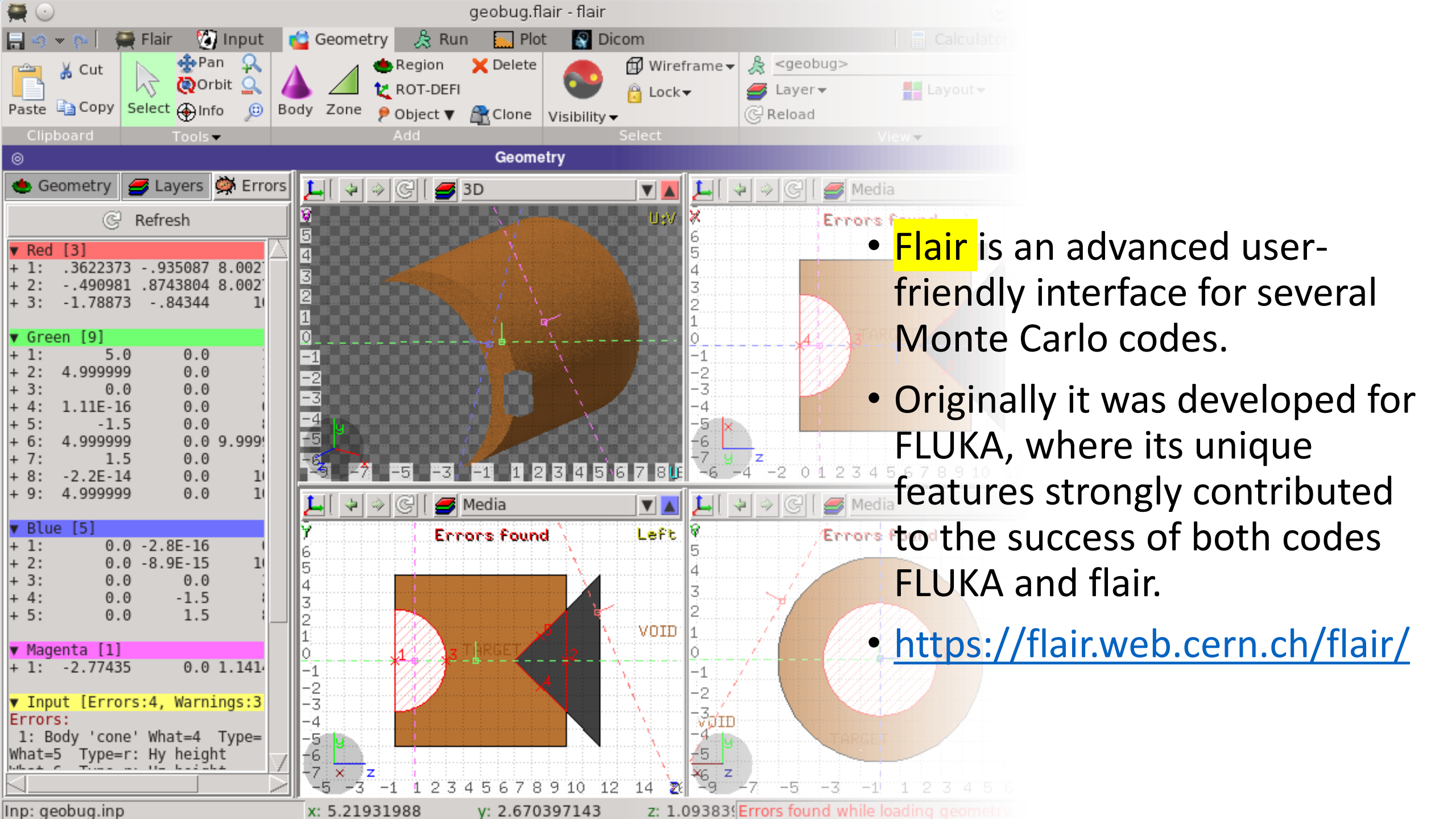


How to use FLUKA and flair for beginner

Audcharapon Pagwhan (Ink)





Color	Count
Red	[3]
Green	[9]
Blue	[5]
Magenta	[1]
Input	[Errors:4, Warnings:3]

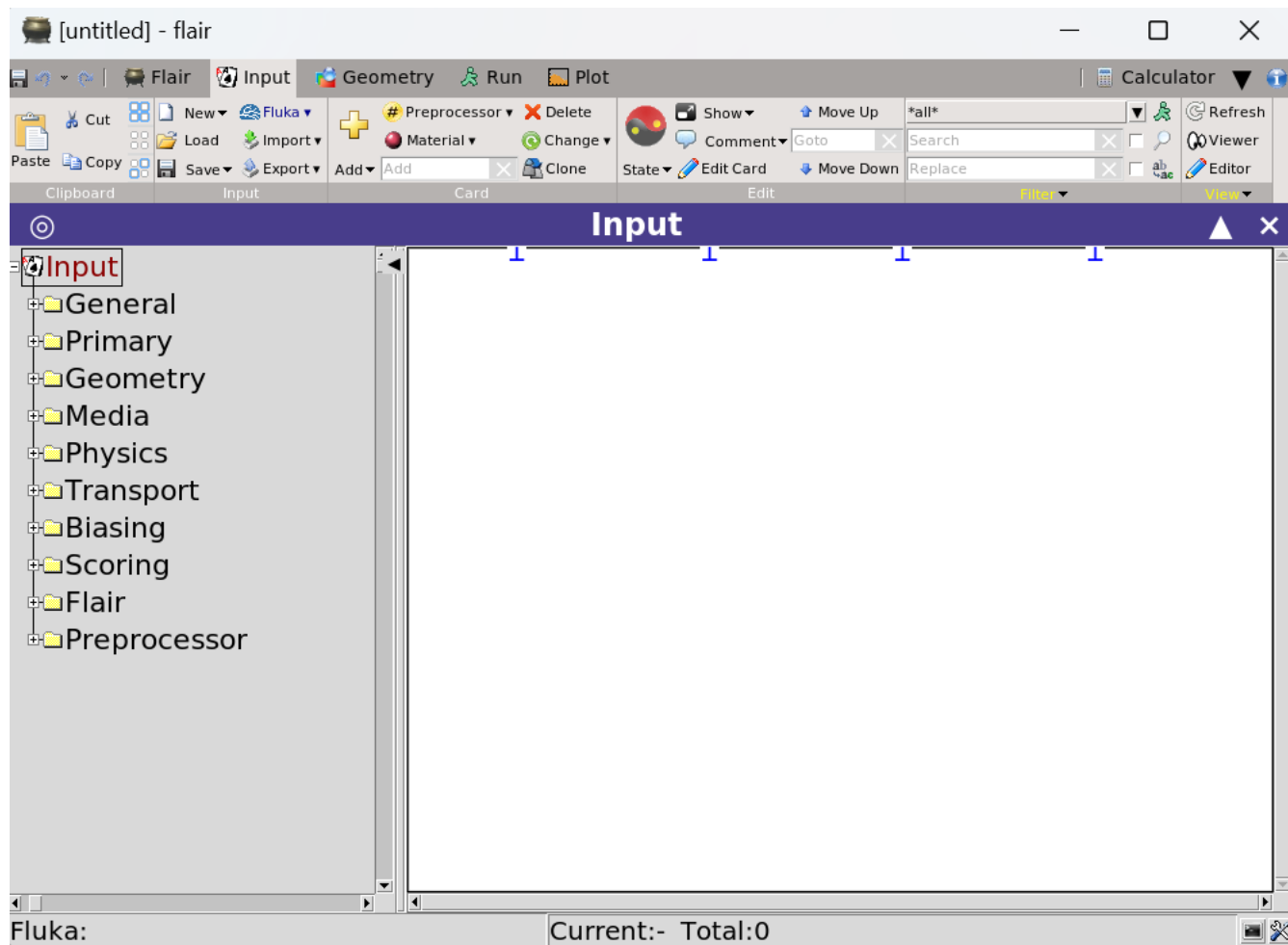
Errors:

- 1: Body 'cone' What=4 Type=What=5 Type=r: Hy height

- 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)



Toolbar



Move Up/Down



Quick Access to:

1. Project Frame
2. Input Editor
3. Geometry Editor (if installed)
4. Process Summary
5. Compile executables/Add user routines
6. Debug Geometry
7. Run/monitor simulations
8. View output files
9. Data merging
10. Plots
11. Databases (not yet functional)
12. Material Database
13. Help

How to create a model? (using flair)

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

[untitled] - flair

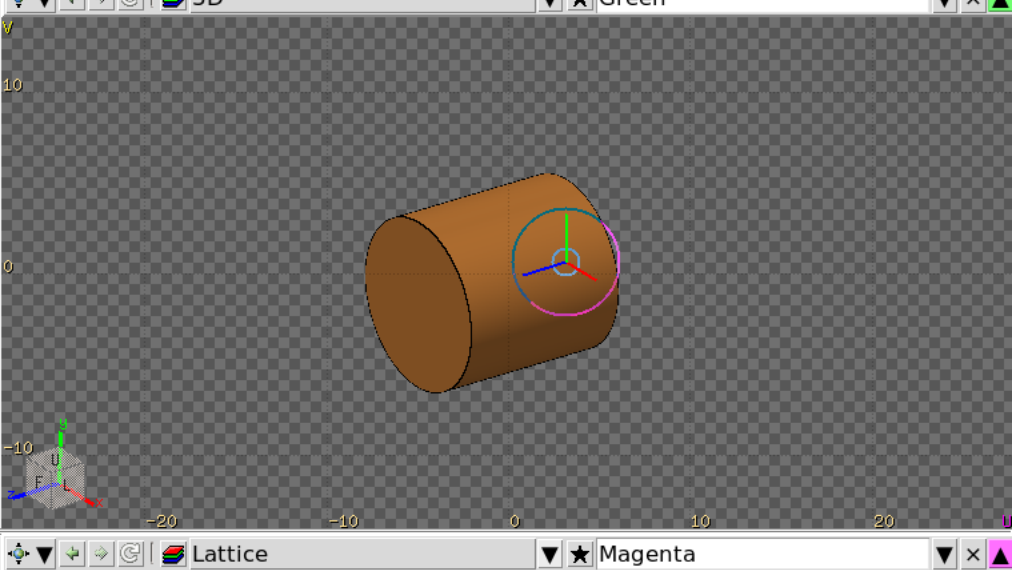
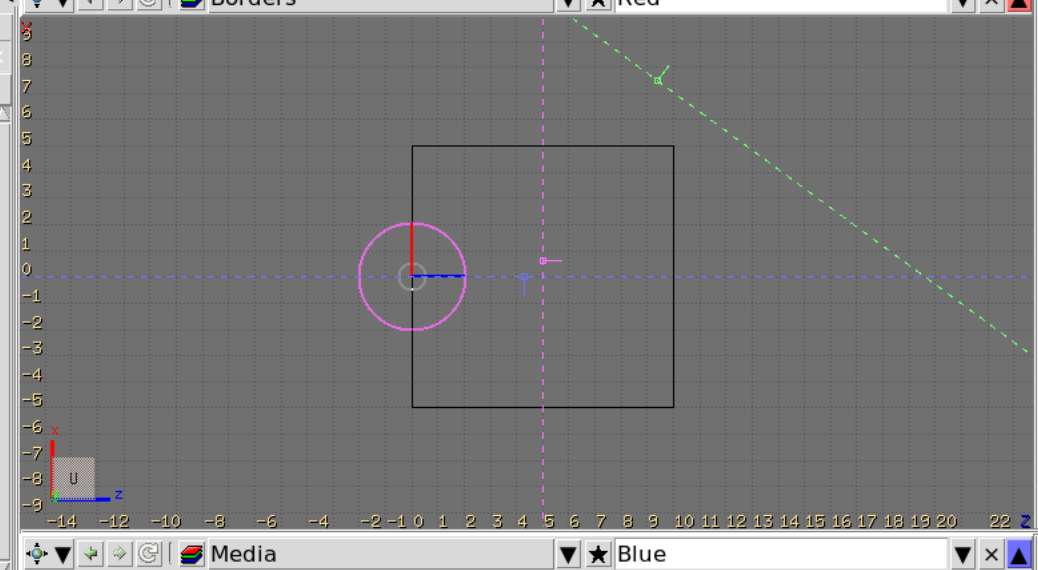
The screenshot displays the FLAIR software interface. At the top, there is a toolbar with icons for File, Edit, and various simulation actions. The 'New' button is highlighted with a red rectangle, and its dropdown menu is open, listing several input types: basic, decay, empty, heavy-ions, lattice, void, and voxel. The 'basic' option is currently selected and highlighted in yellow. Below the toolbar is a navigation pane on the left with a tree view showing a hierarchy of folders: Input, General, Primary, Geometry, Media, Physics, Transport, Biasing, Scoring, Flair, and Preprocessor. The 'Input' folder is expanded, and the 'New' menu is overlaid on it. The main workspace on the right shows a dark blue bar with the word 'Input' in white text. The top right corner contains search and filter controls, including a search bar with the text '*all*', a 'Goto' field, and 'Search' and 'Replace' buttons.

Geometry

Geometry Layers Errors

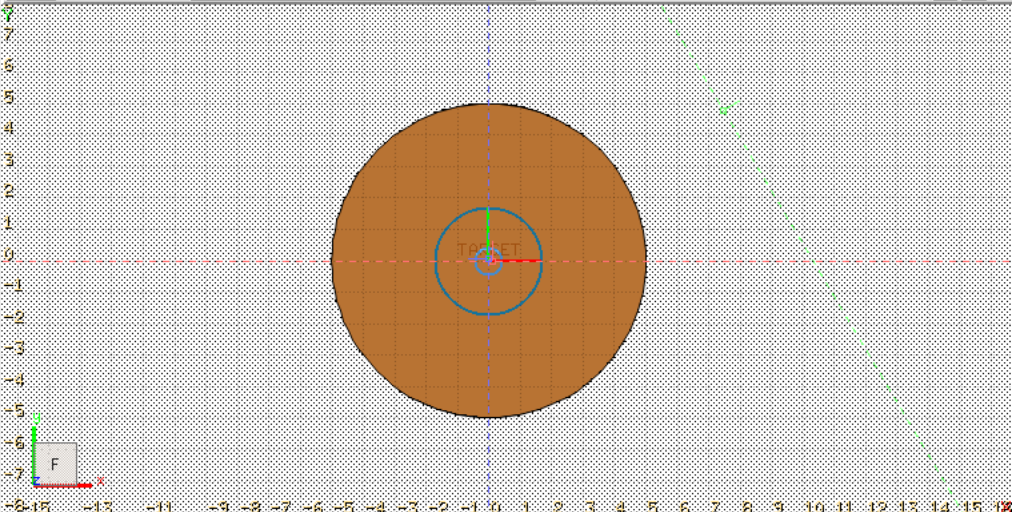
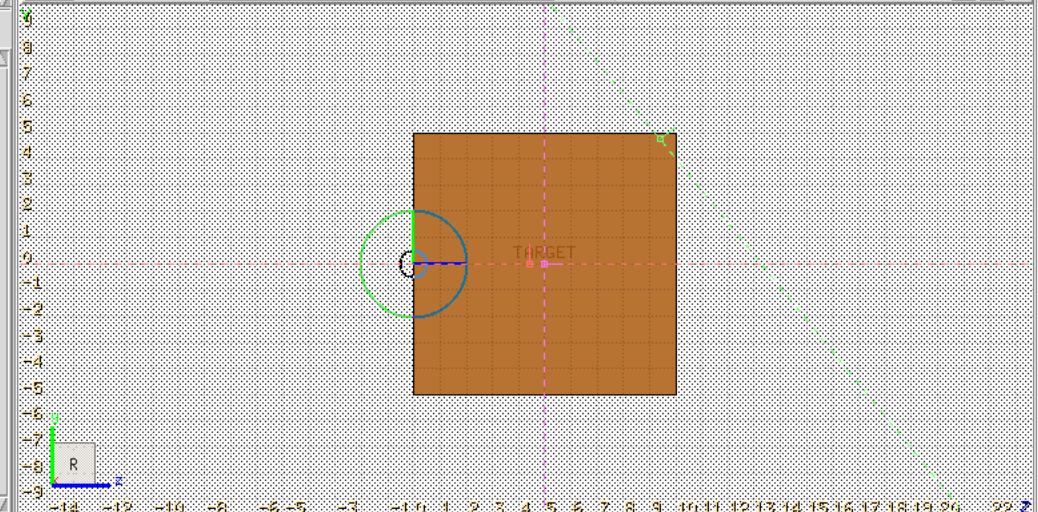
Filter

