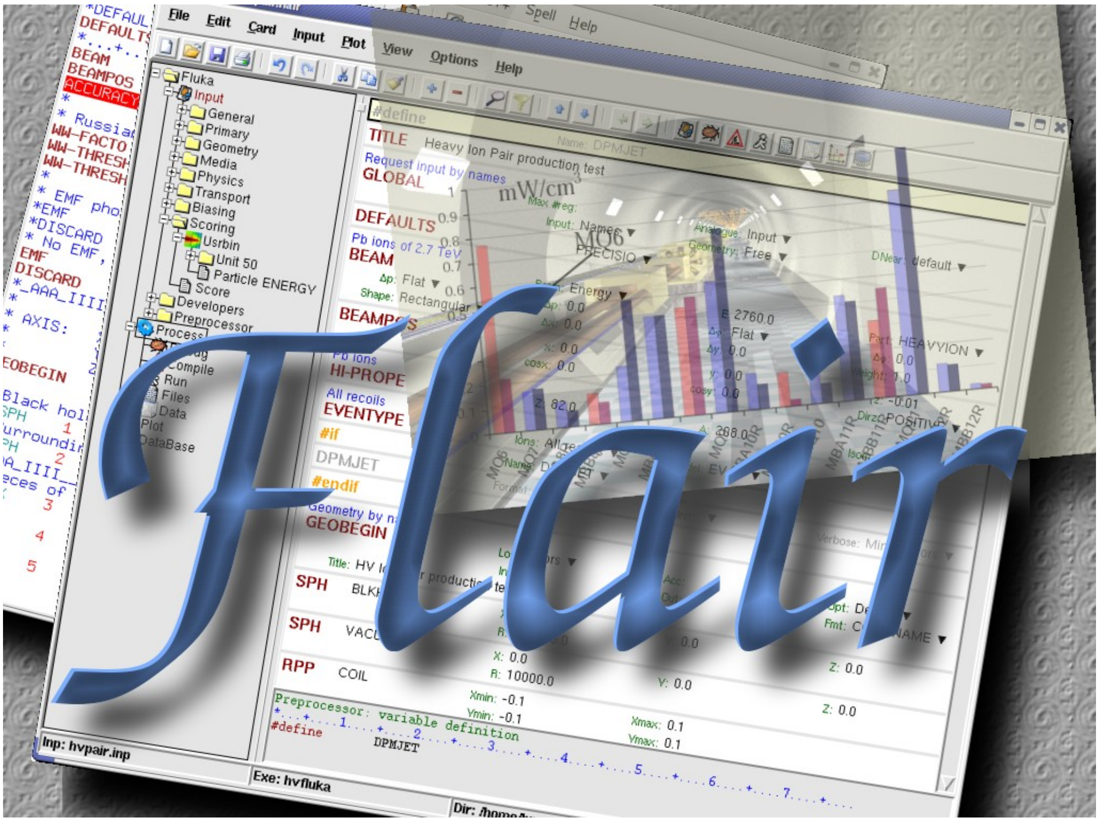

flair for FLUKA

/fleə(r)/ n [U,C][1] natural or instinctive ability (to do something well,
to select or recognize what is best, more useful, etc.
[*Oxford Advanced Dictionary of Current English*]

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[1] n: noun, U=Uncountable, C=Countable

Contents

1. Introduction

flair is an advanced user interface for FLUKA (http://www.fluka.org) to facilitate the editing of FLUKA input files, execution of the code and visualization of the output files. It is based entirely on python and Tkinter. Flair provides the following functionality:

1. **front-end** interface for an easy and almost error free editing as well as validation and error correction, of the input file during editing;
2. **compiling, debugging, running** and **monitoring** of the status during a run;
3. **back-end** interface for post-processing of the output files and plot generation through an interface with gnuplot (http://www.gnuplot.info) or 3D photorealistic images with povray (http://www.povray.org);
4. **library** of **materials** and **geometrical objects**, for easier editing, storing and sharing among other users and projects;
5. python **API** for manipulating the input files, post processing of the results and interfacing to gnuplot;

The philosophy of flair was to work on an intermediate level of user interface. Not too high, that hides the inner functionality of FLUKA from the user, and not so low that the user is in constant need of the FLUKA manual to verify the options needed for each card. Flair works directly with the input file of FLUKA and is able to read/write all acceptable FLUKA input formats. Inside the flair editor the user is working directly with the FLUKA cards having a small dialog for each card that displayes the card information in an interpreted human readable way. The only exception is that the cards in flair are called “extended cards” where each card is not composed only by 6 *whats* and 1 *sdum,* but rather it contains all related information in one unit (comments preceding the card, continuation cards, titles etc).

2. Installation

2.1. Download

The program can be downloaded either from the website http://www.fluka.org/flair in the download section, either as a .tgz (tar gzipped) archive or as rpm. It is possible to checkout always the latest **development** version directly from the CVS server using anonymous access, using the following commands:

```
$ CVSROOT=:pserver:anonymous@isscvs.cern.ch:/local/reps/flair
$ export CVSROOT
$ cvs login (Empty password)
$ cvs co .
```

2.2. Requirements

Flair, apart from the latest version of FLUKA, requires the following programs:

- Python interpreter V2.4+. Python usually comes pre-installed in most of the linux distributions, otherwise it can be downloaded from http://www.python.org
- Tkinter toolkit, this is the default graphical toolkit for python and usually it is shipped together with the interpreter. In some Linux distributions like Fedora (V3+)

it has to be installed separately. In this case install it with the command (as superuser)

```
$ yum -y install tkinter
```

- Tcl/Tk V8.4+. Usually installed on all linux systems, while for MS-Windows it comes together with the python distribution.

Optionally, for the plot creation

- gnuplot version V4.0 or greater (http://www.gnuplot.info)
- PovRay version V3.6 or greater (http://www.povray.org)

2.3. Version numbering

Flair version numbering, consists of 3 numbers starting from 0, in the form: **flair-M.m-R**

- M: Major version, this number is increased by one only when a major modification in the structure of the program takes place. During the initial phase of development is 0.
- m: Minor version, this number is increased by one every time a addition in the program functionality is made. e.g. Adding new plotting forms, mechanism, databases etc.
- R: Release, this number is increased every time when bug fixes take place or minor changes in the functionality. e.g. Addition of extra fields in a form etc.

The About Dialog of the program displays the Major and minor version as well the CVS release number, every time changes in the program are committed to the CVS server. It is recommended the user to pay attention on the date of the last change as well the date when the program is uploaded on the web site.

2.4. Installation Methods

2.4.1. RPM Installation:

For Linux systems that uses the rpm installer like Fedora or SuSE, the recommended way of installation is to use the rpm package from flair web site. As super user then you can issue the command:

```
$ rpm -ivh flair-X-XX.noarch.rpm
```

The rpm installer, will install the program in the **/usr/local/flair** directory and the executable launcher programs in the **/usr/local/bin**. It will also create all necessary files, modify the system mime database to add the program in the **educational/science/physics** category menu. Finally it will generate the following mime types text/x-flair and text/x-fluka and define the appropriate file associations for the file types .flair, .fluka and .inp.

2.4.2. Tarball Installation

For a manual installation download the latest version tar archive from flair web site the latest version and expand to the an appropriate directory using the following commands:

```
$ tar xzvf flair-X-XX.tgz
```

or

```
$ gunzip -c flair-X-XX.tgz | tar xvf -
```

> Note the tar file will not create any association of the extensions .flair, .fluka and .inp, and it would neither create links in the Desktop start menu. This have to be created manually

2.4.3. CVS Installation:

For a CVS installation, download from the flair CVS Repository as it is described in the “Download section” using Anonymous access, or get directly the latest version in a form of .tar.gz from the CVS Web interface from the following addresses:

CVSWeb:	http://isscvs.cern.ch/cgi-bin/cvsweb.cgi/?cvsroot=flair
CVSView:	http://isscvs.cern.ch/cgi-bin/viewcvs.cgi/?cvsroot=flair

2.4.4. Finalization of the Installation (tar or CVS)

For the moment the installation is not preparing automatically any launch script. Therefore it is recommended to create an alias in your login script to easier accessing of the program

```
alias flair=/path-where-you-install-flair/flair
```

Most of the programs in flair can be run as stand alone via the python interpreter. It could be quite useful to create a alias for the manual browser and for the Nuclear Wallet Cards like

```
alias pt='PYTHONPATH=/path-where-you-install-flair/lib python
/path-where-you-install-flair/PeriodicTable.py'
alias fm='PYTHONPATH=/path-where-you-install-flair/lib python
/path-where-you-install-flair/Manual.py'
```

Optionally one can copy also the flair.desktop quick launcher from the flair directory to the KDE or GNOME desktop. Edit the file and change the path to correspond to the one where flair is installed. Then by double-clicking on the flair icon the program will start.

3. Concepts

3.1. *Project File*

Flair is operating with the concept of the "*FLUKA projects*". A flair FLUKA project contains the following information:

1. general project information like: title, notes, override formating options for the input file;
2. links to the filenames for the default input, optional geometry files and executable;
3. it will maintain a list of debugging regions;
4. links to auxiliary Fortran files and libraries for compiling a user FLUKA executable if necessary;
5. list of runs; For each run the user can change the input name, override the default preprocessor defines, title, random seed, number of start particles, run cycles and executable file;
6. list of output files and rules for merging the output of scoring cards;
7. list of user defined plots, for Geometry, all **USRxxx** cards, **RESNUCLEi** and visualization of the input file information i.e. graphical representation of the beam profile, particle thresholds, weight-windows etc.

All the above information is stored in an text file with the extension **.flair**, and is editable with the flair program.

3.2. *Input File*

Flair is able to read and write all formats recognized by FLUKA, but internally it works always in the names format, and treats the input as a list of extended cards. The default format for saving is always fixed with names for the input and free with names for the geometry. The user can override the default exporting format either by the appropriate use FLUKA cards (like **FREE**, **GLOBAL**, **GEOBEGIN**) or by overriding the format in the project definition.

The positioning of the input cards is not so important, flair will try to reorganize the input file during saving and move all the geometry cards in the correct position. The only exception is that geometry cards (bodies, regions and lattices) controlled by the preprocessor outside the **GEOBEGIN** .. **GEOEND** block while be moved inside the geometry definition. While the preprocessor cards if any will remain at their initial position. All geometry cards that are correctly placed inside the **GEOBEGIN** .. **GEOEND** block while not be affected.

3.3. Extended input cards

All FLUKA cards in flair, are described by the extended input card (class Input.Card). Each extended card is composed by:

1. **comment lines**, the ones preceding the card definition, as well the in-line comments
2. a **tag**, which corresponds to the FLUKA card name. With a few additions: regions are defined with the **REGION** card. All preprocessor cards have tag names like **#define, #undef, #if, ...**
3. a variable number of **whats**. Starting from **what[0]** which corresponds to the **sdum**, **what[1]..what[6]** are the same with the FLUKA whats, **what[7]-what[12]** correspond to the what(1)-what(6) of the first continuation line etc.
4. Some cards what an extra field of information called **extra** or accessible as what[-1]. This is used to store long strings event multi-line information used by some cards, like **TITLE**, **GEOBEGIN, PLOTGEOM** or **REGION**
5. state of the card can be either **enabled** or **disabled**. Since cards cannot be commented with flair, the only way of excluding them from the input without deleting them is to disable. The program while place the card around an **#if 0 .. #endif** block. On the contrary all commented cards present in the input file, (with no space between the * and the card tag) will be converted to disabled cards.
6. All **obsolete cards** present in the input will be converted to the closest match if any, otherwise will be treated as error
7. All **unknown cards** will be converted to the card "**error**" and be disabled.

3.4. Card Grouping

FLUKA cards in flair are grouped into the following categories for easier accessing and more flexible editing of the input file:

Category	***Description***
General	Cards of general purpose (like **TITLE, DEFAULTS, GLOBAL**, etc..)
Primary	Cards dealing with the definition of the primary starting particles
Geometry	Cards related to the definition of the geometry bodies/regions/lattices plotting and rotations/translations
Media	Cards for the definition of materials
Physics	Cards defining physics properties for the simulation
Transport	Cards that modify the way particles are transported in FLUKA
Biasing	Cards for importance biasing definition
Scoring	Cards related to scoring

Category	***Description***
Developers	Cards reserved by the developers
Preprocessor	Preprocessor definitions for creating conditional input files

The user is encouraged to give a look first on the menu “**Add**” and browse the various categories to become familiar with the grouping.

4. Quick Start

In the present section we will go through a step-by-step example and we will build from scratch, run and analyze the results of a simple FLUKA example. We will simulate the neutron production and energy deposition of a lead target like n_TOF at CERN (http://cern.ch/n_TOF). The target has a rectangular shape of 80x80x60 cm^3 and is submerged in a water container with a ~5 cm layer of water that is used both for cooling and moderation. The neutrons are produced by a 20 GeV a proton beam, impacting with 10º angle on the horizontal plane.
To follow this tutorial, basic knowledge of FLUKA is required.

