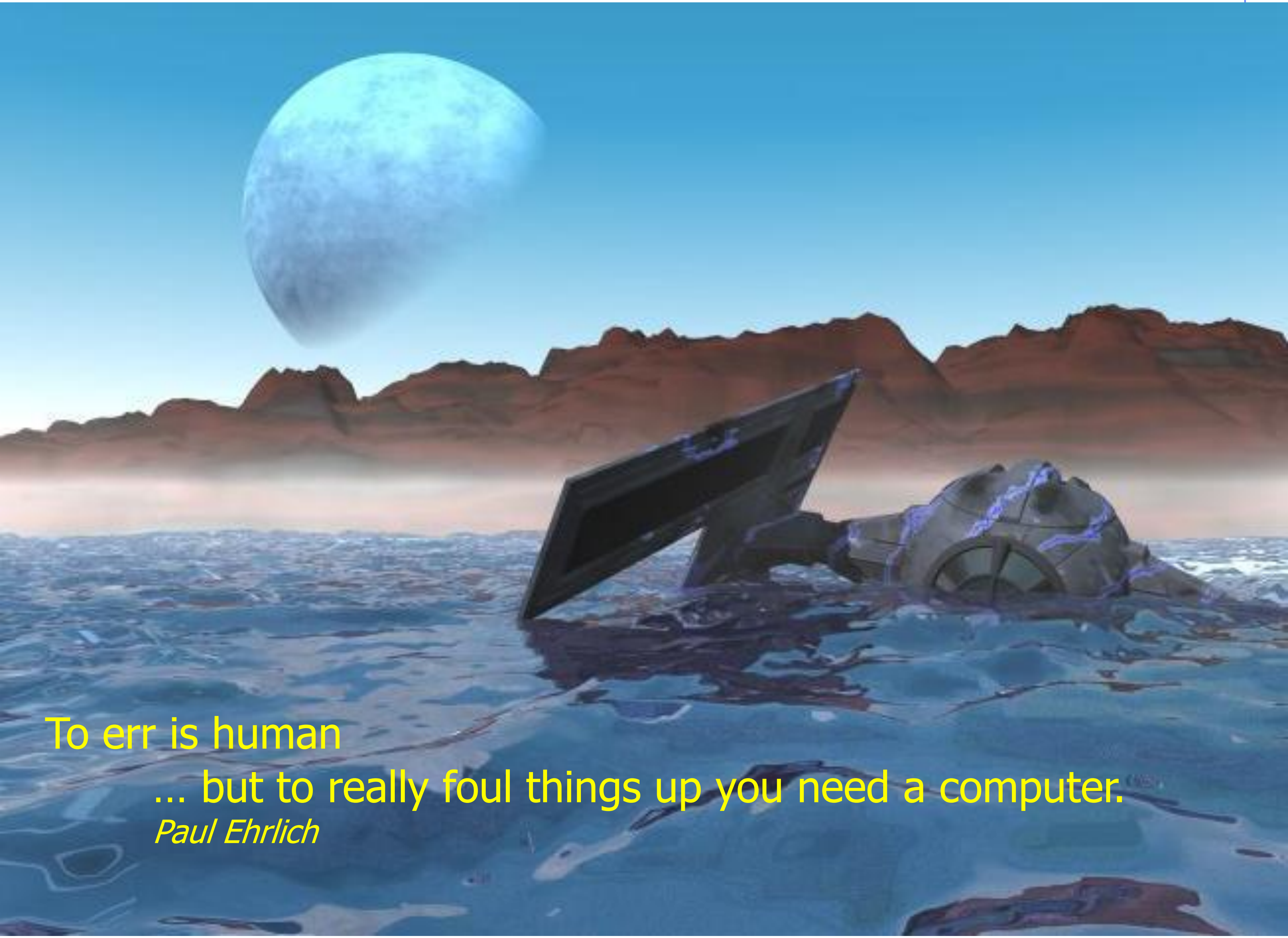
Handling of Errors and Crashes

FLUKA Beginner’s Course



To err is human

… but to really foul things up you need a computer.

