CURSO INTRODUTÓRIO FLUKA

23 DE JANEIRO A 8 DE MARÇO DE 2023

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AULA 08
Detectores – USRBIN (parte II)

Iniciaremos em breve

Código Monte Carlo de interação e transporte de partículas

23 FLUKA 2023

08

CNPEM MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E INOVAÇÃO

GOVERNO FEDERAL BRASIL UNIÃO E RECONSTRUÇÃO

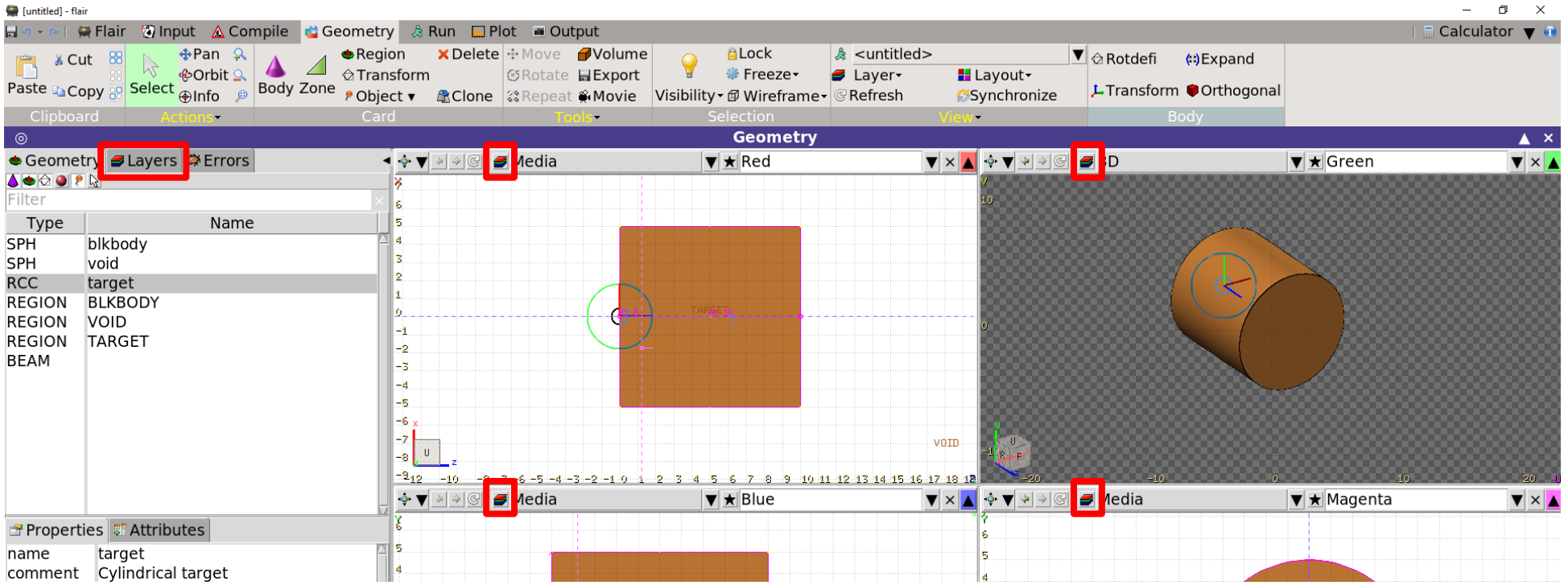
Scoring physical quantities I

Introduction to built-in estimators

3D distributions (`USRBIN`) & 1D-2D plots

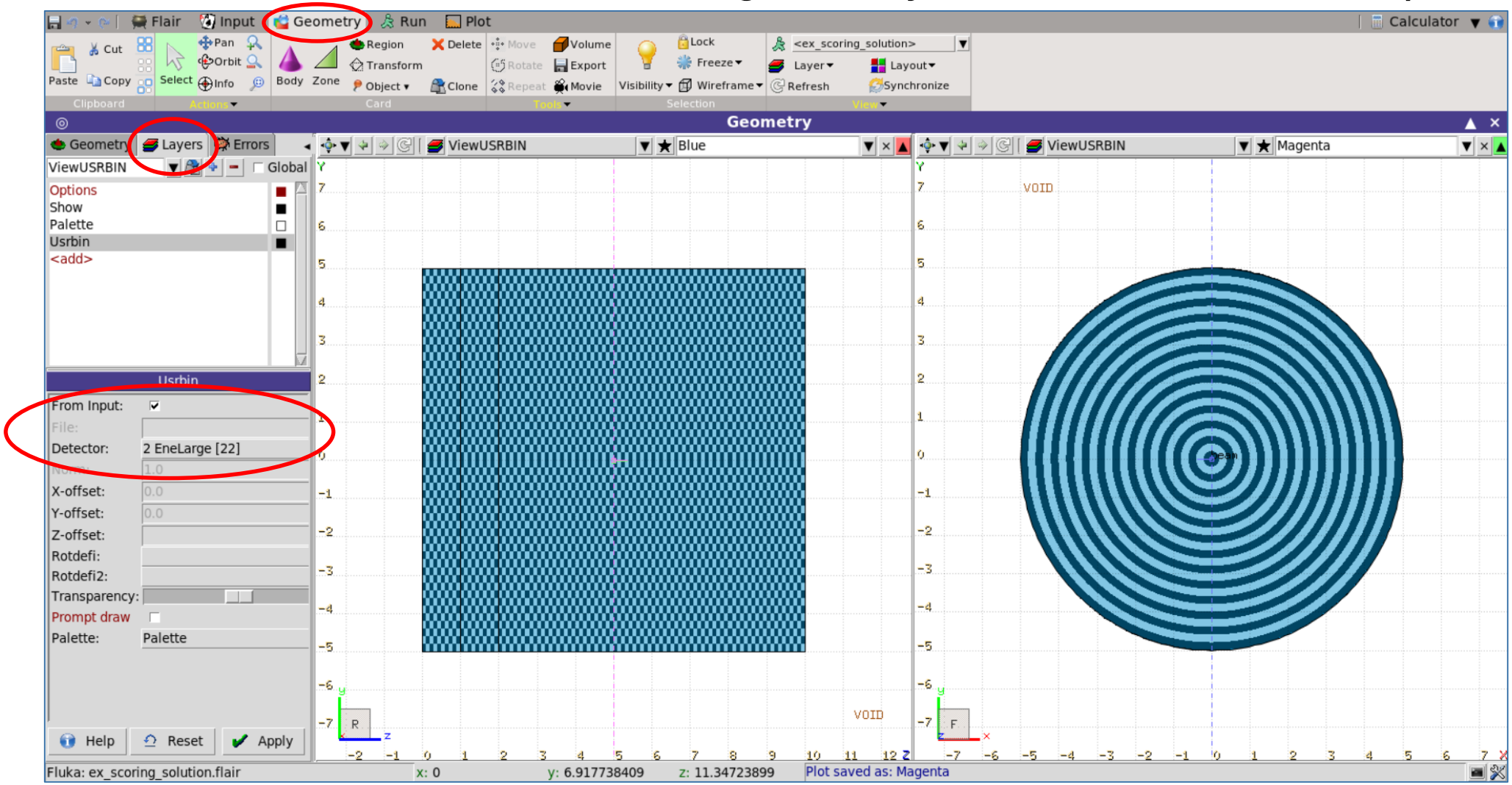
Geometry tab: Layers

- Somewhat introduced in the first Flair lecture
- Custom layers can be defined in the “Configure layer menu” 



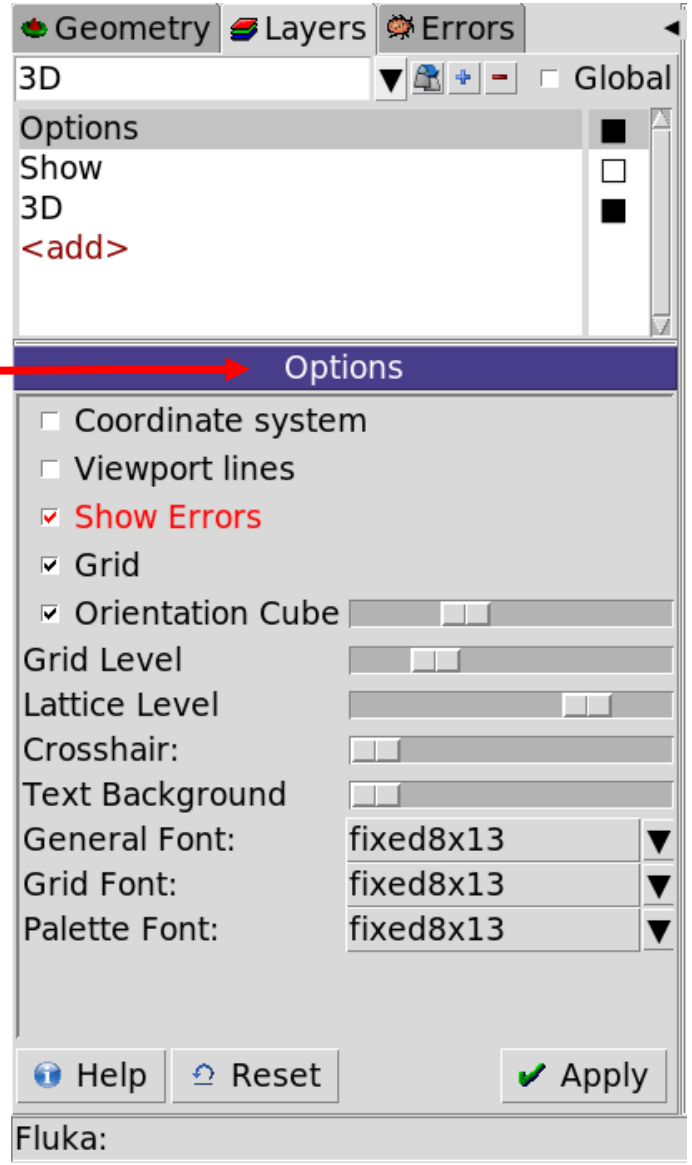
Visualisation

- A defined mesh can be overlaid on the geometry to check that it is well-positioned



