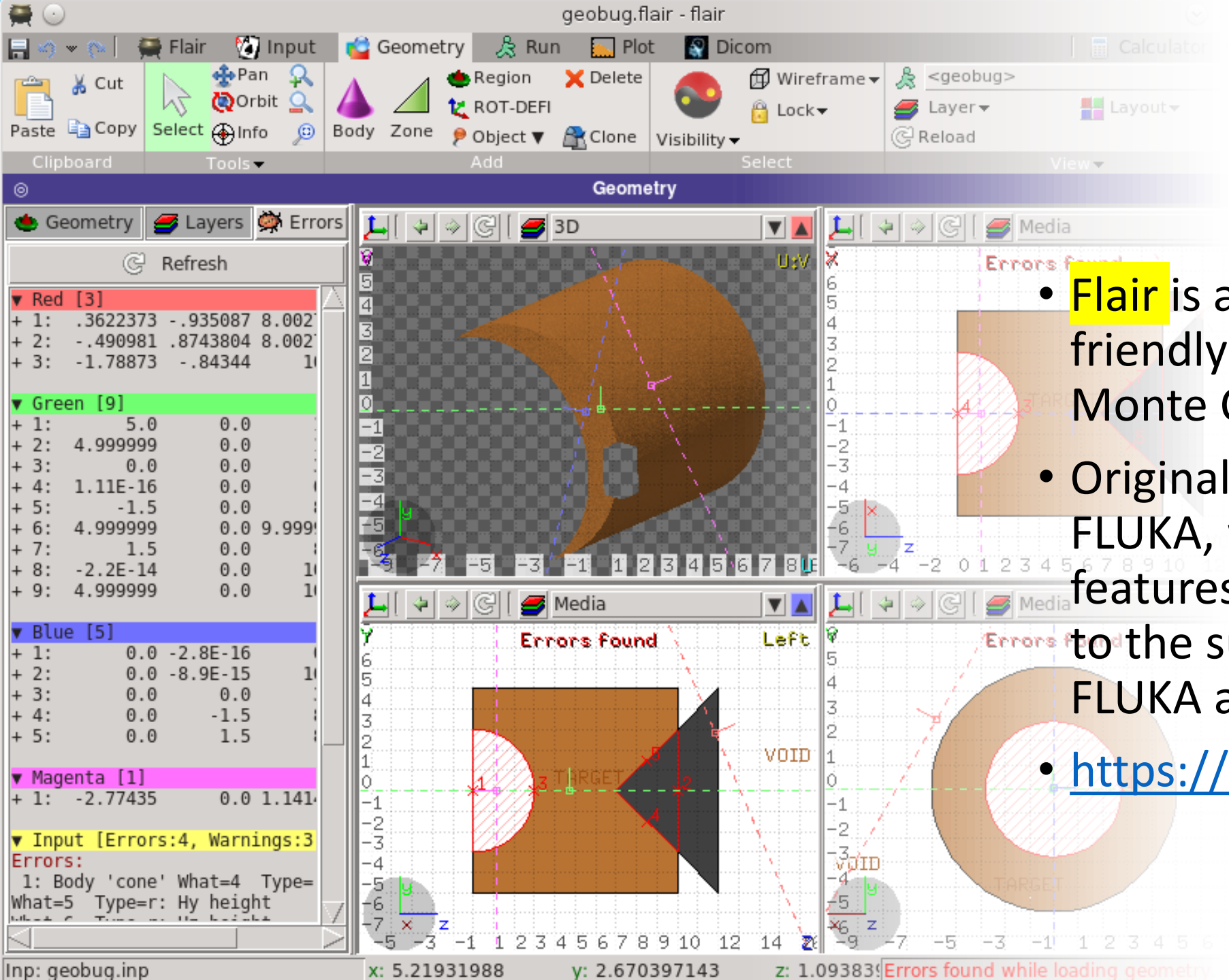
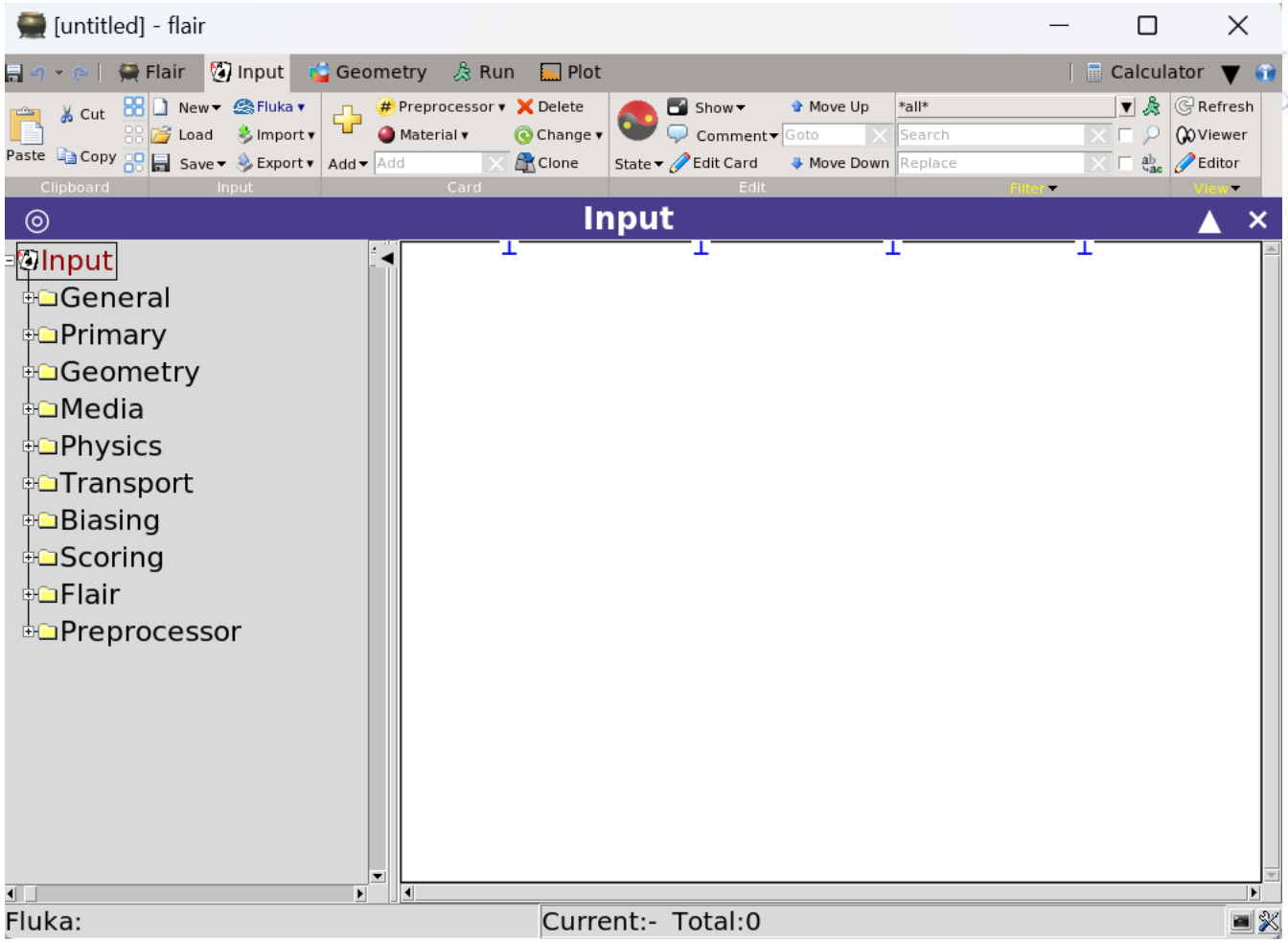
# How to use FLUKA and flair for beginner

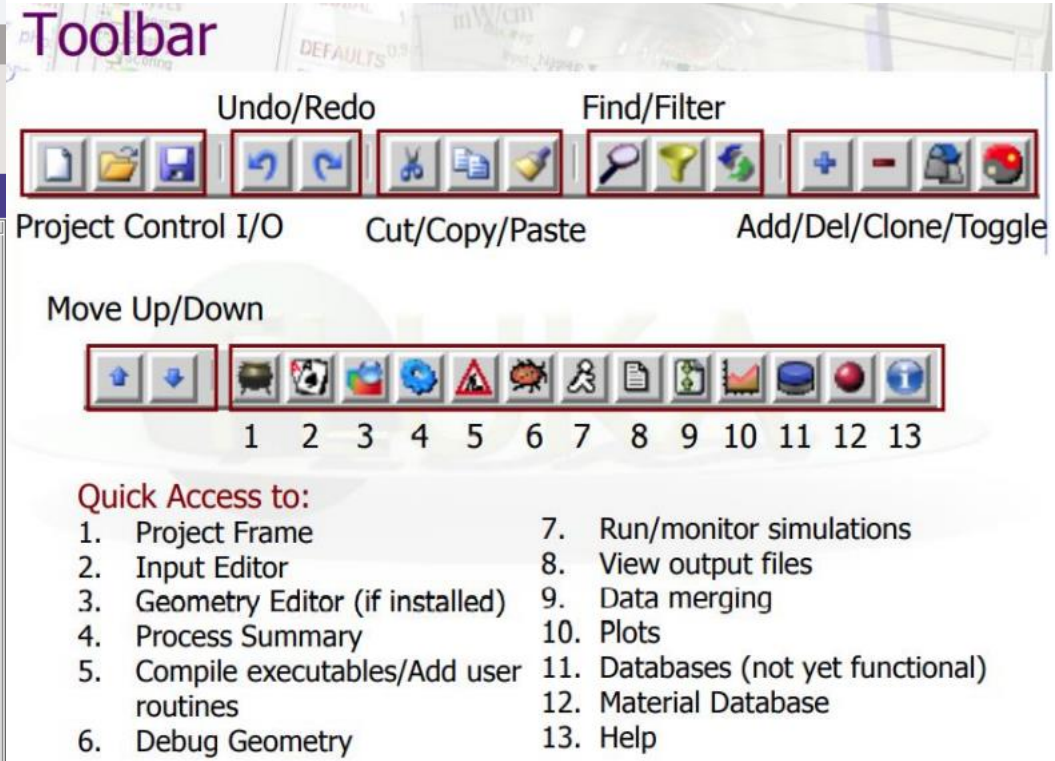
Audcharapon Pagwhan (Ink)




- Flair is an advanced user-friendly interface for several Monte Carlo codes.
- Originally it was developed for FLUKA, where its unique features strongly contributed to the success of both codes FLUKA and flair.
- https://flair.web.cern.ch/flair/

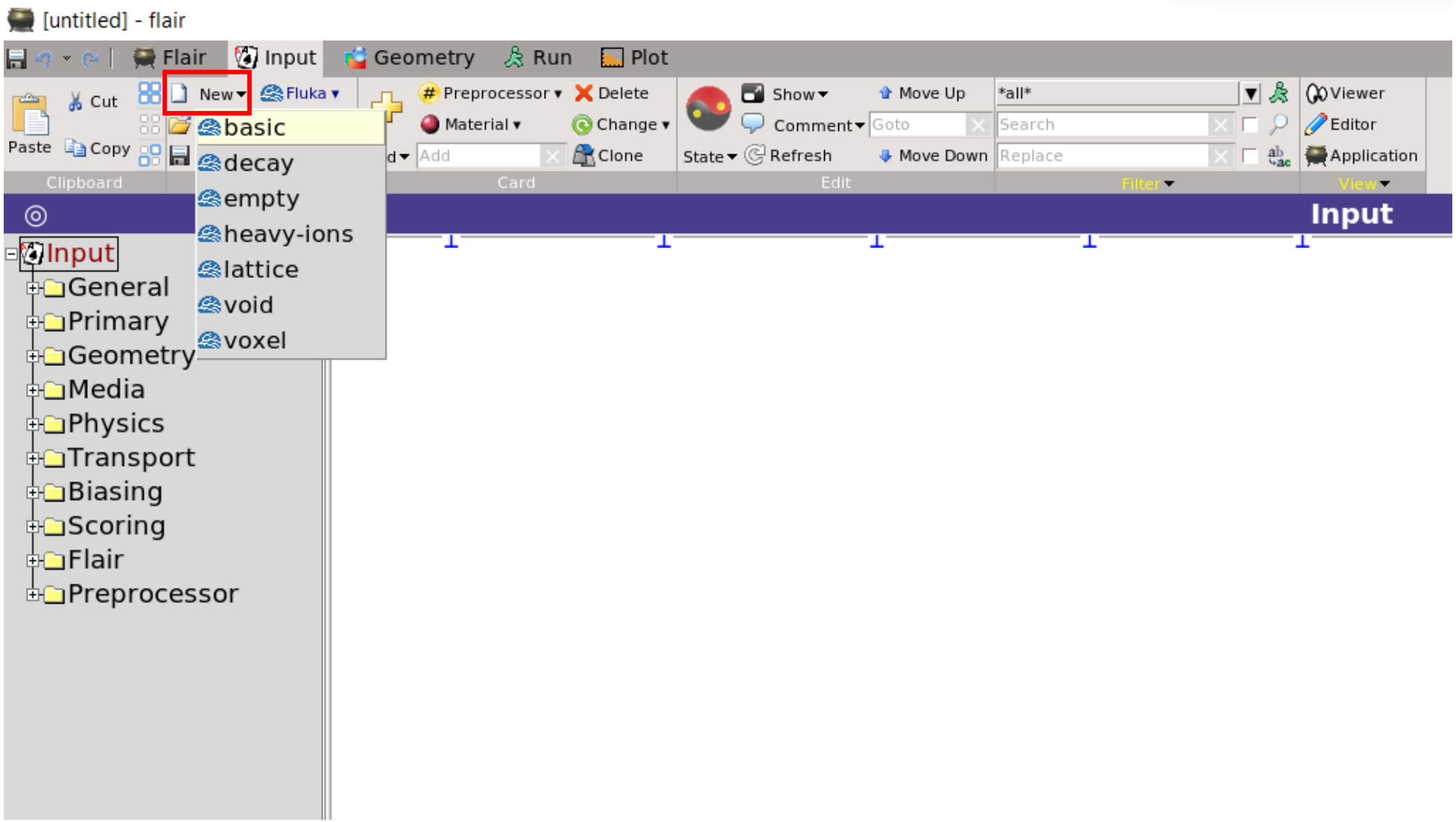
# Flair program (interface for FLUKA program)

