



Standard output, common errors and mistakes

Exploring the standard output | Handling errors | Common mistakes

Introduction

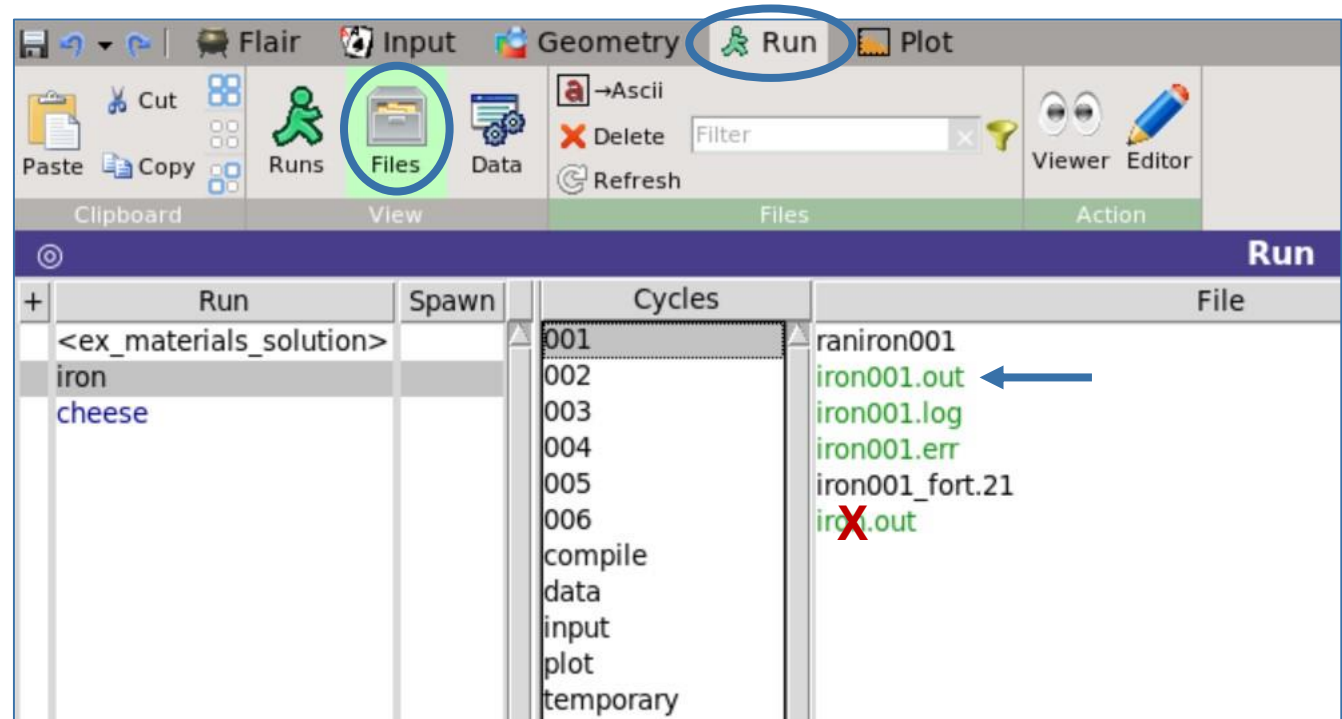
- We have already encountered most of the basic functions of **FLUKA** and introduced **Flair** as the main interface for setting up FLUKA simulations (building the geometry, defining materials and beams etc.)
- In the background, the code generates various output files that provide useful information
- The first objective of this lecture is to present the information that can be found in these files, focusing on the **standard output file (.out)** and, more briefly, on the **.err** and **.log** files
- In the second part, we shall present a non-exhaustive list of **possible errors** and, most importantly, how to use the available information in order to **identify their cause**