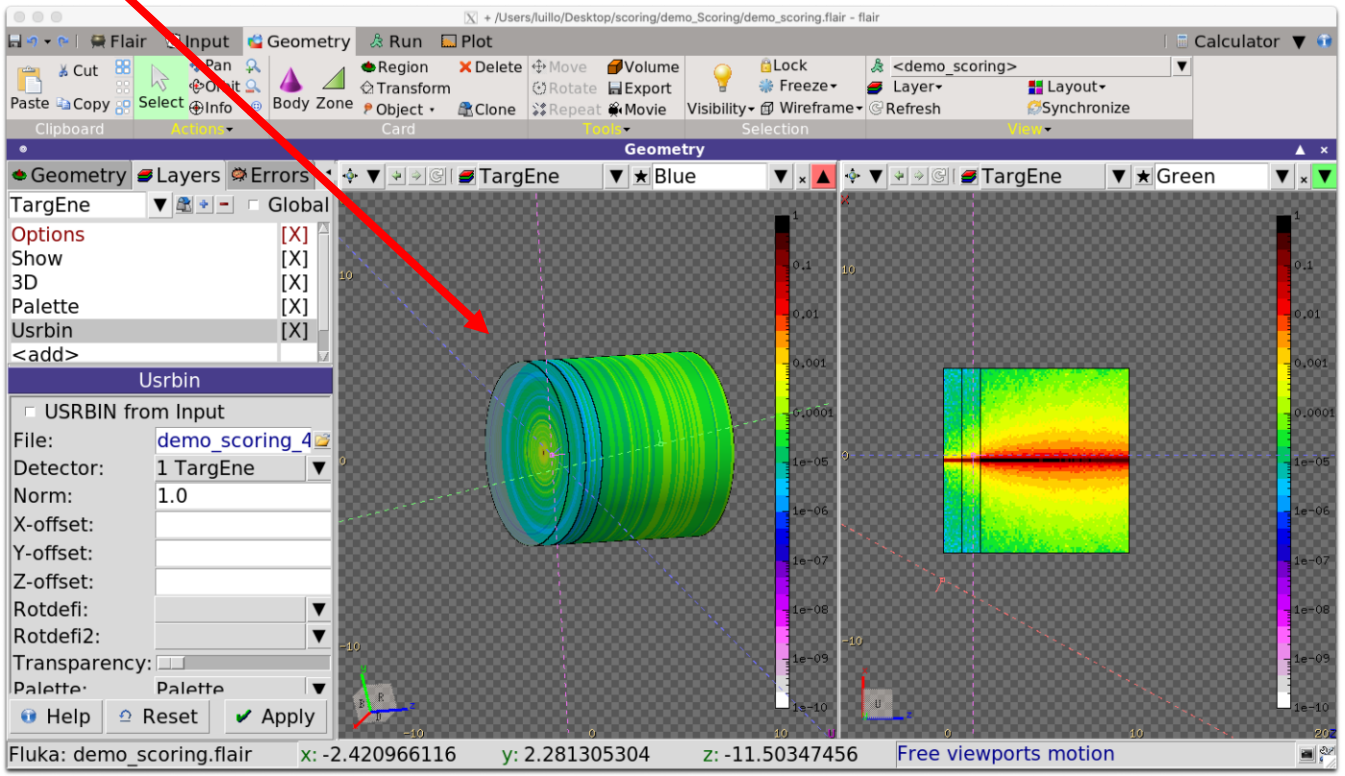
Geometry tab: Layers

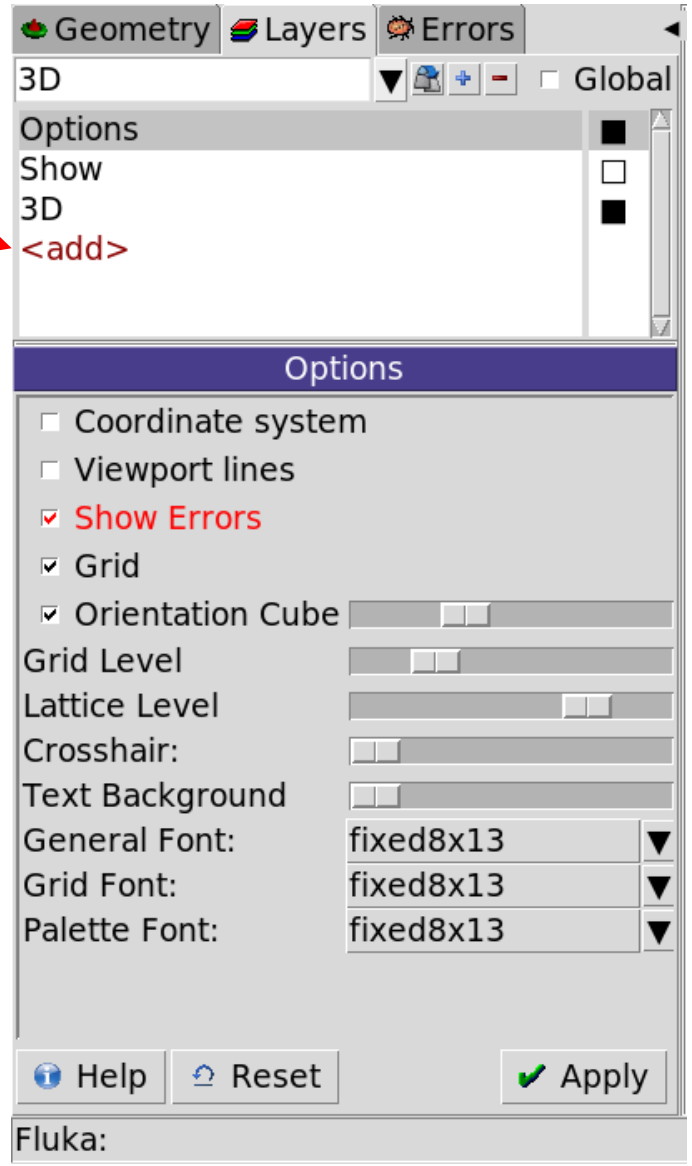
- Toolbar
  - Add / delete / rename / clone layers
  - Global: to make a layer available on every project
- Options
  - Enable/disable
    - coordinate system, viewport lines, grid, orientation cube
  - Adjust:
    - Grid level (set grid intensity)
    - Lattice level (set lattice hash intensity)
    - Crosshair (set dimension of the cross in the viewport center)
    - Orientation cube size
    - Fonts



Geometry tab: Layers combination

- “(Sub-)layers” can be combined together via <add> button
  - Image & USRBIN
  - Custom color values & 3D
  - USRBIN & 3D
  - …

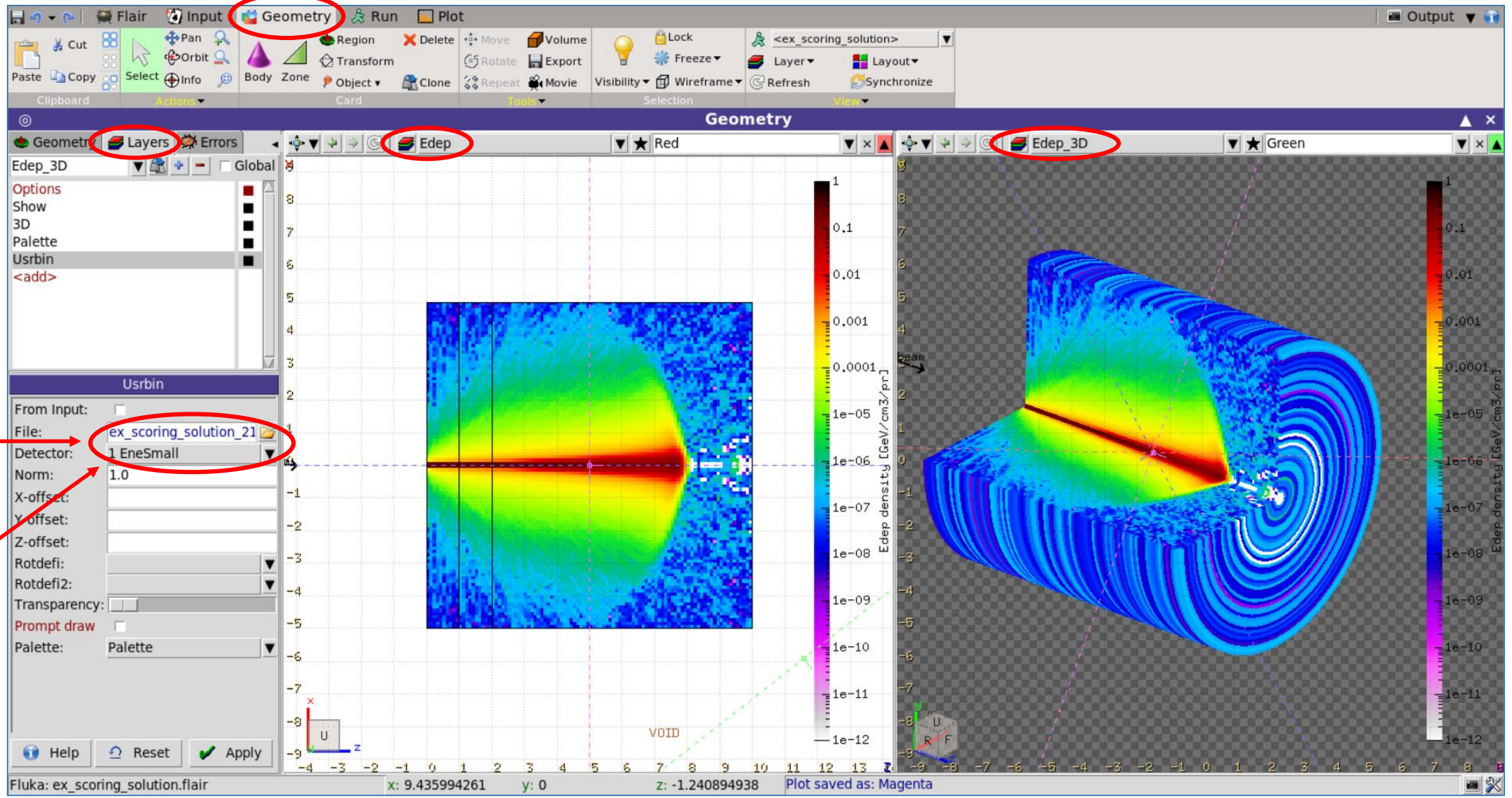




Overlaying USRBIN mesh results on 2D/3D geometry

Merged file

Detector from file

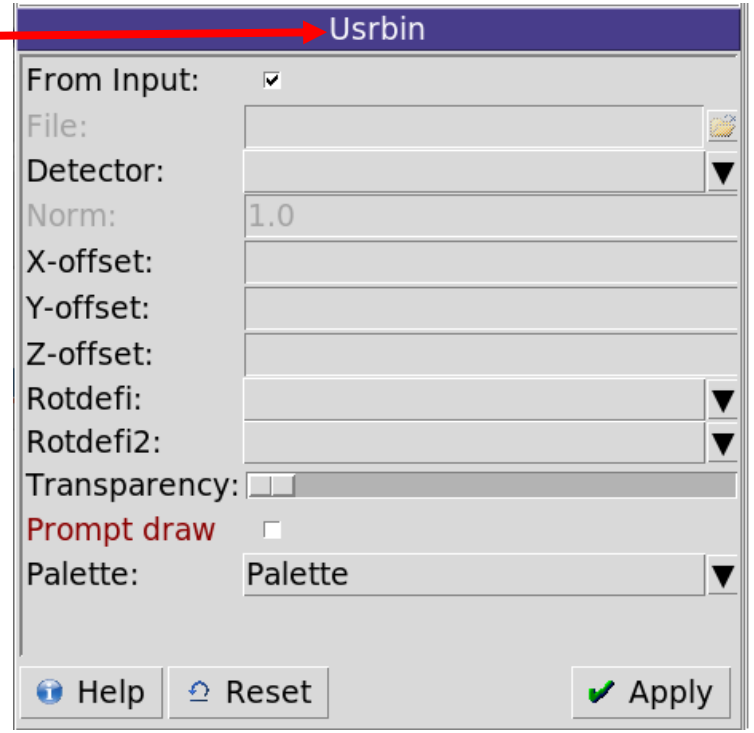


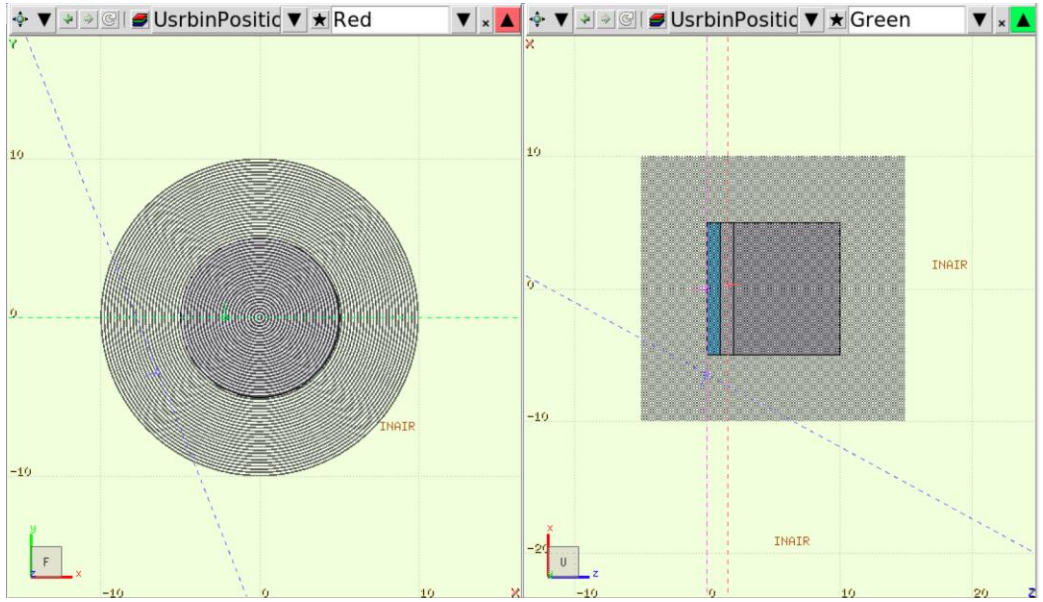
Geometry tab: Layers

- USRBIN (to show a USRBIN scoring)
  - Already seen in the first Flair lecture
  - Possible to add more USRBIN on the same layer
  - Possible to load a USRBIN from the input