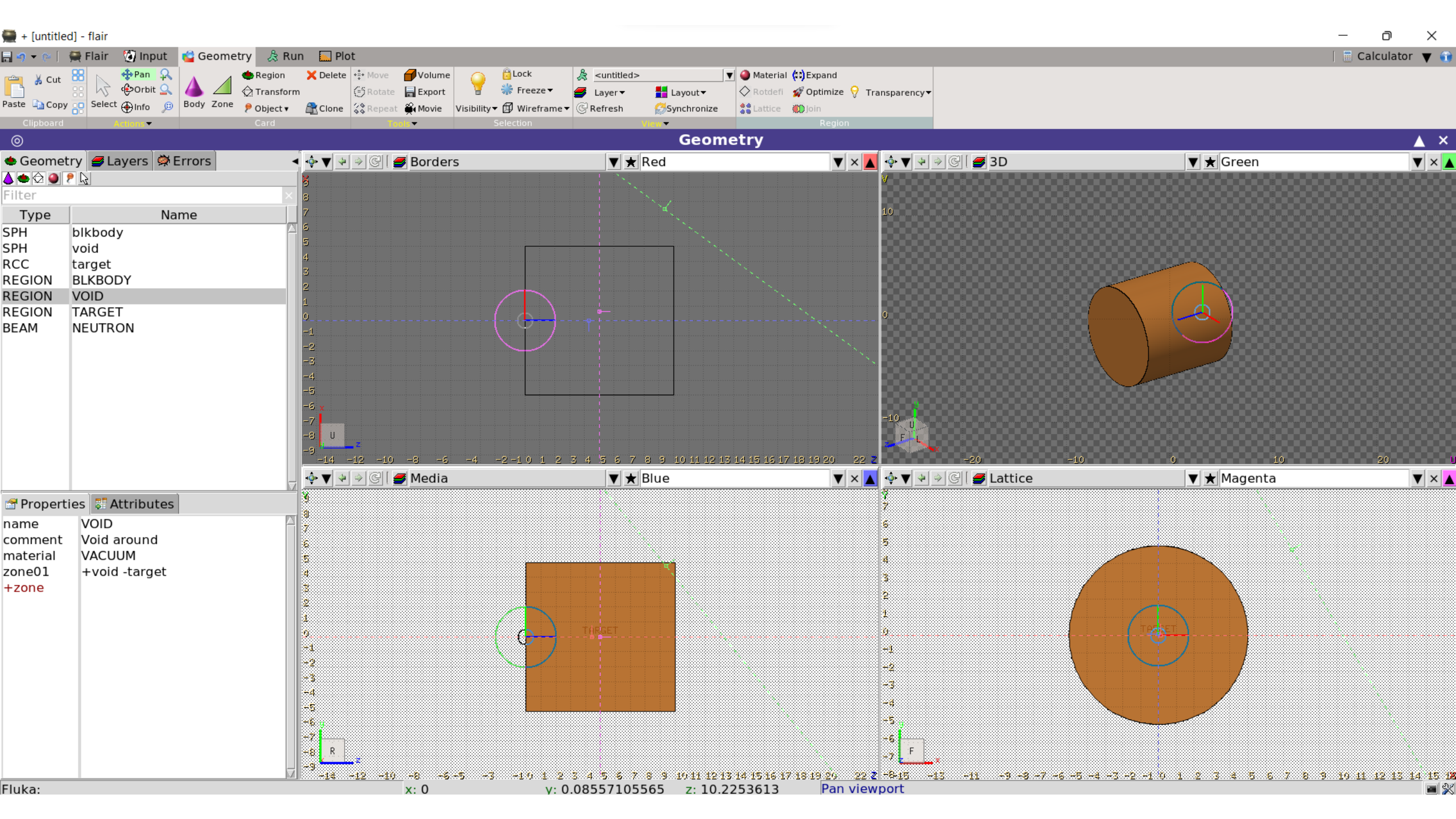


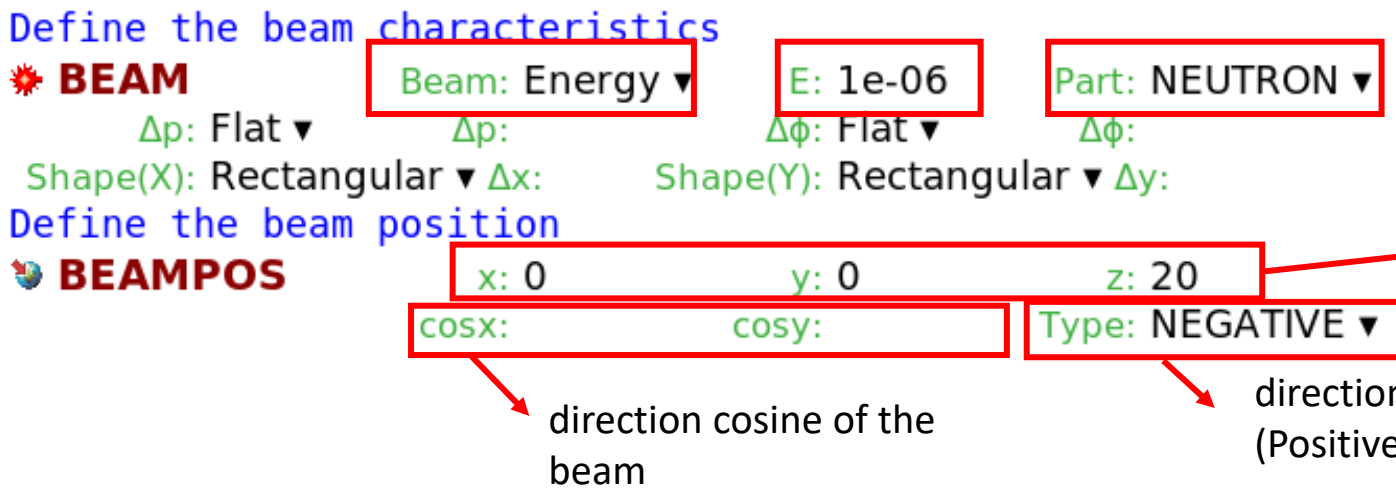
# How to create a model? (using flair)

1. Beam
2. Geometry
3. Region
4. Assign material


[untitled] - flair
Flair
Input
Geometry
Run
Plot
Cut
Paste
Copy
New
Fluka
basic
decay
empty
heavy-ions
lattice
void
voxel
Preprocessor
Material
Add
Delete
Change
Clone
Clipboard
Card
Show
Comment
State
Refresh
Move Up
Goto
Move Down
Edit
*all*
Search
Replace
Filter
Viewer
Editor
Application
View
Input
Input
General
Primary
Geometry
Media
Physics
Transport
Biasing
Scoring
Flair
Preprocessor


+ [untitled] - flair
Flair
Input
Geometry
Run
Plot
Calculator
Paste
Cut
Copy
Select
Pan
Orbit
Info
Body
Zone
Region
Transform
Object
Delete
Clone
Move
Rotate
Repeat
Volume
Export
Movie
Visibility
Lock
Freeze
Wireframe
<untitled>
Layer
Refresh
Layout
Synchronize
Material
Rotdefi
Lattice
Expand
Optimize
Join
Transparency
Clipboard
Actions
Card
Tools
Selection
View
Region
Geometry
Layers
Errors
Filter
Type
Name
SPH blkbody
SPH void
RCC target
REGION BLKBODY
REGION VOID
REGION TARGET
BEAM NEUTRON
Properties
Attributes
name VOID
comment Void around
material VACUUM
zone01 +void -target
+zone
Borders
Red
3D
Green
Media
Blue
Lattice
Magenta
TARGET
Fluka:
x: 0
y: 0.08557105565
z: 10.2253613
Pan viewport

# Beam and Beam's Position




x-coordinate y-coordinate and z-coordinate of the spot center.

direction cosine of the beam

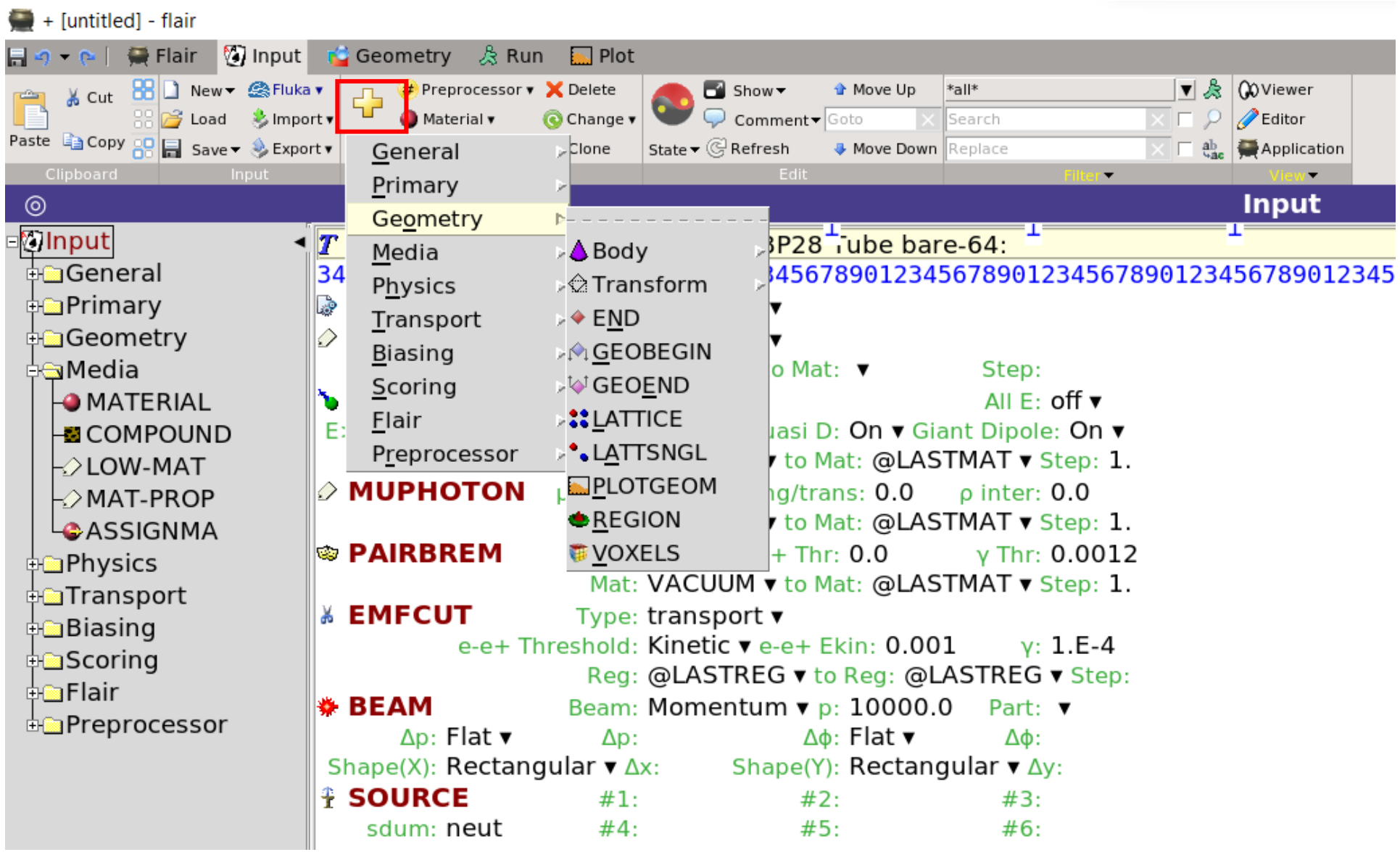
direction of the beam (Positive ↑, Negative↓)

```
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....
BEAM          -1E-06                                                  NEUTRON
```