The standard output file

and the *.err* and *.log* files

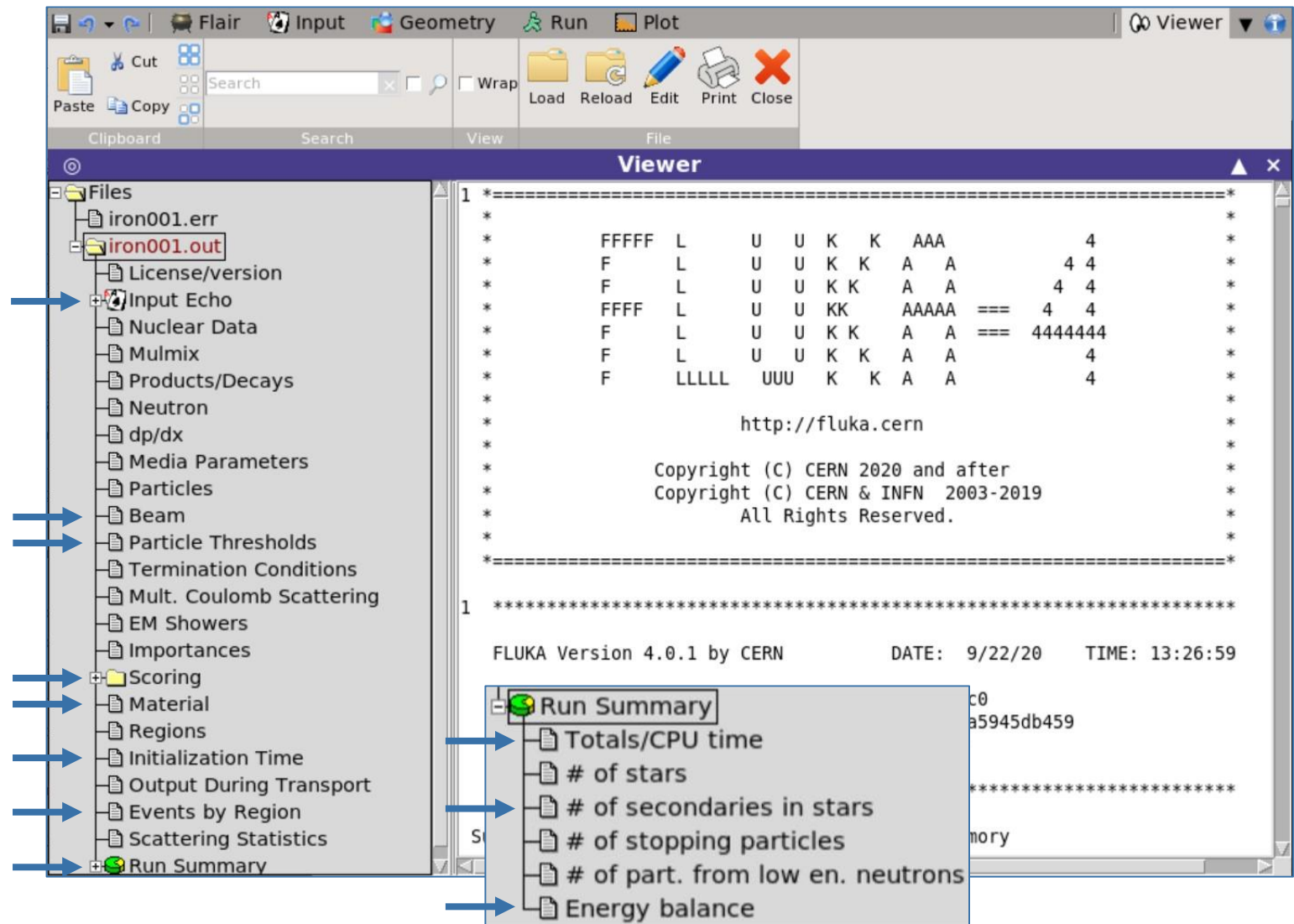
The standard output file (.out)

- The standard output file (and other generated files) can be listed and viewed inside Flair via the **Files** menu under the **Run** tab
- It may be found in the working directory (i.e. the directory in which you launched the run) or in the temporary **fluka_*** subdirectory if the run is still ongoing or if it ended with errors
- Name: **<inputname>###.out**, e.g. **myrun001.out**
- One output file is produced per cycle (***001.out**, ***002.out** etc.)
- **Note:** Not to be confused with the **<inputname>.out** file



The standard output file (.out)

- The .out file can be quite large
- The Flair viewer organises it into sections for easier navigation
- It contains a trove of useful information concerning the simulation
- Extremely useful for investigating strange results and errors
- Let's look at some of the contents!



The standard output file (.out)

- **Beam information**

- Particle type, energy, source position and spatial profile (as long as you are not generating arbitrary distributions via source routine)

```
=== Output before the actual run - Beam properties ===
```

```
Fluka incident beam properties:
```

```
Beam particle: PROTON   Id:   1 (Fluka) 2212 (PDG) Charge:   1 Baryon n.:   1
                   Mass: 0.9383      (GeV/c^2) Mean life: 1.0000E+18 (s) Weight:  1.000
Average beam momentum      :                               0.644445 (GeV/c)
Average beam kinetic energy:                               0.200000 (GeV)
Momentum deviation at FWHM (rectangular):                 0.0000000 (GeV/c)
Beam hit position      :   0.00000000   0.00000000   -5.00000000   cm
Beam direction cosines: 0.00000000   0.00000000   1.00000000
Beam spot FWHM X-width (Rectangular ): 0.0000   cm
Beam spot FWHM Y-width (Rectangular ): 0.0000   cm
Beam FWHM angular divergence (Rectangular ):                0.0000 (mrad)
(Spatial distribution, polarization, and angular direction and distribution
are given in the beam frame of reference)

Beam reference frame (world coordinates):
Beam X axis:   1.00000000   0.00000000   0.00000000
Beam Y axis:   0.00000000   1.00000000   0.00000000
Beam Z axis:   0.00000000   0.00000000   1.00000000

The nominal beam position belongs to region:   2 (VOID   ),
lattice cell:   0 (   )
```

The standard output file (.out)

• Summary of transport thresholds

=== Particle transport thresholds:

100 keV (PRECISION DEFAULTS)

Global cut-off kinetic energy for particle transport: 1.000E-04 GeV

The cut-off kinetic energy is superseded by individual particle thresholds if set