    Displayed with a checker pattern

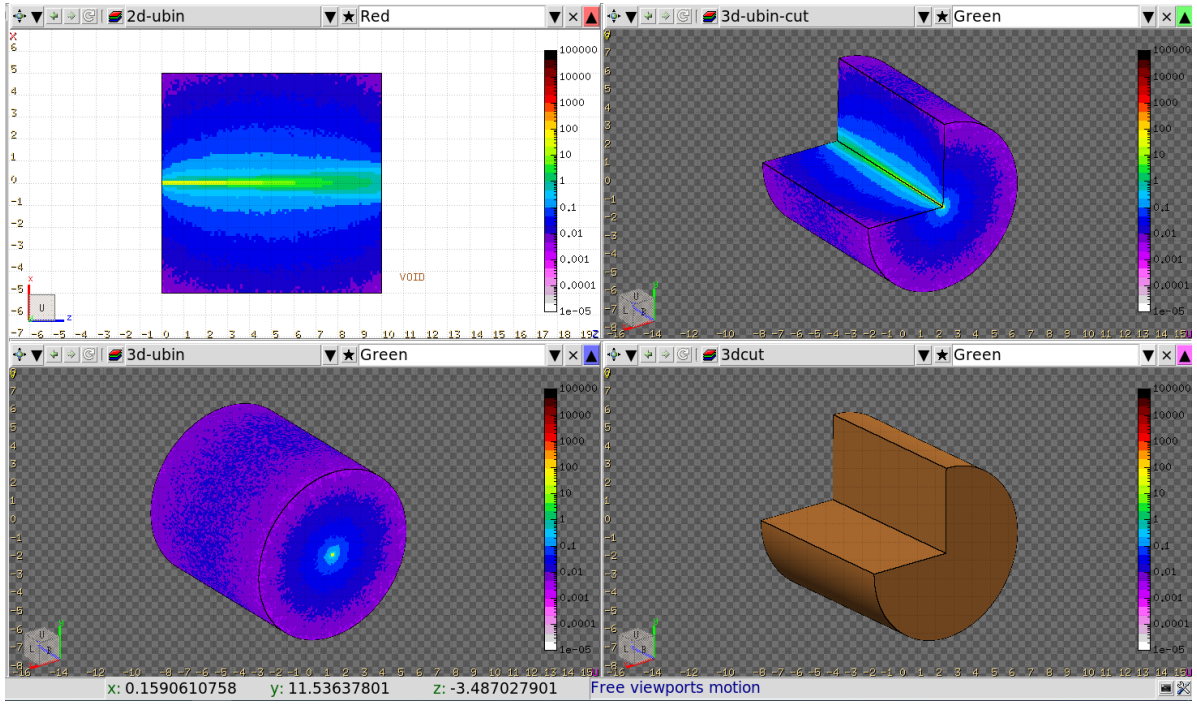
    Useful to the its location before running

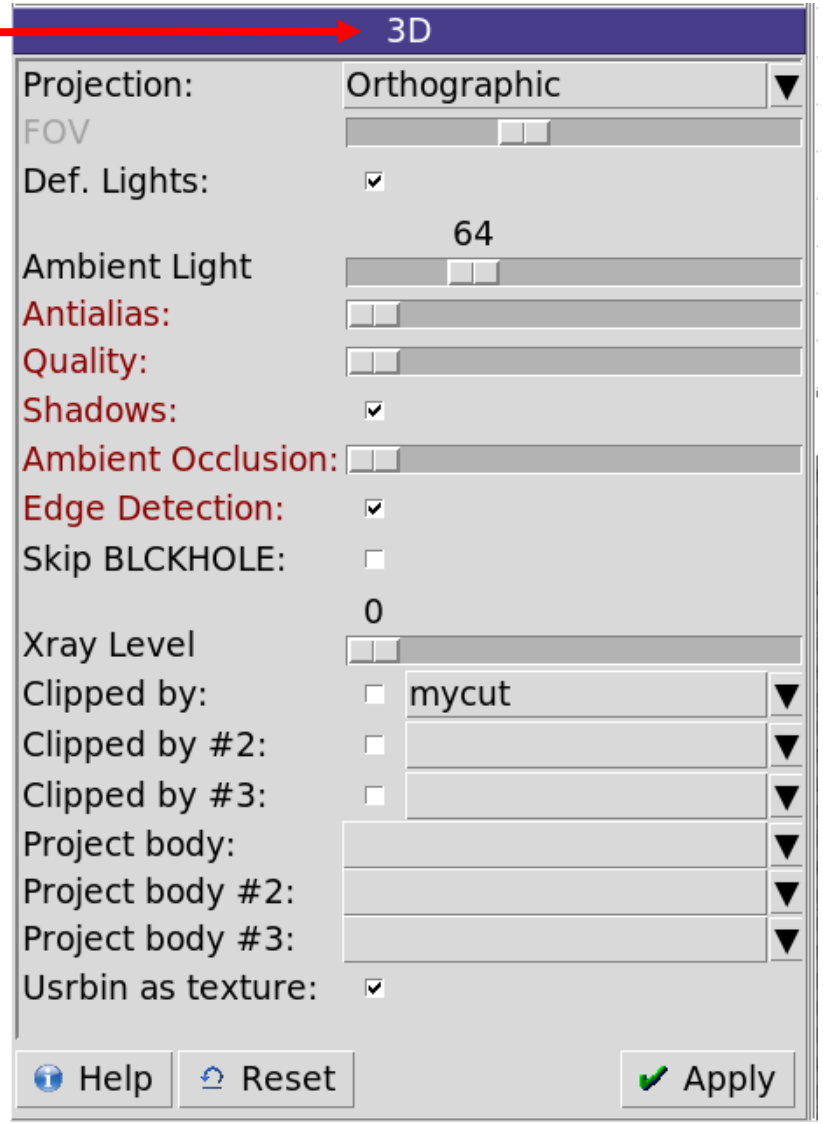




Geometry tab: Layers

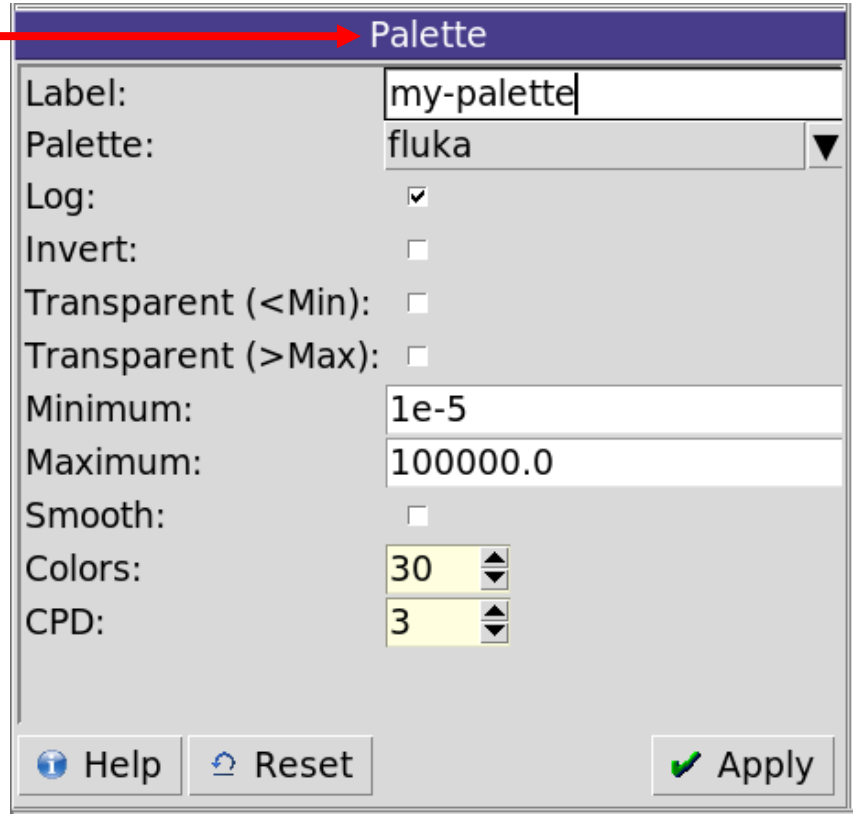
- 3D (to enable 3D rendering)
  - Plenty of options
  - Red indicate time consuming options
  - Select up to 3 bodies to cut the view
  - Project USRBIN info on up to 3 bodies





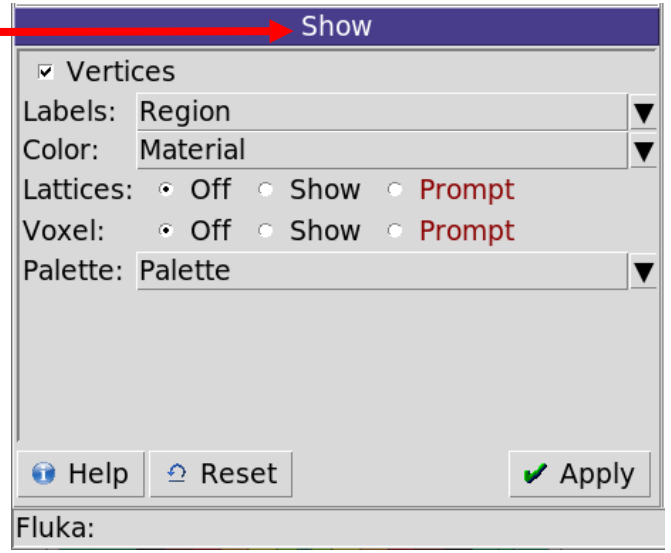
Geometry tab: Layers

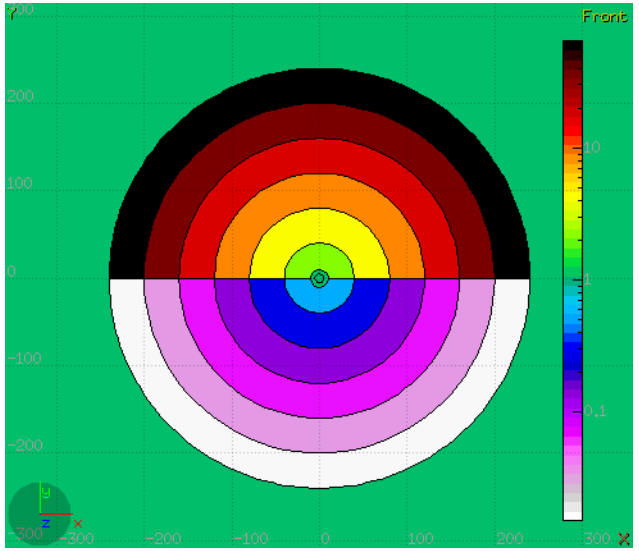
- Palette (to set palette properties)
  - Assign label
  - Change palette colors
  - Set linear or log scale
  - Set minimum and maximum values
  - Set color range



Geometry tab: Layers

- Show (to set visualization details)
  - Visibility of Vertices, Lattices, and Voxels
  - Set label (Region, Material, Value, or none)
  - Choose palette
  - Associate region color to:
    - Regions
    - Material
    - Density
    - Region Importance
    - Thresholds
    - …