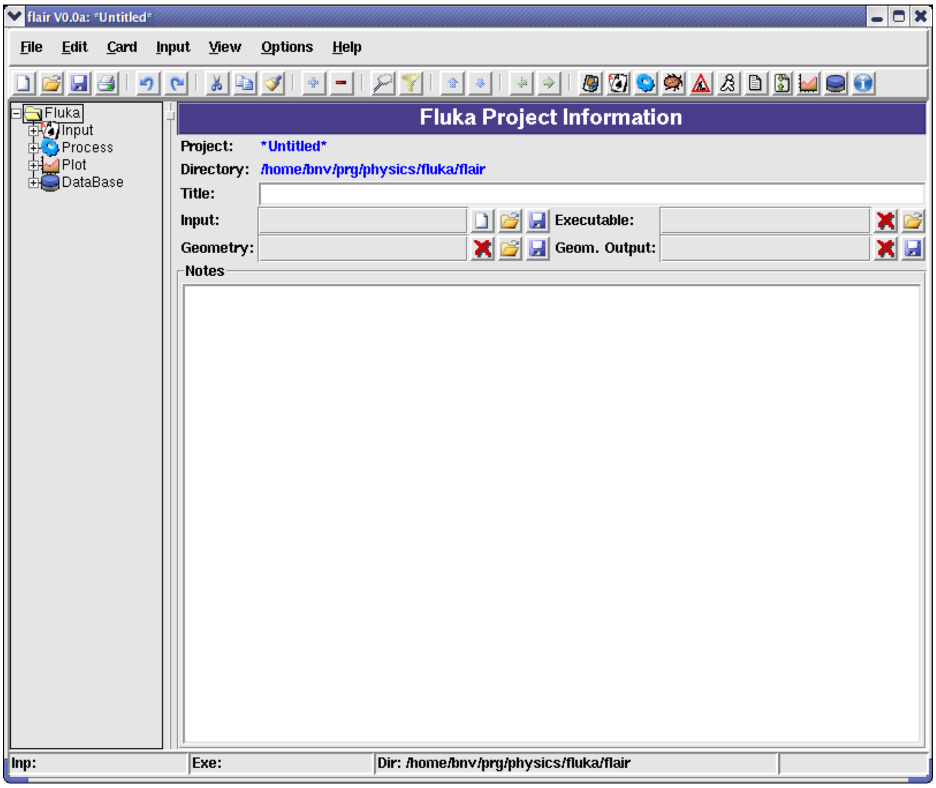
> The user must make a choice on the coordinate system. The general tendency is to use the Z-axis collinear with the beam axis (usually lying on the horizontal plane), and then select the vertical and horizontal axis. In this example we will use the following convention:
>
> X – horizontal axis, pointing to the left, with respect to beam direction
>
> Y – vertical axis, pointing upwards
>
> Z – beam axis, usually horizontal

4.1. Start a flair Project

Launch **flair** by typing the following command, or by clicking the flair icon

```
$ flair
```

The flair main window and the output window will appear:



Project: *Untitled*
Directory: /home/bnv/prg/physics/fluka/flair
Title:
Input:
Executable:
Geometry:
Geom. Output:

Inp:
Exe:
Dir: /home/bnv/prg/physics/fluka/flair

On the flair main window one can find:

- a menu bar on top
- a tool-bar with icons for fast access of the most common commands
- a status bar at the bottom to display some useful information for the current frame
- and two frames in the center separated by a horizontal splitter:
  1. on the left frame, there is a tree browser for the various sections of the project. By expanding and clicking on the appropriate node of the tree a different frame appears on the right side.
  2. the right frame encapsulates all the project frames used for editing the information stored in the project file.

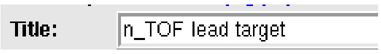
The window-title displays the program name, version and the name of the project we are currently are working on. Since we didn't specify any name it will show the word *Untitled*.

The Output window displays all information that are printed on the standard output and standard error unit.

If you want to start flair without the output window, use the **-x** as command line argument **flair -x**

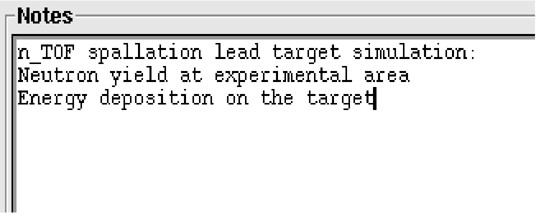
- We start by selecting the root node ⊟ Fluka on the left frame (it should be already selected). The right frame should show the general FLUKA project information, like title, input, geometry and executable filenames and notes.

- In the title entry field, type a title like**:**



Title: n_TOF lead target

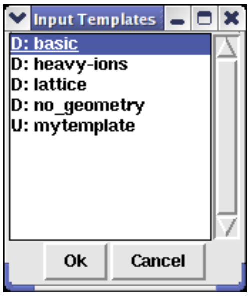
- add also a small note describing the present project



Notes

```
n_TOF spallation lead target simulation:
Neutron yield at experimental area
Energy deposition on the target
```

- Click on the button with the new icon (on the right of the Input Filename field) to create a new input file. The new icon on the toolbox creates a new project. A list box will pop up to select one of the various standard templates. Select the **basic** by double clicking on it.

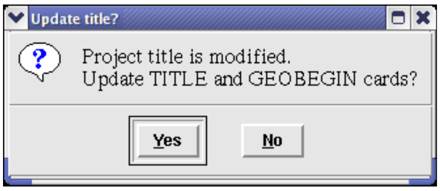


Input Templates

D: basic
D: heavy-ions
D: lattice
D: no_geometry
U: mytemplate

The dialog will show the default templates that exist in the flair package prefixed with the label "**D:**" and all the user defined templates with the label "**U:**". The user defined templates are located in the user directory **~/.flair/templates**

An information dialog box will appear asking if you want to update the **TITLE** and **GEOBEGIN** cards inside the FLUKA input using the title that was entered in the project. Click yes and automatically all FLUKA cards that require a title string will be set with the project title.



Project title is modified.
Update TITLE and GEOBEGIN cards?

4.2. Edit the input file

Next we move the Input editor by selecting and clicking on the tree the Input Input node . The right frame will change and the input editor will appear.

The editor and all the project frames can be accessed with various ways:

i. by selecting the appropriate node in the project tree;

ii. with the function **F2** – **F9** keys**. F3** is for the Input editor;

iii. with the tool bar buttons

iv. From the menu item **View**

During input editing there are two modes:

i. **Card mode** where you can manipulate the cards as a single object i.e. Drag and drop, move, delete, insert, copy, paste...,

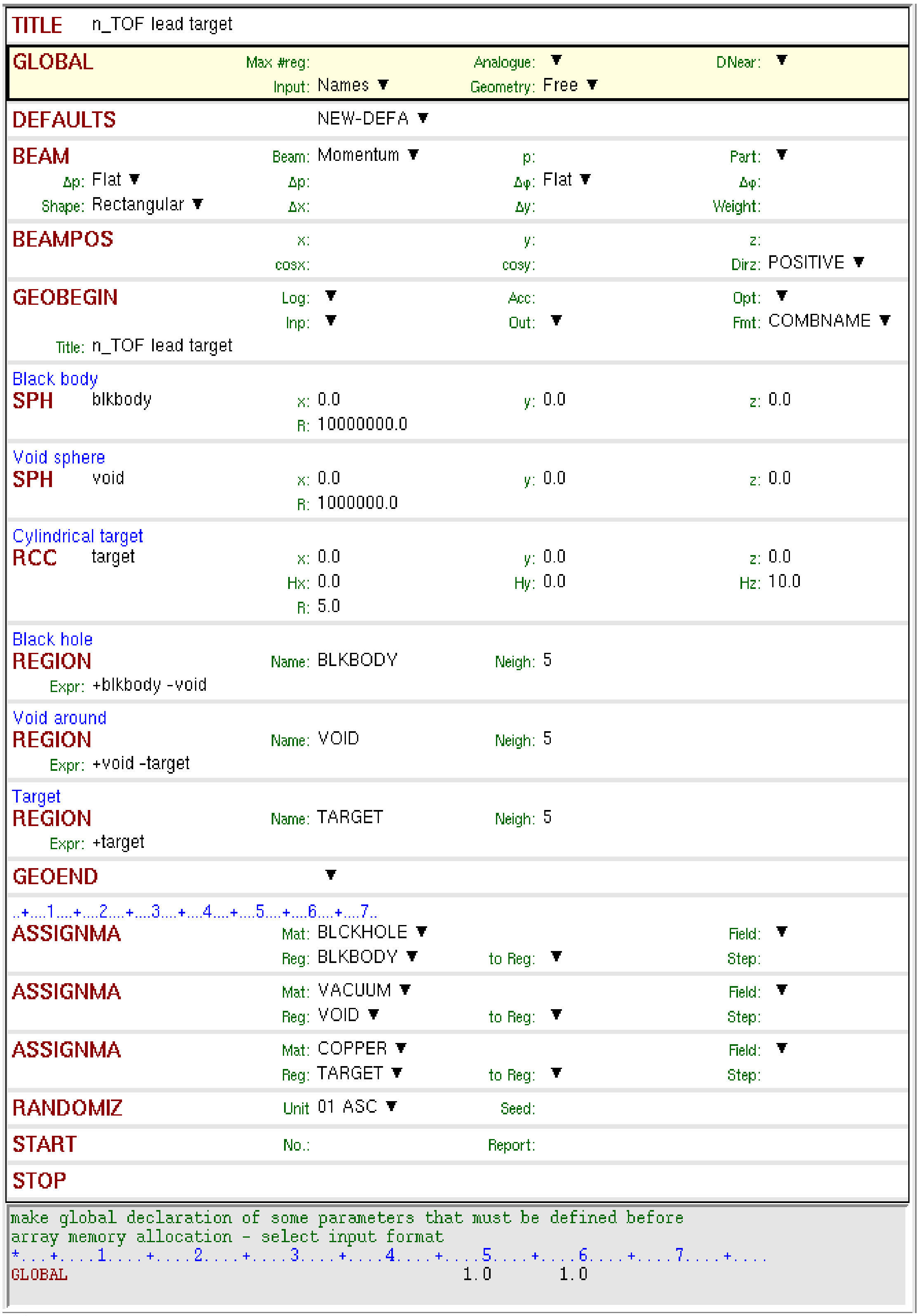
ii. **Field editing mode**, to modify the contents of a card.

To start editing the fields of a card, first select the card with the **Up/Down** arrows or **Ctrl-F** (Find) and press **ENTER**-key to start the field editing mode. To exit editing press **ESCAPE**-key, and you will return to Card mode.

WARNING: The present version of flair doesn't have a fully featured undo/redo mechanism. Therefore is wise to save the project from time to time while editing or before any major modification.

The editor now contains the default template, with the TITLE and GEOBEGIN card filled with our Project title. The selected cards are highlighted with a Light Yellow background color, while the active card has a thick black border around it.

We start editing the file by going through one by one the input cards:



TITLE n_TOF lead target

GLOBAL Max #reg: Analogue: ▼ DNear: ▼
Input: Names ▼ Geometry: Free ▼

DEFAULTS NEW-DEFA ▼

BEAM Beam: Momentum ▼ p: Part: ▼
Δp: Flat ▼ Δp: Δφ: Flat ▼ Δφ:
Shape: Rectangular ▼ Δx: Δy: Weight:

BEAMPOS x: y: z:
cosx: cosy: Dirz: POSITIVE ▼

GEOBEGIN Log: ▼ Acc: Opt: ▼
Inp: ▼ Out: ▼ Fmt: COMBNAME ▼
Title: n_TOF lead target

Black body
SPH blkbody x: 0.0 y: 0.0 z: 0.0
R: 10000000.0

Void sphere
SPH void x: 0.0 y: 0.0 z: 0.0
R: 1000000.0

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

Black hole
REGION Name: BLKBODY Neigh: 5
Expr: +blkbody -void

Void around
REGION Name: VOID Neigh: 5
Expr: +void -target

Target
REGION Name: TARGET Neigh: 5
Expr: +target

GEOEND ▼

..+....1....+....2....+....3....+....4....+....5....+....6....+....7..

ASSIGNMA Mat: BLCKHOLE ▼ Field: ▼
Reg: BLKBODY ▼ to Reg: ▼ Step:

ASSIGNMA Mat: VACUUM ▼ Field: ▼
Reg: VOID ▼ to Reg: ▼ Step:

ASSIGNMA Mat: COPPER ▼ Field: ▼
Reg: TARGET ▼ to Reg: ▼ Step:

RANDOMIZ Unit 01 ASC ▼ Seed:

START No.: Report:

STOP

```
make global declaration of some parameters that must be defined before
array memory allocation - select input format
*...+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....
GLOBAL                                          1.0       1.0
```

We skip the cards **TITLE**, **GLOBAL** and **DEFAULTS** they are already filled with the default values to enable the input in Fixed format with Names and Free format for the geometry.

- Select the **BEAM** card and start editing either by pressing **ENTER**-key or by clicking with the mouse on the appropriate field. Use the **TAB**-key to move to the next field:
  - Select **Energy** on beam type. They next label will change to "E:"
  - Type **20** at the beam energy labeled "E:"

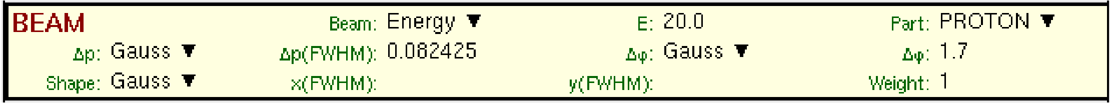
  > You will notice that the card display at the bottom of the screen will start to fill in with the values you typed, highlighting with yellow the changes from the previous state. Flair always converted the numbers into floating point format using the best representation of the number to ensure the maximum accuracy.

  - Select **PROTON** as particle type.

  > In all flair list boxes you can key-in the starting characters of the item you are searching and the closest match will be selected

  - Select **Gauss** as momentum distribution from the field labeled "Δp"
  - Type **0.082425** in the "Δp(FWHM)" as momentum spread (GeV/c)
  - Select **Gauss** as angular distribution from the field labeled "Δφ"
  - Type **1.7** in the next field "Δφ" as angular spread in mrad
  - Type **1** in the field of the particle "Weight". The particle weight is omitted by FLUKA but the sign is important. Therefore is wise to set it always to one.

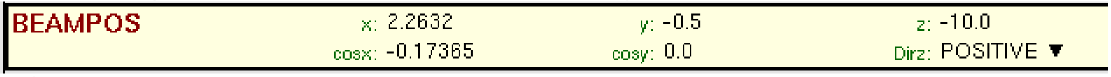
  The card should look like the following:



```
BEAM                  Beam: Energy ▼          E: 20.0          Part: PROTON ▼
     Δp: Gauss ▼   Δp(FWHM): 0.082425        Δφ: Gauss ▼         Δφ: 1.7
  Shape: Gauss ▼    x(FWHM):            y(FWHM):              Weight: 1
```

> At any time you can hit **F1** to browse the FLUKA manual for the active card

- Fill up the **BEAMPOS** card with the following values:



```
BEAMPOS                 x: 2.2632           y: -0.5            z: -10.0
                     cosx: -0.17365      cosy: 0.0          Dirz: POSITIVE ▼
```

- Next we start building the geometry. To de-clatter the display expand the project tree (Left frame) and select the Geometry node ⊞ Geometry. Now the right frame will show only the cards belonging to the geometry group.