Cut-off kinetic energy for 4-HELIUM transport: 1.000E-04 GeV

Cut-off kinetic energy for 3-HELIUM transport: 1.000E-04 GeV

Cut-off kinetic energy for TRITON transport: 1.000E-04 GeV

Cut-off kinetic energy for DEUTERON transport: 1.000E-04 GeV

Cut-off kinetic energy for PROTON transport: 1.000E-04 GeV

Cut-off kinetic energy for APRON transport: 1.000E-04 GeV

Cut-off kinetic energy for ELECTRON transport defined in the Emfcut card

Cut-off kinetic energy for POSITRON transport defined in the Emfcut card

Cut-off kinetic energy for NEUTRIE transport: 0.000E+00 GeV

Cut-off kinetic energy for ANEUTRIE transport: 0.000E+00 GeV

Cut-off kinetic energy for PHOTON transport defined in the Emfcut card

Cut-off kinetic energy for NEUTRON transport: 1.000E-14 GeV

Correspondence of regions and EMF-FLUKA material numbers

Region	EMF	FLUKA
1 BLKBODY	0	VACUUM
2 VOID	0	VACUUM
3 TARGET	1	IRON

Prompt:

Ecut = 6.1100E-01 MeV, Pcut = 3.3333E-02 MeV

BIAS = F, Ray. = T, S(q,Z) = T, Pz(q,Z) = T, Acolin.= F

Delayed:

Ecut = 6.1100E-01 MeV, Pcut = 3.3333E-02 MeV

In the absence of an **EMFCUT** card explicitly setting them, **electron/positron** and **γ** transport thresholds are calculated internally

The standard output file (.out)

- **Materials and material properties**

- Includes FLUKA predefined materials and user-defined materials
- Basic material properties
- (In)elastic scattering length, radiation length for selected **BEAM** particle/energy

=== Material compositions: ===

Material Number&Name	Atomic Number	Atomic Weight	Density	Inelastic Scattering Length for PROTON at Beam energy	Elastic Scattering Length for PROTON at Beam energy	Radiation Length
			g/cm**3	cm	cm	cm
1 BLCKHOLE	0.000	0.000	0.000	0.1000E+31	0.1000E+31	0.1000E+31
2 VACUUM	0.000	0.000	0.000	0.1000E+31	0.1000E+31	0.1000E+31
3 HYDROGEN	1.000	1.008	0.8370E-04	0.3641E+10	0.8848E+06	0.7532E+06
30 GRUYERE	3.294	5.975	0.9153	115.2	219.2	41.98
Material	Number	Atom content	Partial Densities			
HYDROGEN	3	0.62121	0.95916E-01			
OXYGEN	8	0.17083	0.41870			
CARBON	6	0.18469	0.33981			
NITROGEN	7	0.19411E-01	0.41649E-01			
CALCIUM	21	0.15141E-02	0.92953E-02			
PHOSPHO	28	0.11754E-02	0.55772E-02			
SODIUM	19	0.95020E-03	0.33463E-02			
POTASSIU	29	0.11485E-03	0.68786E-03			
MAGNESIU	9	0.99864E-04	0.37181E-03			
31 WATER	3.333	6.005	1.000	109.5	194.4	36.08
Material	Number	Atom content	Partial Densities			
HYDROGEN	3	0.66667	0.11190			
OXYGEN	8	0.33333	0.88810			

The standard output file (.out)

- **Summary of requested scoring**
 - Interpreted scoring cards

```
***** "usrbin" option:
```

```

                                     Proton
Cartesian binning n.  1 "Protons  " , generalized particle n.  1
{ X coordinate: from -1.0000E+01 to  1.0000E+01 cm,   201 bins ( 9.9502E-02 cm wide)
  Y coordinate: from -1.0000E+01 to  1.0000E+01 cm,   201 bins ( 9.9502E-02 cm wide)
  Z coordinate: from -5.0000E+00 to  1.5000E+01 cm,   200 bins ( 1.0000E-01 cm wide)
data will be printed on unit  -21 (unformatted if < 0)
accurate deposition along the tracks requested
normalized (per unit volume) data will be printed at the end of the run
this is a track-length binning
```

```
***** "USRBDX" option:
```

```
No user bdrx defined
```

```
***** "USRTRACK" option:
```

```
No user track-length estimator defined
```

The standard output file (.out)

- **Input echo**

- Interpreted body and region definitions
- Very useful in case of complex inputs controlled by many different preprocessor directives, where the options may not be activated as intended due to a mistake
- The input echo will only contain the parts which were actually active in the run

- **Initialisation time**

- Run initialisation happens at the beginning of each cycle
- It is generally quite fast (especially relative to the total duration of the run) but can reach up to several minutes for inputs with complex geometries, many LATTICEs, scorings, preprocessor directives etc., e.g.:

```
Total time used for initialization: 0.539 s Basic input template
```

```
Total time used for initialization: 82.1 s Complex LHC simulation,  
34000 line input file
```

The standard output file (.out)