Paul Ehrlich

DON’T PANIC

Overview

Sometimes the users get crashes…

Sometimes results look weird…

- Often, these are simple problems the users can address and solve on their own: the first purpose of this lecture is to help you to identify this type of errors

- In few other cases, a real FLUKA problem is found: the second purpose of this lecture is to help you to spot this types of errors

- Other cases mainly deal with the sensibleness of the results and the best approach to simulations

Overview

Typical errors:

- Installation problems
- Crashes at run initialization, usually due to mistyping / wrong setting of cards in the input file
- Crashes while tracking particles (typically due to geometry)
- Problems found after the end of the simulation, usually due to subtle errors in the input file

NB: (NOT trivial) crashes at runtime NOT explicitly related to geometry issues usually need the use of gdb…

Installation problems

- Nothing happens, or “executable not found” message in FLAIR
  - Check you have the proper version of FLUKA for your platform and you have all packages needed for compiling and executing Fortran programs

    For LINUX distributions, you generally need:

    g77 , **compat-gcc-34-g77** or **gfortran**, **libg2c**

    (check the supported versions on the RELEASE-NOTES file included in the distribution)

  - Verify your $FLUPRO environment variable is properly set, then issue a make command in the $FLUPRO directory: all the FLUKA tools and the default executable $FLUPRO/flukahp will be compiled
  - The $FLUPRO variable must always be set (in .bashrc, .tcshrc, .cshrc…) and in FLAIR - Preferences

Installation problems

- In the .out file you get a message like this:

```
**** This version is obsolete and is  ****
**** going expire in few days.        ****
**** Please contact the FLUKA list    ****
**** or look for an updated version   ****
**** at http://www.fluka.org          ****
```

update your version of FLUKA
"make" again
re-link if you are using user routines

Starting a run

ERROR: Running in the FLUKA folder XXXX is a very bad idea

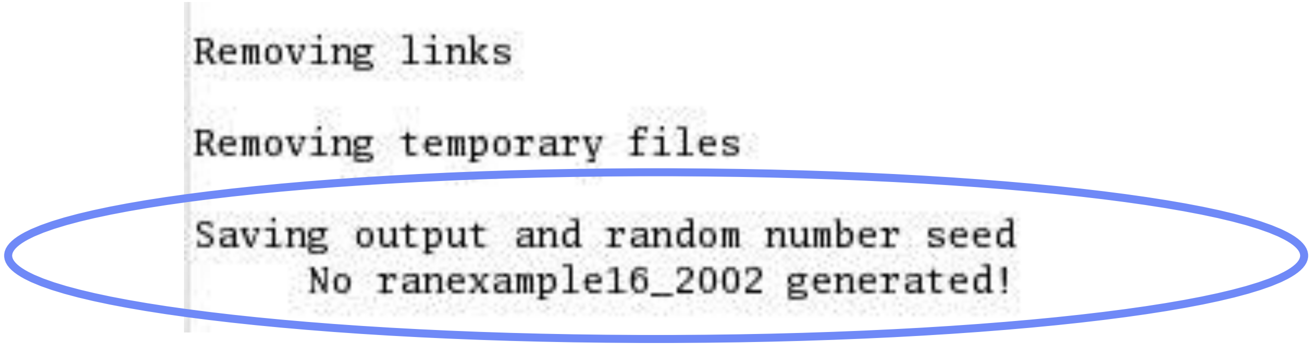
DO NOT RUN inside the FLUKA folder!!

ERROR: XXX/libflukahp.a is newer than YYYY. Please recompile

If you have updated FLUKA you need to recompile, your custom executables

Crashes at run initialization: general

- The following message appears on the terminal (or in the nohup.out file when using Flair) and no results are produced



```
Removing links

Removing temporary files

Saving output and random number seed
     No ranexample16_2002 generated!
```

Look at the beginning of the .log and/or at the end of the .out files and check the error messages

The files can be located in:

- your working directory
- temporary subdir fluka_#####
- Output Files window in FLAIR

Formatting errors in the .inp file

This type of error was very common before the development of FLAIR

- FLUKA echoes all the parsed lines of the *.inp file in the *.out file

  In case of problems, the echo stops at the last card correctly interpreted

  WARNING: FLUKA reads the input file in many passages

  therefore, the order of the echoed cards does not necessarily correspond to the order in the .inp file!