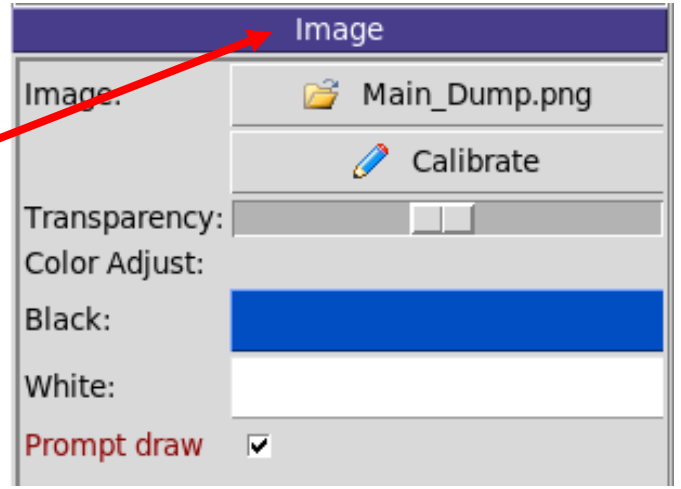


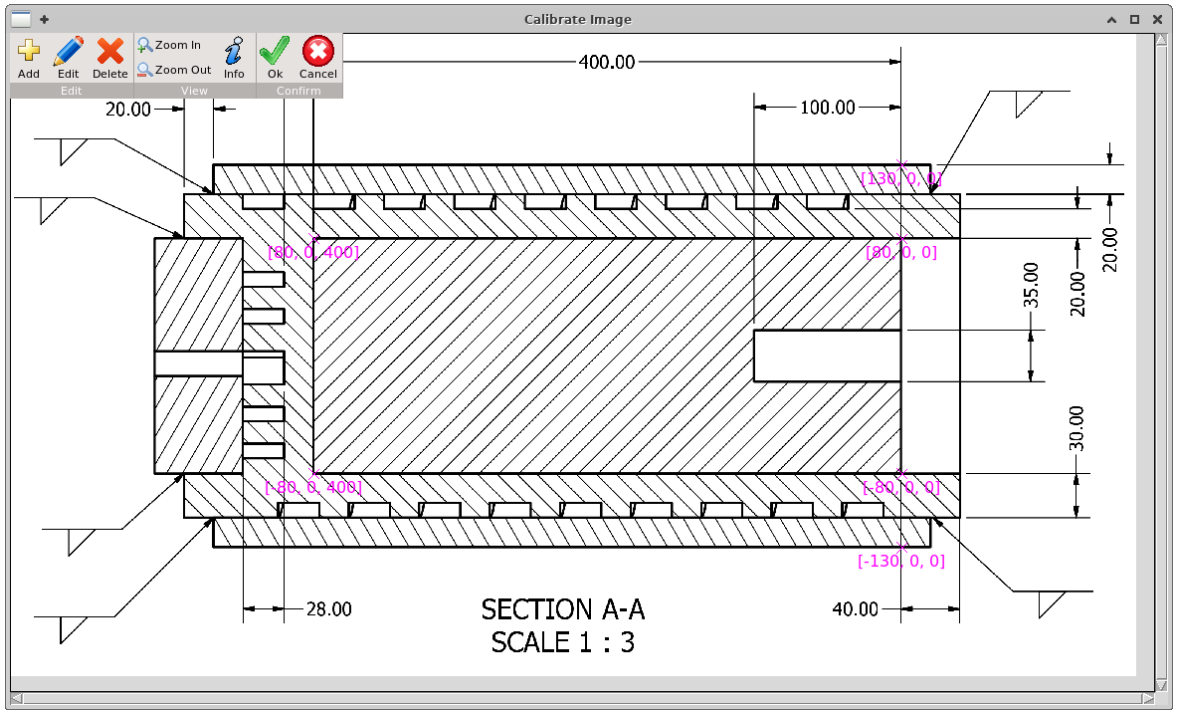


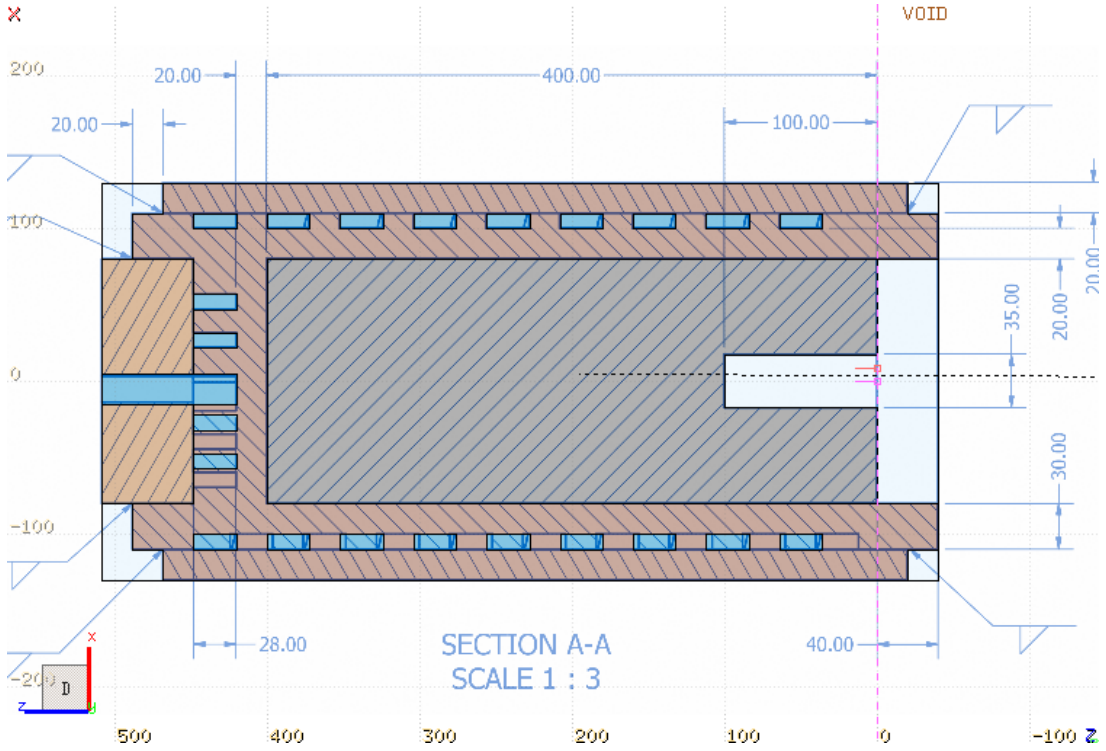
Geometry tab: Layers

- Image (to set a background image, i.e. a CAD drawing)
  - Image: select **`.png`**, **`.gif`**, or **`.jpg`** file
  - Calibrate: to input coordinates of specific points
  - Prompt draw: immediate image draw for idle display

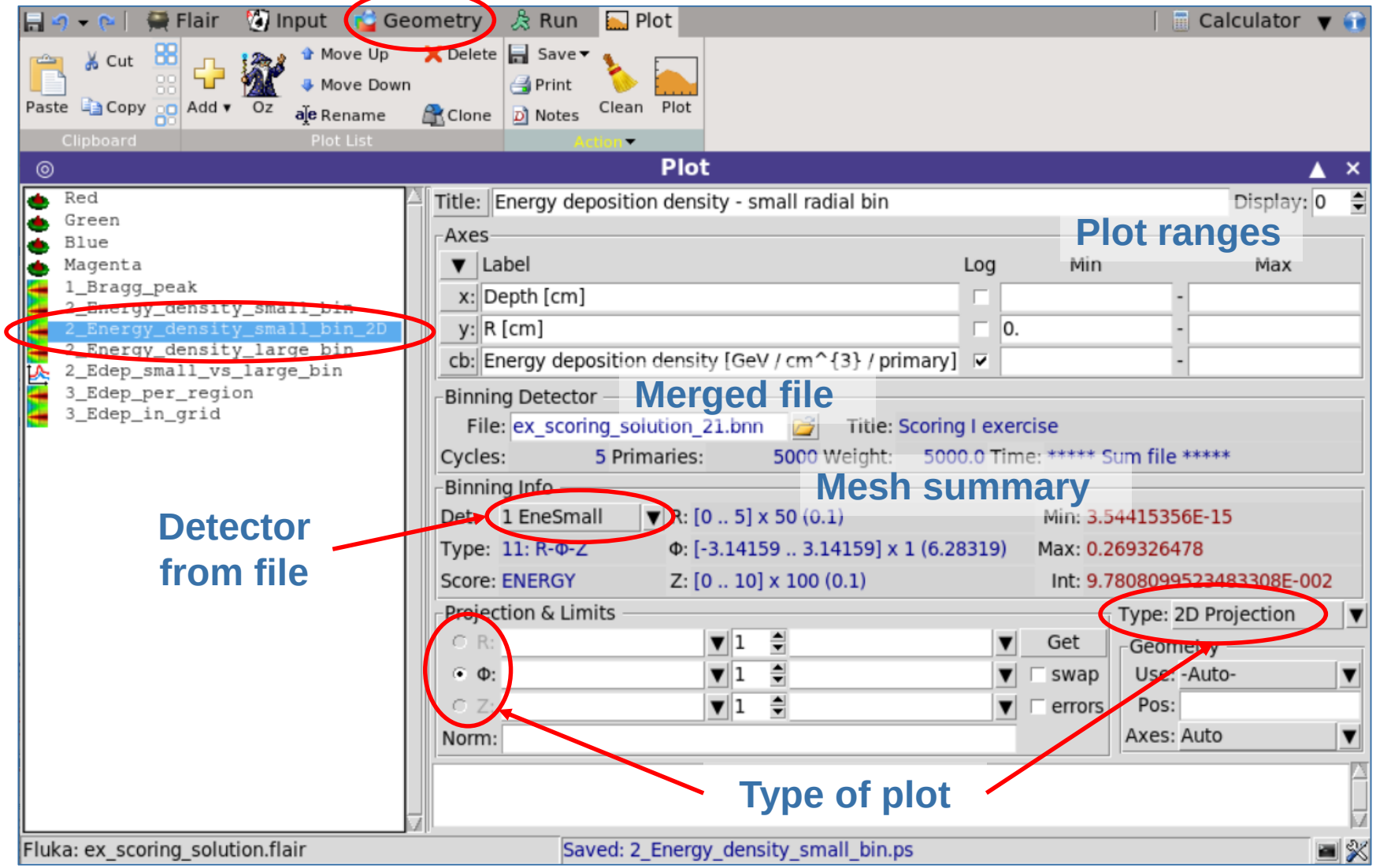
    (warning: it slows flair)