  The template generated a default geometry consisting of two concentric huge spheres named **blkbody** and **void**, and a cylindrical target named **target**. We will replace the target by a right parallelepiped named **watercnt** and add two parallelepipeds named **pbtarget** and **niche**

- Select the card **RCC target** either by clicking on it or using the up/down keys

- Select from the menu the command:

  Add → Change To → Geometry → Bodies → Rpp

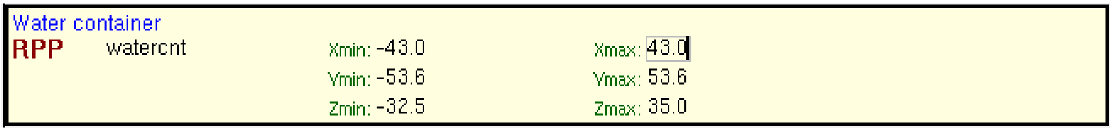
  > **WARNING:** **Change To** commands change the type of card, while at the same time trying to keep as much as possible from the whats. All exceeding whats in the new type will be discarded.

  The above command will convert the **RCC** to **RPP**

- Start editing the card by pressing the **ENTER**-key.
  - Change the comment to **Water container**
  - Press tab to move to next field and change the body name to **watercnt**. The program will ask you to change the name of all references to body

target renamed to **watercnt**. Click Yes.

When changing a body name, region name, material, or detector all cards that refer to this name will be changed also.



Water container

RPP	watercnt	Xmin: -43.0	Xmax: 43.0
		Ymin: -53.6	Ymax: 53.6
		Zmin: -32.5	Zmax: 35.0

Create two new **RPP** bodies. Either by right clicking and selecting

Add → Bodies → Rpp

or from the menu bar

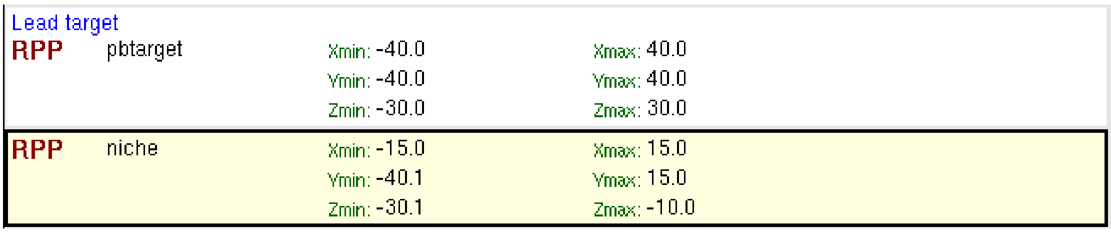
Add → Geometry → Bodies → Rpp

or even by hitting **Ctrl-Enter** and selecting again

Bodies → Rpp

or by clicking the icon ✚ in the tool bar

To add a comment on a card, right click the card and select **Insert Comment** or from the **Input** menu select the **Insert Comment**. From the configuration panel you can change the default behavior and add a comment line by default on every newly inserted card.

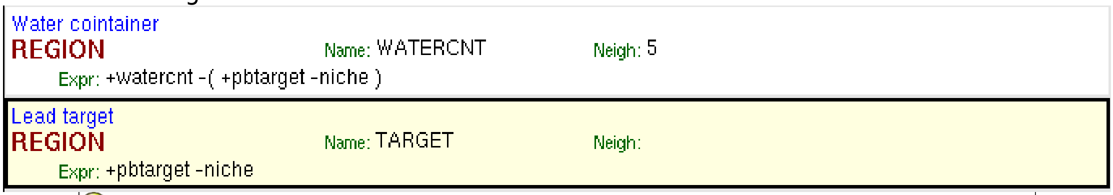


Lead target

RPP	pbtarget	Xmin: -40.0	Xmax: 40.0
		Ymin: -40.0	Ymax: 40.0
		Zmin: -30.0	Zmax: 30.0
RPP	niche	Xmin: -15.0	Xmax: 15.0
		Ymin: -40.1	Ymax: 15.0
		Zmin: -30.1	Zmax: -10.0

Is always a good practice to avoid touching (co-planar) bodies in FLUKA. Either try to cut the bodies with the use of infinite planes, or slightly overlap the bodies and then performing the appropriate logical operation in the region definition.

Now modify the **TARGET** region to **WATERCNT.** Click on **Yes** to the pop up dialog requesting a name change, and type the expression as shown in the next image. Create also a new **REGION** named **TARGET** as shown below.



Water cointainer

REGION   Name: WATERCNT   Neigh: 5

Expr: +watercnt -(+pbtarget -niche)

Lead target

REGION   Name: TARGET   Neigh:

Expr: +pbtarget -niche

Hitting the **+**, **-**, "**Insert**" keys or the icon ✚ while editing a **REGION**'s expression shows a list of bodies to select from. Press the **ESC**ape key if you are not interested in adding any body. This behavior can change from the configuration panel.

Lists in flair are search-able. Type the beginning of the item you are looking for and the closest match will be highlighted. **Ctrl-N** or **Ctrl-G** repeats the last search

Now is time to create the water material. There are two ways:

- create manually the necessary **MATERIAL** and **COMPOUND** cards, directly in the input editor;

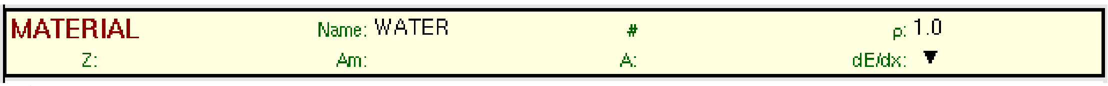
- use directly the material from the Material Database and then import it to the input editor (recommended). Using the Material Database you can benefit from the pre-existing materials, and create or store your own materials to be exchanged between various input files.

To create manually the water material:

Select from the project tree the Input node ⊞ Input, to show all cards. Click to select the **GEOEND** card, in order to add a new card immediately after using the menu command

Add → Media → Material

Enter **WATER** as name and density of **1.0**

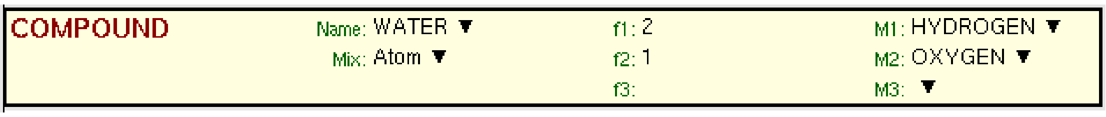


MATERIAL Name: WATER # ρ: 1.0
Z: Am: A: dE/dx: ▼

- Add a new **COMPOUND** card.

Add → Media → Compound

Select the **WATER** from the material list, set the mixing type to **Atom** and fill up with the following values:



COMPOUND Name: WATER ▼ f1: 2 M1: HYDROGEN ▼
Mix: Atom ▼ f2: 1 M2: OXYGEN ▼
f3: M3: ▼

To create/use the Material Database:

- Expand and select the node Material, which is found under the Database. The Material Database frame will appear. In this frame you can create or modify the material database, which is global for all flair projects.

  The materials are divided into groups where one material can belong to many groups. Each material contains:

  1. a title which should be unique
  2. some notes explaining the material
  3. a list of possible FLUKA names with the preference order in case of doubles
  4. the stoichiometric composition given as fraction in atoms, mass or volume
  5. density in g/cm^3
  6. Sternheimer parameters.

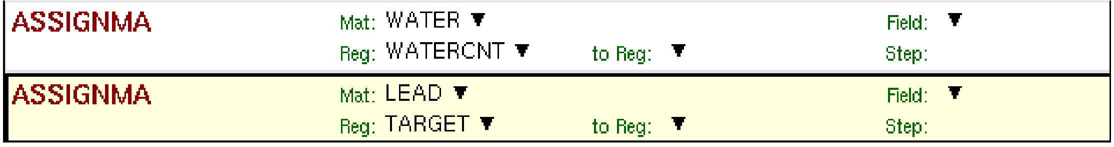
  By default all groups are selected

- Enter the word "**water**" in the **Search:** field and click the search icon or press **Enter**. The Material List will show only the materials in the selected groups matching the search string. A few choices will appear.

- Click with the mouse on the "Water (liquid)" to select the material and then click on the icon or from menu item "**Tools → Insert to Input**", or by right-clicking and select the "**Insert to Input**". The WATER material will be inserted after the last **MATERIAL**/**COMPOUND**/**GEOEND** card in the input. The action will be confirmed by a message box as well printing the inserted cards in the output window

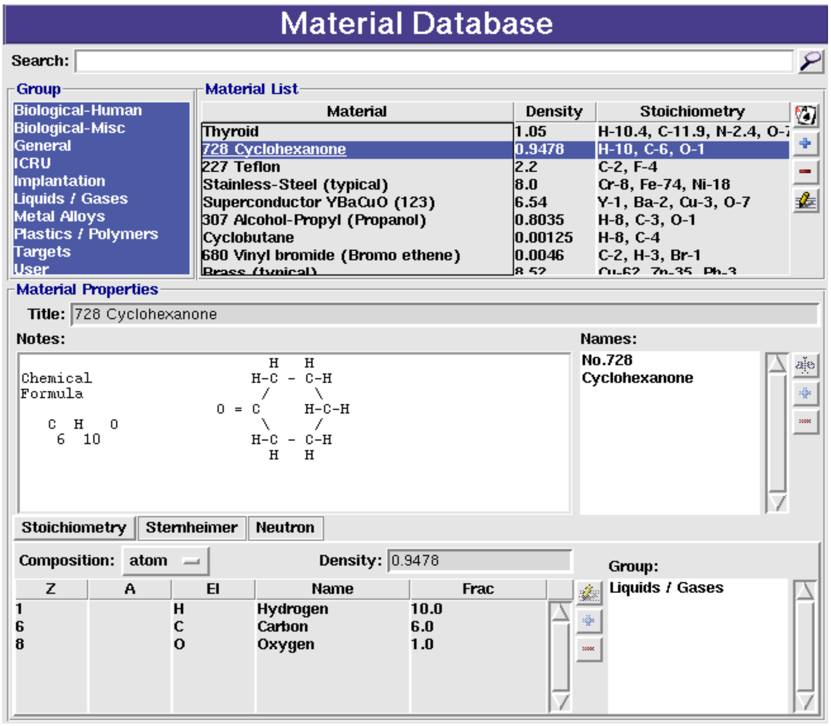
  WARNING: The existing materials are there for reference. Please verify the correctness of the information.

- To assign the materials to the regions we need to modify and add the necessary **ASSIGNMAt** cards as shown below



ASSIGNMA Mat: WATER ▼ Field: ▼
Reg: WATERCNT ▼ to Reg: ▼ Step:

ASSIGNMA Mat: LEAD ▼ Field: ▼
Reg: TARGET ▼ to Reg: ▼ Step:



Material Database

Search:

Group: Biological-Human, Biological-Misc, General, ICRU, Implantation, Liquids / Gases, Metal Alloys, Plastics / Polymers, Targets, User

Material List

Material	Density	Stoichiometry
Thyroid	1.05	H-10.4, C-11.9, N-2.4, O-7
728 Cyclohexanone	0.9478	H-10, C-6, O-1
227 Teflon	2.2	C-2, F-4
Stainless-Steel (typical)	8.0	Cr-8, Fe-74, Ni-18
Superconductor YBaCuO (123)	6.54	Y-1, Ba-2, Cu-3, O-7
307 Alcohol-Propyl (Propanol)	0.8035	H-8, C-3, O-1
Cyclobutane	0.00125	H-8, C-4
680 Vinyl bromide (Bromo ethene)	0.0046	C-2, H-3, Br-1
Brass (typical)	8.52	Cu-62, Zn-35, Pb-3

Material Properties

Title: 728 Cyclohexanone

Notes:

```
                                H   H
Chemical                      H-C - C-H
Formula                        /     \
                          O = C       H-C-H
   C  H   O                    \     /
    6  10                     H-C - C-H
                                H   H
```

Names: No.728 Cyclohexanone

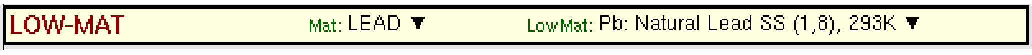
Stoichiometry | Sternheimer | Neutron

Composition: atom   Density: 0.9478

Group: Liquids / Gases

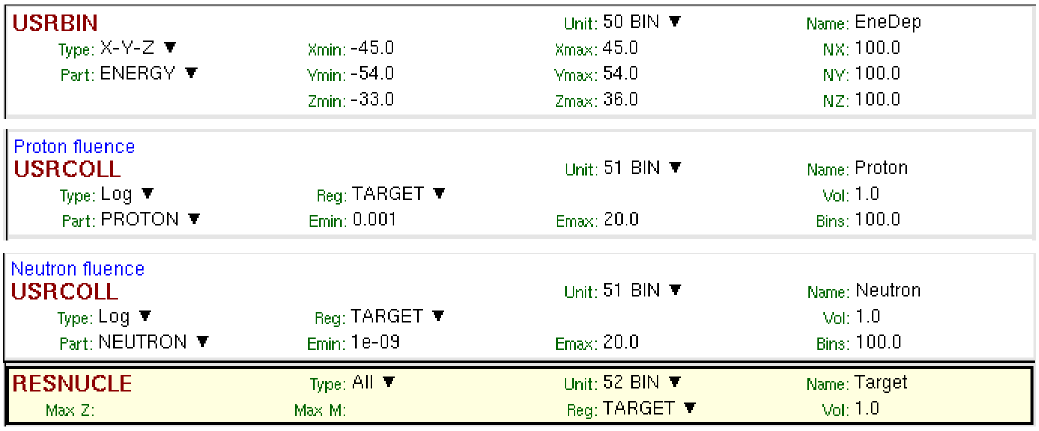
Z	A	El	Name	Frac
1		H	Hydrogen	10.0
6		C	Carbon	6.0
8		O	Oxygen	1.0

🗲 After the **COMPOUND** card add a **LOW-MAT** card from the **Media** group, to specify that we want to use Self Shielded Lead for the low-energy neutron cross section.