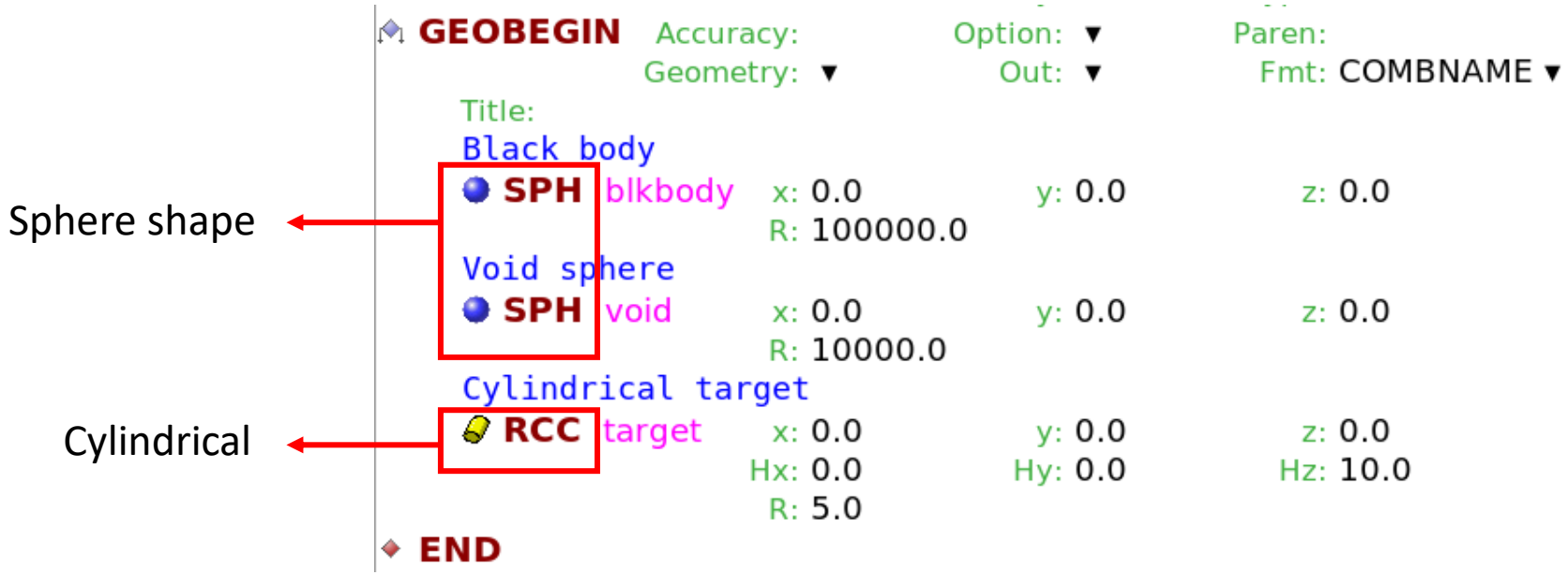
```
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....
BEAMPOS             0.        0.       20.                            NEGATIVE
```

* If we use source.f, we don't create BEAMPOS card.

# Geometry


+ [untitled] - flair
Flair
Input
Geometry
Run
Plot
Cut
Copy
Paste
New
Load
Save
Fluka
Import
Export
Preprocessor
Material
Delete
Change
Clone
Show
Comment
State
Refresh
Move Up
Move Down
Goto
*all*
Search
Replace
Viewer
Editor
Application
Clipboard
Input
Edit
Filter
View
General
Primary
Geometry
Media
Physics
Transport
Biasing
Scoring
Flair
Preprocessor
Body
Transform
END
GEOBEGIN
GEOEND
LATTICE
LATTSNGL
PLOTGEOM
REGION
VOXELS
Input
MATERIAL
COMPOUND
LOW-MAT
MAT-PROP
ASSIGNMA
MUPHOTON
PAIRBREM
EMFCUT
BEAM
SOURCE
Step:
All E: off
Giant Dipole: On
to Mat: @LASTMAT Step: 1.
ρ inter: 0.0
γ Thr: 0.0012
Mat: VACUUM to Mat: @LASTMAT Step: 1.
Type: transport
e-e+ Threshold: Kinetic e-e+ Ekin: 0.001 γ: 1.E-4
Reg: @LASTREG to Reg: @LASTREG Step:
Beam: Momentum p: 10000.0 Part:
Δp: Flat Δp: Δϕ: Flat Δϕ:
Shape(X): Rectangular Δx: Shape(Y): Rectangular Δy:
#1: #2: #3:
sdum: neut #4: #5: #6:

# Geometry

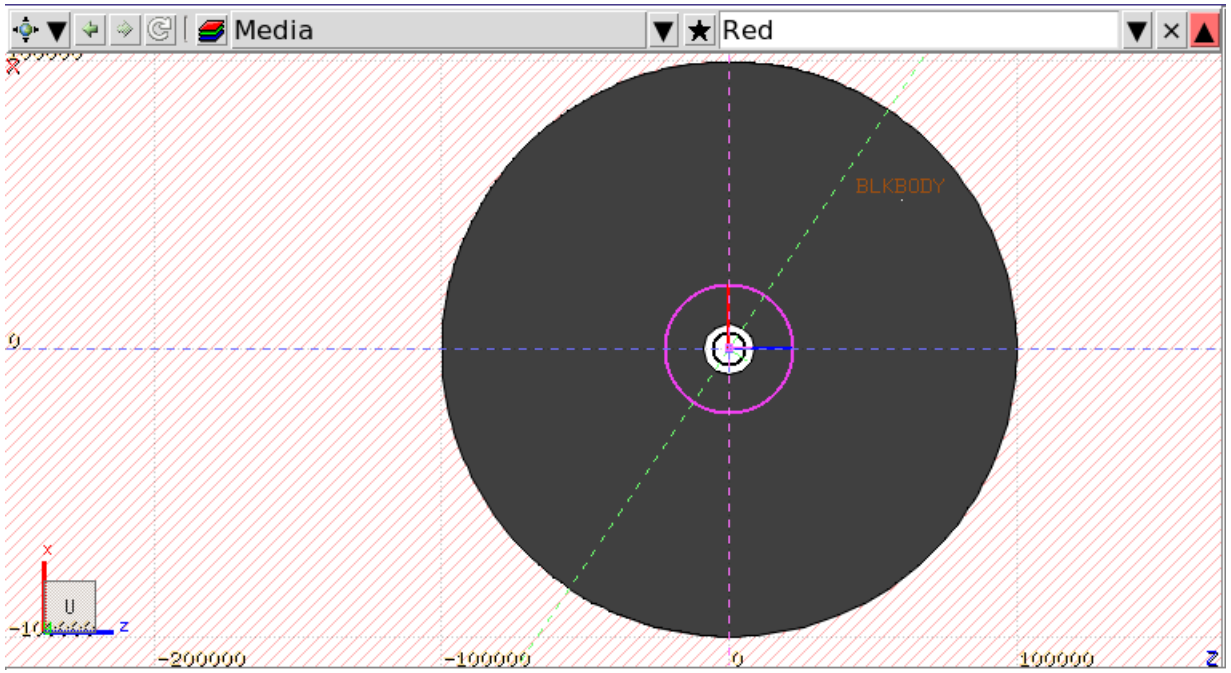


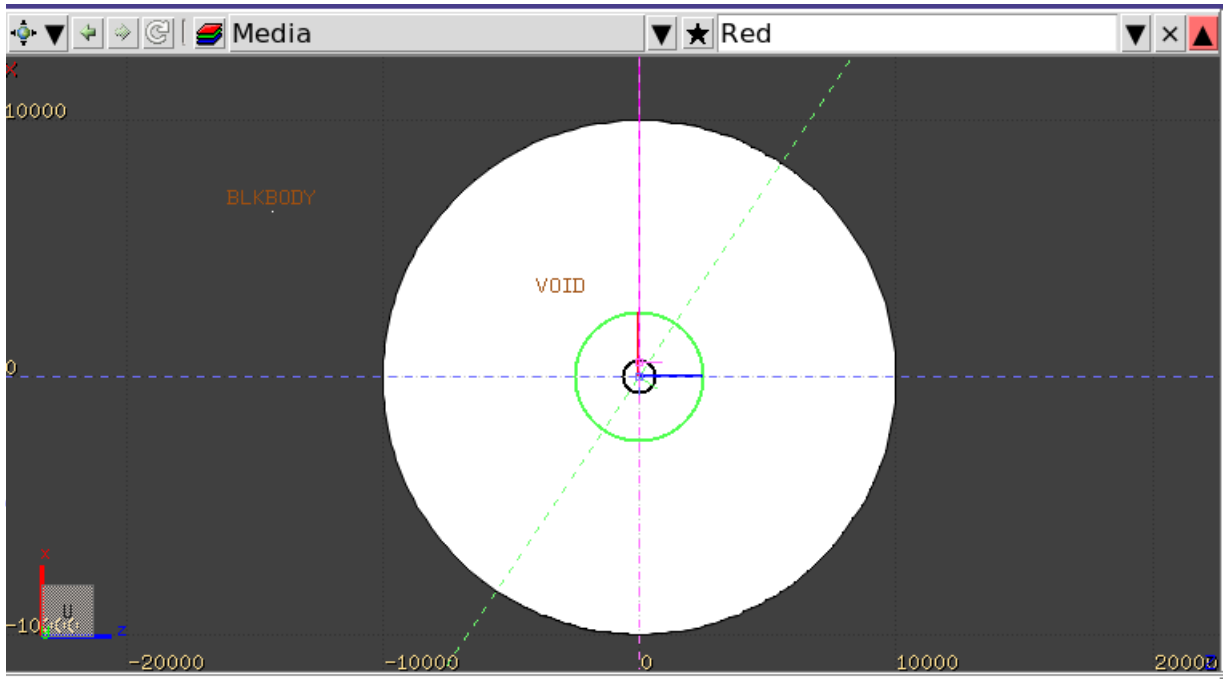

```
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....
SPH blkbody    0.0 0.0 0.0 100000.0
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....
RCC target     0.0 0.0 0.0 0.0 0.0 10.0 5.0
```

# Region

```
Black hole
 REGION  BLKBODY          Neigh: 5
  expr: +blkbody -void
Void around
 REGION  VOID             Neigh: 5
  expr: +void -target
Target
 REGION  TARGET           Neigh: 5
  expr: +target
END
GEOEND                    : ▼
```

```
*...+....1....+....2....+....3....+....4....+..
BLKBODY       5 +blkbody -void
```



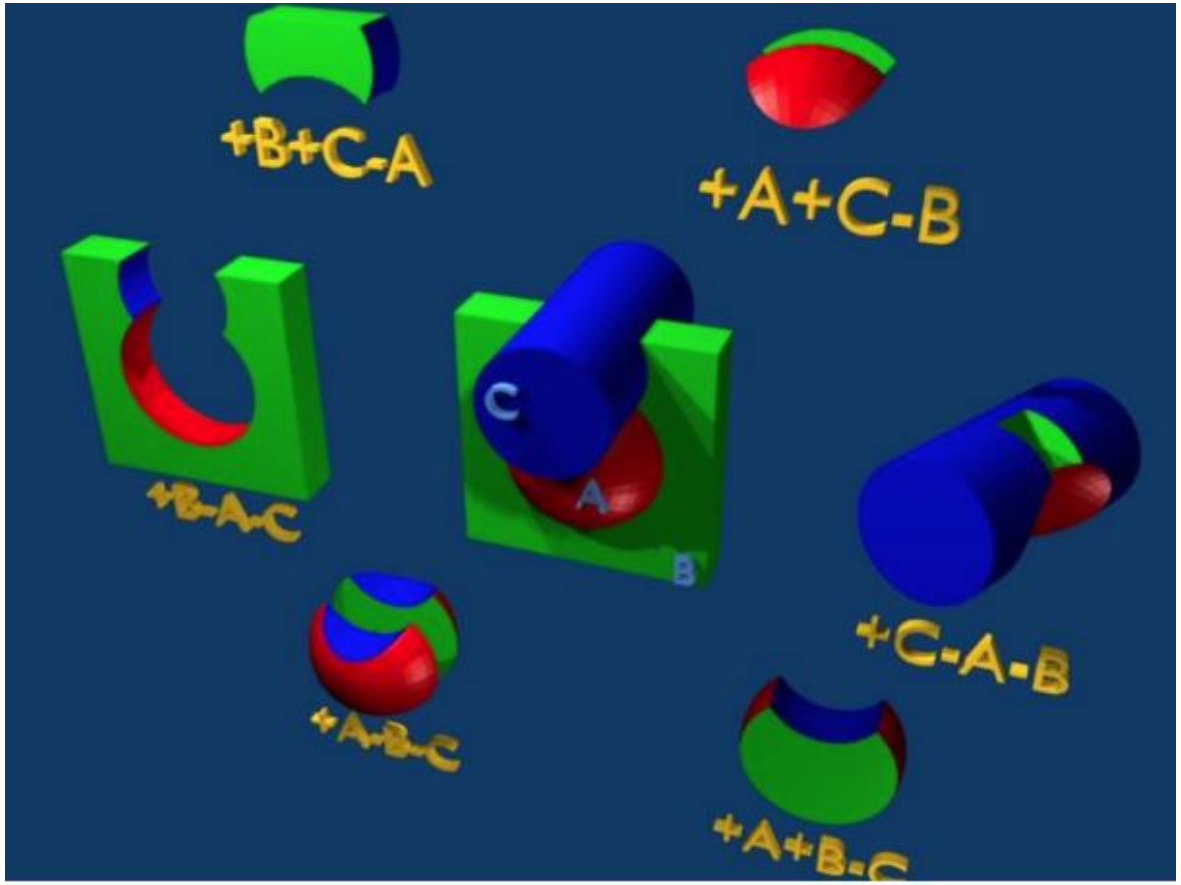
# Concept

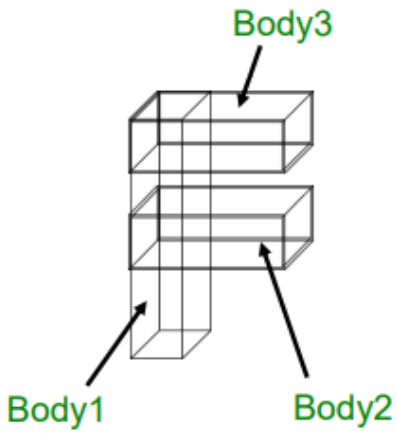
Regions are defined as combinations of bodies obtained by boolean operations:

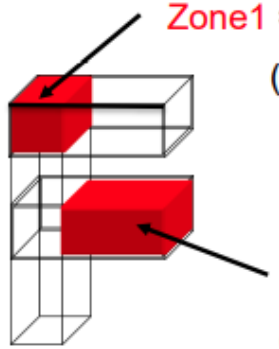
| | Union | Subtraction | Intersection |
|---|---|---|---|
| Name based format | \| | – | + |
| Fixed format | OR | – | + |
| Mathematically | $\cup$ | $-$ | $\cap$ |

Regions but must be of homogeneous material composition.