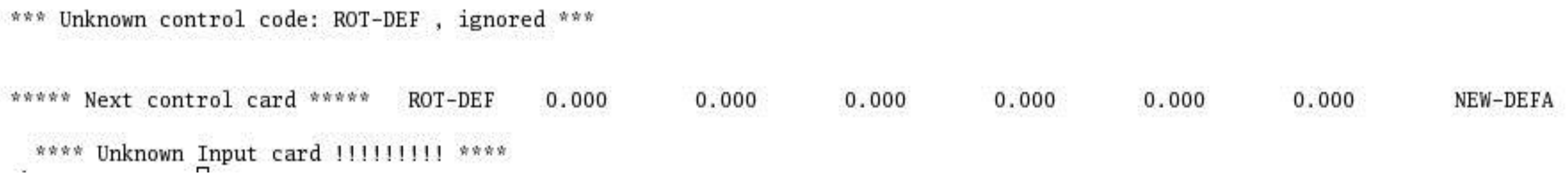
- In case the problem is located in the geometry declaration, please have a look also at the fort.16 file in the fluka_##### temp subdir

- Some non visible control characters (e.g. tab, \t, \n, ^M) may be present. You can clean your input using text editors, perl or “dos2unix” Linux command. TIP some mail clients can show these characters

- Remember to *always* check the first cycle you requested (e.g. *_001.out)

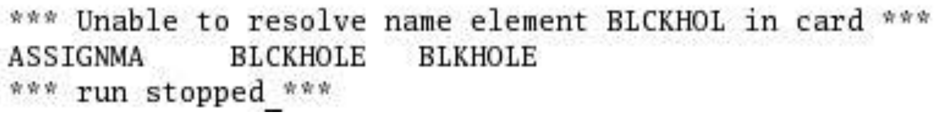
- Remember that the total length of a line in FREE format is 132 characters

Formatting errors: Examples



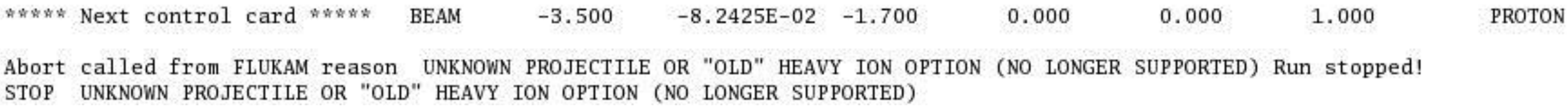
```
*** Unknown control code: ROT-DEF , ignored ***

***** Next control card *****   ROT-DEF    0.000       0.000       0.000       0.000       0.000       0.000       NEW-DEFA

  **** Unknown Input card !!!!!!!!! ****
```

Mistyped ROT-DEFI card: ROT-DEF



```
*** Unable to resolve name element BLCKHOL in card ***
ASSIGNMA      BLCKHOLE   BLKHOLE
*** run stopped_***
```

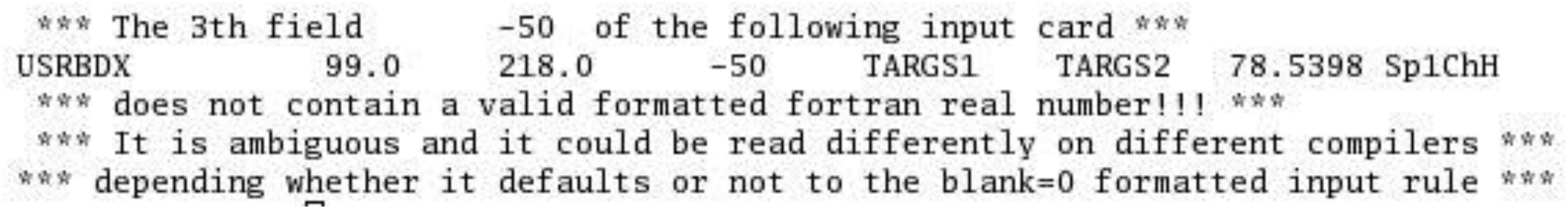
.inp file in fixed format: misalignment in the BLCKHOLE word (the final “E” is lost)



```
***** Next control card *****   BEAM      -3.500     -8.2425E-02  -1.700      0.000       0.000       1.000        PROTON

Abort called from FLUKAM reason  UNKNOWN PROJECTILE OR "OLD" HEAVY ION OPTION (NO LONGER SUPPORTED) Run stopped!
STOP  UNKNOWN PROJECTILE OR "OLD" HEAVY ION OPTION (NO LONGER SUPPORTED)
```