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	



Beam and Beam's Position

Define the beam characteristics

BEAM

Beam: Energy ▾

E: 1e-06

Part: NEUTRON ▾

Δp : Flat ▾

Δp :

$\Delta\phi$: Flat ▾

$\Delta\phi$:

Shape(X): Rectangular ▾ Δx :

Shape(Y): Rectangular ▾ Δy :

Define the beam position

BEAMPOS

x: 0

y: 0

z: 20

cosx:

cosy:

Type: NEGATIVE ▾

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

direction cosine of the beam

direction of the beam (Positive \uparrow , Negative \downarrow)

```
*...+...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

The screenshot shows the Flair software interface. The top menu bar includes 'Flair', 'Input', 'Geometry', 'Run', and 'Plot'. The 'Geometry' menu is open, showing options like 'General', 'Primary', 'Geometry', 'Media', 'Physics', 'Transport', 'Biasing', 'Scoring', 'Flair', and 'Preprocessor'. The 'Geometry' option is highlighted. Below the menu, a list of input parameters is displayed, including 'MUPHOTON', 'PAIRBREM', 'EMFCUT', 'BEAM', and 'SOURCE'. The 'BEAM' section is expanded, showing parameters like 'Beam: Momentum', 'Part', 'Shape(X)', 'Shape(Y)', and 'sdum: neut'. The 'SOURCE' section shows parameters like '#1', '#2', '#3', '#4', and '#5'. The interface also features a toolbar with various icons and a search bar.

Geometry

GEOBEGIN Accuracy: Option: ▾ Paren:
Geometry: ▾ Out: ▾ Fmt: COMBNAME ▾

Title:
Black body

SPH blkbody x: 0.0 y: 0.0 z: 0.0
R: 100000.0

Void sphere

SPH void x: 0.0 y: 0.0 z: 0.0
R: 10000.0

Cylindrical target

RCC target x: 0.0 y: 0.0 z: 0.0
Hx: 0.0 Hy: 0.0 Hz: 10.0
R: 5.0

END

Sphere shape ←

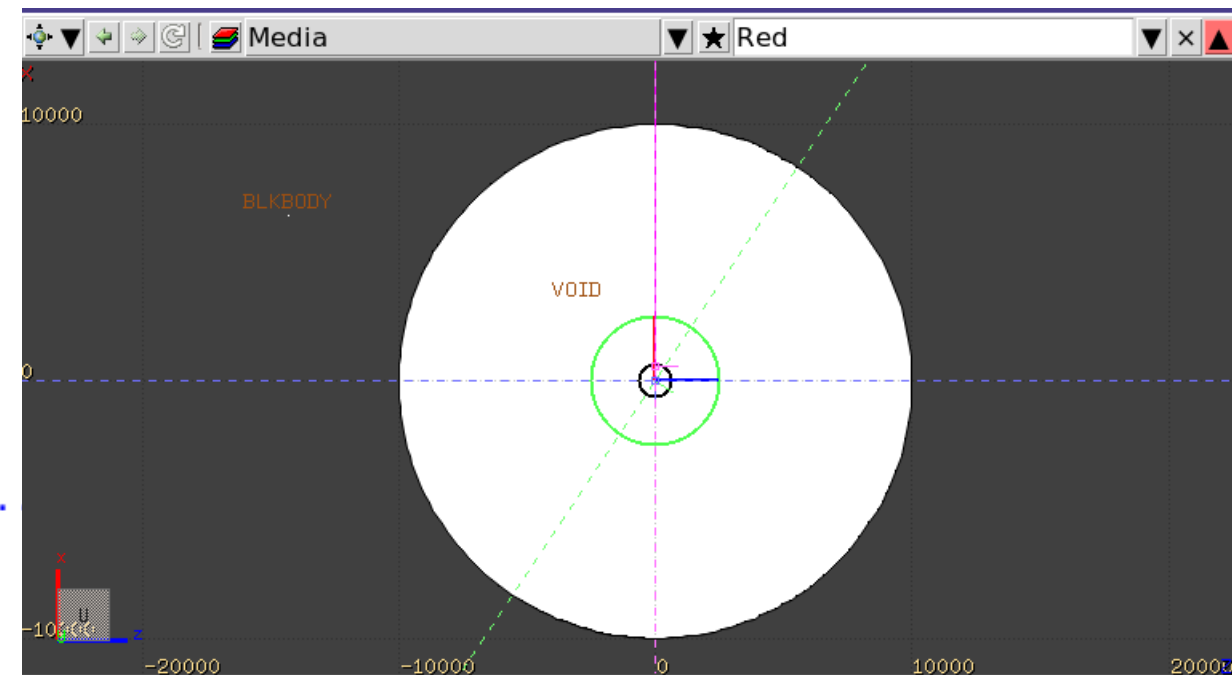
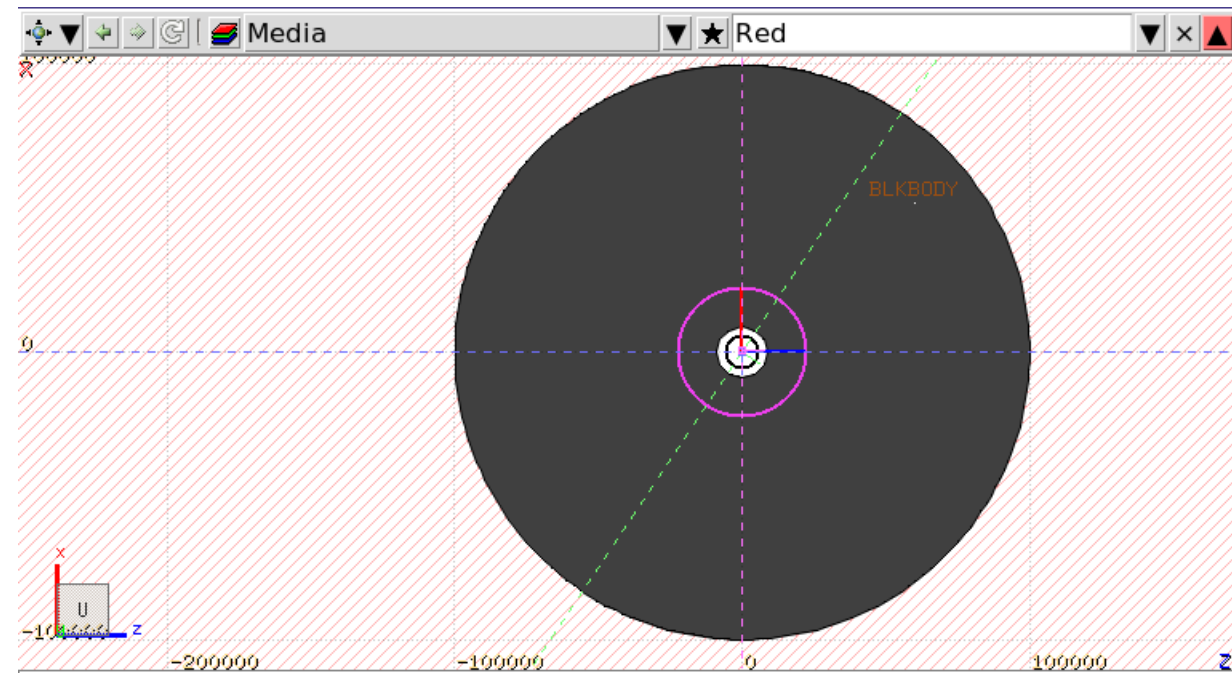
Cylindrical ←