Each point of space must belong to one and only one region!



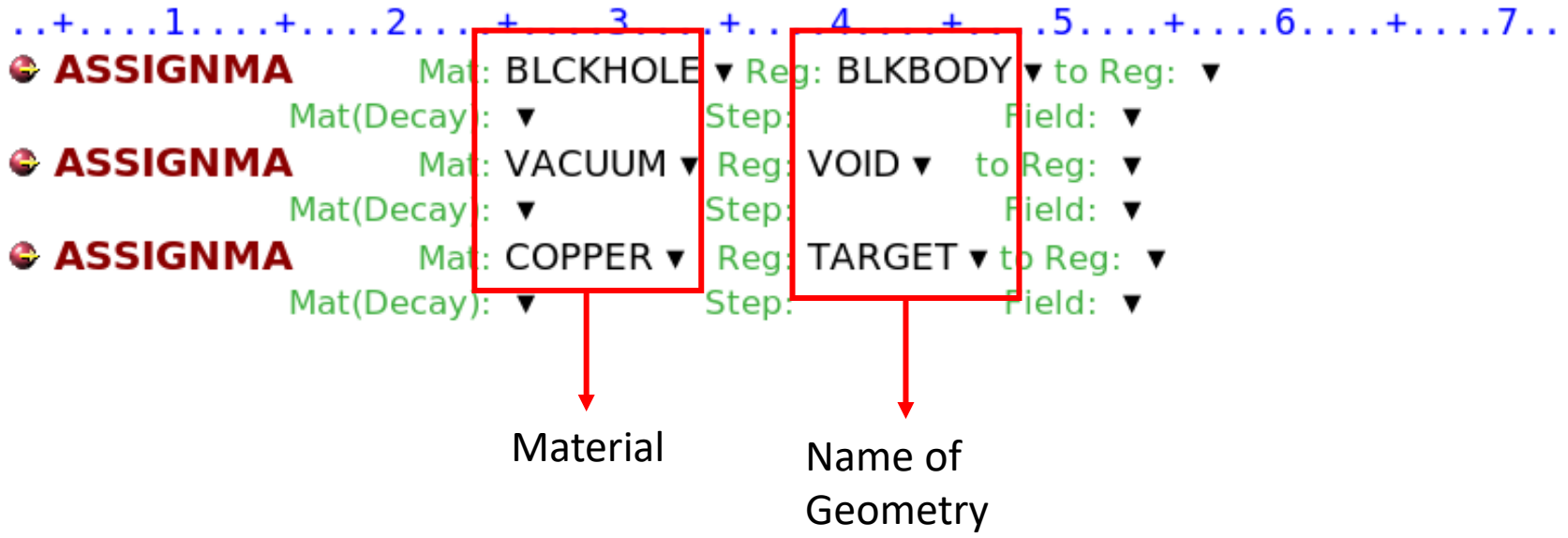
Zone1 = +Body1 +Body3

(Zone1 is the space common to Body1 and Body3)

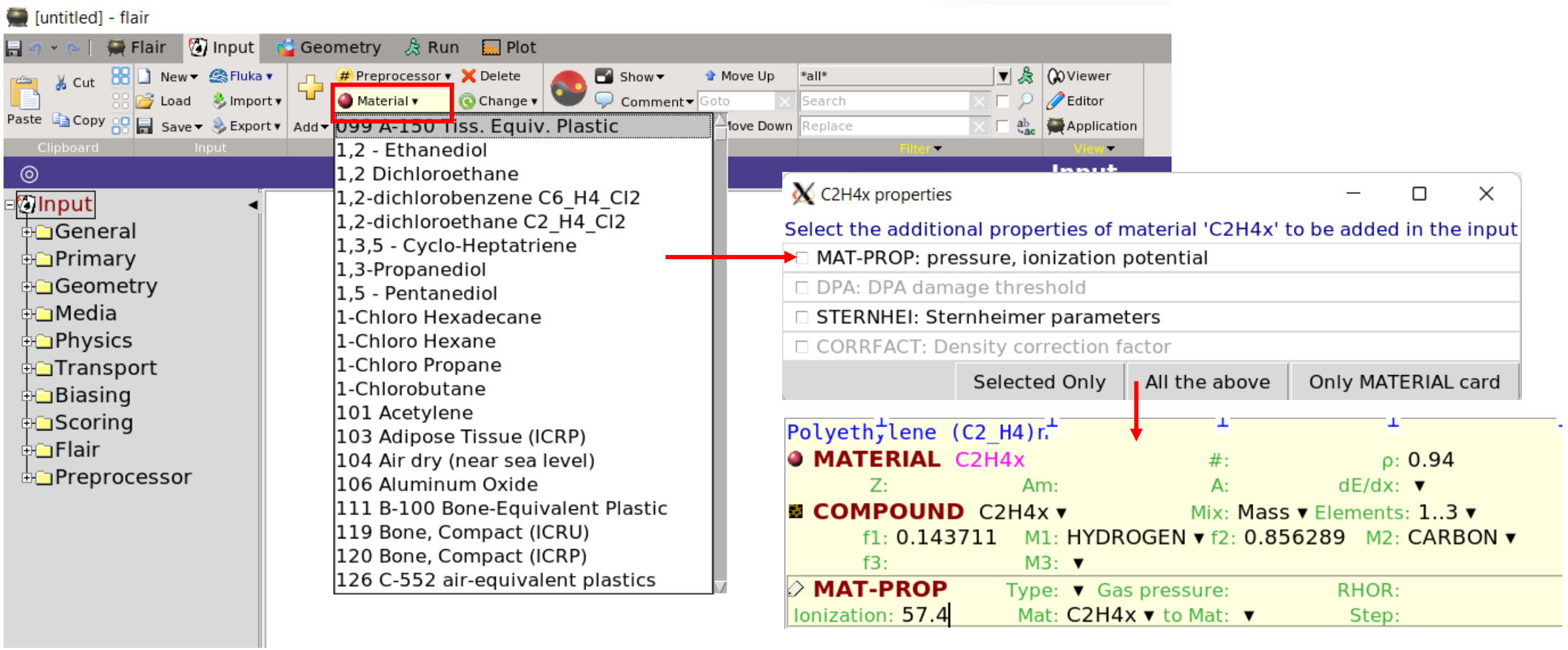
Zone2 = +Body2 –Body1

(Zone2 is the space inside of Body2 but outside of Body1)