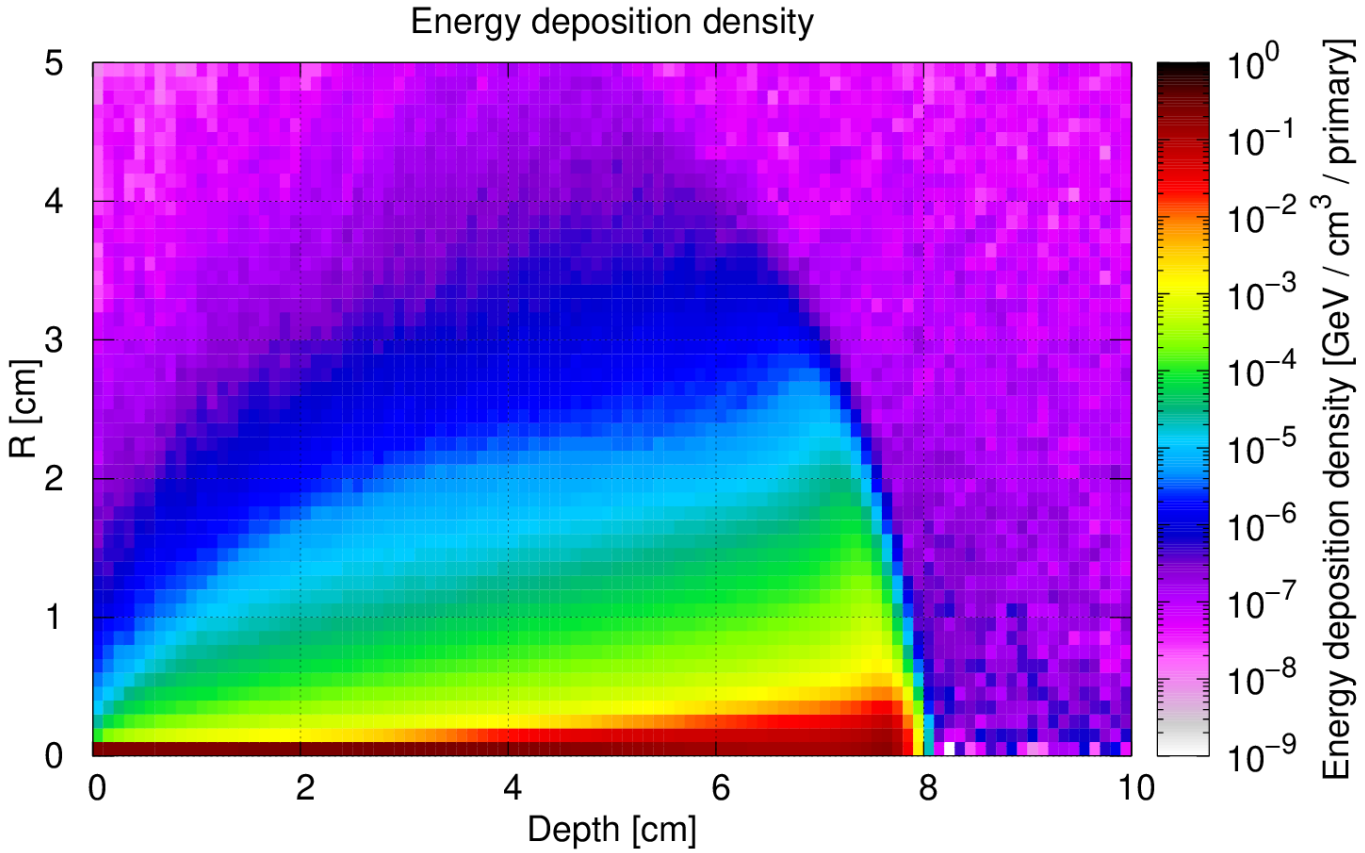




Plotting example – energy deposition density



Plotting example – energy deposition density



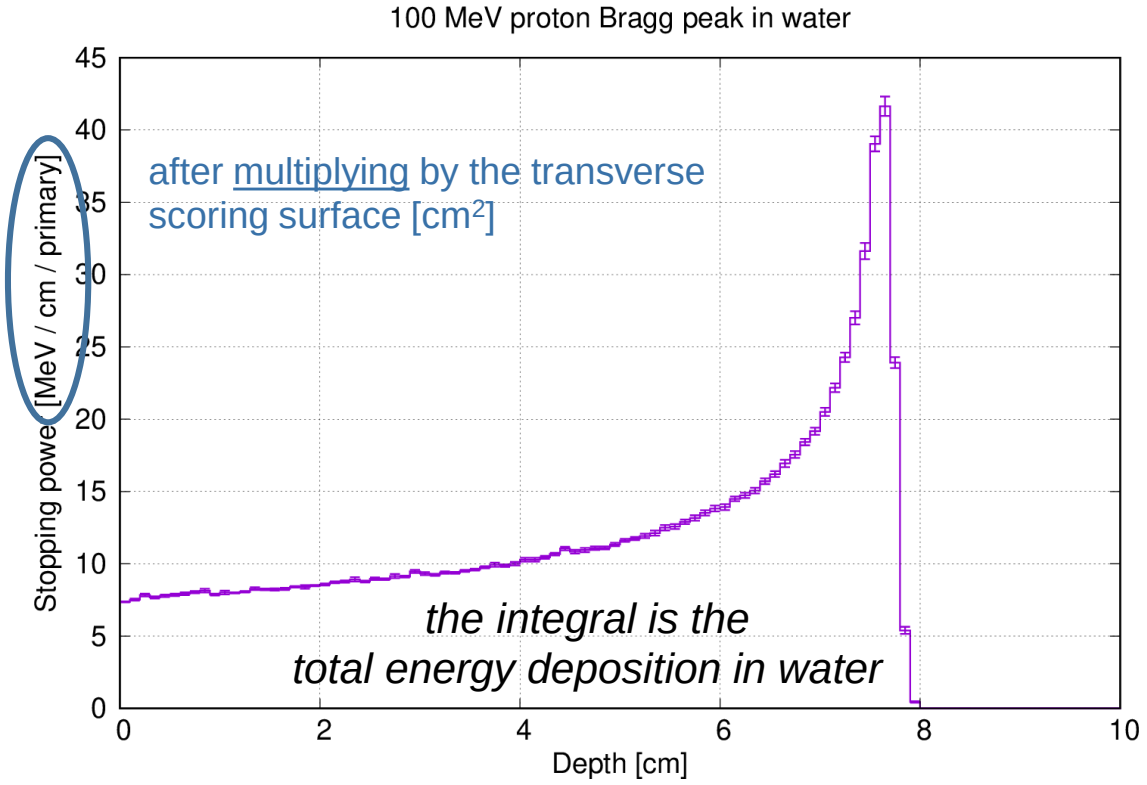
- **N.B.:** This plot is a **2D projection** of a 3D structure → **the result is the average over the 3rd coordinate** (Φ in the above case)
- Projection limits can be set in Flair

One dimensional plots

- 1D plots can be obtained from 3D **USRBIN** meshes, e.g. (for an R-Φ-Z mesh):

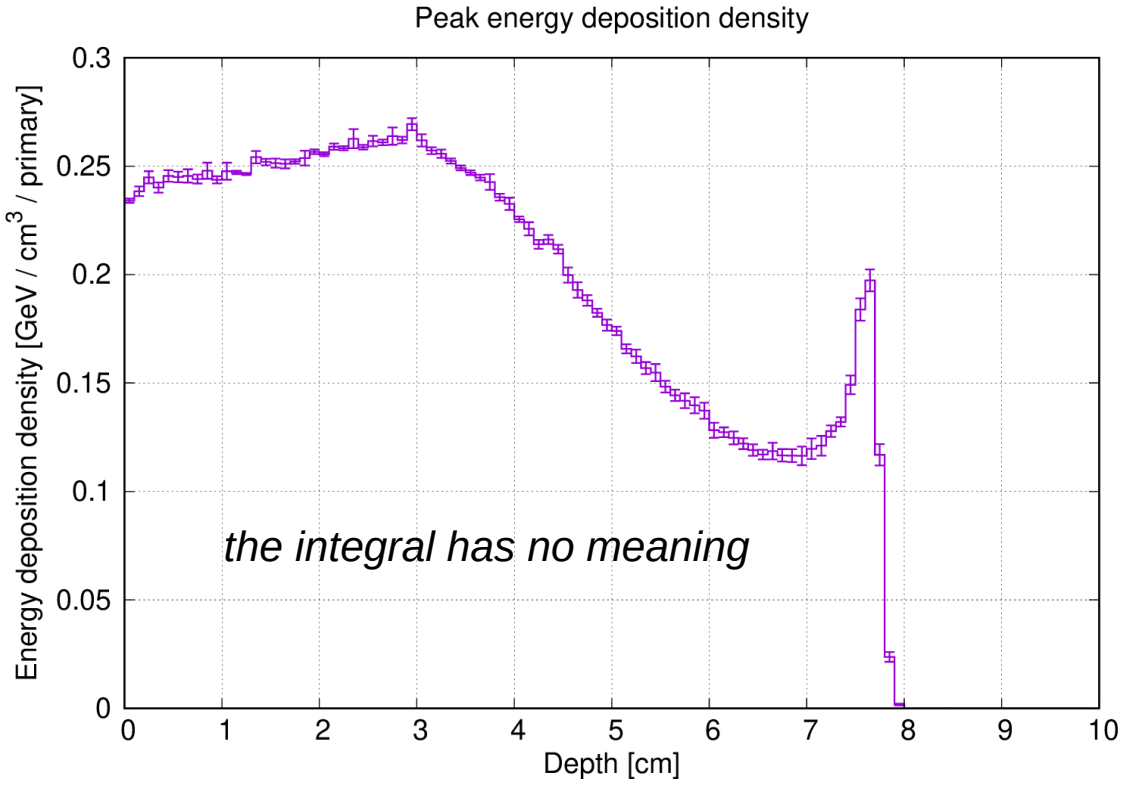
1D Projection

- The average of the values in each z-bin (i.e. over all R, Φ)



1D Max

- The highest value in each z-bin




FLUKA

CURSO INTRODUTÓRIO

FLUKA

23 DE JANEIRO
A 8 DE MARÇO
DE 2023

Código Monte Carlo de interação e transporte de partículas

Pausa

Voltamos em 15 minutos

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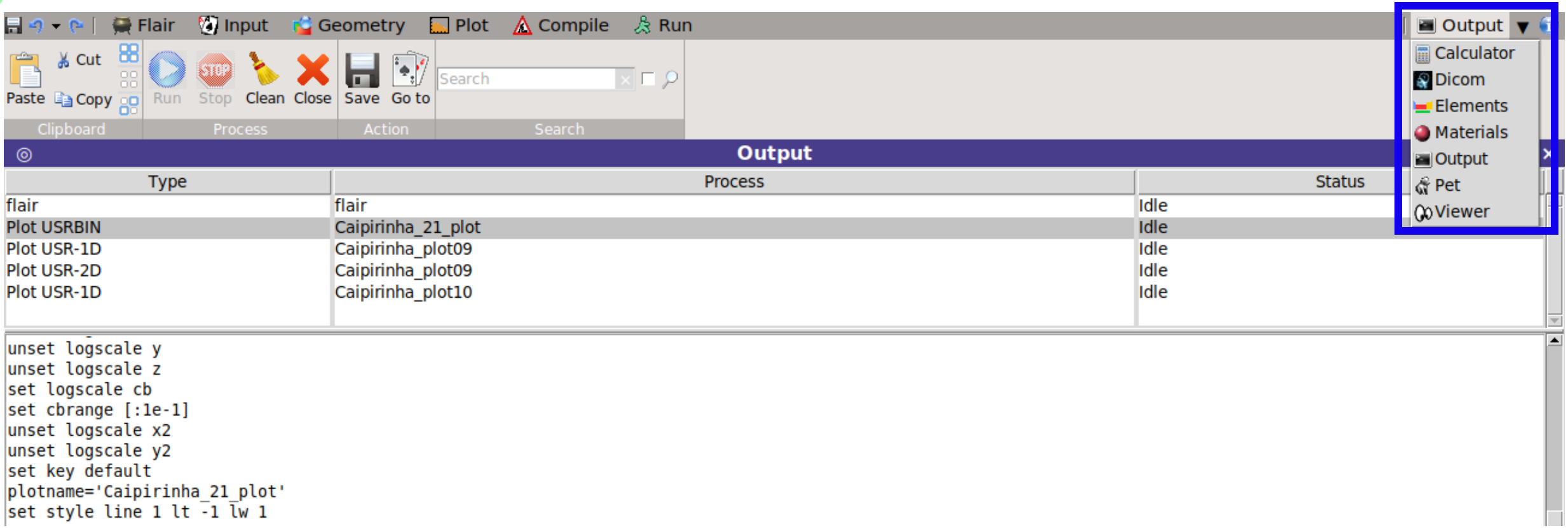
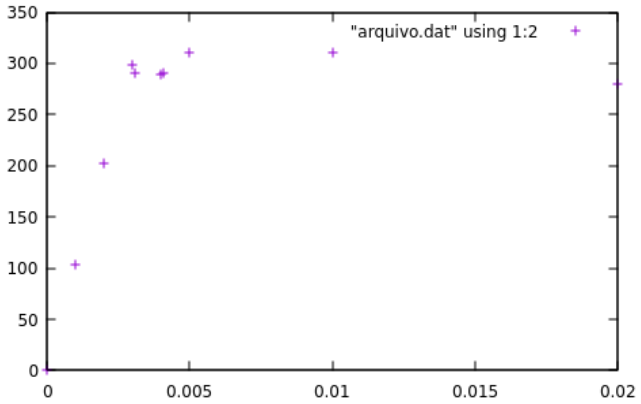
gnuplot no Flair



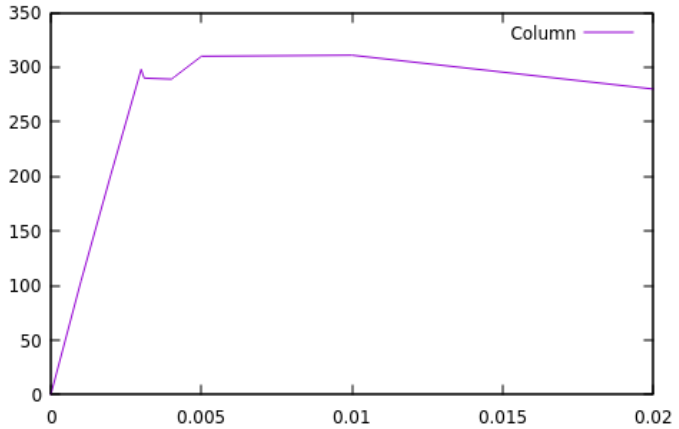
gnuplot – Plot 1D de arquivo

```
# Esse arquivo chama "arquivo.dat"
# Par1   Par2    Par3
0.000     0       0
0.001    104      51
0.002    202     101
0.003    298     148
0.0031   290     149
0.004    289     201
0.0041   291     209
0.005    310     250
0.010    311     260
0.020    280     240
```