```
*...+...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

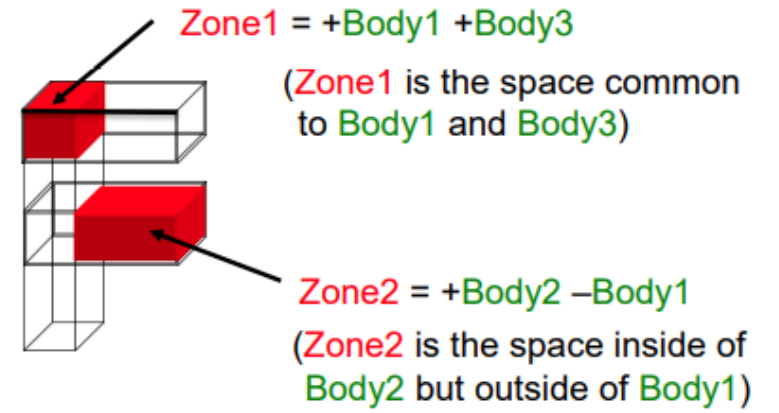
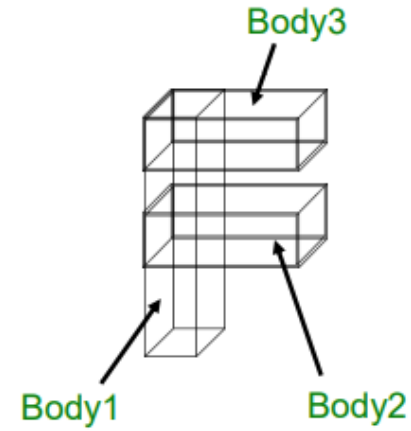
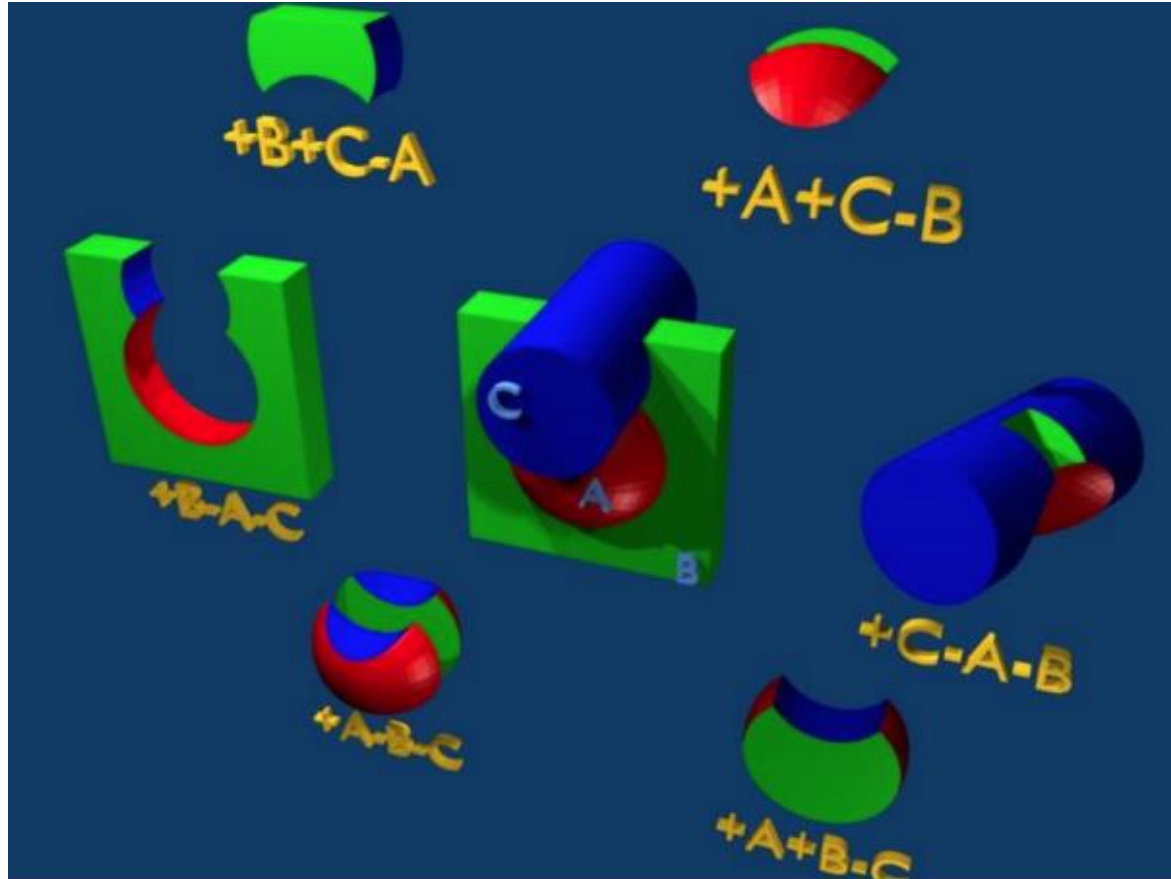
Regions are defined as combinations of bodies obtained by boolean operations:

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

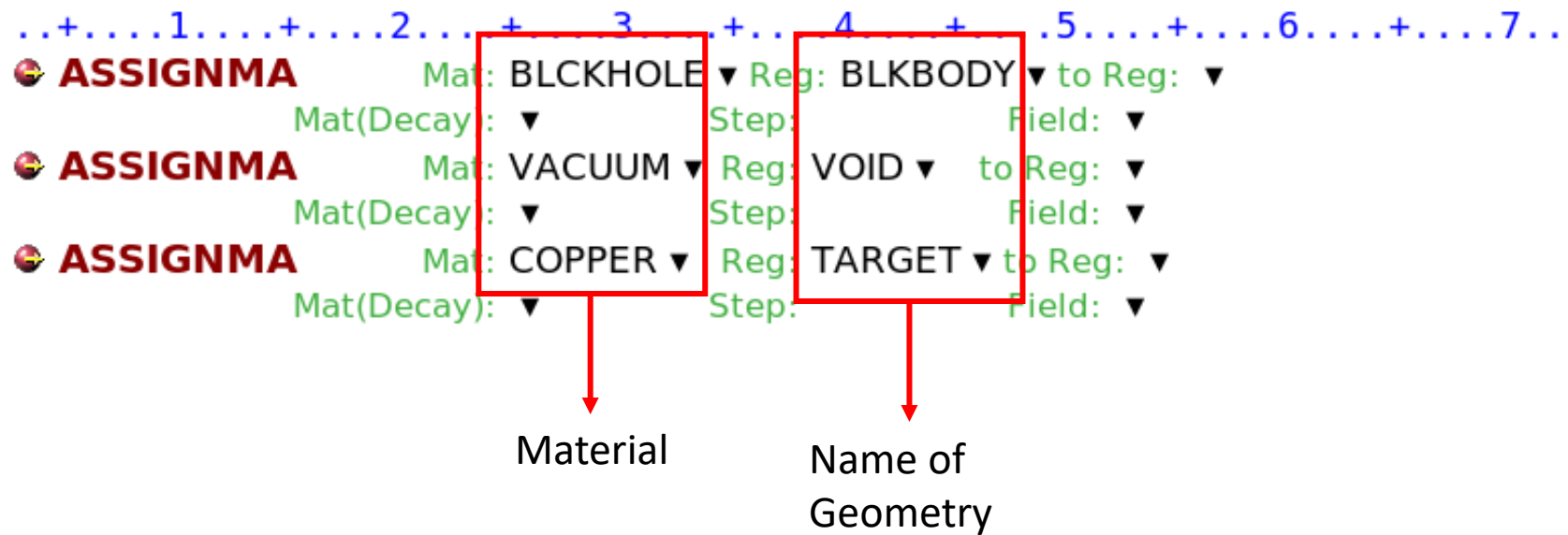
Regions but must be of homogeneous material composition.



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



Assign Materials



Materials and Compound Materials

The screenshot displays the FLAIR software interface. The top menu bar includes 'Flair', 'Input', 'Geometry', 'Run', and 'Plot'. The 'Input' menu is open, with the 'Material' option highlighted. A list of materials is shown, including '099 A-150 Tiss. Equiv. Plastic', '1,2 - Ethanediol', '1,2 Dichloroethane', '1,2-dichlorobenzene C6_H4_Cl2', '1,2-dichloroethane C2_H4_Cl2', '1,3,5 - Cyclo-Heptatriene', '1,3-Propanediol', '1,5 - Pentanediol', '1-Chloro Hexadecane', '1-Chloro Hexane', '1-Chloro Propane', '1-Chlorobutane', '101 Acetylene', '103 Adipose Tissue (ICRP)', '104 Air dry (near sea level)', '106 Aluminum Oxide', '111 B-100 Bone-Equivalent Plastic', '119 Bone, Compact (ICRU)', '120 Bone, Compact (ICRP)', and '126 C-552 air-equivalent plastics'. A red box highlights the 'Material' menu item. A red arrow points from the 'Material' menu to the 'C2H4x properties' dialog box. The dialog box has a title bar 'C2H4x properties' and a close button. It contains the text 'Select the additional properties of material 'C2H4x' to be added in the input' and a list of checkboxes: 'MAT-PROP: pressure, ionization potential', 'DPA: DPA damage threshold', 'STERNHEI: Sternheimer parameters', and 'CORRFAC: Density correction factor'. Below the checkboxes are three buttons: 'Selected Only', 'All the above', and 'Only MATERIAL card'. A red arrow points from the 'All the above' button to the 'Polyethylene (C2_H4)r+' material entry in the input list. The 'Polyethylene (C2_H4)r+' entry is highlighted in yellow and shows the following properties: 'MATERIAL C2H4x', '#: 1', 'ρ: 0.94', 'Z: 6', 'Am: 12', 'A: 14', 'dE/dx: ▾', 'COMPOUND C2H4x ▾', 'Mix: Mass ▾ Elements: 1..3 ▾', 'f1: 0.143711 M1: HYDROGEN ▾ f2: 0.856289 M2: CARBON ▾', 'f3: 0 M3: ▾', 'MAT-PROP', 'Type: ▾ Gas pressure: ▾ RHOR: ▾', 'Ionization: 57.4 Mat: C2H4x ▾ to Mat: ▾ Step: ▾'.

Materials and Compound Materials

The screenshot shows the Flair software interface. The 'Input' menu is open, and the 'Media' option is selected, which has opened a sub-menu where 'COMPOUND' is highlighted. In the bottom right corner, a material definition for 'MATERIAL SNOW' is shown, including its properties and a 'COMPOUND' definition.

MATERIAL SNOW #: ρ : 0.37
Z: Am: A: dE/dx: ▼


COMPOUND SNOW ▼ Mix: Atom ▼ Elements: 1..3 ▼
f1: 2.0 M1: HYDROGEN ▼ f2: 1.0 M2: OXYGEN ▼
f3: M3: ▼