- Run summary

- Energy balance

2.0000E-01 (100.%) GeV available per beam particle divided into		
Prompt radiation	Radioactive decays	
1.7460E-01 (87.3%)	0.0000E+00 (0.0%)	GeV hadron and muon dE/dx
9.8263E-03 (4.9%)	0.0000E+00 (0.0%)	GeV electro-magnetic showers
4.4650E-04 (0.2%)	0.0000E+00 (0.0%)	GeV nuclear recoils and heavy fragments
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	GeV particles below threshold
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	GeV residual excitation energy
8.4339E-05 (0.0%)	0.0000E+00 (0.0%)	GeV low energy neutrons
6.1338E-03 (3.1%)	0.0000E+00 (0.0%)	GeV <u>particles escaping the system</u>
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	GeV particles discarded
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	GeV particles out of time limit
8.9106E-03 (4.5%)		GeV <u>missing</u>

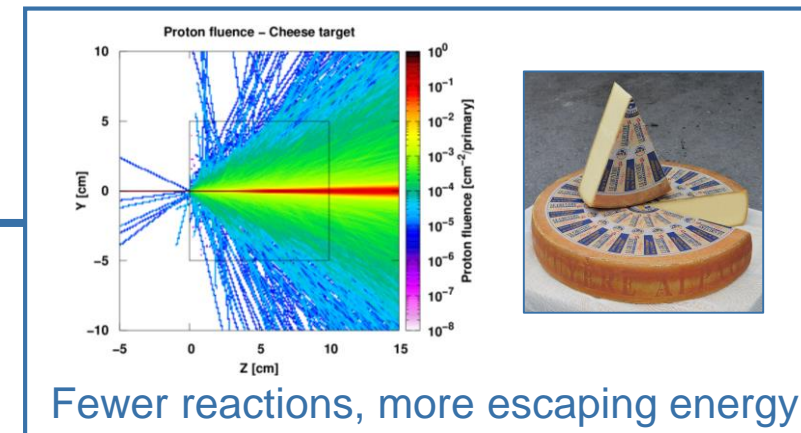
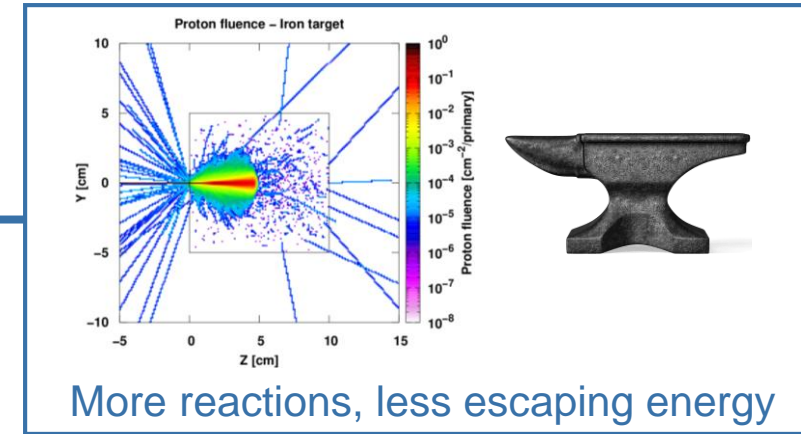
} Hadronic / EM break-down

→ Exiting the geometry

→ Nuclear reactions, particle production

2.0000E-01 (100.%) GeV available per beam particle divided into		
Prompt radiation	Radioactive decays	
4.5129E-02 (22.6%)	0.0000E+00 (0.0%)	GeV hadron and muon dE/dx
3.1495E-03 (1.6%)	0.0000E+00 (0.0%)	GeV electro-magnetic showers
2.6012E-04 (0.1%)	0.0000E+00 (0.0%)	GeV nuclear recoils and heavy fragments
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	GeV particles below threshold
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	GeV residual excitation energy
5.9178E-06 (0.0%)	0.0000E+00 (0.0%)	GeV low energy neutrons
1.4916E-01 (74.6%)	0.0000E+00 (0.0%)	GeV <u>particles escaping the system</u>
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	GeV particles discarded
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	GeV particles out of time limit
2.2925E-03 (1.1%)		GeV <u>missing</u>

Recall the materials exercise:
200 MeV protons on iron & cheese

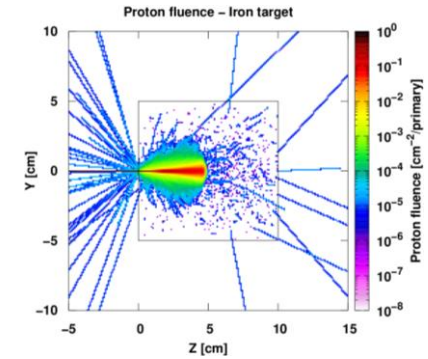


The standard output file (.out)