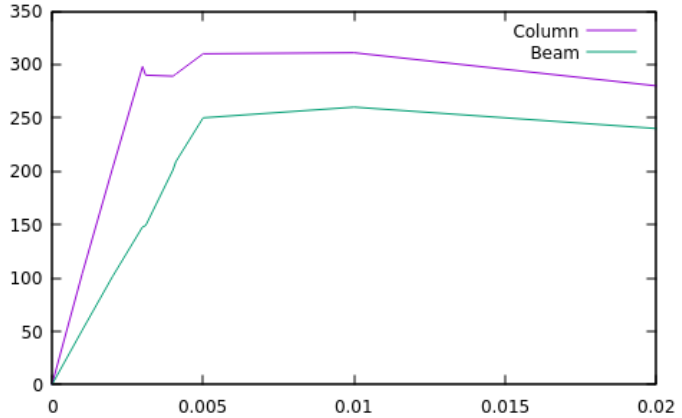
plot "arquivo.dat" using **1**:**2**



plot "arquivo.dat" using 1:2 **title 'Column'** **with lines**

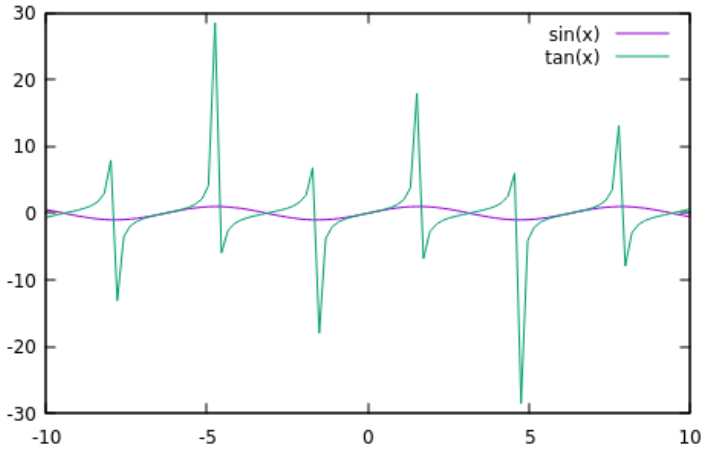


plot "arquivo.dat" using 1:2 title 'Column' with lines**, **
"arquivo.dat" using 1:3 title 'Beam' with lines



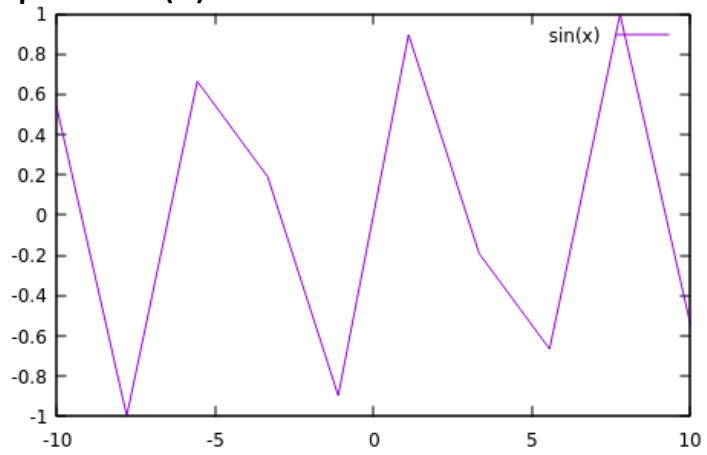
gnuplot – Plot 1D de funções

plot **sin(x)**, **tan(x)**



set samples 10

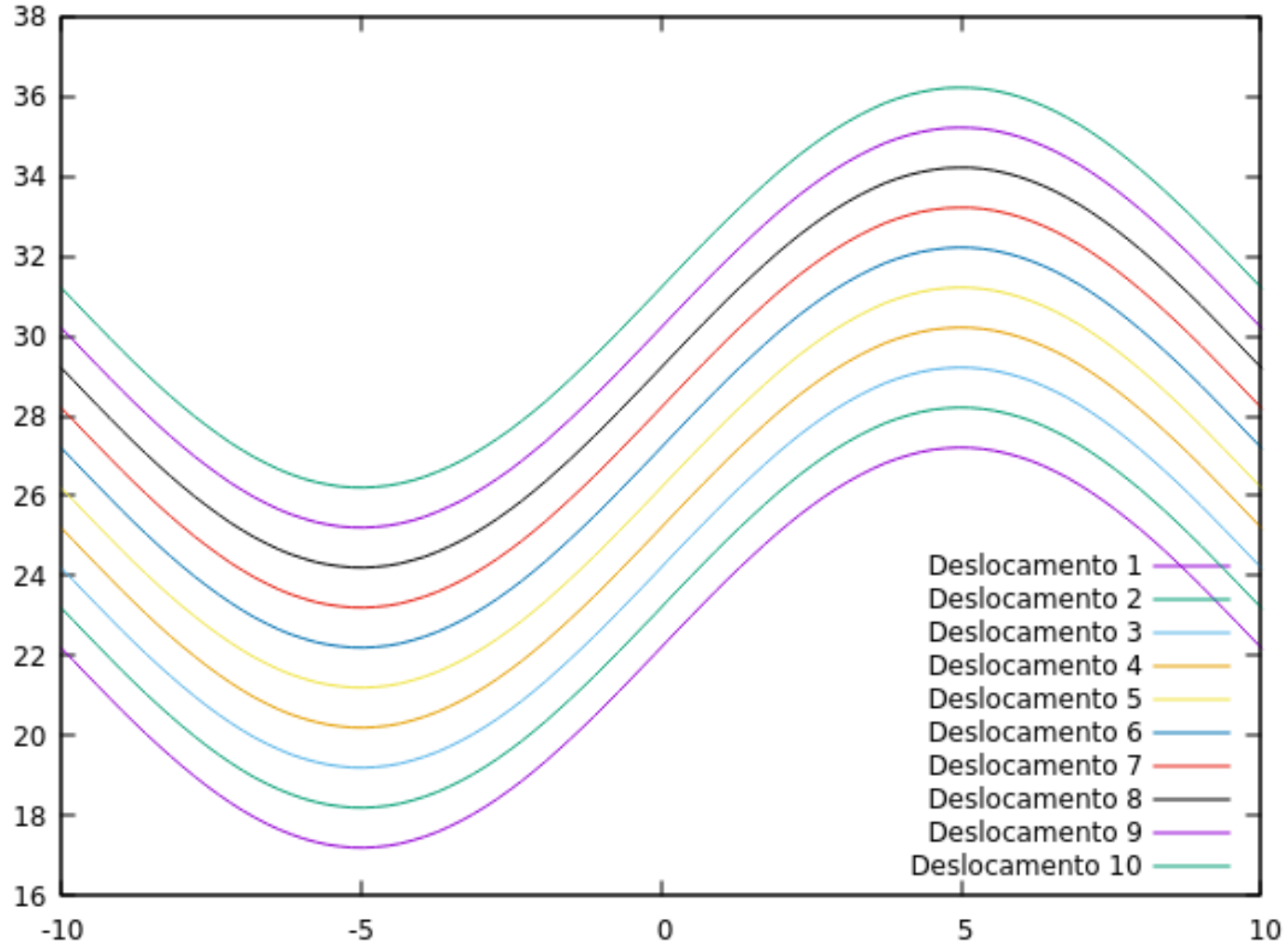
plot sin(x)



abs(x)	absolute value of x, |x|
acos(x)	arc-cosine of x
asin(x)	arc-sine of x
atan(x)	arc-tangent of x
cos(x)	cosine of x, x is in radians.
cosh(x)	hyperbolic cosine of x, x is in radians
erf(x)	error function of x
exp(x)	exponential function of x, base e
inverf(x)	inverse error function of x
invnorm(x)	inverse normal distribution of x
log(x)	log of x, base e
log10(x)	log of x, base 10
norm(x)	normal Gaussian distribution function
rand(x)	pseudo-random number generator
sgn(x)	1 if x > 0, -1 if x < 0, 0 if x=0
sin(x)	sine of x, x is in radians
sinh(x)	hyperbolic sine of x, x is in radians
sqrt(x)	the square root of x
tan(x)	tangent of x, x is in radians
tanh(x)	hyperbolic tangent of x, x is in radians

gnuplot – Variáveis e cálculos


```
per = 10
amp = 5
desloc= log(100)**2
f(x) = amp * sin(pi*x/per) + (desloc + t)

plot    for [t=1:10]   f(x)   title 'Deslocamento '.t
```

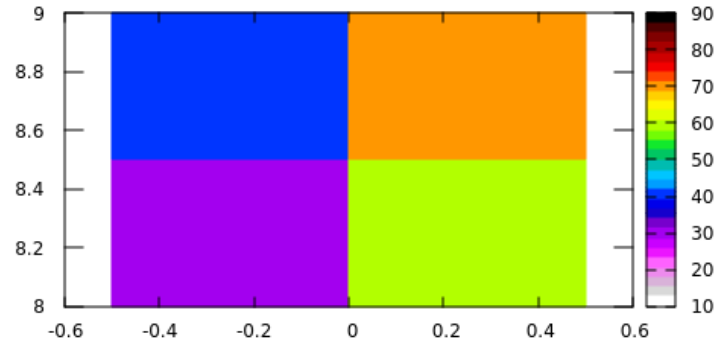


gnuplot – Plot 2D de arquivo

```
# Esse arquivo chama "arquivo.dat"
# x   y   cb
-0.5  8.0  10.0
-0.5  8.5  20.0
-0.5  9.0  30.0

 0.0  8.0  40.0
 0.0  8.5  50.0
 0.0  9.0  60.0

 0.5  8.0  70.0
 0.5  8.5  80.0
 0.5  9.0  90.0
```

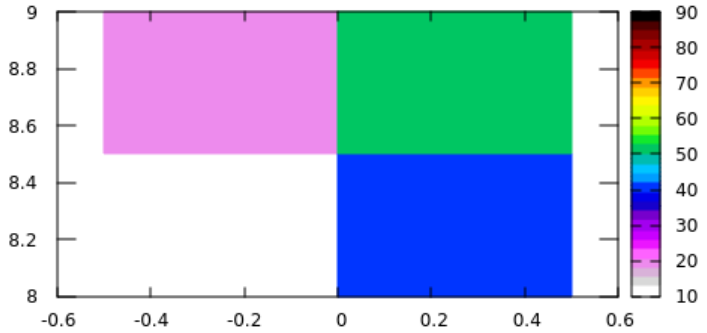
set pm3d map

splot "arquivo.dat" using **1:2:3** notitle



set pm3d map **corners2color c1**

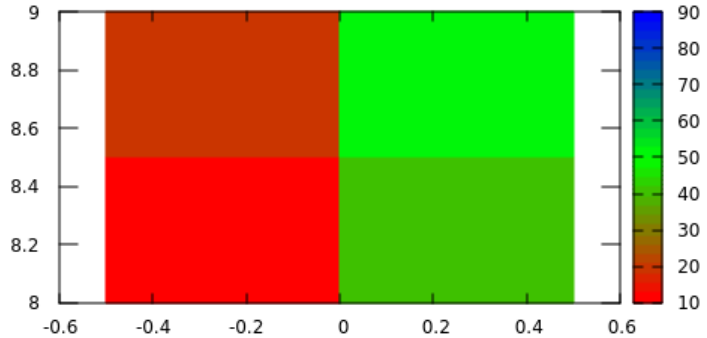
splot "arquivo.dat" using 1:2:3 notitle



set pm3d map corners2color c1

set palette defined (**1.** 1 0 0, **2.** 0 1 0, **3.** 0 0 1)

splot "arquivo.dat" using 1:2:3 notitle

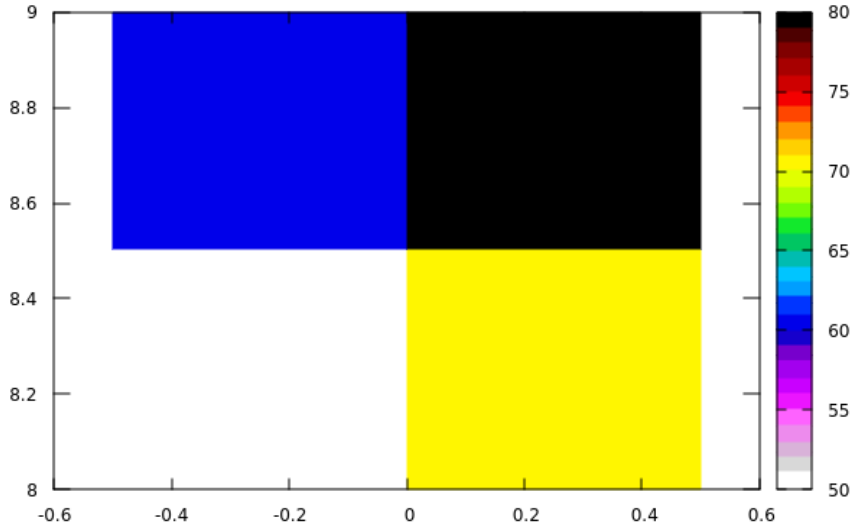


gnuplot – Plot 2D "soma" de 2 arquivos

```
# Esse arquivo chama "arquivo1.dat"
# x1   y1   cb1
-0.5  8.0  10.0
-0.5  8.5  10.0
-0.5  9.0  10.0

 0.0  8.0  10.0
 0.0  8.5  10.0
 0.0  9.0  10.0

 0.5  8.0  10.0
 0.5  8.5  10.0
 0.5  9.0  10.0
```

```
# Esse arquivo chama "arquivo2.dat"
# x2   y2   cb2
-0.5  8.0  20.0
-0.5  8.5  20.0
-0.5  9.0  20.0

 0.0  8.0  20.0
 0.0  8.5  20.0
 0.0  9.0  20.0

 0.5  8.0  20.0
 0.5  8.5  20.0
 0.5  9.0  20.0
```