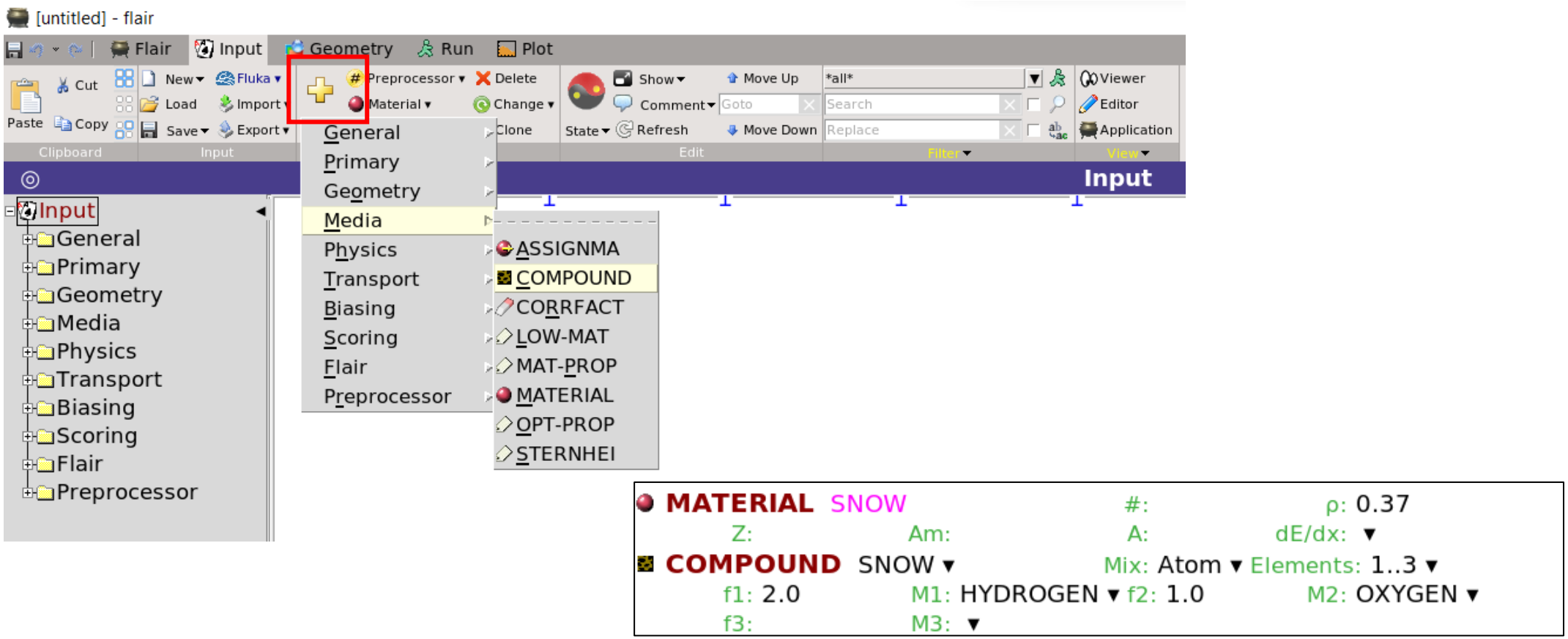
# Assign Materials



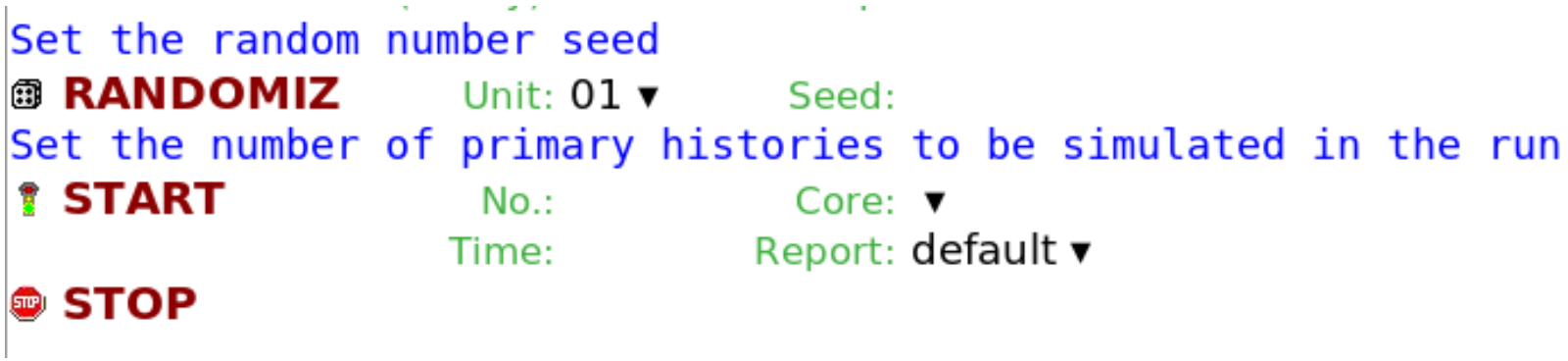
# Materials and Compound Materials



# Materials and Compound Materials

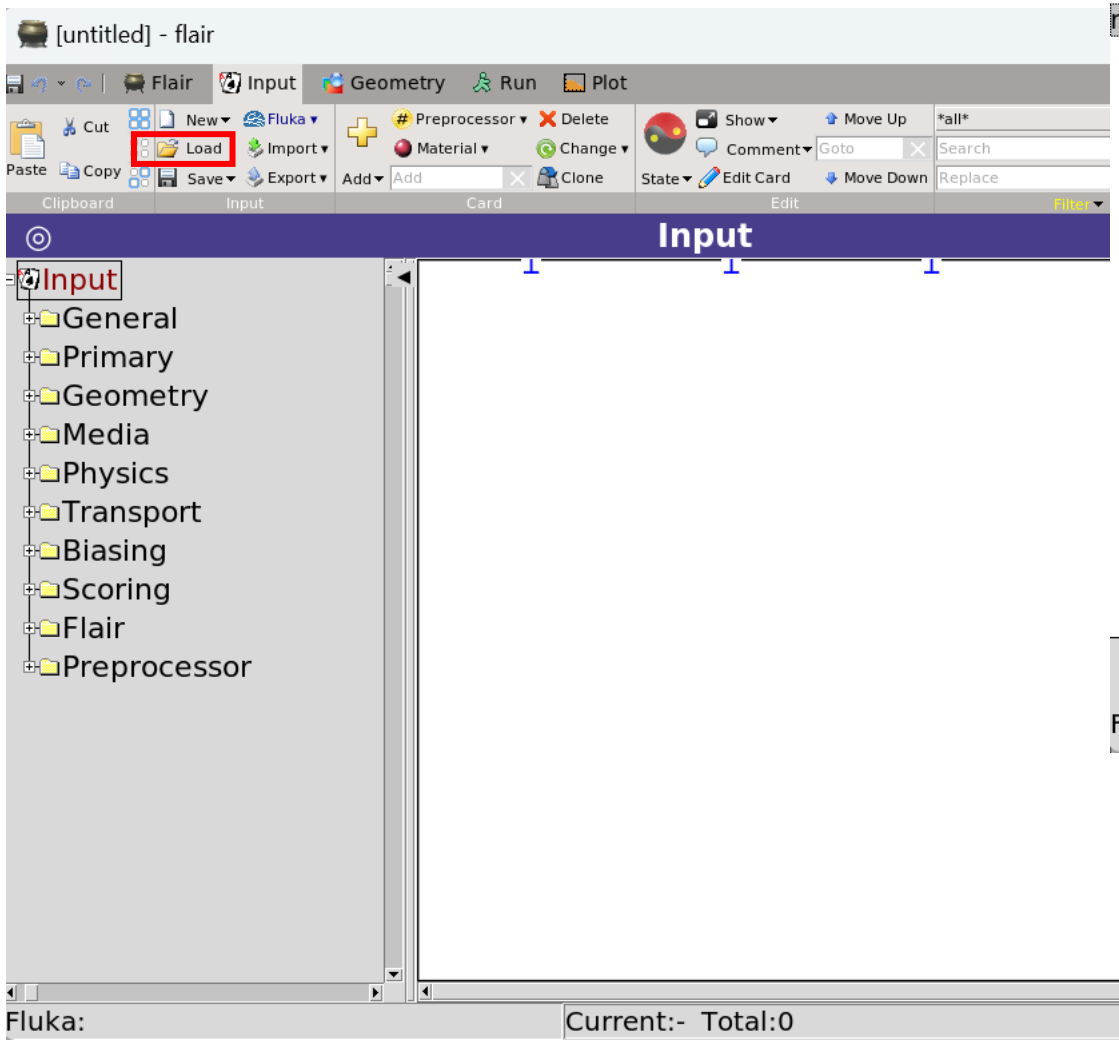


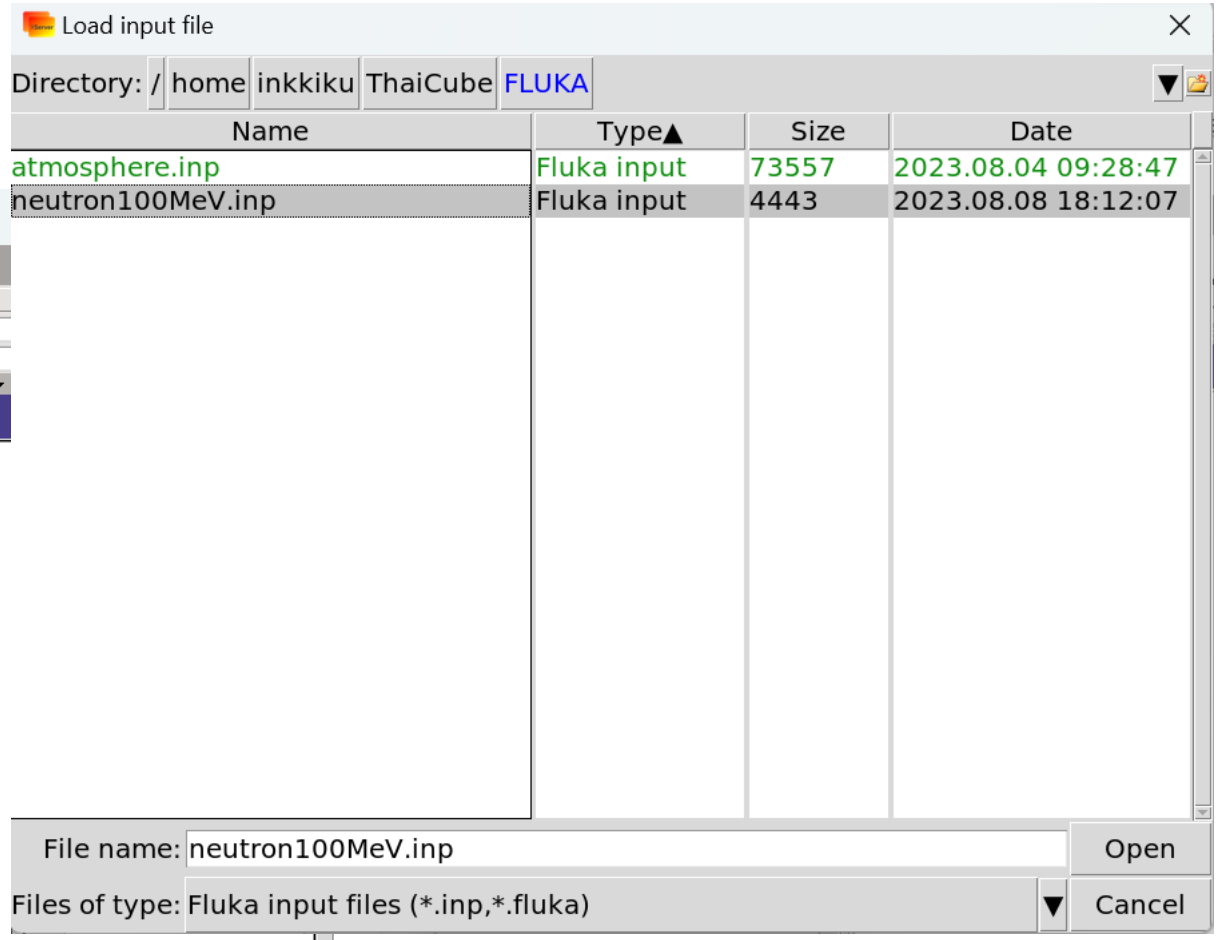
# Scoring

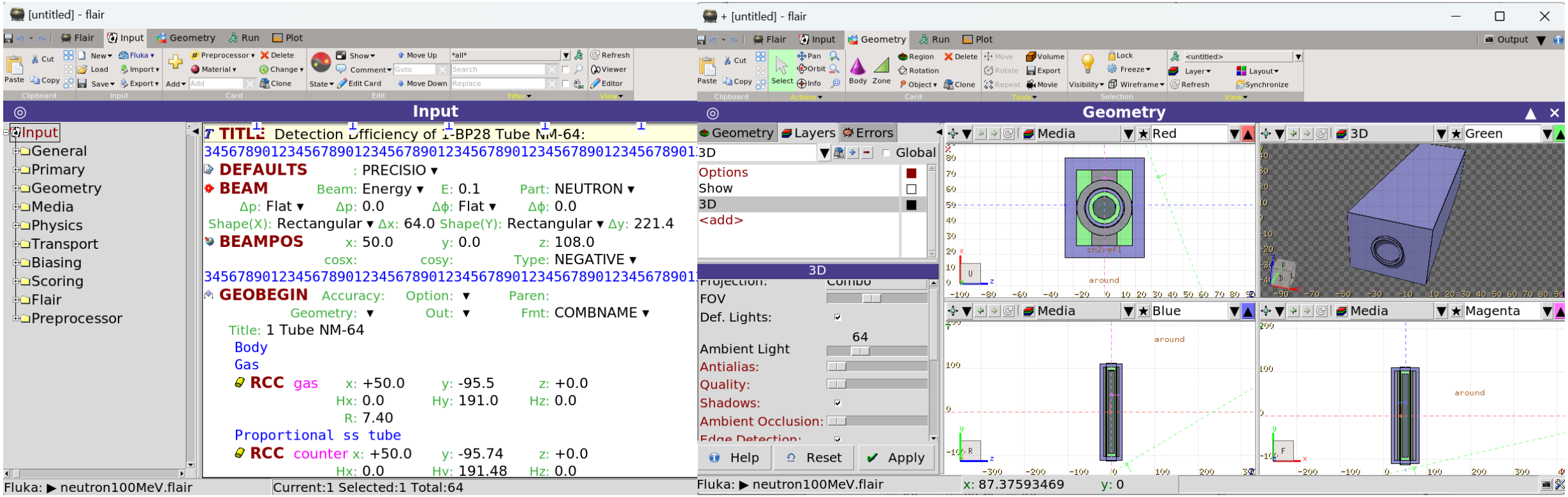

Set the random number seed
RANDOMIZ
Unit: 01
Seed:
Set the number of primary histories to be simulated in the run
START
No.:
Core:
Time:
Report: default
STOP