- Information per region
 - Energy deposition

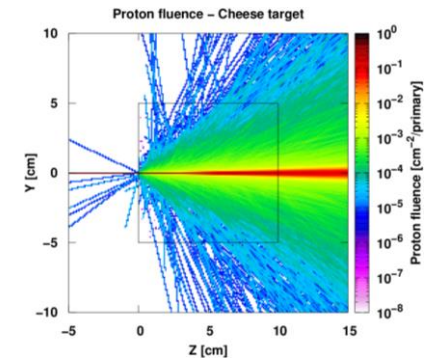
Region #	name	volume in cubic cm	ALL-PART Star Density Stars/cm**3 /one beam particle	BEAMPART Star Density Stars/cm**3 /one beam particle	ENERGY GeV/cm**3 /one beam particle	Density	EM-ENERGY GeV/cm**3 /one beam particle	Density
1	BLKBODY	1.000000000D+00	0.000000000D+00	0.000000000D+00	6.133758472D-03		7.633542712D-04	
2	VOID	1.000000000D+00	0.000000000D+00	0.000000000D+00	0.000000000D+00		0.000000000D+00	
3	TARGET	1.000000000D+00	3.153000000D-01	2.530000000D-01	<u>1.849556851D-01</u>		9.826343461D-03	
Total (integrated over volume):			3.153000000D-01	2.530000000D-01	1.910894436D-01		1.058969773D-02	

≈ 185.0 MeV/pr.



Region #	name	volume in cubic cm	ALL-PART Star Density Stars/cm**3 /one beam particle	BEAMPART Star Density Stars/cm**3 /one beam particle	ENERGY GeV/cm**3 /one beam particle	Density	EM-ENERGY GeV/cm**3 /one beam particle	Density
1	BLKBODY	1.000000000D+00	0.000000000D+00	0.000000000D+00	1.491629305D-01		1.177755188D-04	
2	VOID	1.000000000D+00	0.000000000D+00	0.000000000D+00	0.000000000D+00		0.000000000D+00	
3	TARGET	1.000000000D+00	9.630000000D-02	8.840000000D-02	<u>4.854454810D-02</u>		3.149463521D-03	
Total (integrated over volume):			9.630000000D-02	8.840000000D-02	1.977074786D-01		3.267239040D-03	

≈ 48.5 MeV/pr.



The standard output file (.out)

- **Run summary**

- Primary particles, number of interactions, CPU-time

```
Total number of primaries run:                10000 for a weight of: 1.000000E+04
!!! Please remember that all results are normalized per unit weight !!!
The main stack maximum occupancy was           12 out of           70000 available
```

```
Total number of inelastic interactions (stars):           963
Total weight of the inelastic interactions (stars):  9.630000E+02
```

```
Total number of elastic interactions:                   649
Total weight of the elastic interactions:  6.490000E+02
```

```
Total number of low energy neutron interactions:           1047
Total weight of the low energy neutron interactions: 1.047000E+03
```

From fractions of a millisecond to tens of minutes or more

```
Total CPU time used to follow all primary particles:  6.594E+00 seconds of:
Average CPU time used to follow a primary particle:  6.594E-04 seconds of:
Maximum CPU time used to follow a primary particle:  5.707E-03 seconds of:
Residual CPU time left:                               1.000E+30 seconds of:
```

The standard output file (.out)

- **Run summary**

- Number and type of produced secondary particles

Number of secondaries generated in inelastic interactions per beam particle:

Prompt radiation

Radioactive decays

1.9023E+00 (100.%)	0.0000E+00 (100.%)	
6.4300E-02 (3.4%)	0.0000E+00 (0.0%)	4-HELIUM
1.4000E-03 (0.1%)	0.0000E+00 (0.0%)	3-HELIUM
2.4000E-03 (0.1%)	0.0000E+00 (0.0%)	TRITON
1.3900E-02 (0.7%)	0.0000E+00 (0.0%)	DEUTERON
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	HEAVYION
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	OPTIPHOT
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	RAY
5.1690E-01 (27.2%)	0.0000E+00 (0.0%)	PROTON
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	APROTON
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	ELECTRON
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	POSITRON
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	NEUTRIE
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	ANEUTRIE
7.0840E-01 (37.2%)	0.0000E+00 (0.0%)	PHOTON
5.9500E-01 (31.3%)	0.0000E+00 (0.0%)	NEUTRON

The .err file

- **Note:** The .err file is generated even for successful runs, its presence does not necessarily imply that any errors were encountered
- It contains information concerning the progress of the run
- Run-time error messages and warnings will also be written to this file

	NUMBER OF BEAM PARTICLES HANDLED	NUMBER OF BEAM PARTICLES LEFT	APPROXIMATE NUMBER OF BEAM PARTICLES THAT CAN STILL BE HANDLED	AVERAGE TIME USED BY A BEAM PARTICLE	TIME LEFT (RESERVED 10000.0 SECONDS FOR PRINTOUT)	NUMBER OF STARS CREATED
NEXT SEEDS: 0	0	0	0	0	0	1
1	9999	9999	9999	5.6219101E-03	1.0000000E+30	1
NEXT SEEDS: 6318	0	0	0	0	0	69
200	9800	9800	9800	2.1123397E-03	1.0000000E+30	69
NEXT SEEDS: 267D54	0	0	0	0	0	138
400	9600	9600	9600	2.1135074E-03	1.0000000E+30	138
NEXT SEEDS: 4D16E6	0	0	0	0	0	200
600	9400	9400	9400	2.1636081E-03	1.0000000E+30	200
NEXT SEEDS: 7403F5	0	0	0	0	0	255
800	9200	9200	9200	2.1459064E-03	1.0000000E+30	255
NEXT SEEDS: 9A00D5	0	0	0	0	0	310
1000	9000	9000	9000	2.1301692E-03	1.0000000E+30	310
NEXT SEEDS: BF1323	0	0	0	0	0	367
1200	8800	8800	8800	2.1327207E-03	1.0000000E+30	367
NEXT SEEDS: E4F1F5	0	0	0	0	0	418
1400	8600	8600	8600	2.1358556E-03	1.0000000E+30	418

