

Exercise : EM Thresholds

Aim of the exercise:

- Examine the effect of setting different threshold values
- Further interaction with the FLUKA manual
- Practice the use of preprocessor directives
- Strengthen plotting skills





Input file

mputme	×		
 10 MeV electron beam Circular beam with 2 mm radius Starting at x=0 cm, y=0 cm, z=-1 cm 	0.5 0.4 0.3		
 Cylindrical target along z, 5-mm radius, split in three layers, each 50 µm thick Set to H₂O – Pb – Al 	0,2 (0,1		
 Thin layers require high tracking precision. Thus, we set DEFAULT PRECISION 	0 -0.1		
 Notice that three preprocessor variables are defined HI-THR, LOW-THR, VLOW-THR 	-0.2		
 USRBIN scoring DOSE over the entire target 1 µm bins in z, 1 bin in R, unformatted unit 55 	-0.5 -0.1	0	0,1

Ζ

Add EMFCUT cards

- Set both production and transport thresholds in all materials
 - Hint: when specifying the range of materials/regions, use @LASTMAT/@LASTREG as needed to refer to the last
 material or region, respectively
- Use preprocessor instructions to prepare three runs, one for each threshold case, exploiting the already defined preprocessor variables:

#it HI-THR		
photons: 1 keV ,	electrons: 1 MeV kinetic energy,	FUDGEM=1
#elif LOW-THR		
photons: 1 keV ,	electrons: 100 keV <mark>kinetic</mark> energy,	FUDGEM=1
#elif VLOW-THR		
photons: 1 keV ,	electrons: 10 keV kinetic energy,	FUDGEM=0.5
#endif		

- Note that the electron threshold is 100 keV in case of PRECISIOn, corresponding to our LOW-THR case
- Reminder: stopping powers and ranges for electrons, protons, and He ions are available on the NIST webpage: <u>https://physics.nist.gov/PhysRefData/Star/Text/intro.html</u>



Run

	🔀 /Users/luillo/cernbox/shared/FLUKA_course/	/2020_fall/ex_Threasholds/solution/ex_threasholds.f	air - flair			
🔚 🧐 👻 📔 🚝 Flair 🛛 🔞 Input	💕 Geometry 🛛 🚴 Run 🛛 🛄 Plot		🗐 Calculator 🔻 🇊			
Paste Copy Copy Clipboard View	Image: Second	Prev: 0 No: 5 To: 5 Job Action				
		Run	▲ ×			
+ Run Spawn <ex_threasholds> high_thresholds low_threasholds vlow_threasholds</ex_threasholds>	Override Title: Primaries: 100000 Mode: Defines: Default Defines Name HI-THR LOW-THR VLOW-THR VLOW-THR	Time: 0.0 Rr	nd: 0 🗃 🔀			
	-Progress		194) 			
	Status: Finished OK	Input: high_thresholds	Dir:			
	Flapsed:	Cycle:	nme/prim: Bup:			
	Cycles:	cycle.	Nun.			
	Primaries:					
Fluka: ex_threasholds.flair • Running 1 out of 4						

Run three simulations corresponding to high, low, or very low threshold values, with 5 cycles × 100000 primaries for each case The three runs are already set up in the Flair project

Should take less than ~5 minutes on a reasonably up-to-date machine.



Plot and compare the results

Plots are already set up in the Flair project

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	Paste Copy Add • Clipboard	A Move Up X Delete A Move Down A Move Down		
—	•		Plot	▲ ×
First plot these three to make sure all needed files are there for the comparison plot!	 Red Green Blue Magenta high low verylow compare_thresholds 	Title: Axes Label x: Z [cm] y: Dose [GeV/g / primary] cb:	Detector Info File: verylow.dat Show Plot ✓ graph Type: histerror ▼ X Norm: ✓ legend Value: Y ▼ Y Norm: Options Color: green ▼ Line width: 1 €	Display: 0 € Log Min Max -0.001 - 0.016
	Fluka: ex. thresholds flair	set grid	Point type: triangle-up-filled V Point size: 1	
	Fluka: ex_thresholds.flair	saved.compare_mresnoids.png		



Exercise: EM Thresholds

Depth-dose distribution for various threshold settings





Exercise: EM Thresholds

Compare depth-dose curve for various thresholds

- Premature dose deposition for 1-MeV threshold
- Correct deposition on average for 100-keV threshold (the value with DEFAULTS->PRECISION), but lacking details
- More refined result for 10-keV threshold
- Net flow of low energy electrons across boundary from high Z to low Z materials
- Physical effect!



- Correct threshold values depend on the granularity of your geometry/scorings
- Do not blindly rely on default values
- Carefully set threshold values accordingly (range tables are helpful!)
- Do not forget to set the FUDGEM parameter



