Exercise 11: Cutoffs

FLUKA Beginner's Course

Exercise 11: Cutoffs

Aim of the exercise:

1- See the effect of different thresholds (easier with thin layers)

2- Discover DPA-SCO and NIEL-DEP

3- Improve plotting skills

4- Reminder on backscattering

Exercise 11: Cutoffs - I

- Start from the solution of ex5 (copy both inp and flair files):

  mkdir ex11 ; cp ex5/ex5.* ex11/. ; cd ex11

Instructions: changes to beam and geometry

- 10 MeV electron beam (hint: use #define PROTON)
- Beam size: circular with 2 mm radius
- Change the 3 targets 5mm radius and 50 microns thickness
- Change surrounding CO2 into VACUUM
- Swap material for TARGS2 and TARGS3
- (i.e.: target is made of H_2O – Pb – Al)

Instructions: general settings

- Reminder: thin layers require high tracking precision
  therefore DEFAULT PRECISIO is needed (is already there)
- Turn on single scattering at boundaries (find out how)

Exercise 11: Cutoffs - I

Instructions: set thresholds

- Define 3 preprocessor variables: HI-THR, LOW-THR, VLOW-THR
- Use EMFCUT and DELTARAY cards to set both production and transport thresholds in all materials

```
#if HI-THR
        photons: 5 keV , electrons: 1 MeV kinetic energy
#elif LOW-THR
        photons: 5 keV , electrons: 100 keV kinetic energy
#elif VLOW-THR
        photons: 5 keV , electrons: 10 keV kinetic energy
#endif
```

Reminder: stopping powers and ranges for electrons, protons, and Helium ions are available on the NIST webpage:

www.nist.gov/pml/data/star/index.cfm

Exercise 11: Cutoffs - I

Instructions: scoring

- 1 USRBIN scoring DOSE over the target
  (1um bins in z, 5um bins in R, unformatted unit 55)
- 1 USRBDX scoring backscattered electrons & positrons fluence
  (i.e. from TARGS1 to INAIR)
  1 linear bin in angle, 100 linear bins in energy, unformatted unit 56

Instructions: running

- For each threshold setting run 5 cycles x 100000 primaries
- Remember not to overwrite results

Plot the results

- Plot the three backscattered electron cases on the same plot
- Dose: 1D-proj in z (fix y-scale: gnuplot option `set yscale[xx:yy]`)

Exercise 11: Cutoffs - II

Instructions: again proton beam

- 4 MeV proton beam (use #define PROTON)
- For HI-THR, LOW-THR, and VLOW-THR set proton threshold
  at 10 MeV, 100 keV, and 1 kev respectively
- Add MAT-PROP card specifying a DPA-ENERgy threshold
  of 25 eV for lead and 27 eV for aluminum
  (only for the VLOW-THR case)
- Add R-Φ-Z USRBIN to score Displacement Per Atom and
  Non Ionizing Energy Loss deposition over aluminum and lead
  (50 bins in R, 1 bin in Φ, 100 bins in Z)
  Unformatted unit 57