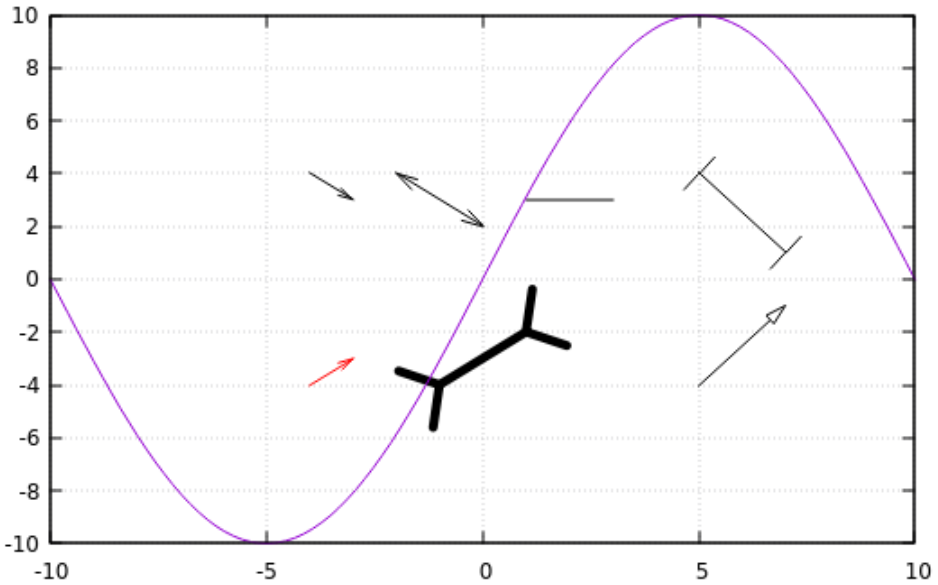
```
# Resultado do <paste
# x1   y1   cb1    x2   y2   cb2
-0.5  8.0  10.0   -0.5  8.0  20.0
-0.5  8.5  10.0   -0.5  8.5  20.0
-0.5  9.0  10.0   -0.5  9.0  20.0

 0.0  8.0  10.0    0.0  8.0  20.0
 0.0  8.5  10.0    0.0  8.5  20.0
 0.0  9.0  10.0    0.0  9.0  20.0

 0.5  8.0  10.0    0.5  8.0  20.0
 0.5  8.5  10.0    0.5  8.5  20.0
 0.5  9.0  10.0    0.5  9.0  20.0
```



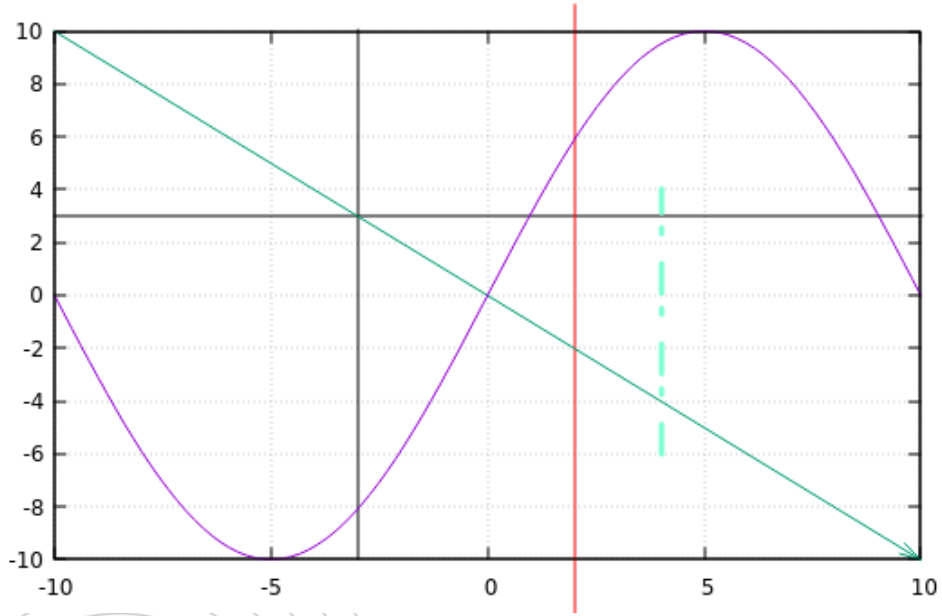
splot '**<paste** arquivo1.dat arquivo2.dat' us 1:2:($3+$6) notitle **front**

gnuplot – Linhas

```
set arrow from -4,4 to -3,3
set arrow from -2,4 to 0,2 heads
set arrow from 1,3 to 3,3 nohead
set arrow from 5,4 to 7,1 heads size 0.5,90
set arrow from -4,-4 to -3,-3 linecolor "red"
set arrow from 5,-4 to 7,-1 empty
set arrow from -1,-4 to 1,-2 heads size 1,130 linewidth 5

plot 10*sin(pi*x/10) notitle
```

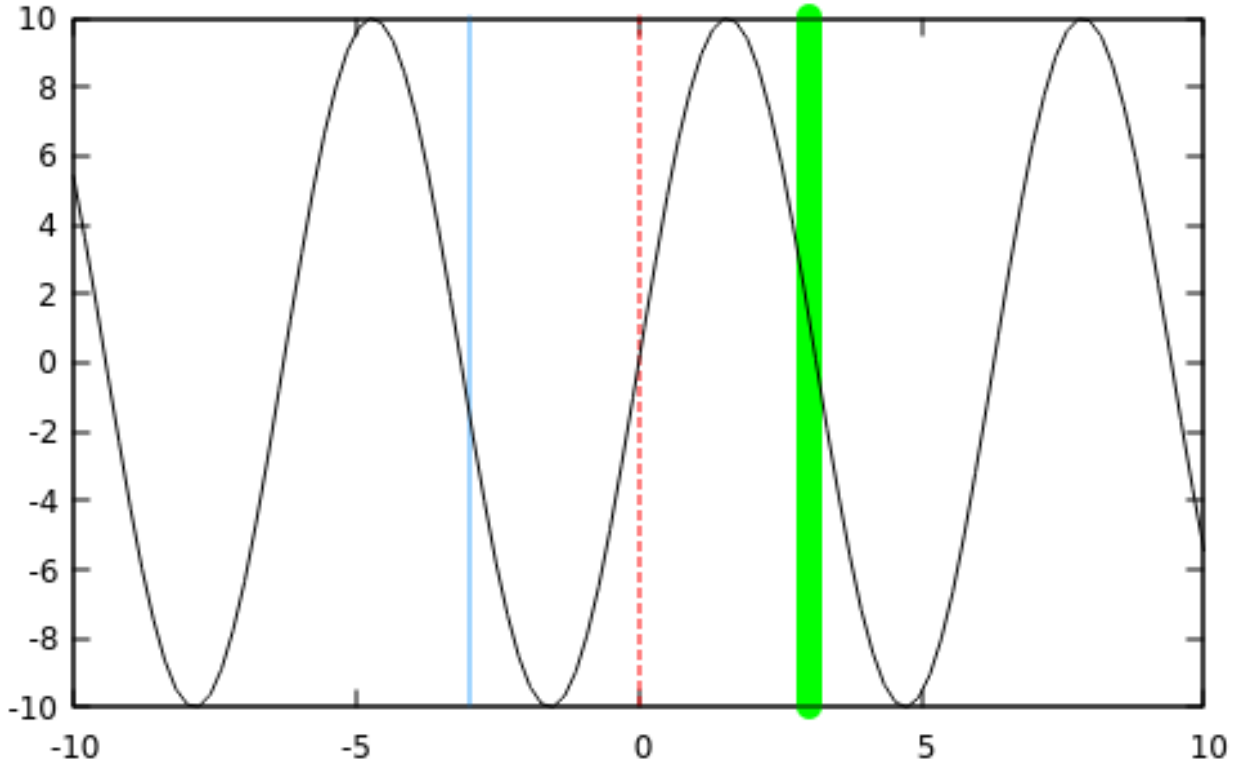



```
set arrow from -3, graph 0  o  -3, graph 1 nohead
set arrow from graph 0, first 3  to  graph 1, first 3 nohead

set arrow from 2, screen 0 to 2, screen 1 nohead linecolor "red"
set arrow from 4, graph 0.2 to 4, graph 0.7 nohead dashtype "-." lc \
                                                "aquamarine" lw 3
set arrow from graph 0,1 to graph 1,0 linetype 2

plot 10*sin(pi*x/10) notitle
```



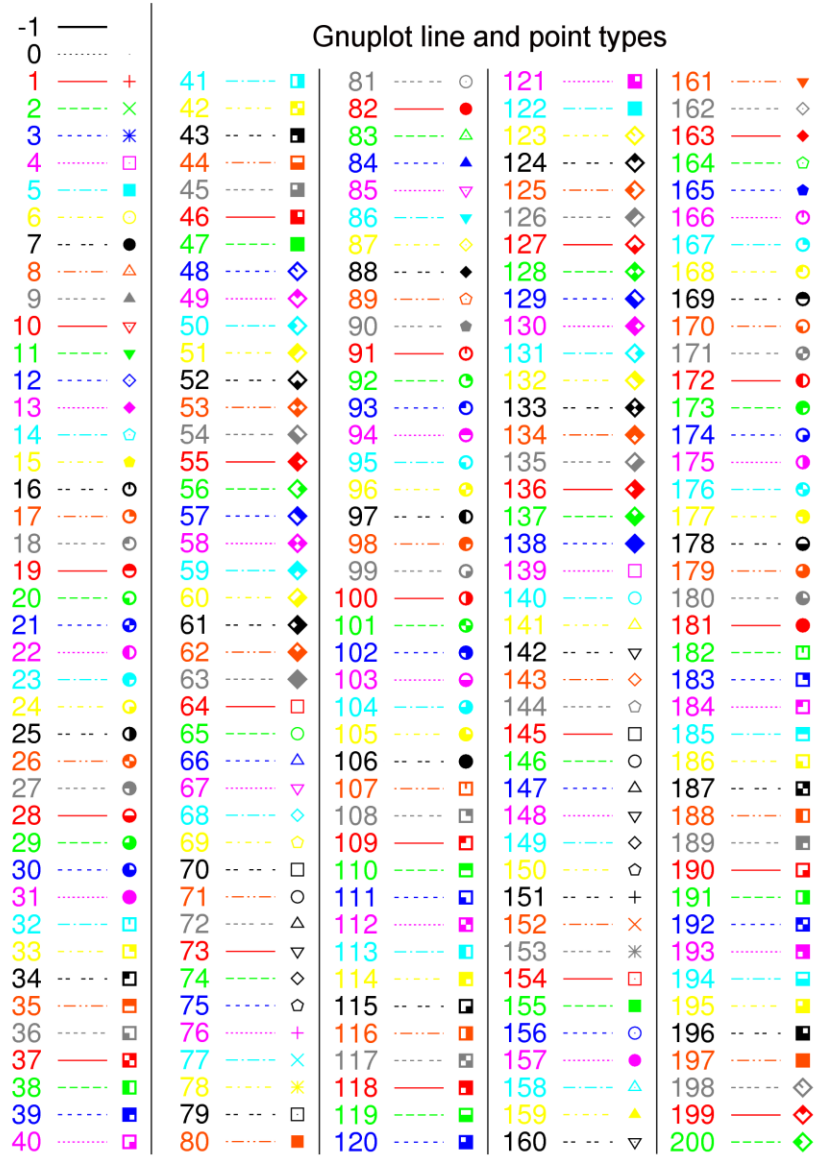
gnuplot – Alterando linhas

```
set arrow from -3, graph 0 to -3, graph 1 nohead linecolor "#0044ABFF"
set arrow from  0, graph 0 to  0, graph 1 nohead linecolor "#00FF0000" dashtype 2
set arrow from  3, graph 0 to  3, graph 1 nohead linecolor "green" linewidth 10
plot 10*sin(x) notitle lc "#00000000"
```