LOW-MAT Mat: LEAD ▼ LowMat: Pb: Natural Lead SS (1,8), 293K ▼

🗲 Add a few scoring cards, a **USRBIN**, **USRCOLL** and **RESNUCLEi** as shown below



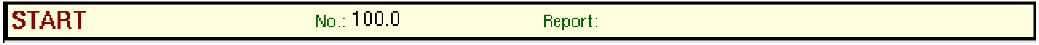
USRBIN Unit: 50 BIN ▼ Name: EneDep
Type: X-Y-Z ▼ Xmin: -45.0 Xmax: 45.0 NX: 100.0
Part: ENERGY ▼ Ymin: -54.0 Ymax: 54.0 NY: 100.0
Zmin: -33.0 Zmax: 36.0 NZ: 100.0

Proton fluence
USRCOLL Unit: 51 BIN ▼ Name: Proton
Type: Log ▼ Reg: TARGET ▼ Vol: 1.0
Part: PROTON ▼ Emin: 0.001 Emax: 20.0 Bins: 100.0

Neutron fluence
USRCOLL Unit: 51 BIN ▼ Name: Neutron
Type: Log ▼ Reg: TARGET ▼ Vol: 1.0
Part: NEUTRON ▼ Emin: 1e-09 Emax: 20.0 Bins: 100.0

RESNUCLE Type: All ▼ Unit: 52 BIN ▼ Name: Target
Max Z: Max M: Reg: TARGET ▼ Vol: 1.0

🗲 Set some primary particles in the **START** card for a test run

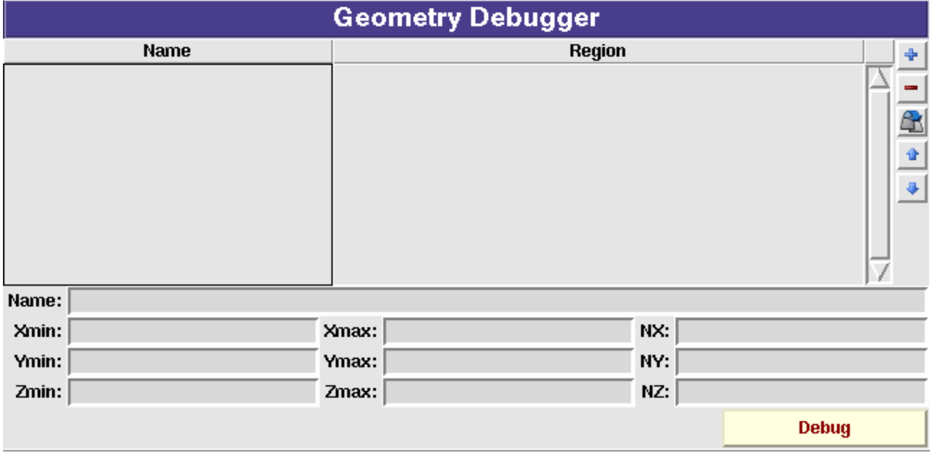


START No.: 100.0 Report:

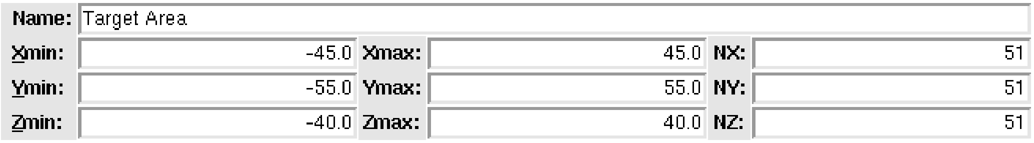
🗲 Finally click on the save 💾 icon from the tool bar. Flair will ask you first to save the input file, use **tutorial.inp**; and then the project file, use **tutorial.flair**.

4.3. Debugging the input file

- Select the Debug node which is under the Process Debug or by clicking directly the **F4** key. The Geometry Debugger will appear. This frame is composed by a listbox and a few entry fields where the user can add various debugging regions. Debugging regions in flair have nothing to do with the regions defined in the geometry of FLUKA. They refer to a volume in the geometry to be scanned for geometry errors with means of the **GEOEND** card.



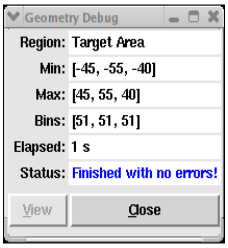
- Start by adding a new debugging region by clicking the add ✚ button or the **Insert** key.
- The region will be automatically named as **Region #1**. Select it and enter the following information in the fields below. To define a region around our target scanned in a grid of 51x51x51 steps.



Name:	Target Area				
Xmin:	-45.0	**Xmax:**	45.0	**NX:**	51
Ymin:	-55.0	**Ymax:**	55.0	**NY:**	51
Zmin:	-40.0	**Zmax:**	40.0	**NZ:**	51

> It is always a good practice to use odd numbers in the number of steps, to decrease the probability of checking a position falling directly on a region boundary.

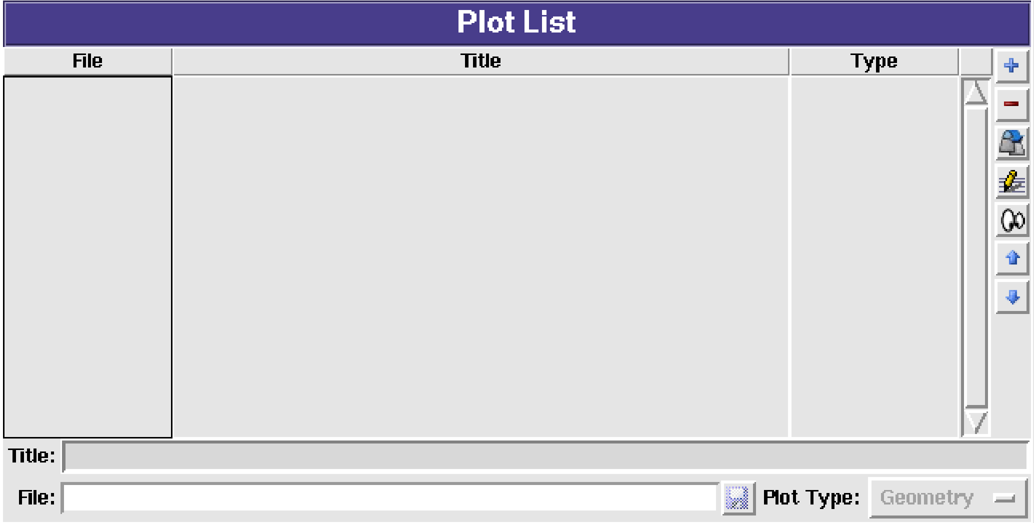
- When ready click the **DEBUG** button (or **Ctrl-Enter**) to start debugging. Flair will build a temporary input file containing only the geometry information and launch a FLUKA run. A dialog will pop up to monitor the progress of debugging. The dialog will show the current region being debugged elapsed time and status. When the run is finished, if there are errors in the geometry, click the **View** button to display the output of the Run, otherwise if the geometry is error free, the only available option will be to close the window.



Region: Target Area
Min: [-45, -55, -40]
Max: [45, 55, 40]
Bins: [51, 51, 51]
Elapsed: 1 s
Status: Finished with no errors!

4.4. Geometry Plotting

- Select the Plot Plot node under Fluka, or by clicking directly the **F9** key. The Plot List frame will appear.



The frame contains a list of all the plots that are associated with the project.

- To create a new plot click on the ✚ button. Now the **Title** will contain the string "Plot #1" and the the **File** will be "plot001" with format .eps.

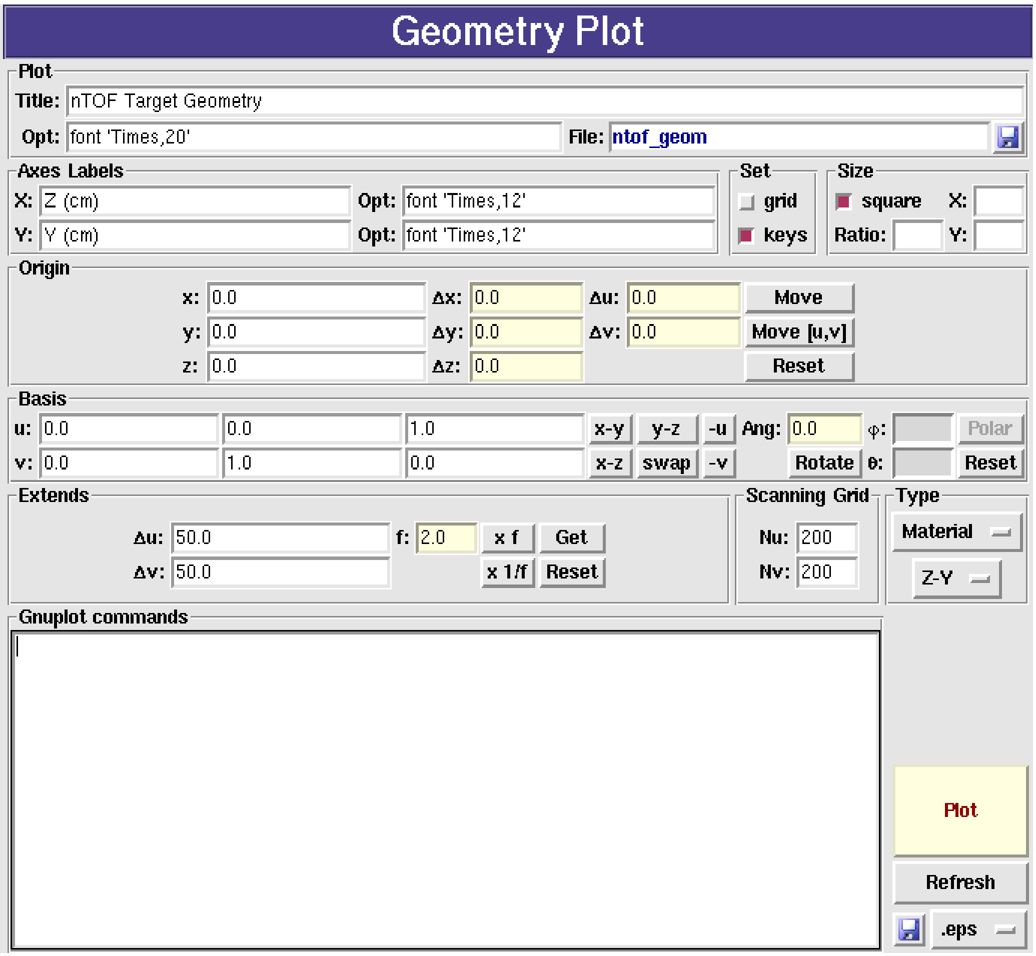
- Change the title field "*nTOF Target Geometry*"

- Click on the save icon ✚ after the **File** field at the bottom of the frame, to change the filename to "*geometry*". This filename will be used for all auxiliary files that will be created during the plot.

- Select and double click the geometry plot entry from the listbox, or from the project tree on the left frame. The Geometry Plot frame will appear.

- The title and the filename should be already filled and the coordinates are set to the axes origin.
  - Click on the Size frame "**square**" to get a square aspect ratio
  - Click on the button labeled **Y-Z** in the **Basis** frame
  - and then click on the **Swap** button. This will set the plotting axis to Z for horizontal and Y for vertical.
  - Set the value **2** in the **f:** field of the **Extends** frame and click the **1/f** button to reduce the plot extends to 50 cm.
  - Select the Type **Material** to be used for the coloring of the regions. The dialog should resemble like the following figure
  - Optionally fill the Axes labels and the "Opt:" fields on the labels to select a different font, color and/or other option from gnuplot. Please look the gnuplot manual for the available options.

- When ready click the **Plot** button (or press **Ctrl-Enter**). A temporary input file will be created containing the geometry and a **PLOTGEOM** card. Flair will launch FLUKA with this temporary file and convert the output PLOTGEOM.STORE file into a file with a gnuplot acceptable format. Finally the gnuplot will be called to plot the geometry.



Geometry Plot

Plot

Title: nTOF Target Geometry

Opt: font 'Times,20'   File: ntof_geom

Axes Labels

X: Z (cm)   Opt: font 'Times,12'

Y: Y (cm)   Opt: font 'Times,12'

Set: □ grid, ■ keys

Size: ■ square, X:, Ratio:, Y:

Origin

x: 0.0   Δx: 0.0   Δu: 0.0

y: 0.0   Δy: 0.0   Δv: 0.0

z: 0.0   Δz: 0.0

Basis

u: 0.0   0.0   1.0   Ang: 0.0   φ:

v: 0.0   1.0   0.0   θ:

Extends

Δu: 50.0   f: 2.0

Δv: 50.0

Scanning Grid

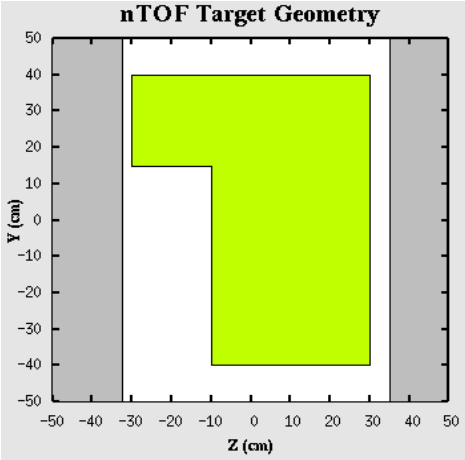
Nu: 200

Nv: 200

Type: Material, Z-Y

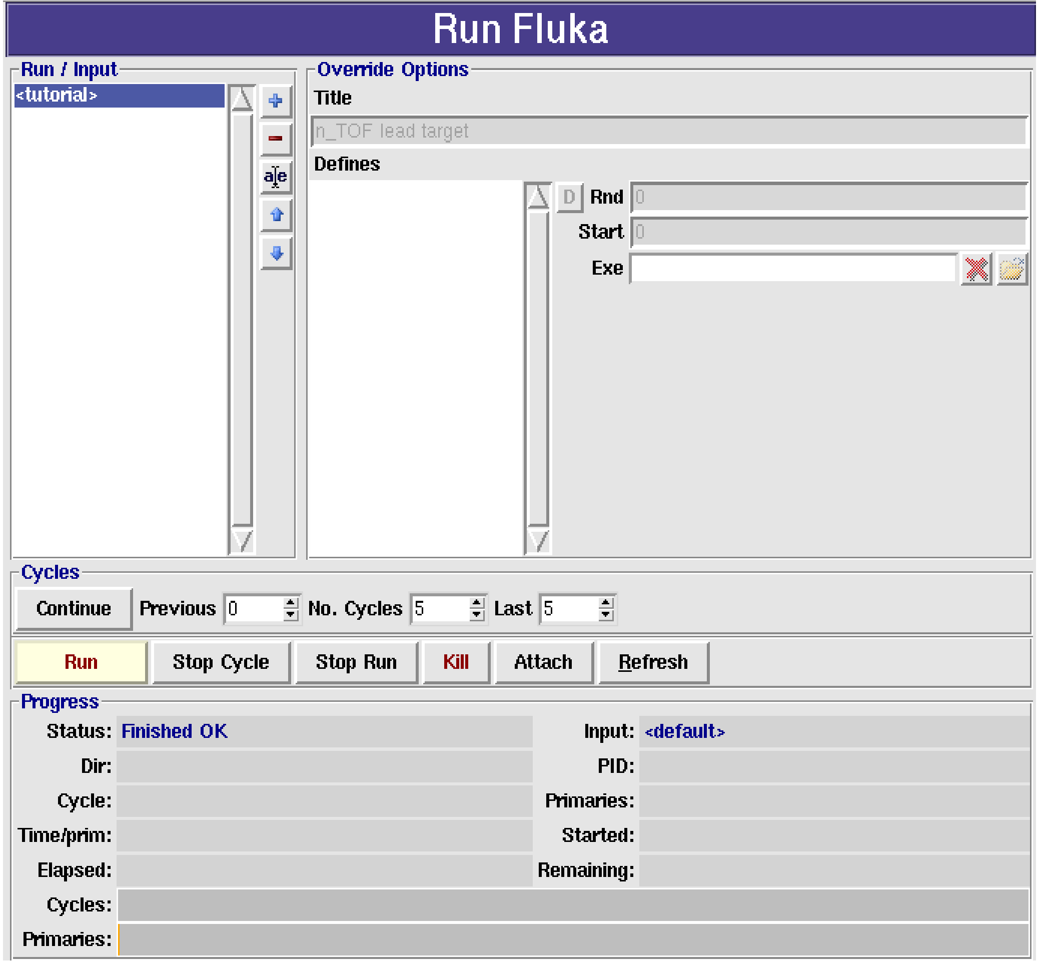
Gnuplot commands

When changing the axes system **flair** tries to select the most appropriate representation in the Type frame. The user is free to modify the plotting system based on his needs.