.inp file in fixed format: the SDUM identifying the particle is not properly aligned

Formatting errors: Examples

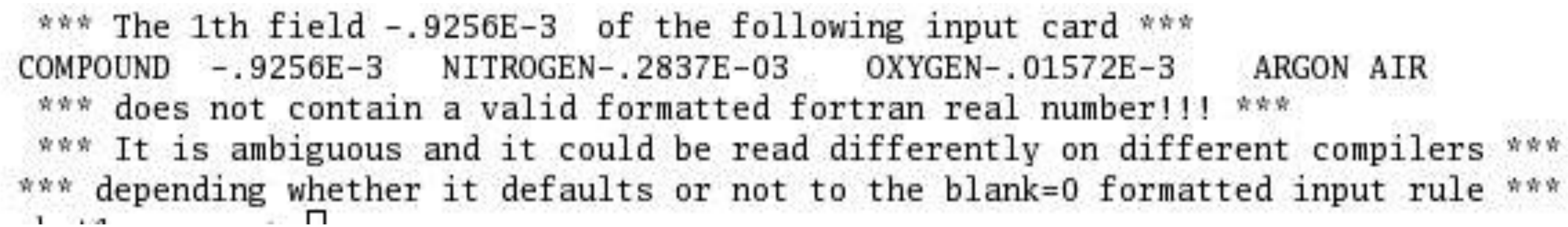


```
  *** The 3th field       -50  of the following input card ***
 USRBDX          99.0      218.0        -50       TARGS1     TARGS2   78.5398 Sp1ChH
  *** does not contain a valid formatted fortran real number!!! ***
  *** It is ambiguous and it could be read differently on different compilers ***
 *** depending whether it defaults or not to the blank=0 formatted input rule ***
```

WHAT(3) has no decimal point

Remember that FLUKA requires ALL numbers to be

in floating point representation, integers included



```
  *** The 1th field -.9256E-3  of the following input card ***
 COMPOUND  -.9256E-3   NITROGEN-.2837E-03    OXYGEN-.01572E-3    ARGON AIR
  *** does not contain a valid formatted fortran real number!!! ***
  *** It is ambiguous and it could be read differently on different compilers ***
 *** depending whether it defaults or not to the blank=0 formatted input rule ***
```

WHAT(1) must be aligned to the right, being in exponential format

USRBIN/EVENTBIN scoring definitions errors

- USRBIN scoring method:
  - **WHAT(1)>=10** Track-length quantities, i.e. they can be distributed along a track (fluence, energy deposition…)
  - **WHAT(1)<10** Point-wise quantities, i.e. they have to be scored on a point, or in the middle of the step (activity, fission, neutron balance…)

  *** Activity/fission/neutron balance binnings cannot be track-length!!!

- Badly defined USRBIN scoring:

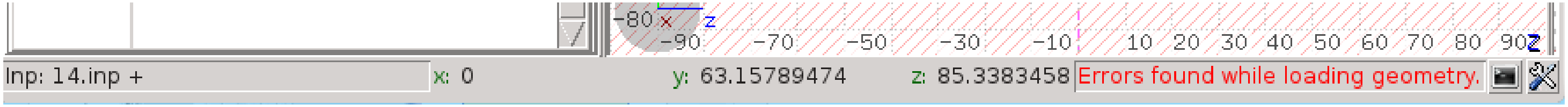
```
******* Fluka stopped in Usrbin: "usr/eventbin" n.    1 *******
******* with zero width   0.000     for axis  R  ******
```

- Output units:
  - Never use unit# <20 (reserved for FLUKA internal use) or >99 (Fortran77 limitation)
  - Never mix the output of different scoring cards in the same unit

Flair fully satisfies all these requirements!