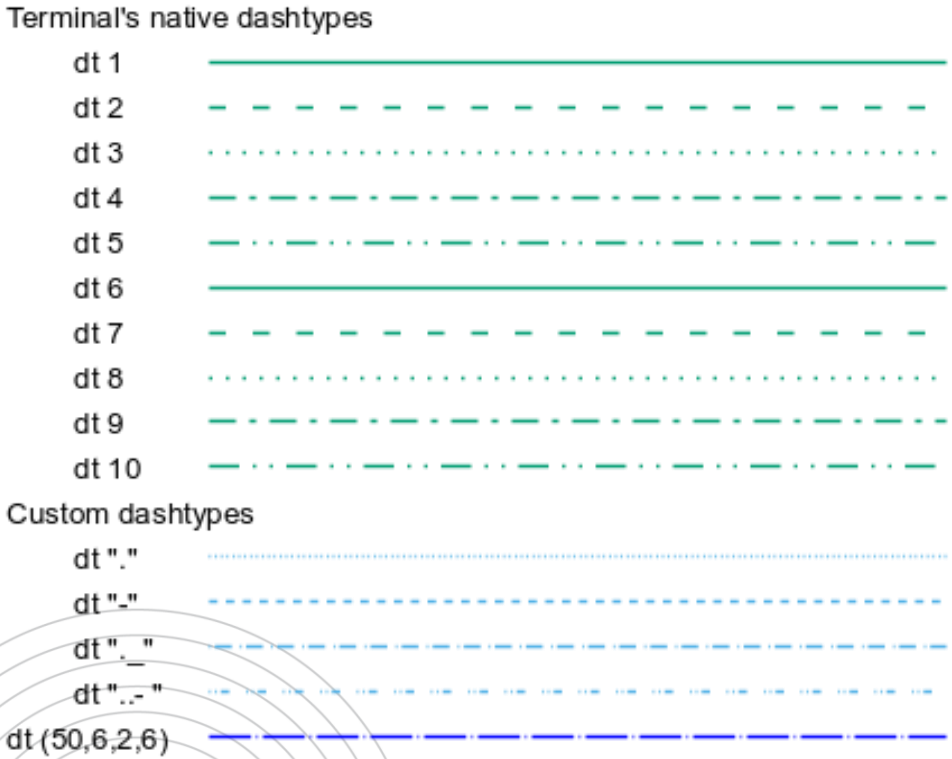


linetype	lt	Tipo de linha
linecolor	lc	Cor da linha
linewidth	lw	Tamanho da linha
pointtype	pt	Tamanho do ponto
pointsize	ps	Tipo do ponto

gnuplot – Alterando linhas

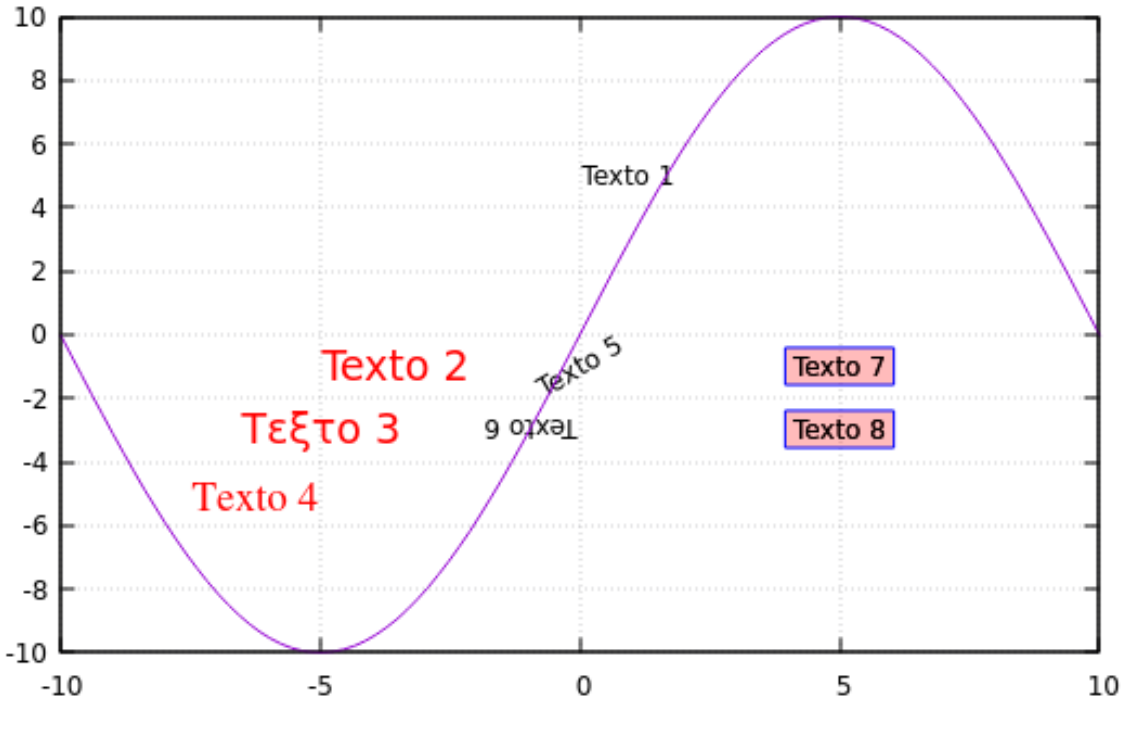


linetype | lt Tipo de linha
linecolor | lc Cor da linha
linewidth | lw Tamanho da linha
pointtype | pt Tamanho do ponto
pointsize | ps Tipo do ponto



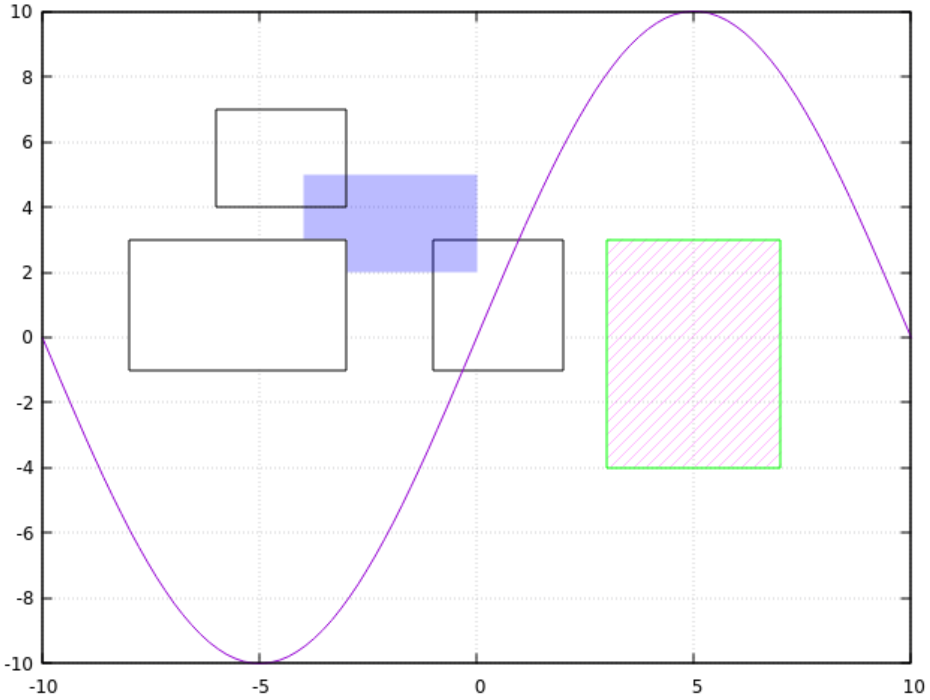
gnuplot – Caixas de texto

```
set label "Texto 1" at 0,5

# Fontes, Estilos e Âncora dos textos
set label "Texto 2" at -5,-1 left textcolor "red" font ',14'
set label "Texto 3" at -5,-3 center tc "red" font 'Symbol,14'
set label "Texto 4" at -5,-5 right  tc "red" font 'Times,14'

# Rotação
set label "Texto 5" at 0,-1 center rotate by 30
set label "Texto 6" at 0,-3  rotate by 180

# Texto dentro de caixa
set style textbox opaque fillcolor "#bbff0000" border linecolor "blue"
set label "Texto 7" at 5, -1 center boxed front
set label "Texto 8" at 5, -3 center boxed front

plot 10*sin(pi*x/10) notitle
```

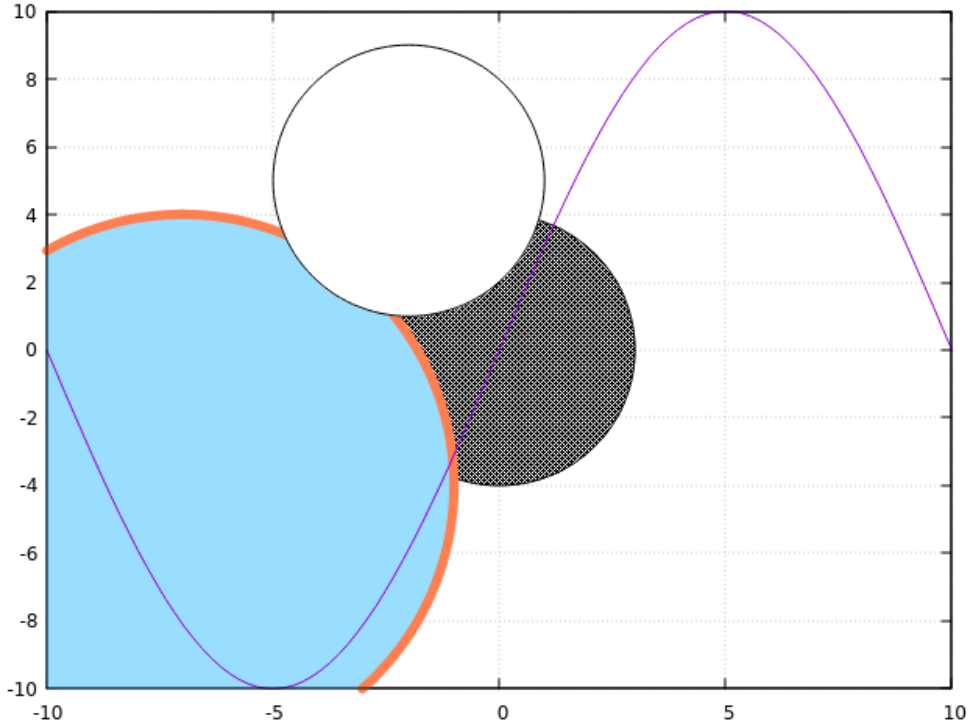


gnuplot – Objetos

```
set object rect from -1,-1 to 2,3
set object rect from -4,2 to 0,5 fillcolor "#bb0000FF" fillstyle noborder
set object rect from 3,-4 to 7,3 fc "#bbFF00FF" fs pattern 5 border lc "green"

# Sobreposto cheio
set object rect from -8,-1 to -3,3
# Sobreposto com fundo transparente
set object rect from -6,7 to -3,4 fc "#FF000000"

plot 10*sin(pi*x/10) notitle
```




```
set object circle at -2,5 size 3 front
set object circle at  graph 0.5, 0.5 size 4.5 fc "black" fs pattern 2
set object circle at -7,-4 size 6 fc "#9900ABFF" fs pattern 3 border lc "coral" lw 6

plot 10*sin(pi*x/10) notitle
```



gnuplot – Outros comandos

Título do gráfico:	`set title "Force-Deflection Data"`
Título do eixo x:	`set xlabel "Deflection (meters)"`
Título do eixo y:	`set ylabel "Force (kN)"`
Tirar todos os títulos:	`unset label`
Mover a legenda:	`set key 0.01,100`
Mover a legenda pra esquerda	`set key left`
Tirar a legenda:	`unset key`
Colocar caixa na legenda	`set key box`
Mudar o alcance do eixo x:	`set xrange [0.001:0.005]`
Mudar o alcance do eixo y:	`set yrange [20:500]`
Alcances altomáticos:	`set autoscale`
Plotar em escala logarítmica:	`set logscale`
Plotar em escala log em y:	`unset logscale; set logscale y`
Mudar o "tics" do eixo x:	`set xtics (0.002,0.004,0.006,0.008)`
Voltar para o tics padrão:	`unset xtics; set xtics auto`
Salvar o gráfico em png:	`set term png; set output "plot.png"`

FLUKA
https://fluka-forum.web.cern.ch/

stackoverflow
https://stackoverflow.com/questions/tagged/gnuplot

gnuplot homepage
https://gnuplot.sourceforge.net/

CURSO INTRODUTÓRIO FLUKA

23 DE JANEIRO A 8 DE MARÇO DE 2023

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AULA 08
Detectores – USRBIN (parte II)

Obrigado pela participação!

Código Monte Carlo de interação e transporte de partículas

23 FLUKA 2023 08

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