4.5. Running the simulation

- Select the Run Run node under the Process, or by clicking directly the **F6** key. The Run Fluka frame will appear.



Run Fluka

Run / Input: <tutorial>

Override Options

Title: n_TOF lead target

Defines

Rnd: 0

Start: 0

Exe:

Cycles

Previous: 0 No. Cycles: 5 Last: 5

Progress

Status: Finished OK

Input: <default>

Dir:

PID:

Cycle:

Primaries:

Time/prim:

Started:

Elapsed:

Remaining:

Cycles:

Primaries:

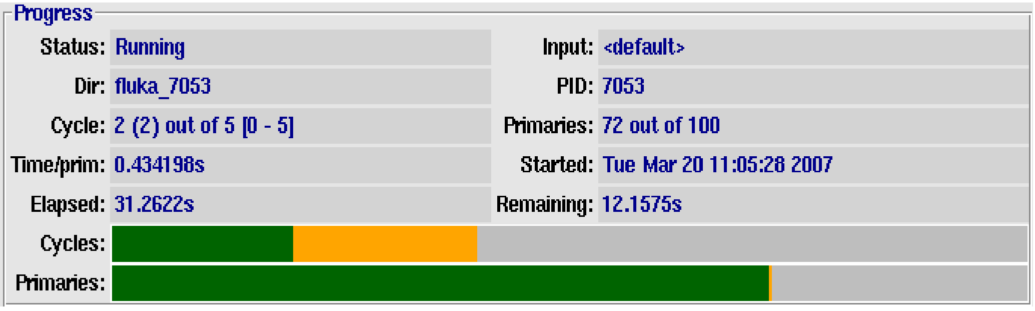
The top-left listbox shows the runs associated with the present project. All runs share the same input file, and for the additional runs there is the possibility to tweak some of the contents of the input file like:

1. run title
2. preprocessor defines to enable/disable blocks of cards
3. random seed
4. number of starting primaries
5. executable file to use

There is already a **<tutorial>** Run, in which we cannot override any option. This is the run using the input file as it described directly in the Input editor.

- Click the **Run** button (or **Ctrl-Enter**) to start the run with the default 5 cycles.

The dialog below the control buttons while change and it will be refreshed every half a minute. During the execution the “Status” will change, initially to **Waiting to attach**, followed by **Running** and finally in **Finished OK**. You can even click on the **Refresh** button to refresh at any time the progress information. The run is submitted using the defined submit program (the default is **nohup**). The program is running decoupled from the flair editor, therefore if you click save on the project and exit the program. The next time you will open the program, flair will try to attach and display the current run status.



Progress

Status:	Running	Input:	<default>
Dir:	fluka_7053	PID:	7053
Cycle:	2 (2) out of 5 [0 - 5]	Primaries:	72 out of 100
Time/prim:	0.434198s	Started:	Tue Mar 20 11:05:28 2007
Elapsed:	31.2622s	Remaining:	12.1575s

> Flair is trying to peek the run information **only by looking the status of the output files**. It doesn't make use of the system process information. This way it increases portability across different platforms, and batch systems (see the **qfluka** example for a substitution of the submit command). Flair will be able to monitor the status only if the run takes place on the same directory. The drawback of this method is that takes some time to attach.

> The **Stop Cycle/Run** button will try to make a clean stop by creating a **fluka.stop** or **rfluka.stop** file in the running directory.
>
> The **Kill** button will try to issue a **kill -SIGHUP** command to the running process. If the user is using a batch system he has to substitute the kill command with the appropriate program
>
> The **Attach** button tries to re-attach to the running process in the case that flair failed to attach correctly, or lost the running status.
>
> The **Refresh** button can be used to update the progress information at any interval.

4.6. Viewing Output Files

During the FLUKA run or when a cycle is completed, the user can inspect and/or delete the output files generated by FLUKA from the "Files" frame.

- Select the Files Files node under the Process, or by clicking directly the **F7** key. The Output Files frame will appear.

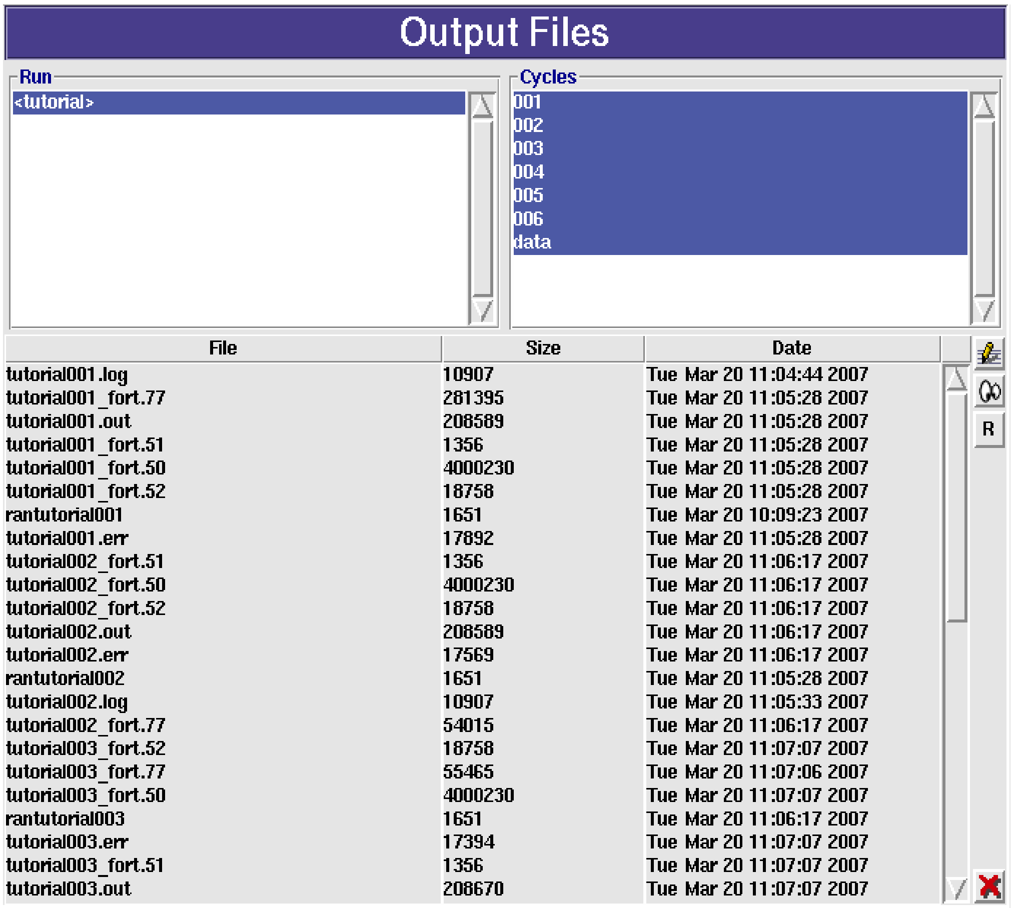
  The frame is composed by 3 list-boxes and a couple of action buttons on the side. The first listbox with the label "Run", contains a list of the different runs present in this project. In our case only one run will appear named "**<tutorial>**" which is the default run with the input filename as it is described in the input editor.

- By selecting a run from the list (The **<tutorial>** is already selected) the other two list will be updated accordingly. The second list called "Cycles" contains all the cycles that are performed and output files exists for the specific run. The last cycle called "data" contains all the files that are generated by mering the output files (see the section on processing the data). By selecting one or multiple cycles the files are updated accordingly.

> Shortcuts in listboxes: **Ctrl-A** selects everything; **Ctrl-I** inverses the

selection; **Ctrl-C** clears the selection; typing the beginning of an item the listbox will highlight the closest match. **Ctrl-G** or **Ctrl-N** repeats the last search. In the multi-column listboxes by clicking on the header sorts the current column Ascending or Descending.

The last multi-listbox contains a list of files for the run & cycles selected in the previous listboxes.



File	Size	Date
tutorial001.log	10907	Tue Mar 20 11:04:44 2007
tutorial001_fort.77	281395	Tue Mar 20 11:05:28 2007
tutorial001.out	208589	Tue Mar 20 11:05:28 2007
tutorial001_fort.51	1356	Tue Mar 20 11:05:28 2007
tutorial001_fort.50	4000230	Tue Mar 20 11:05:28 2007
tutorial001_fort.52	18758	Tue Mar 20 11:05:28 2007
rantutorial001	1651	Tue Mar 20 10:09:23 2007
tutorial001.err	17892	Tue Mar 20 11:05:28 2007
tutorial002_fort.51	1356	Tue Mar 20 11:06:17 2007
tutorial002_fort.50	4000230	Tue Mar 20 11:06:17 2007
tutorial002_fort.52	18758	Tue Mar 20 11:06:17 2007
tutorial002.out	208589	Tue Mar 20 11:06:17 2007
tutorial002.err	17569	Tue Mar 20 11:06:17 2007
rantutorial002	1651	Tue Mar 20 11:05:28 2007
tutorial002.log	10907	Tue Mar 20 11:05:33 2007
tutorial002_fort.77	54015	Tue Mar 20 11:06:17 2007
tutorial003_fort.52	18758	Tue Mar 20 11:07:07 2007
tutorial003_fort.77	55465	Tue Mar 20 11:07:06 2007
tutorial003_fort.50	4000230	Tue Mar 20 11:07:07 2007
rantutorial003	1651	Tue Mar 20 11:06:17 2007
tutorial003.err	17394	Tue Mar 20 11:07:07 2007
tutorial003_fort.51	1356	Tue Mar 20 11:07:07 2007
tutorial003.out	208670	Tue Mar 20 11:07:07 2007

By double clicking on any of the files i.e. tutorial001.out, the file will be opened in the internal viewer of flair for inspection. The action is equivalent to selecting one or several files and clicking the eyes icon 👀. By clicking on the editor icon ✎ the file will be opened on the user defined external editor. The button [**R**] (hotkey **Ctrl-R)** is used to refresh the display.

WARNING: Do not try to open binary files. Could be rather huge for the editor or viewer and in any case incomprehensible.

4.7. Data Merging

The next step before is to merge the output data files of the run in order to create the files contain the average values and the statistical error.

One would expect that the simulation is equivalent to a counting experiment, therefore the data will follow a Poisson distribution and the error will be the square root of the number of events collected. This is true provided that no biasing is used in the simulation. When importance scoring is involved (quite typical and recommended way of working) to calculate correctly the statistical error, apart from the final value one has to record also the square number of events/hits for every value needed. This doubles the memory and increases the complexity for special estimators. Therefore, FLUKA is making use of the Central Limit Theorem for calculating the mean value of a quantity scored and the error on the determination of the mean. The theorem states:

> The distribution of an average tends to be Normal, even when the distribution from which the average is computed is decidedly non-Normal.