Histories completed

Histories remaining

Avg. CPU time per history

The .log file

- Critical errors, usually following a code abort will be written to the `.log` file, as in the following examples

```
Program received signal SIGFPE: Floating-point exception - erroneous arithmetic operation.
```

```
Backtrace for this error:
```

```
#0 0x7f60e3aae3ff in ???  
#1 0x7f60e3ab84fe in ???  
#2 0x7f60e47b13a8 in read_real  
    at /GCC/build/contrib/gcc-8.2.0/src/gcc/8.2.0/libgfortran/io/list_read.c:1872  
#3 0x7f60e47b2fcd in list_formatted_read_scalar  
    at /GCC/build/contrib/gcc-8.2.0/src/gcc/8.2.0/libgfortran/io/list_read.c:2180  
#4 0x6b1859 in flkcgi_  
    at comlat/flkcgi.f:556  
#5 0x56d96e in geoinp_  
    at geolat/geoinp.f:241  
#6 0x40388e in flukam_  
    at main/flukam.f:2442  
#7 0x402100 in fluka  
    at main/fluka.f:77  
#8 0x402100 in main  
    at /shared/src/usflmd.inc:15
```

```
STOP TOO MANY ERRORS IN GEOMETRY
```

```
Note: The following floating-point exceptions are signalling: IEEE_UNDERFLOW_FLAG IEEE_DENORMAL  
STOP STOP: FLUKA ABORTED
```

User-defined messages

- Users may print information, and warning or error messages to the `.out` and `.err` files from within their user routines, e.g.:

```
WRITE ( LUNOUT,* ) 'This is a message'
```

```
WRITE ( LUNERR,* ) 'This is a message'
```

- This can be useful when debugging user routines

Error handling and common mistakes

Progress
Status: Finished with ERRORS

Before running

- Have the latest FLUKA and Flair versions correctly installed, downloading the appropriate version for your system and following the instructions
- Try running a provided example to confirm that there are no installation errors
- Do not run inside the FLUKA directory!
- Avoid using file and directory names with spaces
- Flair will already detect and highlight many mistakes, such as nonsense inputs in certain fields, multiple **ASSIGNMAT** cards for a region etc.:

USRBIN	Unit: 21 BIN ▼	Name: Protons	
Type: X-Y-Z ▼	Xmin: -10.0	Xmax: 10.0	NX: 201.
Part: PROTON ▼	Ymin: 10.0	Ymax: -10.0	NY: 201.
	Zmin: -5.0	Zmax: 15.0	NZ: 200.
MATERIAL POTASSIU	#:	ρ: -0.862	
Z: 19	Am:	A:	dE/dx: ▼

```
>w> Warning: Multiple ASSIGNMAT for region TARGET:
Previous card #19
ASSIGNMA      IRON      TARGET
Current card #20
ASSIGNMA      COPPER     TARGET
```

- Build the geometry carefully, use the Geometry Editor to search for geometry errors



Click “Start” ...

- Runs may fail during **initialisation**; this usually indicates the existence of a blatantly wrong setting in a card, some missing necessary setting, a mistyped expression or value, a missing file, **#if** directive without corresponding **#endif**, ...
- Crashes occurring **once particle tracking has started** are often attributable to geometry errors, numerical exceptions (often associated with user routines), ...

Crashes at initialisation

- **Low-energy neutron cross-sections not found**

- As mentioned in the [Materials](#) lecture, low-energy neutron cross sections are associated to materials based on their names
- If a user-defined elemental material is named differently **(1)** than in the relevant library **(2)** (see section 10.4.1.2 of the FLUKA manual), then FLUKA will not be able to assign any neutron cross sections

(1)	 <pre>MATERIAL F #: ρ: 0.0015803 Z: 9 Am: A: dE/dx: ▼</pre>
(2)	 <pre>MATERIAL FLUORINE #: ρ: 0.0015803 Z: 9 Am: A: dE/dx: ▼</pre>

- This leads to a stop of the execution with the following message (found in the `.out` file)

```
**** Low energy neutron xsec not found for some media
F
```

Crashes at initialisation

- **Missing random number file**

- This error usually indicates that the previous cycle did not end successfully and therefore the random number file `ran<inputname>###` was not generated
- The relevant error messages are found in the `.out`, `.err` and `.log` files:

```
**** No Random file available !!!!!!! ****  
Abort called from FLRM64 reason NO RANDOM FILE Run stopped!  
STOP NO RANDOM FILE
```

`<inputname>###.out`

```
STOP NO RANDOM FILE  
STOP STOP: FLUKA ABORTED
```

`<inputname>###.log`

```
Abort called from FLRM64 reason NO RANDOM FILE Run stopped!  
STOP NO RANDOM FILE
```