Scoring

Set the random number seed

 **RANDOMIZ** Unit: 01 ▼ Seed:

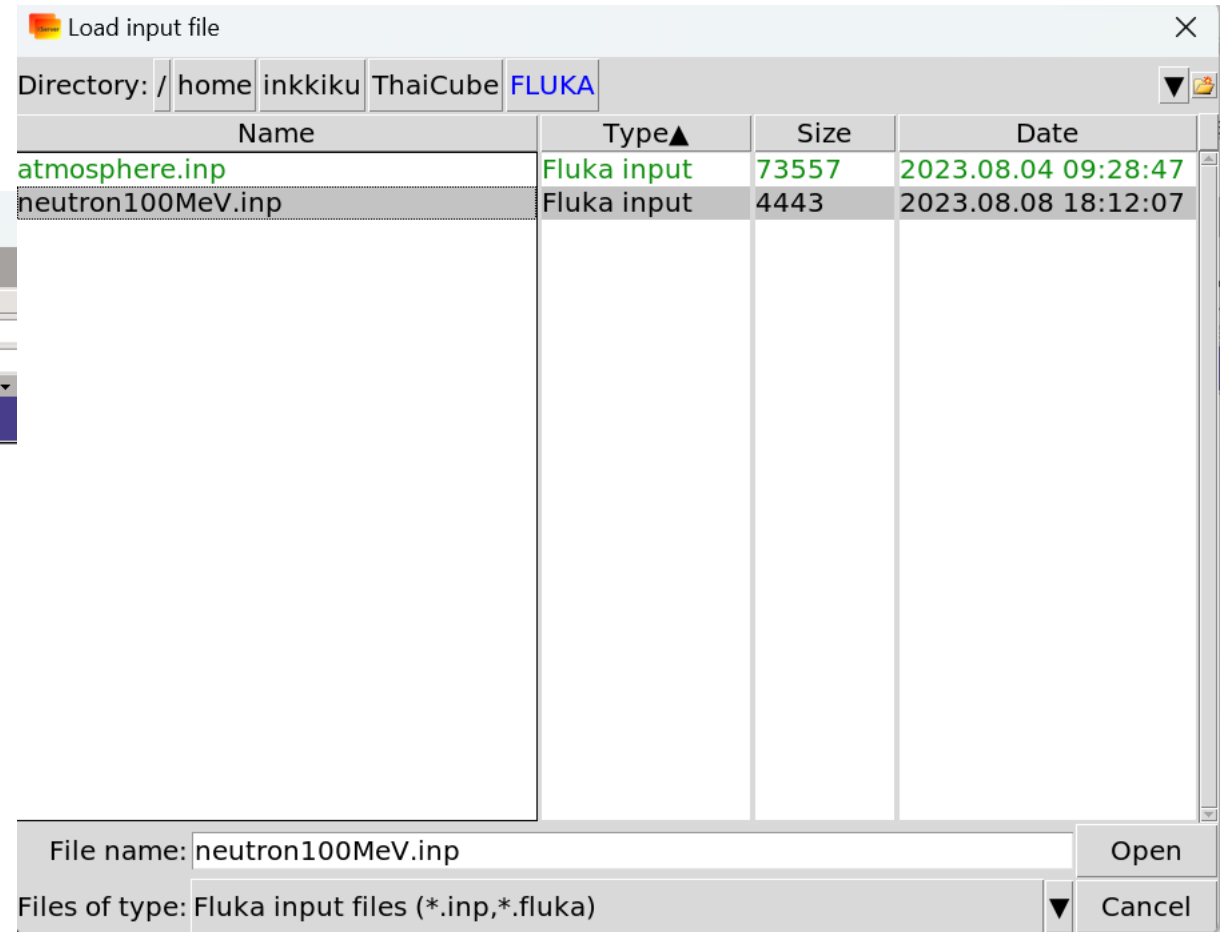
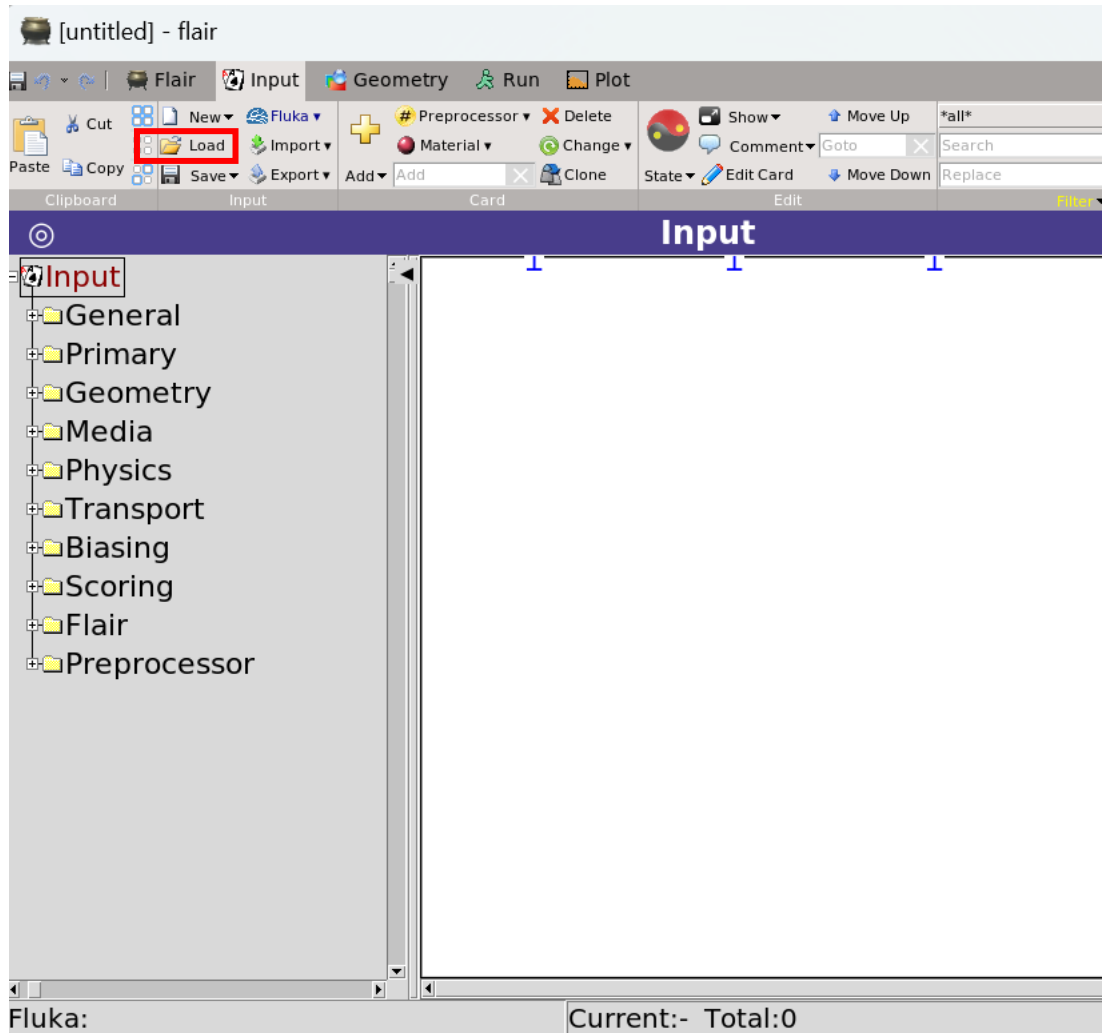
Set the number of primary histories to be simulated in the run

 **START** No.: Core: ▼
Time: Report: default ▼

 **STOP**

**Operate Simulation by
using flair**

1. Insert the input file



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

1. **mgdraw.f**

2. Executable: **flukanm**

3. Build

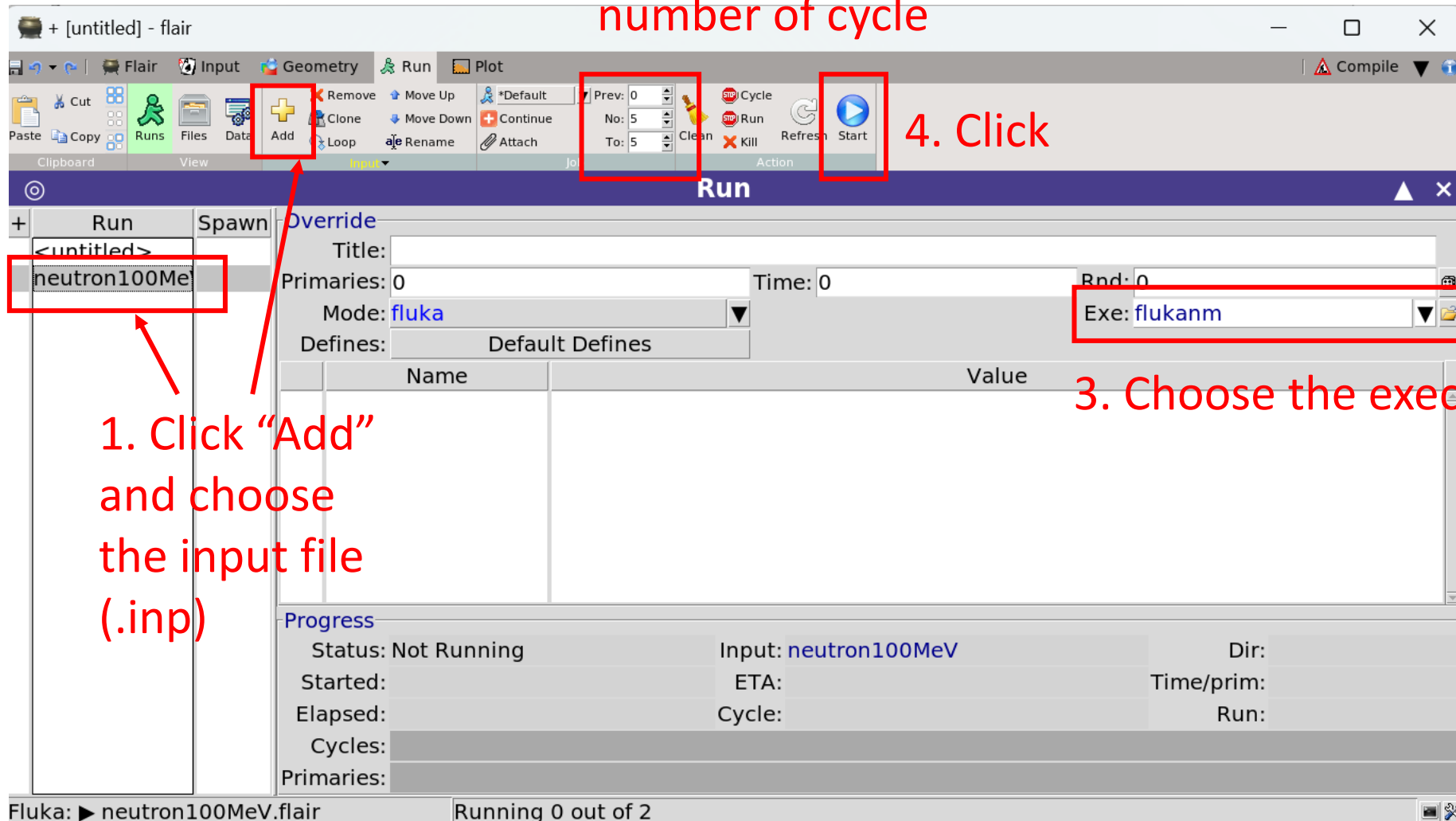
File	Type	Size	Date
mgdraw.f	Fortran	15602	2023.08.04 09:28:43