# Operate Simulation by using flair

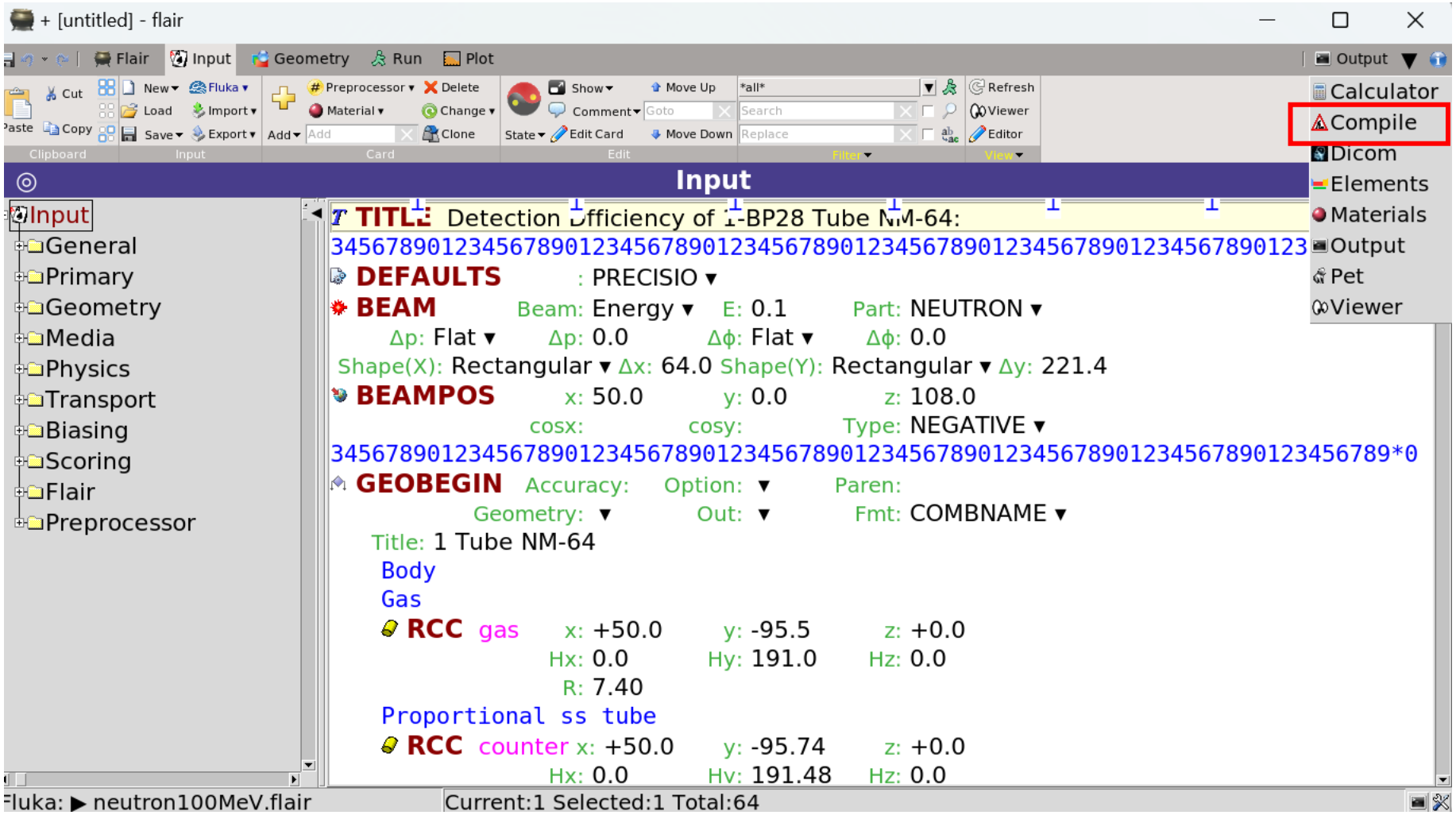
# 1. Insert the input file



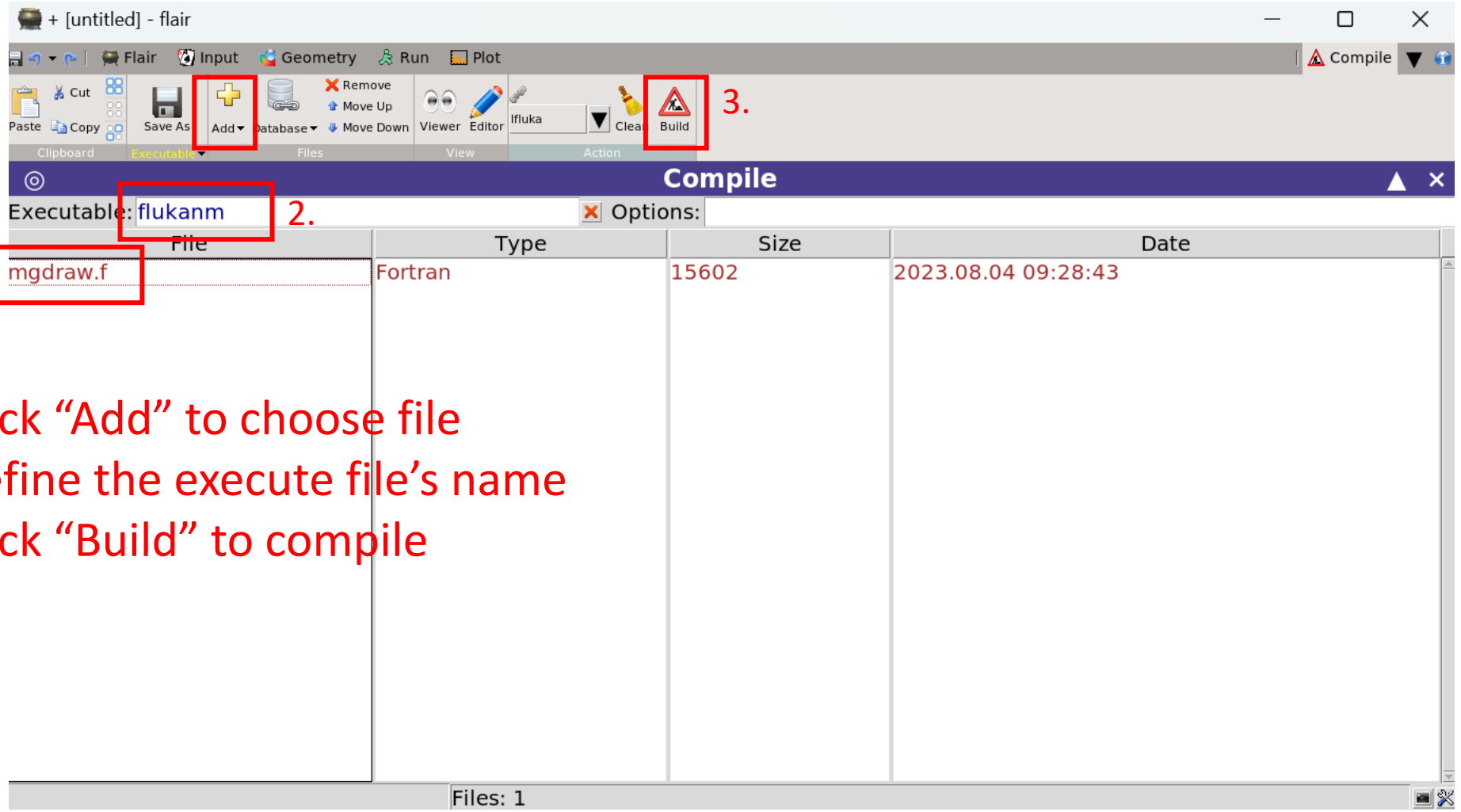




[untitled] - flair
Flair
Input
Geometry
Run
Plot
Input
Input
General
Primary
Geometry
Media
Physics
Transport
Biasing
Scoring
Flair
Preprocessor
TITLE: Detection Efficiency of 1-BP28 Tube NM-64:
DEFAULTS : PRECISIO
BEAM Beam: Energy E: 0.1 Part: NEUTRON
Δp: Flat Δp: 0.0 Δϕ: Flat Δϕ: 0.0
Shape(X): Rectangular Δx: 64.0 Shape(Y): Rectangular Δy: 221.4
BEAMPOS x: 50.0 y: 0.0 z: 108.0
cosx: cosy: Type: NEGATIVE
GEOBEGIN Accuracy: Option: Paren:
Geometry: Out: Fmt: COMBNAME
Title: 1 Tube NM-64
Body
Gas
RCC gas x: +50.0 y: -95.5 z: +0.0
Hx: 0.0 Hy: 191.0 Hz: 0.0
R: 7.40
Proportional ss tube
RCC counter x: +50.0 y: -95.74 z: +0.0
Hx: 0.0 Hy: 191.48 Hz: 0.0
Fluka: ▶ neutron100MeV.flair
Current:1 Selected:1 Total:64
+ [untitled] - flair
Output
Geometry
Geometry
Layers
Errors
3D
Global
Options
Show
3D
<add>
3D
FOV
Def. Lights:
Ambient Light
64
Antialias:
Quality:
Shadows:
Ambient Occlusion:
Help
Reset
Apply
Media
Red
3D
Green
Media
Blue
Media
Magenta
around
Fluka: ▶ neutron100MeV.flair
x: 87.37593469
y: 0