`<inputname>###.err`

- When a run fails, it is generally advisable to look at the output files of the first cycle, because all further cycles will fail with this error after a failed first cycle

Crashes at initialisation

- **Missing executable or external file**

- If a custom executable or external auxiliary file (e.g. to be used for sampling by a source routine) is not found in the working directory, the code will stop
- An example of the error message in the `<inputname>.out` file:

```
*-* Running: errors
Dir: /errors
Cmd: /usr/bin/nohup /soft/fluka4-0.1/bin/rfluka -e /errors/myexe -M 5 errors
/usr/bin/nohup: ignoring input

                                F L U K A

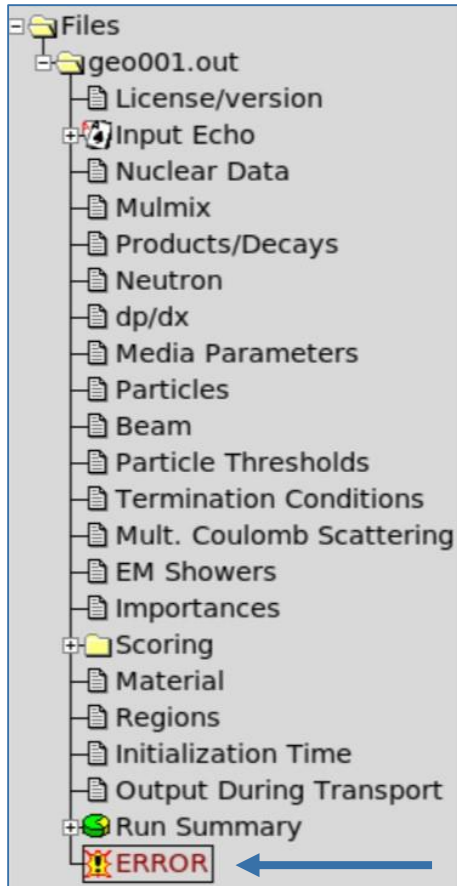
Dir:   /soft/fluka4-0.1
Data:  /soft/fluka4-0.1/data
Exec:  /errors/myexe
Input: /errors/errors.inp
Error: /errors/myexe does not exist or it is not executable! ←
```

- **Input file formatting errors**

- Syntax/alignment errors in manually edited input files
- Presence of hidden DOS characters in files edited in Windows (clean with `dos2unix` command)

Run-time errors

- Where to look?
 - The bottom of the `.out` and `.err` files, and the top of the `.log` file



- When you open the standard output file in Flair, the navigation menu will point to the error message
 - ...or, at least, to the bottom of the file; in case of an uncontrolled crash, the final information printed in the standard output file is less likely to be informative. Instead, more meaningful information may be found in the `.log` and `.err` files

Run-time errors

- **Geometry and tracking accuracy errors**

- A single geometry error or problem with tracking accuracy (often encountered when using LATTICES) may not condemn a run, as the code attempts to recover the lost particle
- These attempts are recorded in the `.err` file (“geofar” errors)

```
NEXT SEEDS:  F0A31F      0      0      0      0      0      181CD   3039      0      0
              3900      1100      1100      2.2694074E-04      1.0000000E+30      23
NEXT SEEDS:  F25D77      0      0      0      0      0      181CD   3039      0      0
Geofar: Particle in region      3 (cell #      0) in position  9.208454725E-01  1.554251376E+00  1.303608751E+00
is now causing trouble, requesting a step of  5.206776825E+00 cm
to direction  8.513230560E-02  3.069905258E-01  9.478973086E-01, error count:  0
R2:  1.806558531E+00 R3:  2.227790273E+00 cm
X*U   (2D):  5.555341454E-01 X*U   (3D):  1.791221372E+00 cm
X*UOLD(2D):  8.622110860E-01 X*UOLD(3D):  4.169256137E-01 cm
Kloop:      32194, Irsave:      3, Irsav2:      3, error code: -33 Nfrom:  5000
old direction  9.398507183E-01 -2.088589279E-03 -3.415790758E-01, lagain, lstnew, lsense, lsnst  F  F  F  T
Particle index  7 total energy  4.547721732E-04 GeV Nsurf  0
Try again to establish the current region moving the particle of a  3.887637526E-08 long step
We succeeded in saving the particle:  current region is n.      3 (cell #      0)
```

- The run will stop if too many errors are encountered and/or the particle cannot be recovered

```
Abort called from FLKAG1 reason T00 MANY ERRORS IN GEOMETRY Run stopped!
STOP T00 MANY ERRORS IN GEOMETRY
```

Run-time errors

- **Geometry errors**

- These error messages offer valuable information that can help locate the problem

```
Geofar: Particle in region 3 (cell # 0) in position 9.208454725E-01 1.554251376E+00 1.303608751E+00  
is now causing trouble, requesting a step of 5.206776825E+00 cm  
to direction 8.513230560E-02 3.069905258E-01 9.478973086E-01, error count: 0  
Particle index 7 total energy 4.547721732E-04 GeV Nsurf 0
```