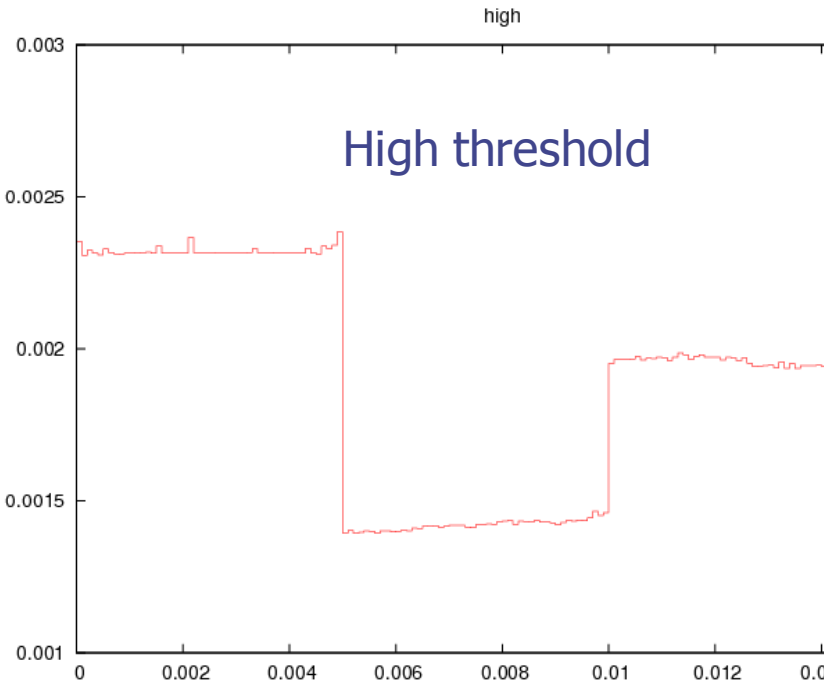
Exercise 11: Cutoffs - II

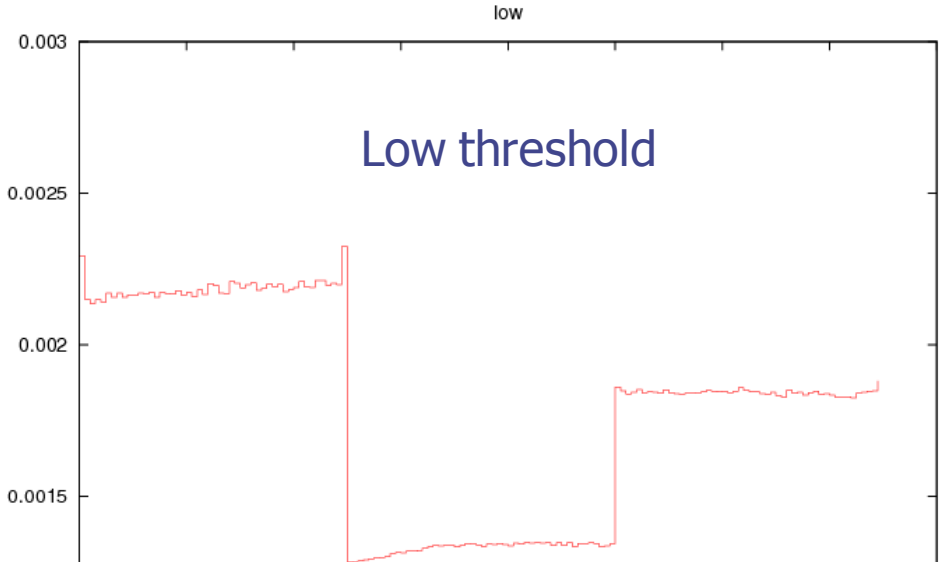
Questions

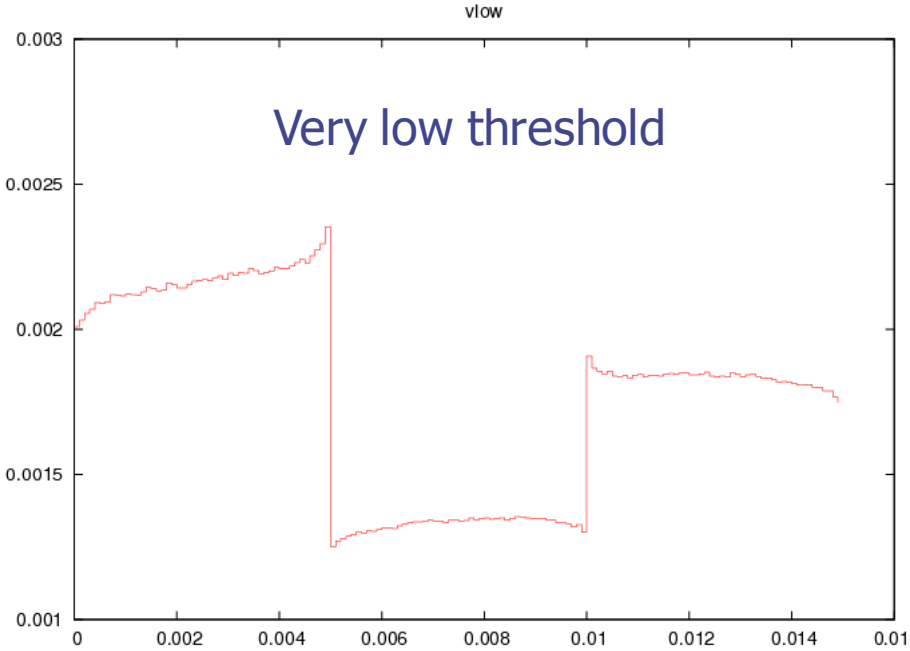
- Why not scoring on water?
- Evaluate the average number of DPA for
  a 100 day long beam time and 1 uA proton
- For HI-THR and LOW-THR case, plot the dose and see the difference
  Can you explain the effect of the different thresholds?