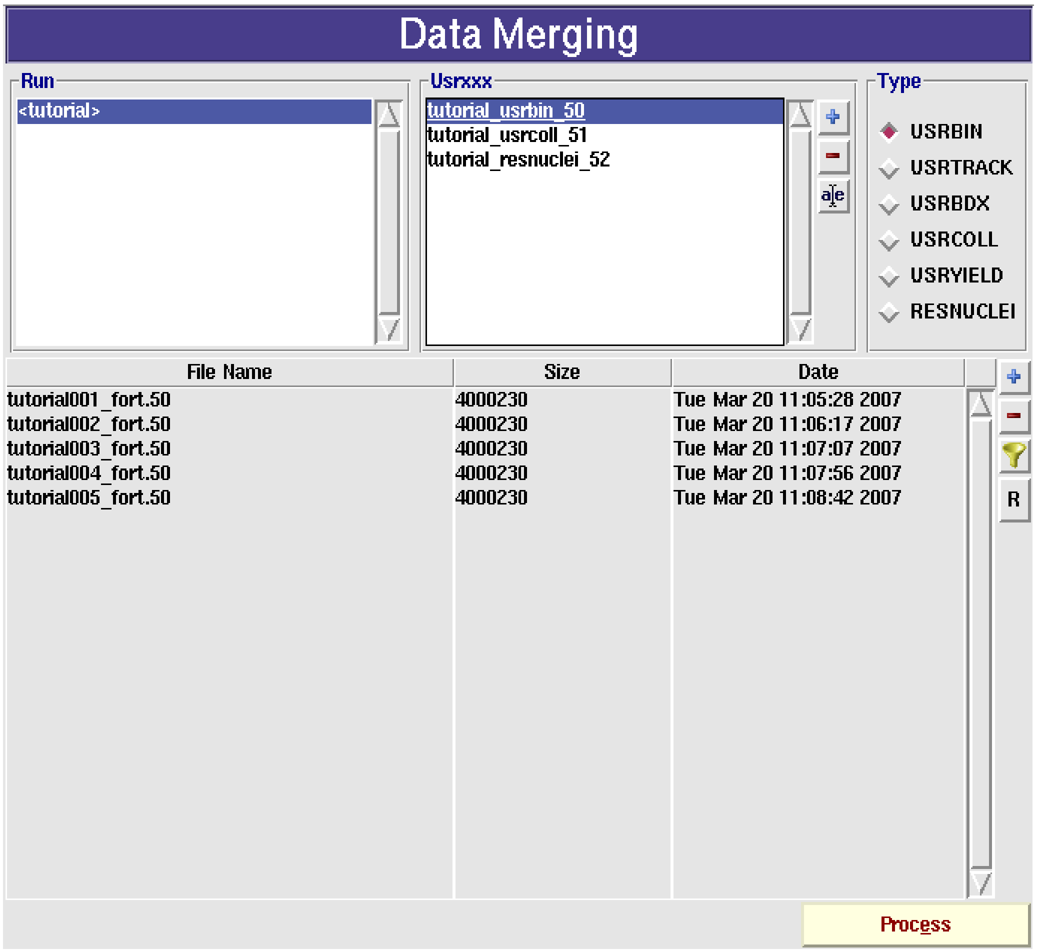
This is the main reason we have to perform several cycles, minimum 5 is recommended to simulate correctly a Normal distribution, and then sum-up and average the results. In FLUKA this is done automatically with the **us?suw** utilities (where **?** can be: **b**=USRBIN, **r**=RESNUCLEi, **t**=USRTRACK or USRCOLL, **x**=USRBDX, **y**=USRYIELD). These programs expect as input a list of binary files generated from FLUKA with the respective card and using as unit a negative number, and in the end they generate a set of output files both binary, text and tabulated with the results.

Flair makes this process transparent to the user with the Process Data frame.

Select the Data Data node under the Process, or by clicking directly the **F8** key. The following frame will appear.

The frame is composed with the following:

1. a listbox for the **runs** described in the flair project
2. the list of scoring units (**Usrxxx**) requested for each run. Automatically a default name will be assigned in the form of “input-name”_”card”_”unit”. The user with the buttons on the right can delete the file, create a new one or rename it.
3. Radial selection buttons (**Type**) for changing the type of the card that the file is referring to. Normally the program selects the correct one based on the input file. A multi-column listbox with the list of files corresponding to each summary file in the **Usrxxx** listbox.
4. With the side buttons the user can add/remove or set a multiple filter rule to modify the list of data files.



Run

<tutorial>

Usrxxx

tutorial_usrbin_50
tutorial_usrcoll_51
tutorial_resnuclei_52

Type

● USRBIN
◇ USRTRACK
◇ USRBDX
◇ USRCOLL
◇ USRYIELD
◇ RESNUCLEI

File Name	Size	Date
tutorial001_fort.50	4000230	Tue Mar 20 11:05:28 2007
tutorial002_fort.50	4000230	Tue Mar 20 11:06:17 2007
tutorial003_fort.50	4000230	Tue Mar 20 11:07:07 2007
tutorial004_fort.50	4000230	Tue Mar 20 11:07:56 2007
tutorial005_fort.50	4000230	Tue Mar 20 11:08:42 2007

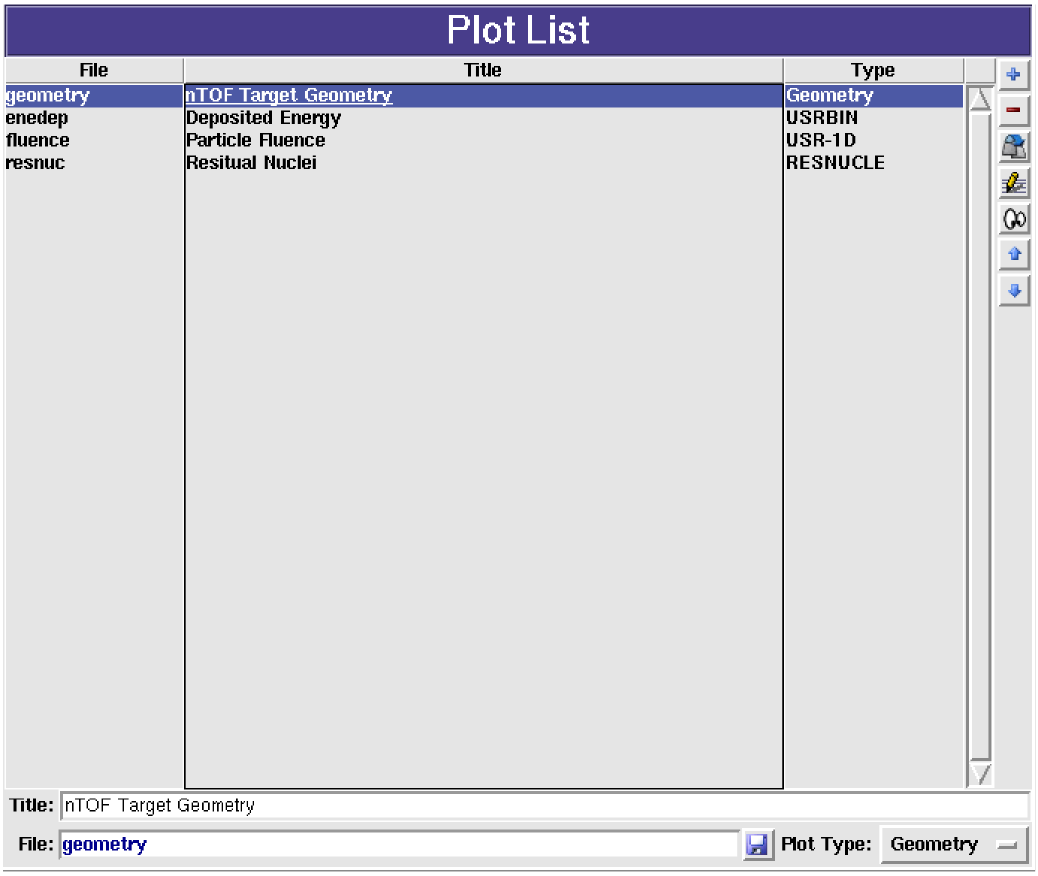
- By pressing the **Process** button (or clicking **Ctrl-Enter**) flair will run the appropriate FLUKA utilities to merge the data files. A dialog will confirm the outcome of the operation.

> The FLUKA utilities usually generate more than one output files. Typically the merge binary data file has the requested name while for a text file is generated with the extension **_sum.lis**, and a tabulated one with the extension **_tab.lis**

4.8. Data Plotting

- The last step is to plot the data, we will create 3 plots one for the **USRBIN** file that contains the energy deposition on the spallation target, one for the **USRCOLL** estimators with the particle fluences and one with the **RESNUCLEi** card containing the residual nuclei produced. We start by creating a plot in the "Plot" frame (**F9**) like what we did for the geometry plotting.
- Click on the + button, a new plot will be added to the list with **Title** "Plot #2" and the **File** will be "plot002" with format **.eps**, and type "Geometry".
- Change the title to "Deposited Energy"
- the file to "enedep". The filename is important since all auxiliary files and the final plot will share the same filename. The extension will only change.

- Finally set the type to "USRBIN"
- Repeat the process until you have create the following plots:
  - File: **geometry** Title: **nTOF Target Geometry** Type: **Geometry**
  - File: **enedep** Title: **Deposited Energy** Type: **USR-1D**
  - File: **resnuc** Title: **Residual Nuclei** Type: **RESNUCLE**



Plot List

File	Title	Type
geometry	nTOF Target Geometry	Geometry
enedep	Deposited Energy	USRBIN
fluence	Particle Fluence	USR-1D
resnuc	Resitual Nuclei	RESNUCLE

Title: nTOF Target Geometry

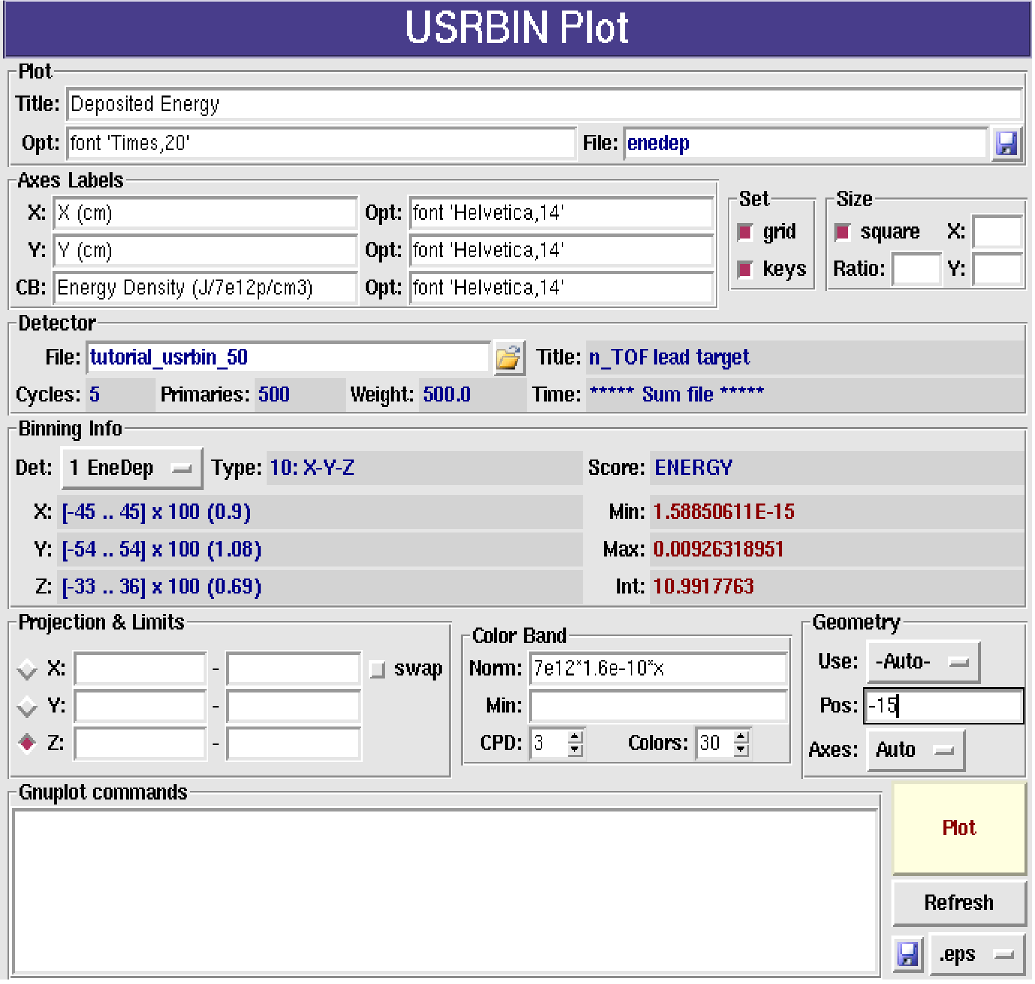
File: geometry Plot Type: Geometry

4.8.1. USRBIN Plotting

- By double clicking on the list or clicking the edit icon, the **USRBIN Plot frame** will appear. By default the Title, and File will be filled in with the values we filled in the Plot List frame.
- Fill in the values as you see in the following image.
  - **Opt:** under the title to supply additional gnuplot options to the title like changing the default font, color etc.
  - **Axes Labels**, supply axes labels and additional options if needed
  - **Size**, click on the **square** to have a square aspect ratio
  - **Detector** click on the button and select the "**tutorial_usrbin_50**" file we created in the Process frame. Automatically the run and detector information in the file will be filled.
  - **Binning Info** select from the drop down list box the first detector
  - **Projection & Limits** select projection on the **Z-axis** without suppling any limits. This will generate a projection from -33 to +36cm on the XY plane.
  - **Color Band** select as normalization the formula "**7e12*1.6e-10*x**", this

way every value will be converted from GeV/cm^3/p to J/cm^3/pulse where a pulse has 7e12 protons. Select the Minimum plotting value and colors per decade (CPD) and the total number of colors as you wish.

- **Geometry** use the automatic generator for the geometry at position **-15**. If we don't supply a position the mean value of the projection limits will be used. In this case the binning is directly fitting the box of the spallation target and the geometry will be empty. Therefore we move the position of the geometry to somewhere that makes sense.
- **Gnuplot commands** you can leave empty or specify additional plotting commands if you don't like the default ones. i.e. **set palette..** to change the default color palette, **set arrow ...** to generate arrows to point regions of interest, **set ?range...** to change the default plotting ranges, and in principle any gnuplot command. Even "**reset**" and supply all needed commands yourself.