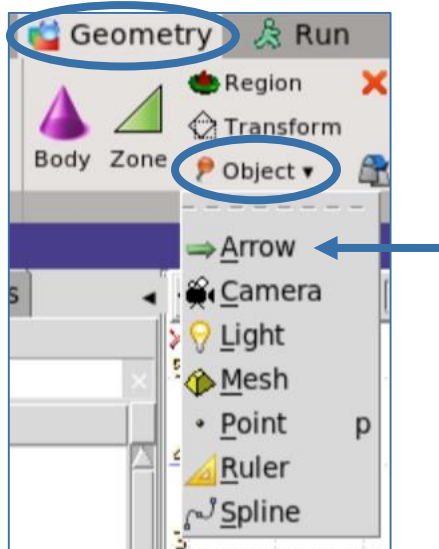
Particle type
(Section 5.1 of
FLUKA manual)

Particle
position

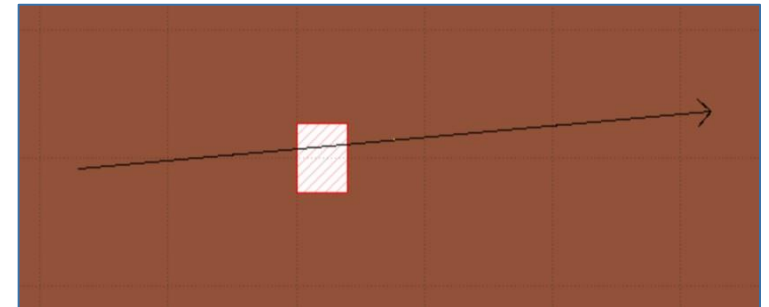
Step length

Particle
direction

- In Flair, you can add a vector (“Arrow”) setting its origin, direction and length according to the error message to help in visualising the geometry problem



Properties	Attributes
name	arrow
comment	
type	arrow
option	head
anchor	none
size	0
color	
x	9.208454725E-01
y	1.554251376E+00
z	1.303608751E+00
dx	0.4432649158483
dy	1.598431155199
dz	4.9354897388025
@length	5.206776825



Advanced debugging

- It can get worse: uncontrolled code aborts may lead to the creation of a core dump in the temporary FLUKA directory (`fluka_*`), with an error message like the following found in the `<inputname>.out` file

```
===== Running FLUKA for cycle # 1 =====  
/soft/fluka4-0.1/bin/rfluka: line 368: 1201 Floating point exception(core dumped) "${EXE}" "${INPF}" > "${LOGF}" 2>&1
```

- Such errors are usually caused by numerical issues, variable type discrepancies, attempts to access non-existent array elements etc., and are often associated with the use of `user routines`
- The `core.*` file contains information on the program state at the time of the crash and the relevant back-trace
- It can be accessed via the GNU debugger (gdb)
 - ...but this is a story for another course...

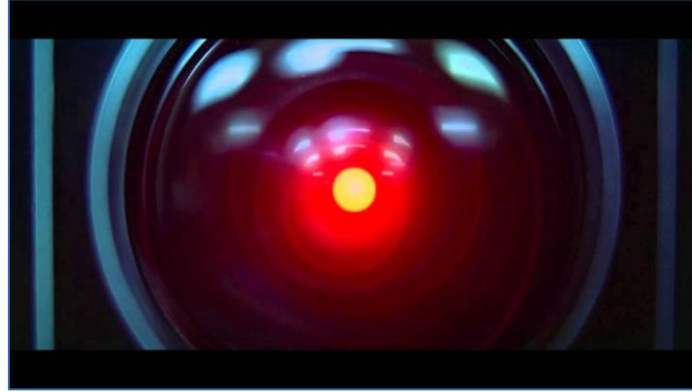
If the run ends without errors...

Progress
Status: Finished OK

- Some mistakes will not lead to run-time crashes, but may have an impact on the results of the simulation
 - Overlapping geometry regions will not generate an error; during particle tracking the code will decide in which region the particle is and continue, potentially distorting the scoring of energy deposition, fluence etc.
 - Wrong beam energy assignment (e.g. MeV vs. GeV, energy vs. momentum, total HEAVYION energy in **BEAM** card instead of energy per nucleon, ...)
 - Wrong material densities
 - Wrong/multiple material assignments for a region
 - Inappropriate thresholds
 - A missing **RANDOMIZ** card will lead to zero statistical errors, as identical cycles are executed
- Such errors can be discovered upon inspection of the results which may completely deviate from expectations, display strange discontinuities etc.
- You should always critically assess your results based on your knowledge of the problem!

To conclude...

- Errors will always crop up, even for experienced users; do not despair!



*“It can only be attributable to human error.”
-- HAL 9000*

- Most of the time, the cause will be fairly mundane, and a hint on its origin will be found in the various error messages and output files
- If you are unable to discover the cause of the problem using the suggestions in this lecture, it's time to explore the FLUKA forum for similar issues and, finally, to post your question on the FLUKA forum
- Remember that meaningful debugging assistance generally requires that you at least provide your .flair file, and other relevant files, user routines etc.