Exercise 11: Cutoffs – solution

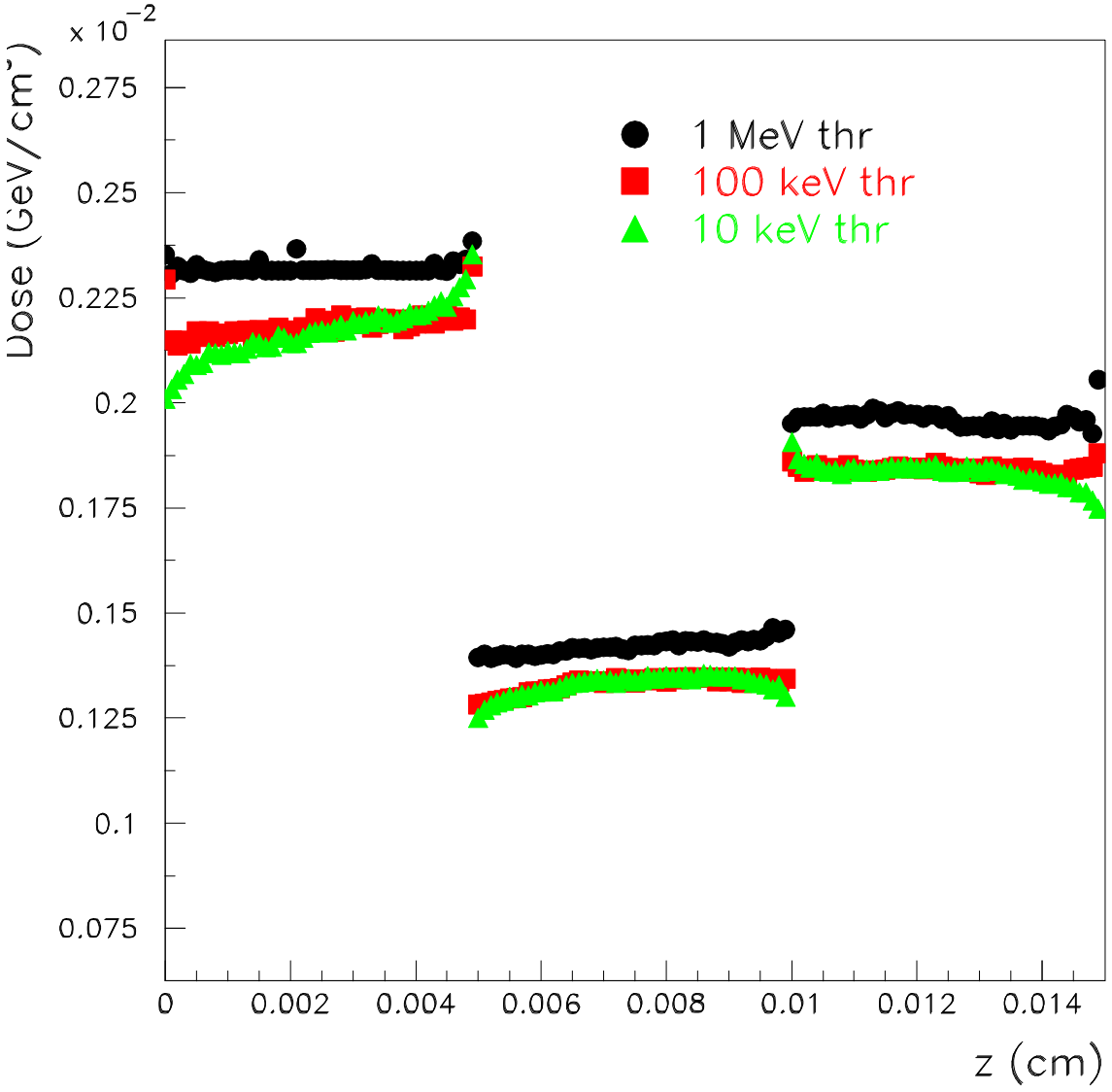
Exercise 11: Cutoffs – I solution



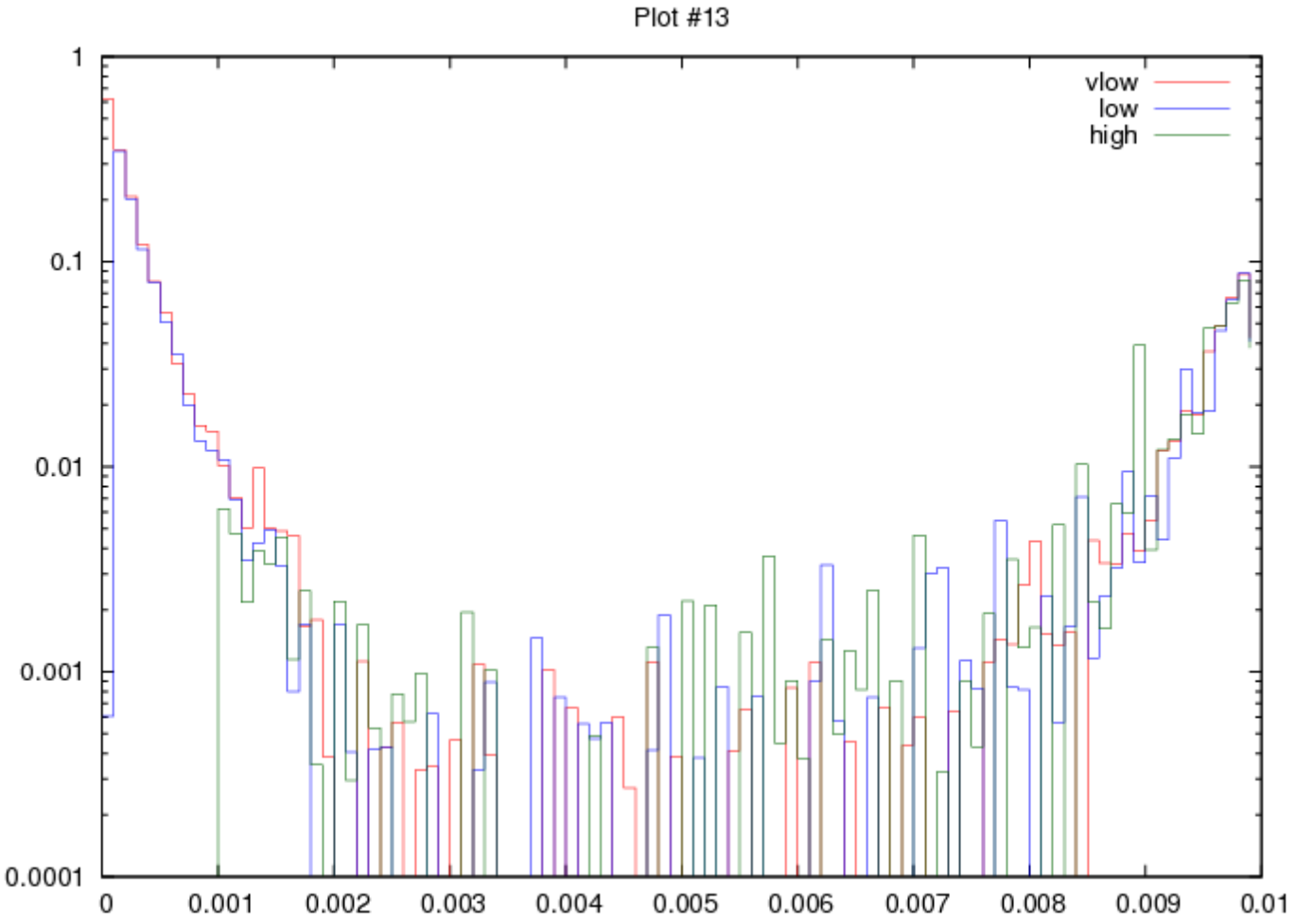




Exercise 11: Cutoffs – I solution



Exercise 11: Cutoffs – I solution



Exercise 11: Cutoffs – II solution