USRBIN Plot

Plot
Title: Deposited Energy
Opt: font 'Times,20'
File: enedep

Axes Labels
X: X (cm) Opt: font 'Helvetica,14'
Y: Y (cm) Opt: font 'Helvetica,14'
CB: Energy Density (J/7e12p/cm3) Opt: font 'Helvetica,14'

Set
■ grid
■ keys

Size
■ square X:
Ratio: Y:

Detector
File: tutorial_usrbin_50 Title: n_TOF lead target
Cycles: 5 Primaries: 500 Weight: 500.0 Time: ***** Sum file *****

Binning Info
Det: 1 EneDep Type: 10: X-Y-Z Score: ENERGY
X: [-45 .. 45] x 100 (0.9) Min: 1.58850611E-15
Y: [-54 .. 54] x 100 (1.08) Max: 0.00926318951
Z: [-33 .. 36] x 100 (0.69) Int: 10.9917763

Projection & Limits
◇ X: - □ swap
◇ Y: -
◆ Z: -

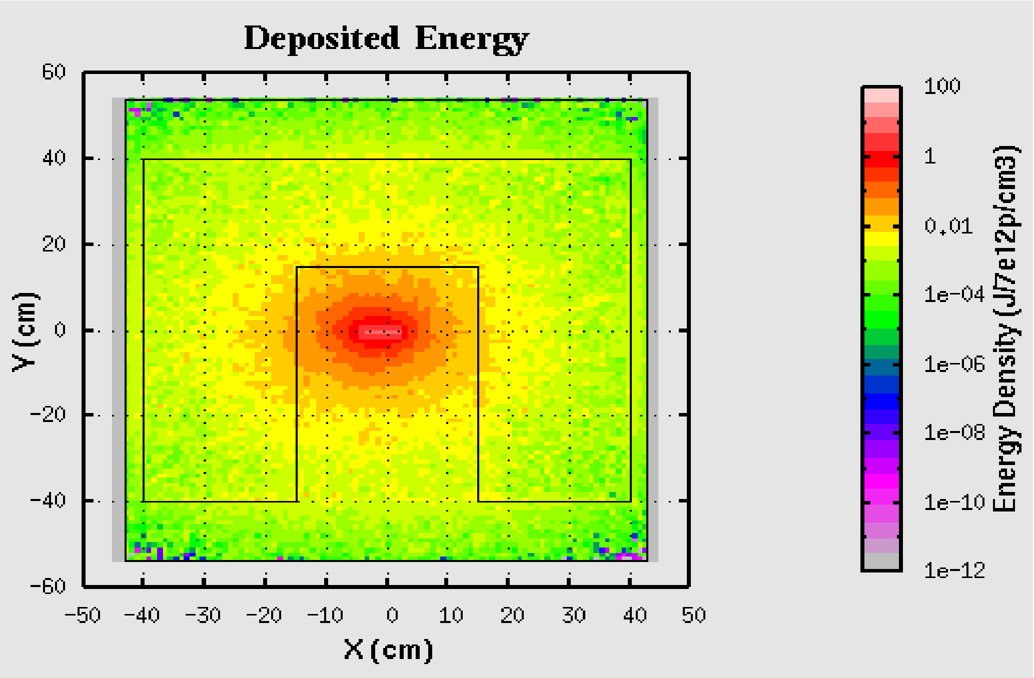
Color Band
Norm: 7e12*1.6e-10*x
Min:
CPD: 3 Colors: 30

Geometry
Use: -Auto-
Pos: -15
Axes: Auto

Gnuplot commands

By clicking the **Plot** button (or **Ctrl-Enter**), flair will create a temporary input file for FLUKA with the appropriate **PLOTGEOM** card, will perform a FLUKA run to create the geometry information, and then process the USRBIN data file with the **gplevbin** program to create the requested projection. Finally it will call **gnuplot** to create the plot. Once the plot is created you can save it as image by clicking the 💾 button at the bottom-right part of the frame.

Prefer to use the .eps format for higher quality figures. The .png format for gnuplot up to version 4.0 is broken and the color band will not appear properly.

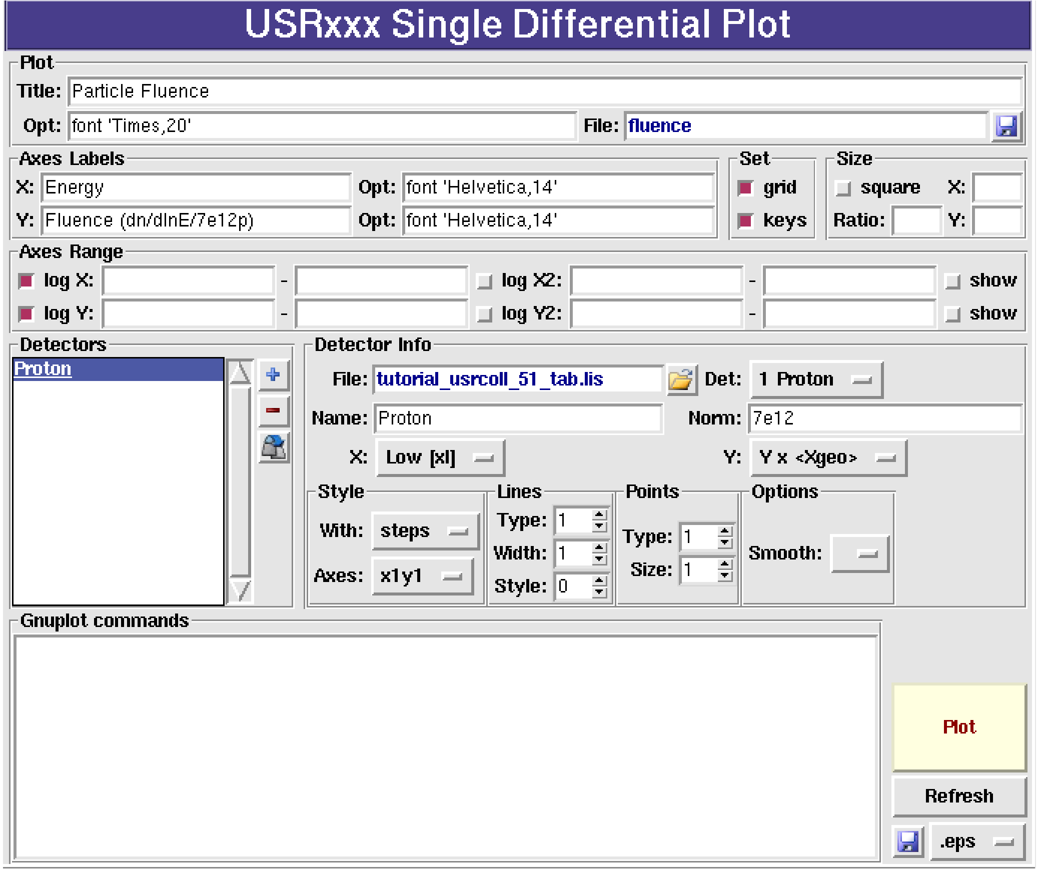


4.8.2. Single Differential Quantities Plot

The scoring cards **USRBDX**, **USRCOLL**, **USRTRACK**, **USRYIELD** after the data merging are producing a single differential quantities that can be plotted with the "USR-1D" plot frame in flair. This frame is using the **_tab.lis** file and many data can be super imposed one on top of the other.

- Select the "fluence" plot from the Plot List or from the Project Tree.
- Fill in the values as you see in the following image.
  - **Opt:** under the title to supply additional gnuplot options to the title like changing the default font
  - **Axes Labels:** supply axes labels and additional options if needed
  - **Axes Range:** click on the "**log X**" and "**log Y**"
- To add now the detectors click on the ✚ inside the Detectors frame. The File Dialog will appear with all the Fluka **_tab.lis** files. Select the "**tutorial_usrcoll_51_tab.lis**" file. Now the Detectors listbox will contain an entry named "#Detector 1" and the "Detector Info" frame will be filled with some basic values.
- Select from the "**Det:"** drop-down box the "**Proton**" detector
- Rename the detector to "**Proton**" with no (#) symbol in front. The (#) symbol is used as a comment not to display the label of the detector in the plot.
- Select from X: the "**Low [xl]**" value to plot and on the Y: leave the default "**Yx<Xgeo>**" which will plot the isolethargic fluence.
- Finally for the proton detector, set the normalization to **7e12,** select as style with: "**steps**"

You can already see the plot by clicking the **Plot** button (or **Ctrl-Enter**). It will show a red histogram of the proton fluence.



USRxxx Single Differential Plot

Plot

Title: Particle Fluence

Opt: font 'Times,20' File: fluence

Axes Labels

X: Energy Opt: font 'Helvetica,14'

Y: Fluence (dn/dlnE/7e12p) Opt: font 'Helvetica,14'

Set: ☒ grid ☒ keys

Size: □ square X: Ratio: Y:

Axes Range

☒ log X: - □ log X2: - □ show

☒ log Y: - □ log Y2: - □ show

Detectors: Proton

Detector Info

File: tutorial_usrcoll_51_tab.lis Det: 1 Proton

Name: Proton Norm: 7e12

X: Low [xl] Y: Y x <Xgeo>

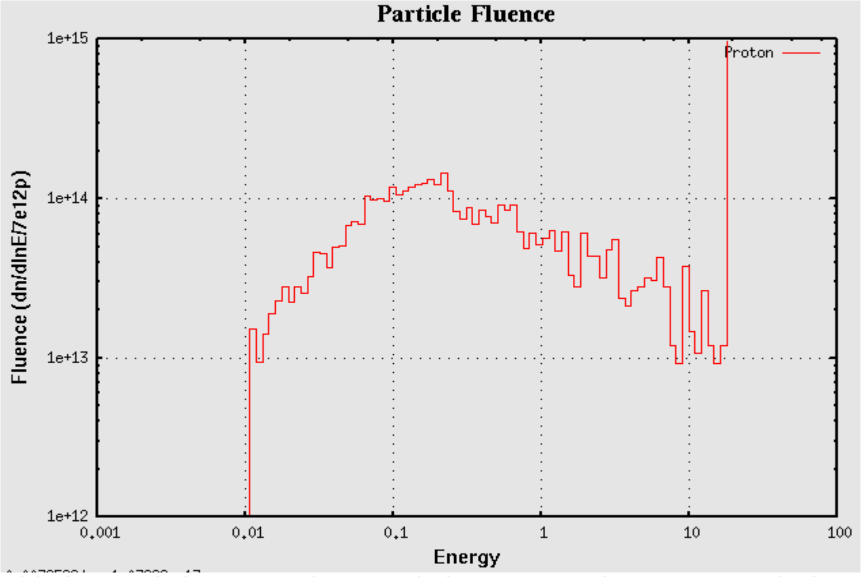
Style — With: steps Axes: x1y1

Lines — Type: 1 Width: 1 Style: 0

Points — Type: 1 Size: 1

Options — Smooth:

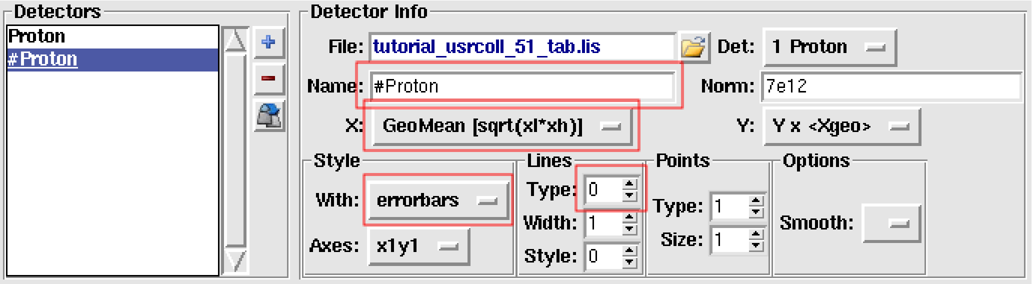
Gnuplot commands



To add the statistical error bars and the neutron fluence you will have to create a couple of other detectors.

Clone the "Proton" detector by selecting in the Detector listbox the "Proton" detector and clicking the icon or the **Ctrl-D** button.

- Insert the **#** character in the name (**#Proton**), to avoid having a duplicate label on the plot, and then fill the values as shown in the following figure



Detectors
Proton
#Proton

Detector Info
File: tutorial_usrcoll_51_tab.lis
Det: 1 Proton
Name: #Proton
Norm: 7e12
X: GeoMean [sqrt(xl*xh)]
Y: Y x <Xgeo>

Style
With: errorbars
Axes: x1y1

Lines
Type: 0
Width: 1
Style: 0

Points
Type: 1
Size: 1

Options
Smooth:

- Click on the ✚ inside the Detectors frame to add an extra detector. Select again the same file “**tutorial_usrcoll_51_tab.lis**” and from the “Det:” select the number “**2 Neutron**”. Or even you can clone the first detector “Proton” and change the corresponding fields.

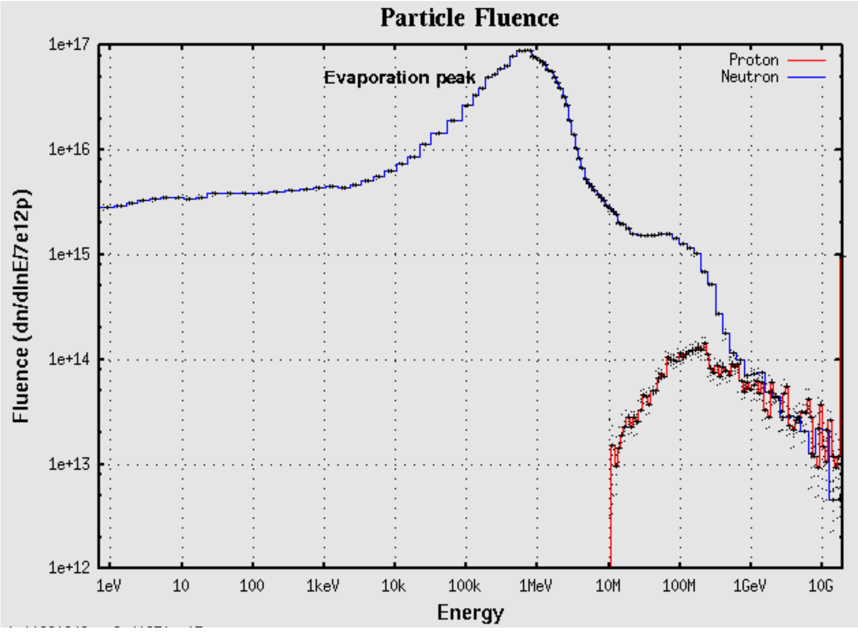
- Change the name of the detector to “**Neutron**” use on X: “**Low [xl]**”, Style with: “**steps**” Type: **3**.

- Clone the “**Neutron**” detector as before with the Protons to add the errorbars. Name the new detector as “**#Neutron**” X: “**GeoMean [sqrt(xl*xh)]**”, and style with: “**errorbars**”, Type: **0**.

- Clicking on the **Plot** button you can see the plot.