# 2. Click at the option “Compile”

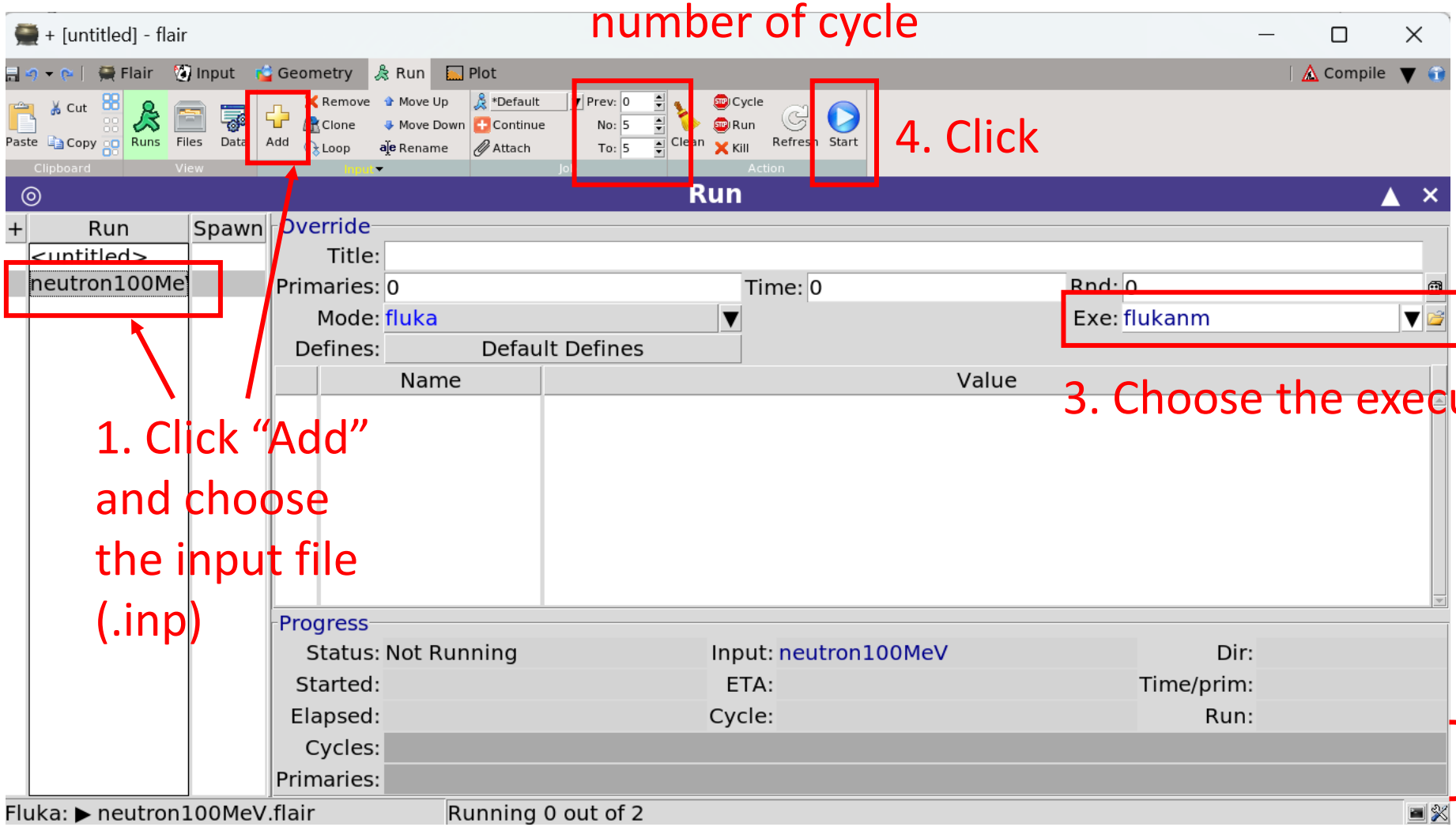


# 3. Put the mgdraw.f to build execute file

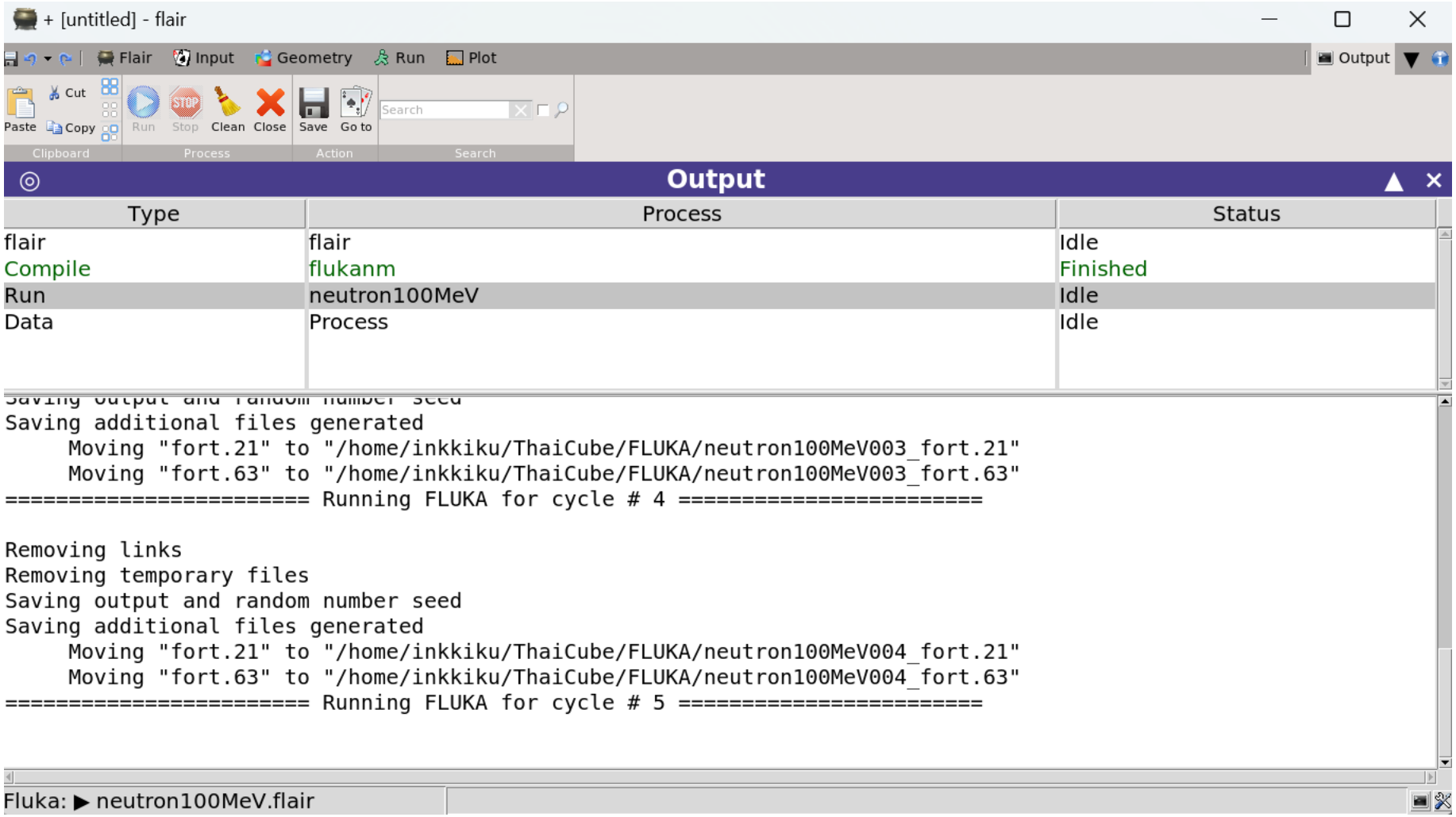



1. Click “Add” to choose file
2. Define the execute file’s name
3. Click “Build” to compile

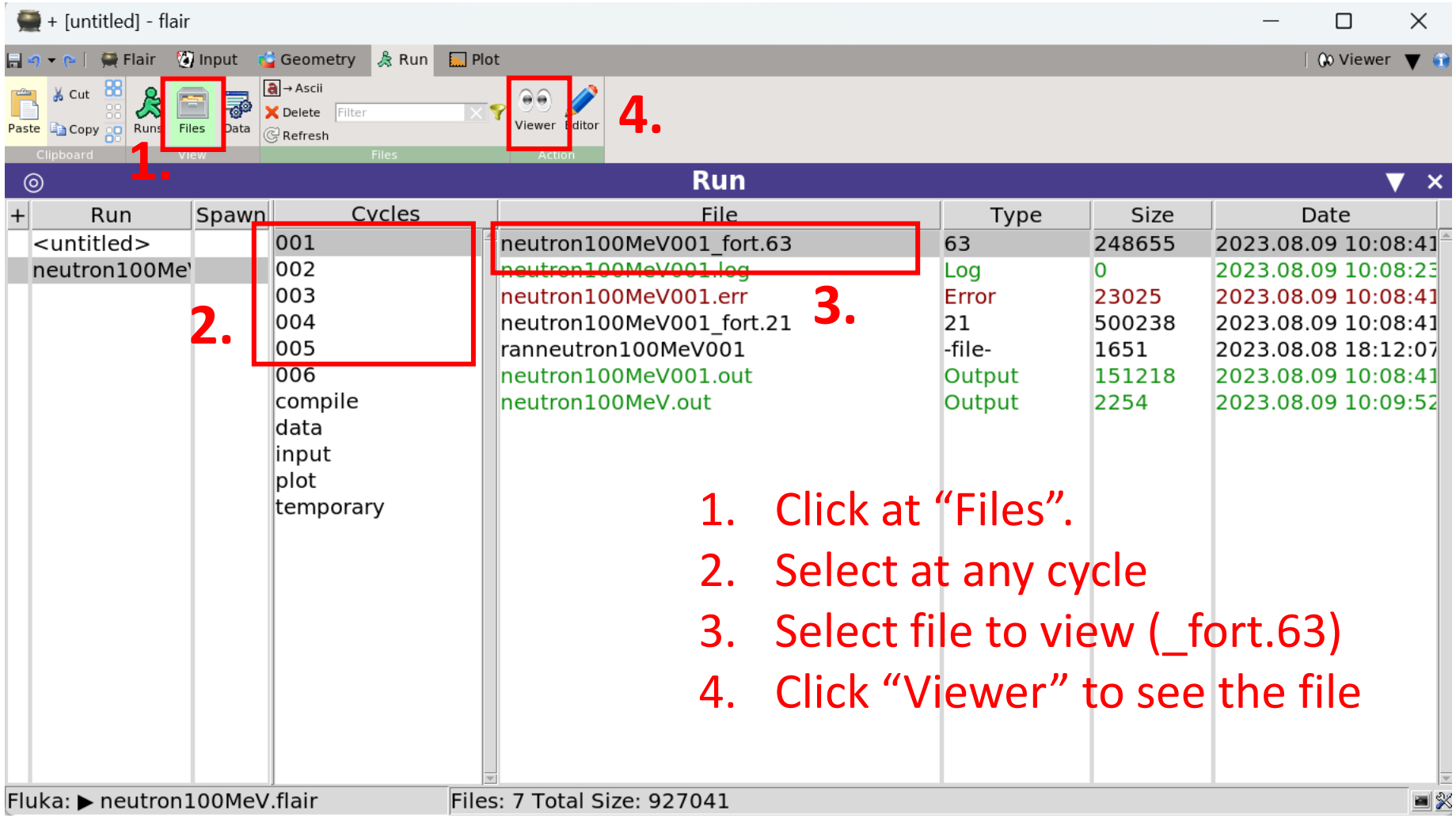
# 4. Run the program



# 5. How it is look like when it finished



# 6. Output files



+ [untitled] - flair

Flair | Input | Geometry | Run | Plot | Viewer

Cut | Copy | Paste | Search | Wrap | Load | Reload | Edit | Print | Close

Clipboard | Search | View | File

# Viewer

Files

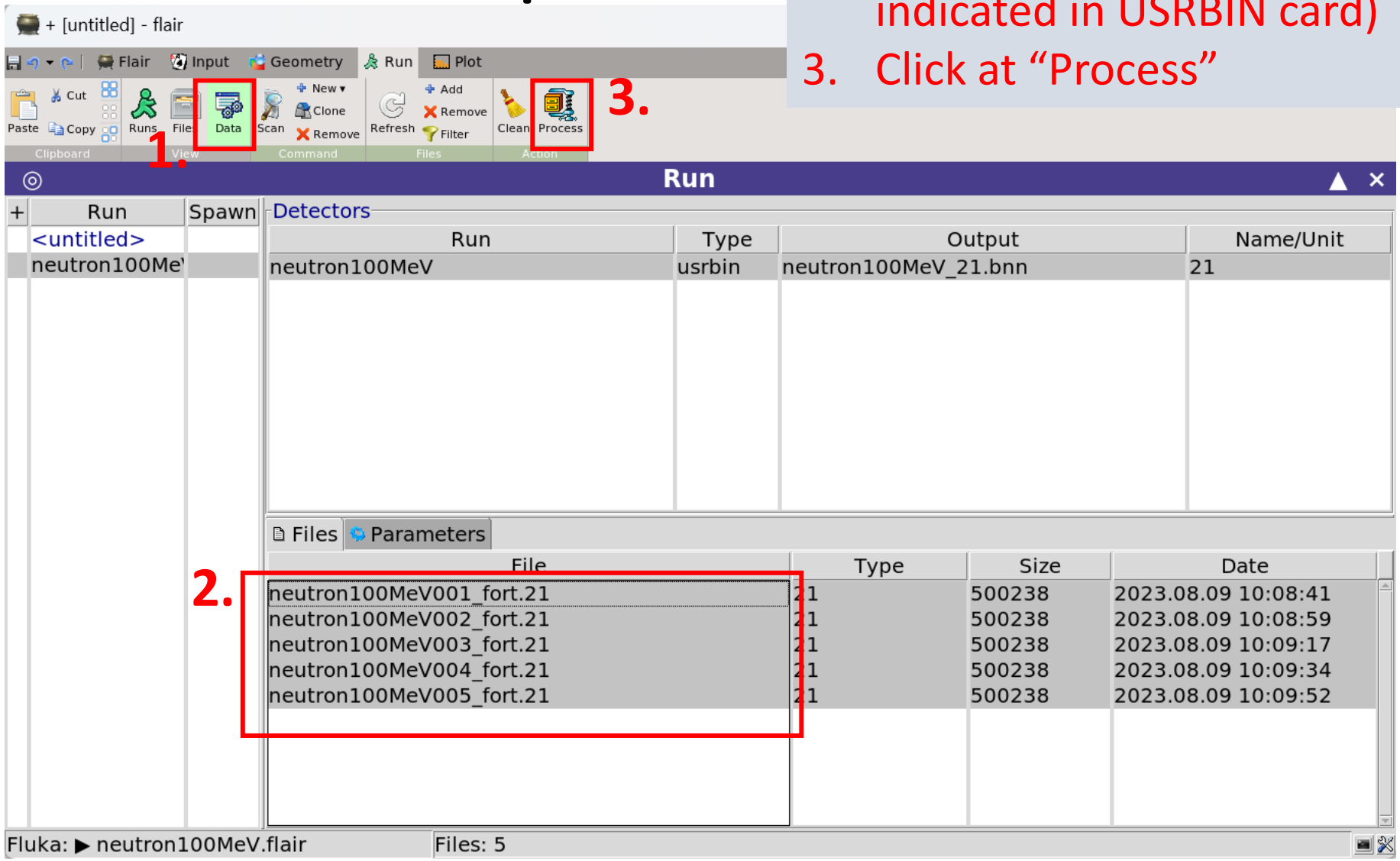
neutron10

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 10 | 300 | 2 | 5 | 248 | 48.124480398001268 | -19.752497936134610 | -7.0245338040078220 | 2.68 |
| 11 | 300 | 2 | 5 | 244 | 51.750345737342464 | -14.926646206215402 | 2.4824426186187658 | 2.80 |
| 19 | 300 | 2 | 5 | 243 | 45.788840398920307 | -31.123966043146197 | -4.4918164284314450 | 6.30 |
| 38 | 300 | 1 | 5 | 245 | 44.153041453118632 | 95.395141255309014 | -4.4344561286519921 | 1.07 |
| 39 | 300 | 2 | 5 | 245 | 49.858127436999304 | -94.389313532457095 | 6.3367514465683161 | 2.54 |
| 51 | 300 | 2 | 5 | 246 | 47.147088946686878 | 31.072977723642996 | -0.84471554510281521 | 4.28 |
| 51 | 300 | 2 | 5 | 244 | 46.387213573017995 | 83.553602694817585 | 6.0042778864832833 | 3.74 |
| 54 | 300 | 2 | 5 | 243 | 47.830597137613964 | -4.3615723700757680 | -3.6560250780604875 | 7.77 |
| 71 | 300 | 2 | 5 | 245 | 55.232006883205138 | 44.655977035677715 | -0.57048327051671599 | 1.36 |
| 79 | 300 | 2 | 5 | 248 | 44.004152848039979 | 36.009635842761568 | 0.49037629730052945 | 4.07 |
| 81 | 300 | 2 | 5 | 247 | 48.865709959230543 | -68.274829447321110 | -2.9458445621756537 | 6.77 |
| 84 | 300 | 2 | 5 | 245 | 52.327066803909041 | -95.447673475170546 | -4.0299415676879491 | 9.26 |
| 85 | 300 | 2 | 5 | 244 | 50.972593568841290 | -44.220323204353924 | 1.6021777371359418 | 4.30 |
| 102 | 300 | 2 | 5 | 249 | 56.659485153835305 | -21.249679748782967 | 1.0865589509303861 | 8.47 |
| 119 | 300 | 2 | 5 | 245 | 50.281803054095292 | 7.2620128874176268 | 2.6651897917633836 | 2.17 |
| 121 | 300 | 2 | 5 | 243 | 51.785390030209186 | -38.491116037519220 | -1.2670961920023407 | 1.00 |
| 121 | 300 | 2 | 5 | 246 | 52.053709115688036 | -5.8464725168287615 | -0.60092290234263501 | 6.11 |
| 121 | 300 | 2 | 5 | 248 | 55.456552554147116 | 51.603274862196287 | -2.3695912119687446 | 9.53 |
| 141 | 300 | 2 | 5 | 250 | 45.370268254260679 | -93.260402079563946 | -3.2903017721991019 | 6.16 |
| 141 | 300 | 2 | 5 | 247 | 55.120622825002918 | -80.682130717091553 | -4.8930448501090620 | 3.40 |
| 144 | 300 | 2 | 5 | 243 | 45.985690177861763 | 73.742313808669351 | -5.5933768876441885 | 1.85 |
| 148 | 300 | 2 | 5 | 246 | 51.463924250203917 | 65.064224458420028 | -1.2331737503861326 | 6.84 |
| 158 | 300 | 2 | 5 | 248 | 48.194723714630172 | 41.962605093611600 | -3.7881432592859019 | 4.11 |
| 170 | 300 | 2 | 5 | 246 | 47.127390430101386 | 17.243765677506726 | -0.18485840685052946 | 9.20 |
| 173 | 300 | 2 | 5 | 240 | 43.944260973539556 | -58.944412625096227 | 0.62327891344773878 | 1.73 |
| 177 | 300 | 2 | 5 | 250 | 43.566192681767738 | -0.72856789155662494 | -2.9045333128607016 | 2.16 |
| 180 | 300 | 2 | 5 | 247 | 53.989988382073520 | -55.818145202900389 | 1.1384587758805780 | 9.39 |
| 180 | 300 | 2 | 5 | 244 | 53.785219067307544 | -57.582631405015093 | 5.6468020705251289 | 6.70 |
| 180 | 300 | 2 | 5 | 240 | 48.091293662200663 | -49.172503579074395 | 4.9954424053244990 | 1.03 |
| 189 | 300 | 2 | 5 | 247 | 54.384555984896487 | -88.705405539782291 | 2.2097758825940548 | 6.34 |
| 190 | 300 | 2 | 5 | 250 | 47.755950787040504 | -28.815326627194363 | -1.2979586908220480 | 1.46 |
| 194 | 300 | 2 | 5 | 245 | 55.389464558488463 | -64.223958332026058 | -6.8636024008677188E-002 | 1.16 |

