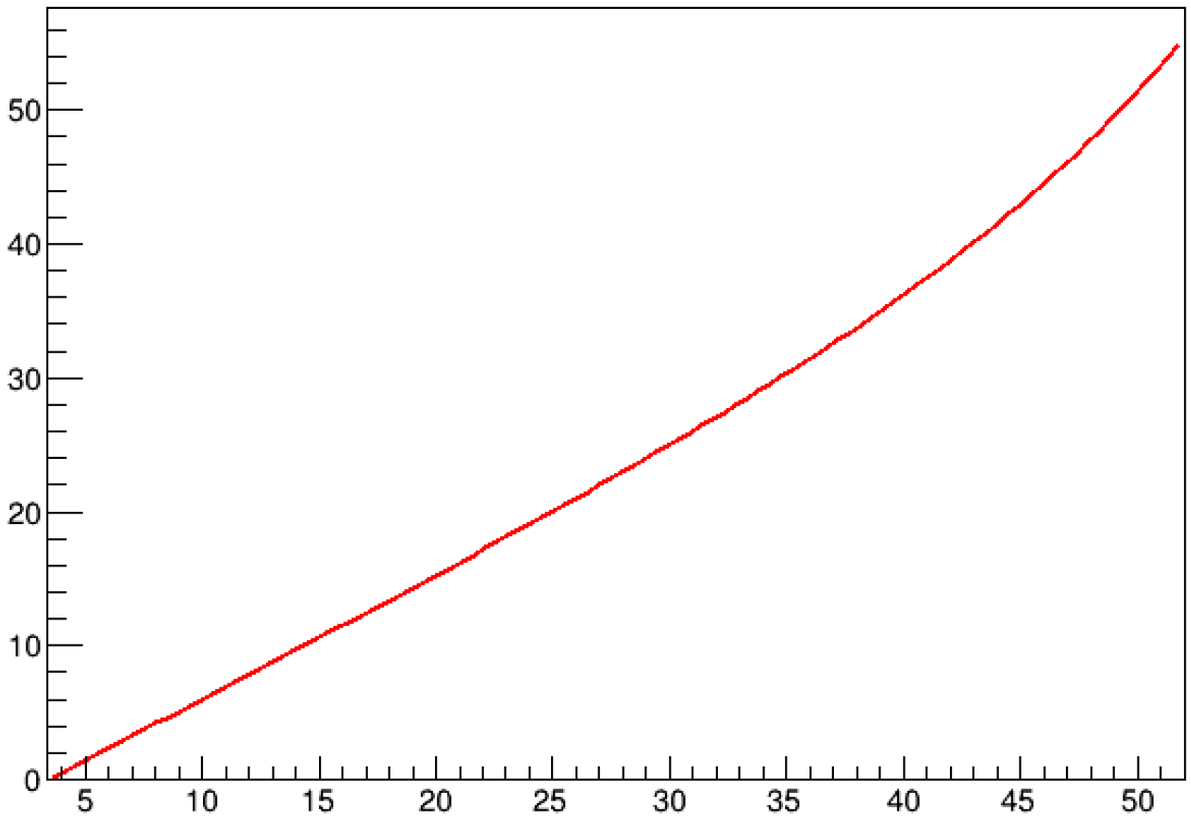
- I also tried the formula Hugo provided in one of the emails, but I can’t reproduce the function.

Hi Yongke,

The function is:

f= g * (exp(a*r) –b) + d*(r–Ri)
With b = exp(a*Ri)
a=0.105
g=0.0.5
d=0.9

That verify f(Ri)= 0



The length of the magnet is also strictly the same as the linear case 123.5 mm.

Exponential / logarithmic shape

- Very preliminary results
- For simplification, in the table below:
  - Fringe field and distance (Target—AMD) NOT considered

	Yield at target exit	Yield at AMD exit	Yield at TW exit	Effective Yield
Linear (reference model)		6.36	0.51	**0**
Exponential		11.9	study in progress	

- There must be a problem. Not sure what the problem is. Maybe due to that the input field map files, which have different format as before. To check if there is a mistake there.
- I didn't have enough time to re-optimise the TW parameters. But I don't think that is the reason. Since in the earlier studies, we know that this should have a small effect.

Conclusions

- Realistic (Opera) field map has different shape with analytic formula
- 1D field map gives smaller yield, 7%~13% less than 2D map. Unless the difference can be reduced, otherwise I would suggest we stick to 2D field maps
- Besides, it's very hard to find an theoretical formula to describe the 1D realistic field
- Suggested distance between target and AMD ~25 mm, which perfectly eliminates the effect of fringe field on PEDD, without much loss in final yield
- Enlarged entrance model improved the yield
- Study of exponential aperture model in progress. Before that, we need to find the problem (probably in input field map)
- Injector linac simulation with Placet in progress