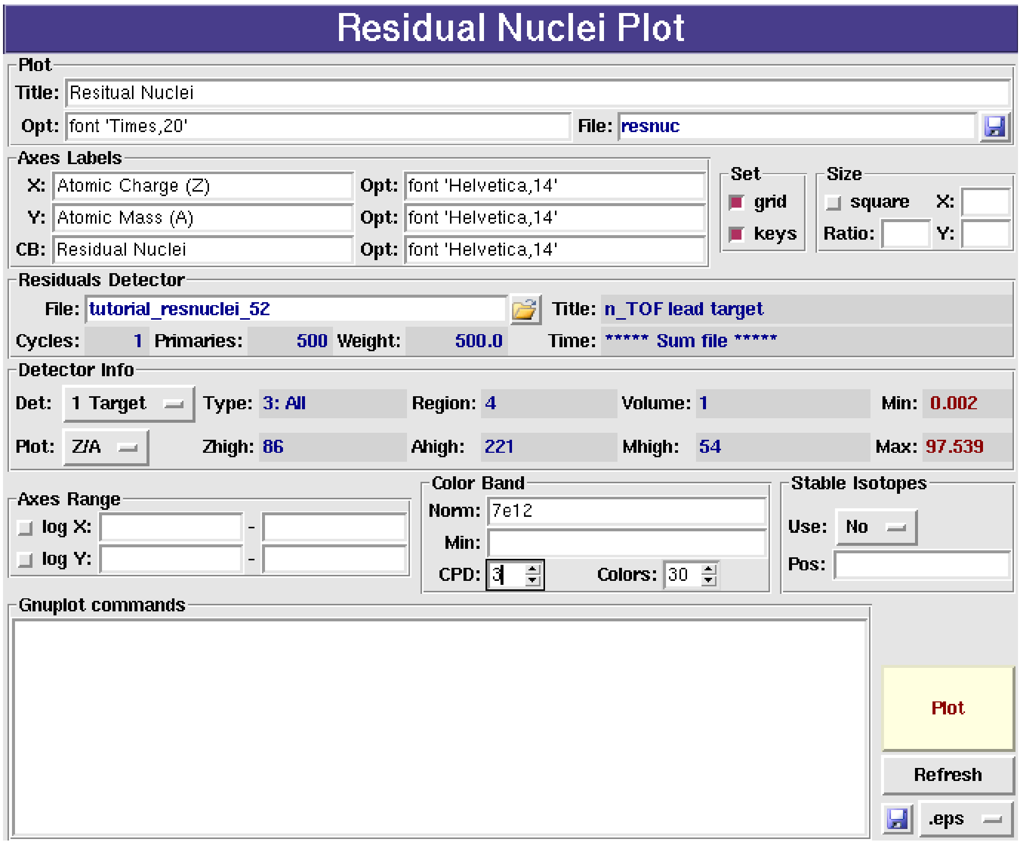
- Optionally to make it even nicer you can add a custom x-scale and a label, in the Gnuplot commands:

```
set xtics ('1meV' 1e-12, '10m' 1e-11, '100m' 1e-10, '1eV' 1e-9, '10' 1e-8,'100'
1e-7,'1keV' 1e-6, '10k' 1e-5, '100k' 1e-4, '1MeV' 1e-3, '10M' 0.01, '100M' 0.1,
'1GeV' 1, '10G' 10, '100G' 100, '1TeV' 1000, '10T' 1e4, '100T' 1e5)
set label 'Evaporation peak' at 1e-6,5e16 font 'Arial,14'
```



4.8.3. Residual Nuclei Plot

As a last example we will make a plot of the residual nuclei scored with the **RESNUCLEi** card. The Residual Nuclei Plot frame is able to do two dimensional plots of Z/A, Z/N or histograms of Z or A. Click on the "**resnuc**" plot from the Plot List or from the Project Tree, and fill the fields with the information as it is shown on the following figure



Residual Nuclei Plot

Plot
Title: Resitual Nuclei
Opt: font 'Times,20' File: resnuc

Axes Labels
X: Atomic Charge (Z) Opt: font 'Helvetica,14'
Y: Atomic Mass (A) Opt: font 'Helvetica,14'
CB: Residual Nuclei Opt: font 'Helvetica,14'

Set
☑ grid
☑ keys

Size
□ square X:
Ratio: Y:

Residuals Detector
File: tutorial_resnuclei_52 Title: n_TOF lead target
Cycles: 1 Primaries: 500 Weight: 500.0 Time: ***** Sum file *****

Detector Info
Det: 1 Target Type: 3: All Region: 4 Volume: 1 Min: 0.002
Plot: Z/A Zhigh: 86 Ahigh: 221 Mhigh: 54 Max: 97.539

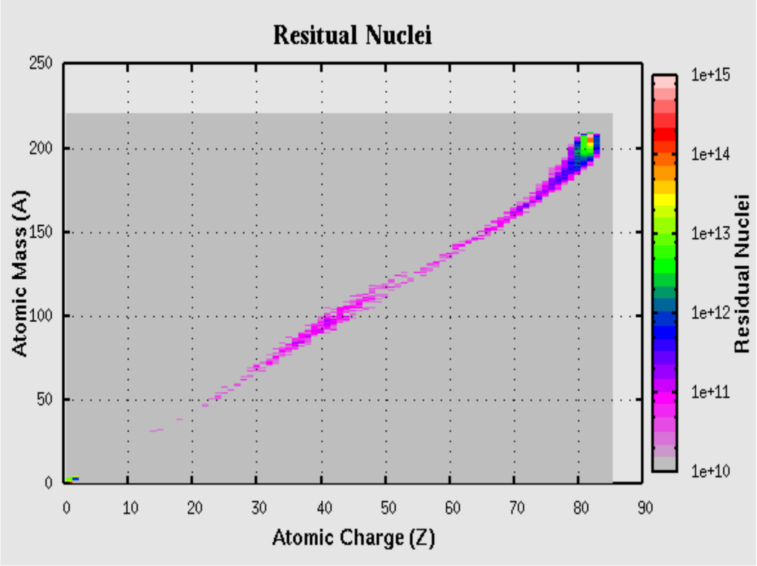
Axes Range
□ log X: -
□ log Y: -

Color Band
Norm: 7e12
Min:
CPD: 3 Colors: 30

Stable Isotopes
Use: No
Pos:

Gnuplot commands

We are requesting a 2-dimensional Z/A plot of the first detector using a normalization factor of 7E12 primary particles. Clicking the Plot will generate the following plot:



A.Appendix

Abbreviations

Mouse abbreviations used in this manual

LMB	Left Mouse Button click
MMB	Middle Mouse Button click
RMB	Right Mouse Button click
LMB-double	Left Mouse Button double click
MMB-double	Middle Mouse Button double click
RMB-double	Right Mouse Button double click
LMB-drag	Left Mouse Button click and drag
MMB-drag	Middle Mouse Button click and drag
RMB-drag	Right Mouse Button click and drag

Flair Commands

Menu	***Shortcut***	***Icon***	***Action***
Menu bar	F10		Access the menu bar
File	Alt-F		Open the File menu
... New Window	Alt-F W		Opens a new flair window, for working on multiple flair projects and exchanging information
... New	Alt-F N	🗋	Create a new flair project
... Open	Ctrl-O	📂	Open an existing flair project
... Open Recent	Alt-F R		Opens the recent project files sub menu
... Save	Ctrl-S	💾	Save project and input files
... Save As	Alt-F S		Save project and input under a different name
... Change Dir	Alt-F C		Change current working directory
... Print	Ctrl-P	🖨	Print current frame
... Close	Ctrl-W		Close current window
... Exit	Ctrl-Q		Exit program
File / Input			Open the FLUKA input file menu
... New			Create a new input file. Accessible from Project Frame from the Input 🗋 field.
...Open			Load an existing input file from disk. Accessible from Project Frame from the Input 📂

Menu	***Shortcut***	***Icon***	***Action***
			field.
... Save			Save the input file
... Save As			Save the input file under a different name. Accessible from Project Frame from the Input 💾 field.
File / Database			Open the database import/export submenu
File / Import	Alt-F I		Open the file import menu
... Fluka			Import the entire input file or parts by category from one input file to current project
File / Export	Alt-F E		Open the file export menu
... Gnuplot	Alt-F E N		Save active plot as a gnuplot script file
... Makefile	Alt-F E A		Create a makefile from the Build frame information
... Mcnp	Alt-F E M		Create a MCNP input file from the FLUKA input
... Povray	Alt-F E P		Export the FLUKA geometry to povray 3D ray tracing format
Edit	Alt-E		Open the Edit sub menu
... Undo	Ctrl-Z	↶	Undo the last action
... Redo	Ctrl-Y	↷	Redo the last undo action
... Cut	Ctrl-X	✂	Cut selected text or cards
... Copy	Ctrl-C	⎘	Copy selected text or cards
... Paste	Ctrl-V	🖌	Paste previously cut/copied text or cards
... Paste Special	Ctrl-Shift-V		Opens the special paste dialog
... Select All	Ctrl-A Ctrl-/		Select all text, cards, items in listboxes etc.
... Add	Ins	+	Add extra items: Input Editor: in REGION editing pops up a body selection list to insert a new body. Input Editor everywhere else: Insert a new card Compile: Adds a new Fortran program library or object Debug: Adds a new debugging region Run: Adds a new run Data: Adds a new output data file Plot: Adds a new plot USR-1D: Adds a new _tab.lis file
... Delete	Del	−	Delete item, reverse action from “Add”
... Clone	Ctrl-D	⧉	Clone selected items
... Find	Ctrl-F	🔍	Search text in editor
... Find Next	Ctrl-G		Search for next match in editor List boxes: Find next match
... Replace	Ctrl-H		Search and replace text

Menu	***Shortcut***	***Icon***	***Action***
... Filter	Ctrl-L	⛛	Input editor: shows the filter dialog to selected cards based on the filter criteria. Data: Modify filter for selecting files Plot: Scans input for scoring cards and automatically insert default plots
Move Up	Ctrl-Up	⇧	Move selected items one item upward
Move Down	Ctrl-Down	⇩	Move selected items one item downward
Card	Alt-C		Open the Card menu, available only in the Input editing mode.
... [Categories]	Alt-C #		Select card to insert grouped in categories
... [Alphabetic]			Select card to insert sorted in alphabetical order
... [Change To]	Alt-C C		Change type of selected card to another type.
Input	Alt-I		Open the Input card sub menu
... Insert Comment	Alt-I I		Add comment to the selected cards
... Delete Comment	Alt-I D		Delete the comments from he selected cards
... Enable Card	Alt-I E		Enable the selected cards
... Disable Card	Alt-I D		Disable the selected cards. Add #if 0 ... #endif before and after the selected cards
... Show Cards	Alt-I S		Show in editor the hidden cards
... Hide Cards	Alt-I H		Hide from the editor the selected cards
... Edit	Alt-I T		Edit the contents of a card with a dialog
... Filter Invalid	Alt-I F		Hide valid cards from the active display
... Show Errors	Alt-I R		Show the error message for the invalid cards
... Remove Unused	Alt-I U		Remove unused cards from the input
... Order Cards	Alt-I O		Sort all input cards according to the specified template
... Transform Geometry	Ctrl-T		Apply geometrical transformations (translations / rotations / scaling) to the selected bodies
... Expand Geometry			Expand a parenthesized geometrical expression to the normal form.
... Optimize Geometry			Optimize a geometrical description, by removing unnecessary terms.
View	Alt-V		Open the view sub menu
... Project	F2	●	Display the FLUKA Project Information frame
... Input	F3	🂠	Display the Input Editor
... Process	Alt-V R	⚙	Display the Process Summary frame
... Compile	F4	⚠	Display the Compile Executable frame

Menu	***Shortcut***	***Icon***	***Action***
... Debug	F5	🐞	Display the Geometry Debugger frame
... Run	F6	🏃	Display the Run Fluka frame
... Files	F7	📄	Display the Output Files frame
... Data	F8	📄	Display the Merge Data Files frame
... Plot	F9	📈	Display the Plot List frame
... Material	Alt-V M		Display the Materials Database
... Periodic Table	Alt-V T		Open Periodic table with Nuclear Wallet Cards information
... Backward	Alt-V B	⬅	Show the previously displayed input cards.
... Forward	Alt-V F	➡	Move forward in the list of the displayed input cards.
... Refresh	Alt-V R	R	Redraw/refresh display. Input Editor: Useful when the display gets corrupted for some reason. Output Files: Update file list Merge Data Files: Update file list
... Toggle Tree	F11		Show/Hide the project browser tree
... Toggle Height	F12		Toggles height of window to maximum or previous setting
Tools	Alt-T		Open the Options sub menu
... Viewer	Alt-T V	👓	Open file in the external or internal viewer Input Editor: Open input file Compile: Open the source code Output Files: Open the selected files Plot List: Display the plots one by one
... Editor	Alt-T E	✎	Open file in an external editor Input Editor: Open input file Compile: Open the source code Output Files: Open the selected files Plot List: Open the dialog to edit the plot
... Terminal	Alt-T T		Open terminal with console at project directory
... File Explorer	Alt-T F		Open file explorer at project directory
... Preferences	Alt-T P		Open the settings dialog to change fonts/colors and default behavior of the program.
Help	Alt-H		Open the Help sub menu
... Help	F1	ℹ	Show the interactive help dialog for the selected card, dialog, option
... Check Installation	Alt-H I		Check the FLUKA and flair installation for missing programs
... Check Updates	Alt-H U		Check the FLUKA and flair web site for new

Menu	***Shortcut***	***Icon***	***Action***
			versions
... Tip	Alt-H T		Open the random tips dialog
... About	Alt-H A		Open out nice about dialog with information on the program
Keyboard short cuts without a menu item			
	F10		Access the menu bar
	Ctrl-Enter		Execute highlighted command of each frame Input Editor: Insert new card Compile: Build the executable Debug: Run the debugger Run: Run the simulation Data: Merge data files Plot: Show the plot
	Ctrl-Space		Open the popup menu
	Ctrl-I		List boxes: Invert selected list
	Ctrl-G		List boxes: Find next match
	Ctrl-N		List boxes: Find next match
	Ctrl-C		List boxes: Clear selection
	Space		List boxes: Select current item
Input editor special keyboard and mouse commands			
	Enter		Input editor: Start editing field or Commit changes and move to next field
	Esc		Input editor: Commit changes and the leave the card editing mode
	Tab		Input editor: Move to next field
	Shift-Tab		Input editor: Move to previous field
	Shift-Up		Input editor: Extend selection upwards
	Shift-Down		Input editor: Extend selection downward
	LMB		Input editor: Select item and start editing
	RMB		Input editor: Open pop up menu
	LMB-drag		Input editor: Drag 'n drop items
	RMB-drag		Input editor: Pan window

B.Legal

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