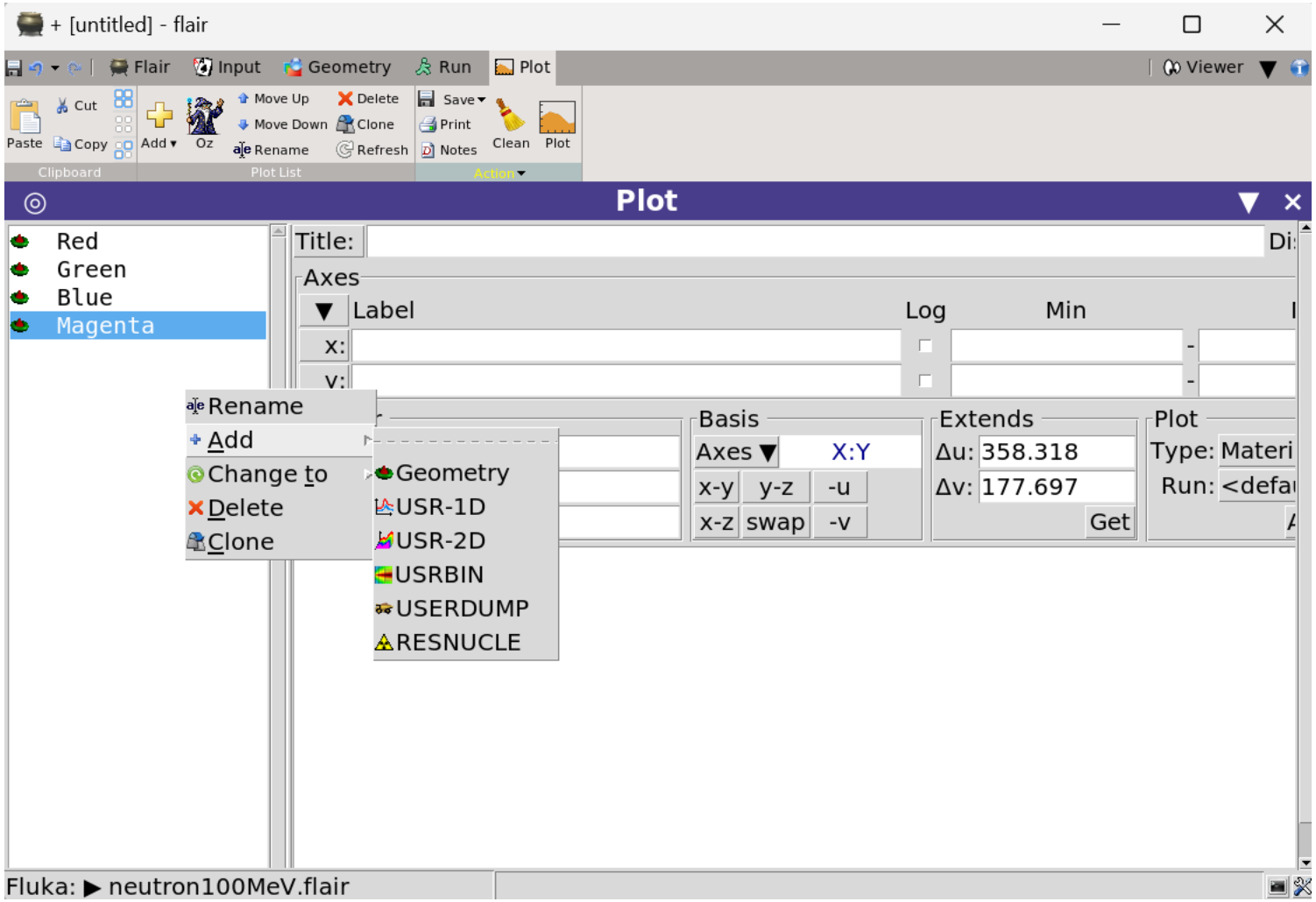
Fluka: ▶ neutron100MeV.flair

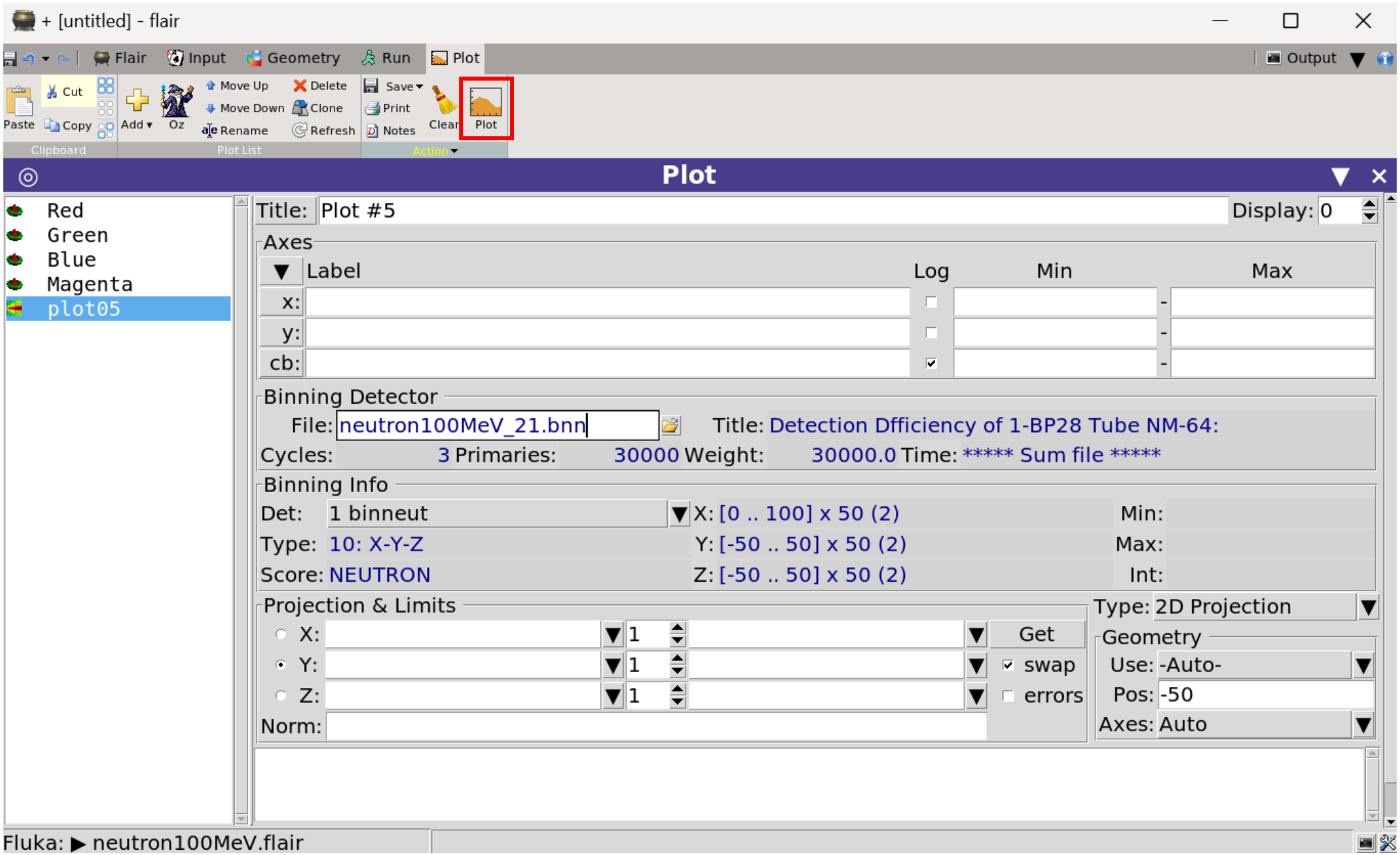
# 7. Combine file to plot

1. Click at “Data”.
2. Select all *_fort.21 (the number 21 is indicated in USRBIN card)
3. Click at “Process”

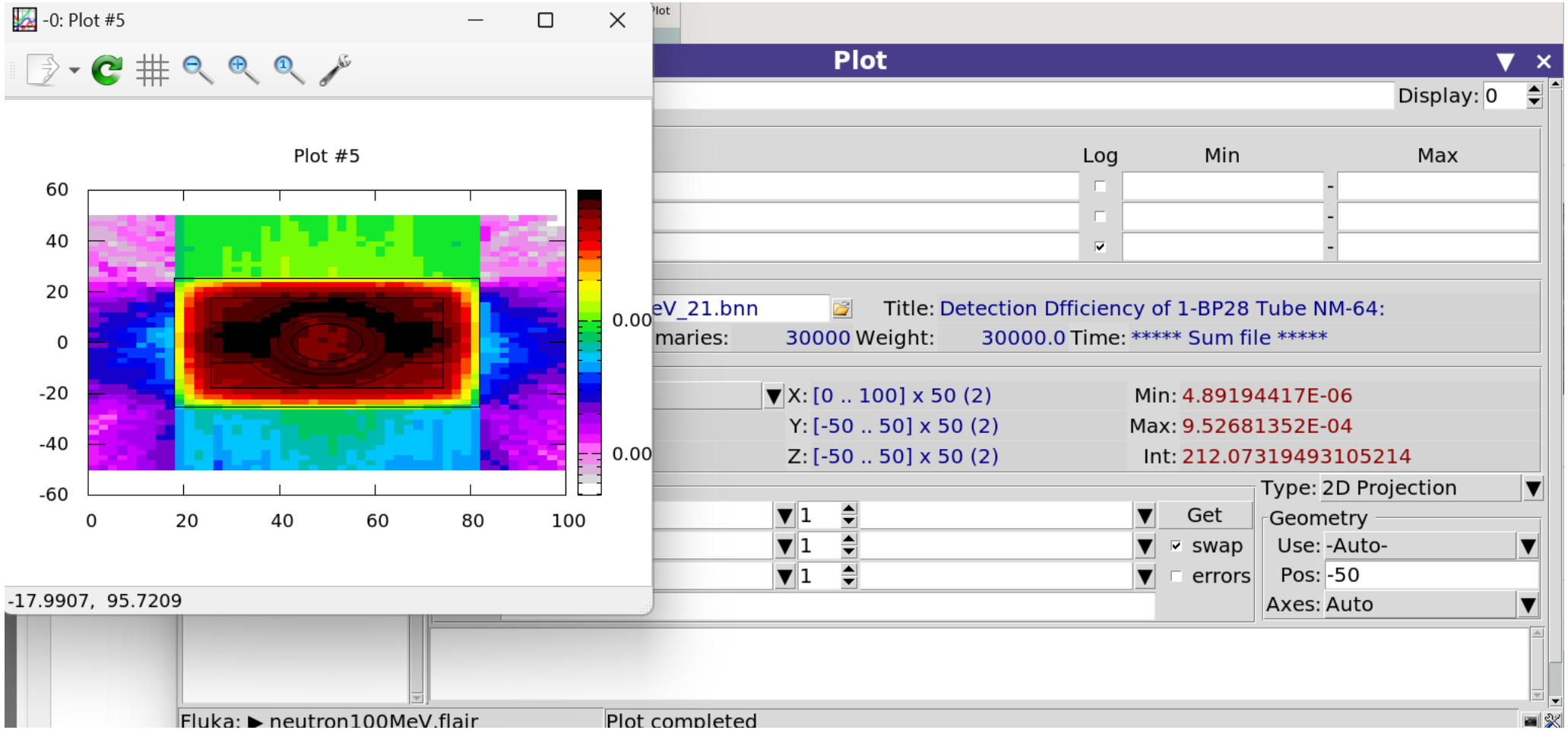


# 8. Add USRBIN and setup options for plot




+ [untitled] - flair
Flair
Input
Geometry
Run
Plot
Output
Cut
Copy
Paste
Add
Oz
Move Up
Move Down
Rename
Delete
Clone
Refresh
Save
Print
Notes
Clear
Plot
Clipboard
Plot List
Action
Plot
Red
Green
Blue
Magenta
plot05
Title: Plot #5
Display: 0
Axes
Label
Log
Min
Max
x:
y:
cb:
Binning Detector
File: neutron100MeV_21.bnn
Title: Detection Dfficiency of 1-BP28 Tube NM-64:
Cycles: 3 Primaries: 30000 Weight: 30000.0 Time: ***** Sum file *****
Binning Info
Det: 1 binneut
X: [0 .. 100] x 50 (2)
Min:
Type: 10: X-Y-Z
Y: [-50 .. 50] x 50 (2)
Max:
Score: NEUTRON
Z: [-50 .. 50] x 50 (2)
Int:
Projection & Limits
Type: 2D Projection
X:
Y:
Z:
Get
swap
errors
Norm:
Geometry
Use: -Auto-
Pos: -50
Axes: Auto
Fluka: ▶ neutron100MeV.flair

# 9. Plotting the graph

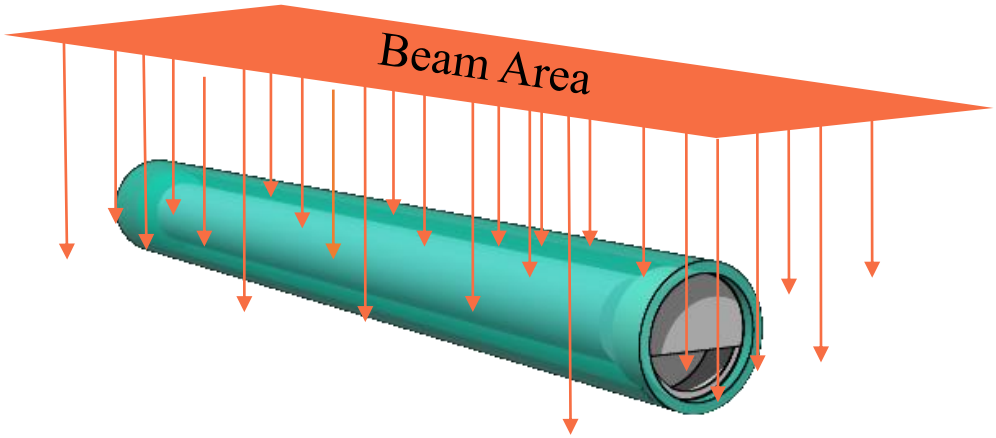


# 10. Export to text file

```
$ wc -l *63 > output.txt
$ vim output.txt
```

```
  1507 neutron100MeV001_fort.63
  1433 neutron100MeV002_fort.63
  1432 neutron100MeV003_fort.63
  1476 neutron100MeV004_fort.63
  1477 neutron100MeV005_fort.63
  7325 total
```

The number of count




Simulation of showering particle that was created in FLUKA program