Files: 1

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

4. Run the program

2. Enter the number of cycle



3. Choose the execute file

1. Click "Add" and choose the input file (.inp)

4. Click

Progress bar

5. How it is look like when it finished

The screenshot shows the FLUKA software interface. The main window is titled "+ [untitled] - flair". The menu bar includes Flair, Input, Geometry, Run, and Plot. The toolbar contains icons for Cut, Copy, Paste, Run, Stop, Clean, Close, Save, and Go to. The Output window is open, displaying a table with the following data:

Type	Process	Status
flair	flair	Idle
Compile	flukanm	Finished
Run	neutron100MeV	Idle
Data	Process	Idle

Below the table, the Output window shows the following text:

```
Saving output and random number seed
Saving additional files generated
  Moving "fort.21" to "/home/inkkiku/ThaiCube/FLUKA/neutron100MeV003_fort.21"
  Moving "fort.63" to "/home/inkkiku/ThaiCube/FLUKA/neutron100MeV003_fort.63"
===== Running FLUKA for cycle # 4 =====

Removing links
Removing temporary files
Saving output and random number seed
Saving additional files generated
  Moving "fort.21" to "/home/inkkiku/ThaiCube/FLUKA/neutron100MeV004_fort.21"
  Moving "fort.63" to "/home/inkkiku/ThaiCube/FLUKA/neutron100MeV004_fort.63"
===== Running FLUKA for cycle # 5 =====
```

The status bar at the bottom indicates "Fluka: ▶ neutron100MeV.flair".

6. Output files

The screenshot shows the Flair software interface. The 'Run' window is open, displaying a table of output files. The table has columns for Run, Spawn, Cycles, File, Type, Size, and Date. The file 'neutron100MeV001_fort.63' is selected in the 'File' column. Red boxes and numbers 1-4 indicate the steps to view the file: 1. Click 'Files' in the toolbar, 2. Select a cycle (001-005), 3. Select a file (neutron100MeV001_fort.63), and 4. Click 'Viewer'.

Run	Spawn	Cycles	File	Type	Size	Date
<untitled>		001	neutron100MeV001_fort.63	63	248655	2023.08.09 10:08:41
neutron100MeV		002	neutron100MeV001.log	Log	0	2023.08.09 10:08:23
		003	neutron100MeV001.err	Error	23025	2023.08.09 10:08:41
		004	neutron100MeV001_fort.21	21	500238	2023.08.09 10:08:41
		005	ranneutron100MeV001	-file-	1651	2023.08.08 18:12:07
		006	neutron100MeV001.out	Output	151218	2023.08.09 10:08:41
		compile	neutron100MeV.out	Output	2254	2023.08.09 10:09:52
		data				
		input				
		plot				
		temporary				

1. Click at "Files".

2. Select at any cycle

3. Select file to view (_fort.63)

4. Click "Viewer" to see the file

Fluka: ▶ neutron100MeV.flair Files: 7 Total Size: 927041

Viewer

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
104	300	2	5	245	45.217110507006137	50.750006172510001	2.3886702220776066	1.00

7. Combine file to plot

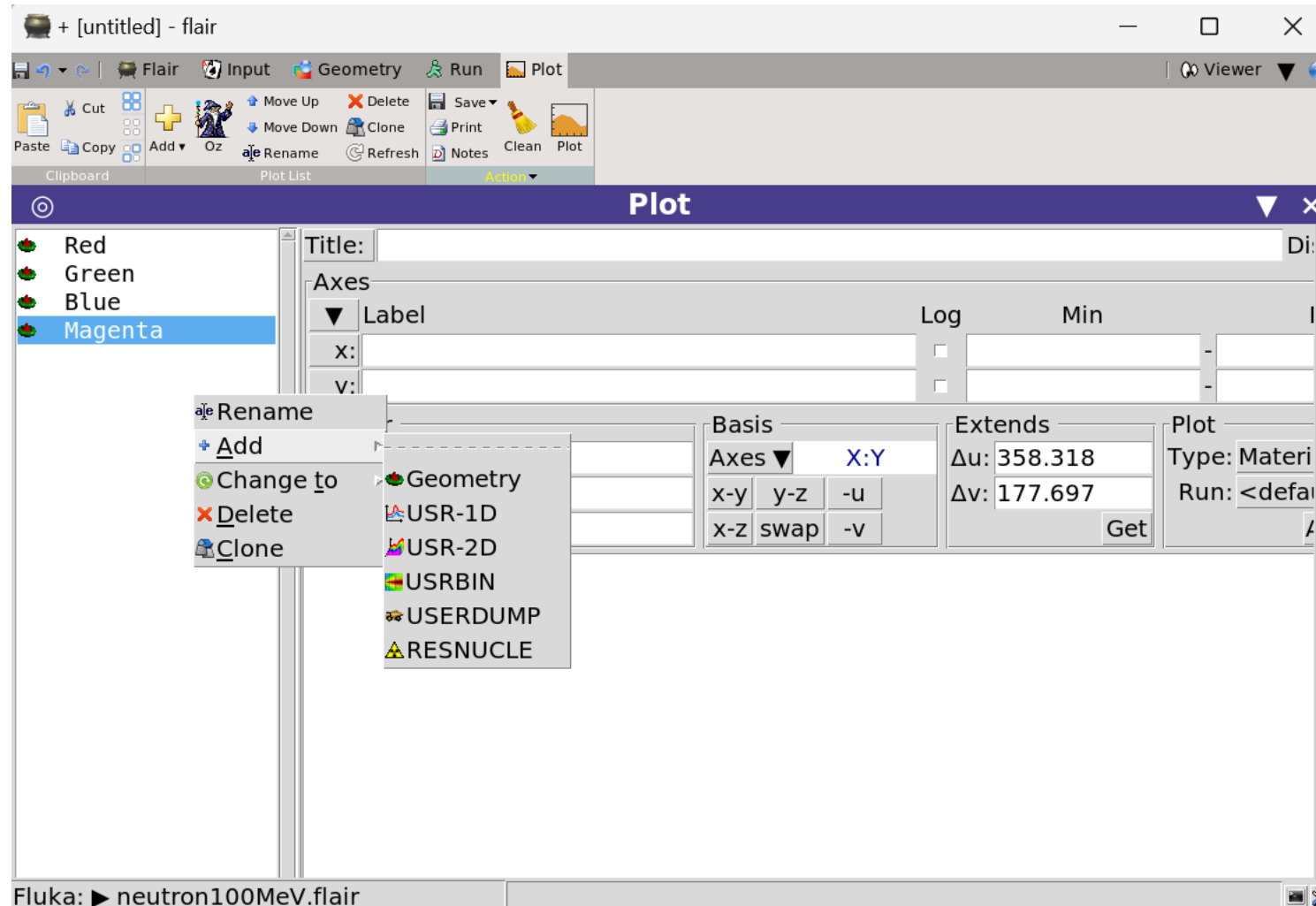
1. Click at "Data".
2. Select all *_fort.21 (the number 21 is indicated in USBIN card)
3. Click at "Process"

The screenshot shows the Flair software interface. The 'Run' window is open, displaying a table of data files. The 'Data' button in the top toolbar is highlighted with a red box and labeled '1.'. The table below shows a list of files with columns for File, Type, Size, and Date. The files listed are *_fort.21 files, and the first row is highlighted with a red box and labeled '2.'. The 'Process' button in the top toolbar is also highlighted with a red box and labeled '3.'. The status bar at the bottom shows 'Fluka: neutron100MeV.flair' and 'Files: 5'.

Run	Spawn	Detectors	Run	Type	Output	Name/Unit
<untitled>			neutron100MeV	usrbin	neutron100MeV_21.bnn	21

File	Type	Size	Date
neutron100MeV001_fort.21	21	500238	2023.08.09 10:08:41
neutron100MeV002_fort.21	21	500238	2023.08.09 10:08:59
neutron100MeV003_fort.21	21	500238	2023.08.09 10:09:17
neutron100MeV004_fort.21	21	500238	2023.08.09 10:09:34
neutron100MeV005_fort.21	21	500238	2023.08.09 10:09:52

8. Add USRBIN and setup options for plot



Flair Input Geometry Run Plot

Clipboard Plot List

Plot

Red
Green
Blue
Magenta
plot05

Title: Plot #5 Display: 0

Axes

Label	Log	Min	Max
x:	<input type="checkbox"/>	-	-
y:	<input type="checkbox"/>	-	-
cb:	<input checked="" type="checkbox"/>	-	-

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

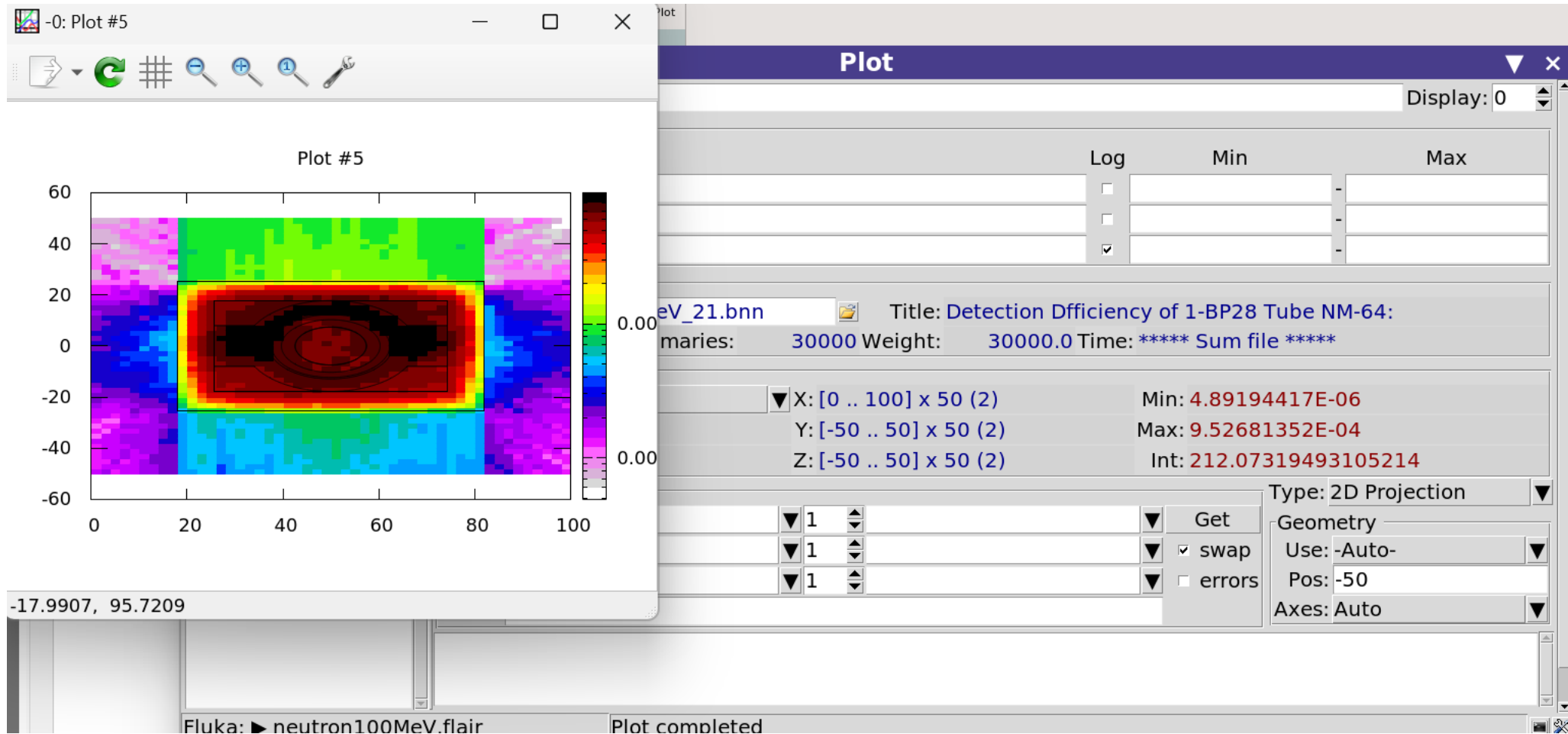
Geometry

Use: -Auto-
Pos: -50
Axes: Auto

Norm:

Fluka: neutron100MeV.flair

9. Plotting the graph

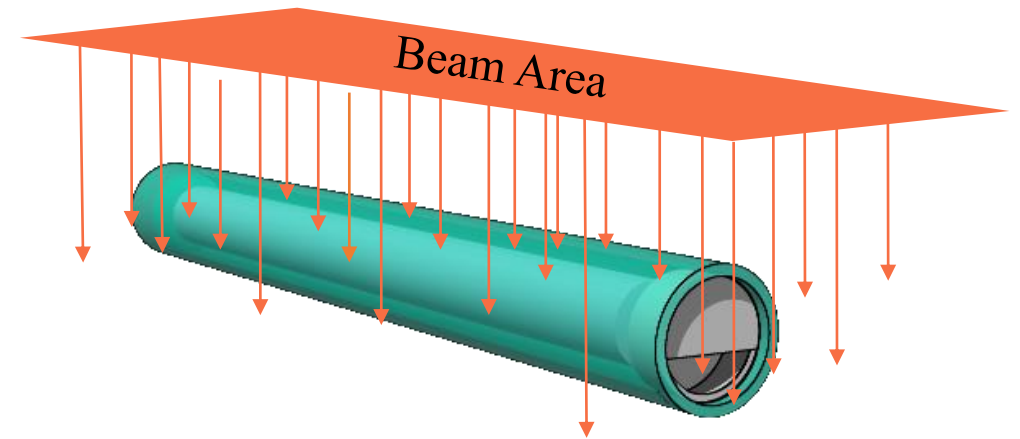


10. Export to text file

```
$ 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