Geometry Errors

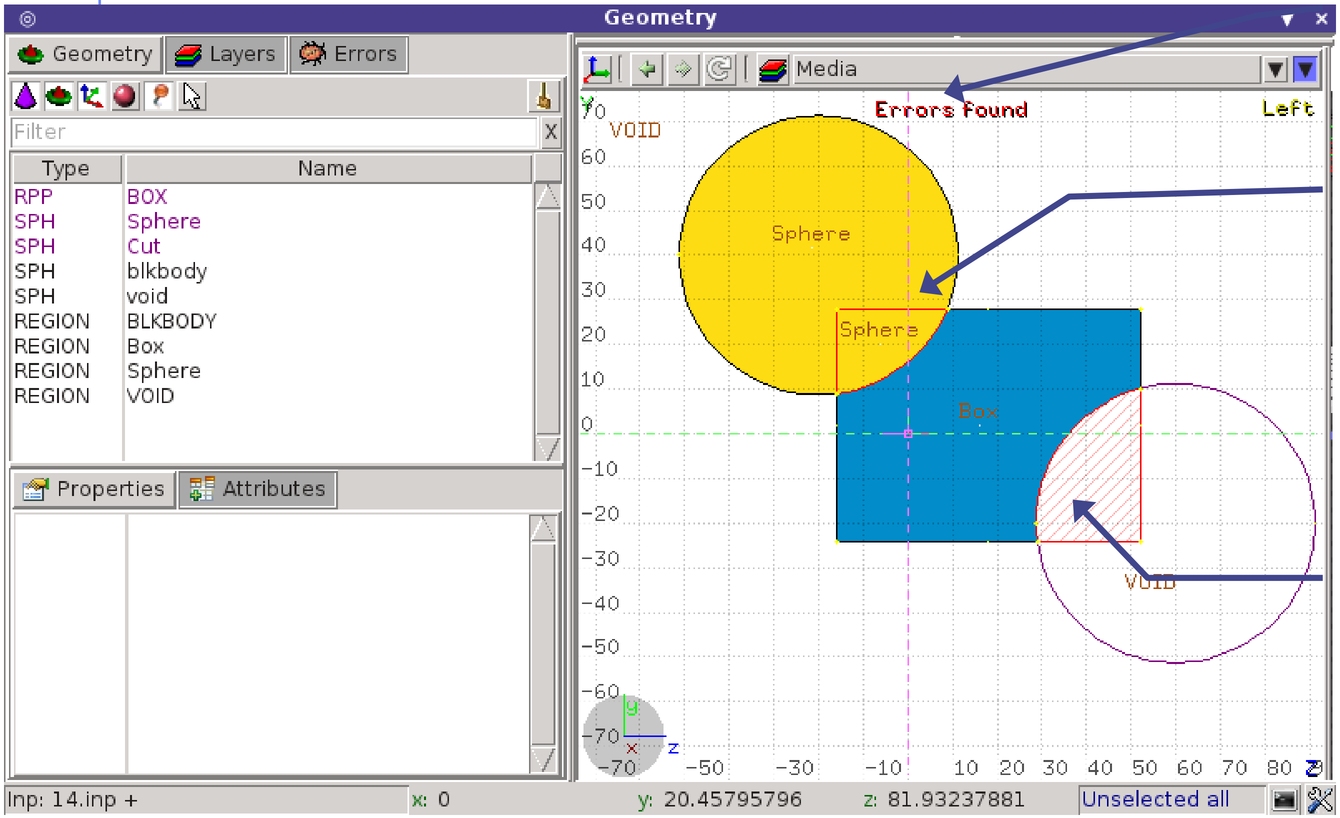
- The Geometry Editor allows to spot geometry errors when the .inp file is parsed/updated (recall dedicated lecture!)
- A warning message in the Geometry status bar notifies the user about the presence of geometry errors
- A warning is also issued for not strictly geometrical errors (e.g.: missing material assignment to a region, unknown card…)



Inp: 14.inp + x: 0 y: 63.15789474 z: 85.3383458 Errors found while loading geometry.

Geometry Errors

- Affected areas are surrounded by red lines:
  - Areas filled with a full color correspond to overlapping regions
  - Areas filled with red lines correspond to a missing region definition
- Clicking the Errors icon displays the dialog box with the errors
- Touching surfaces are checked against 10 significant digits



Type	Name
RPP	BOX
SPH	Sphere
SPH	Cut
SPH	blkbody
SPH	void
REGION	BLKBODY
REGION	Box
REGION	Sphere
REGION	VOID

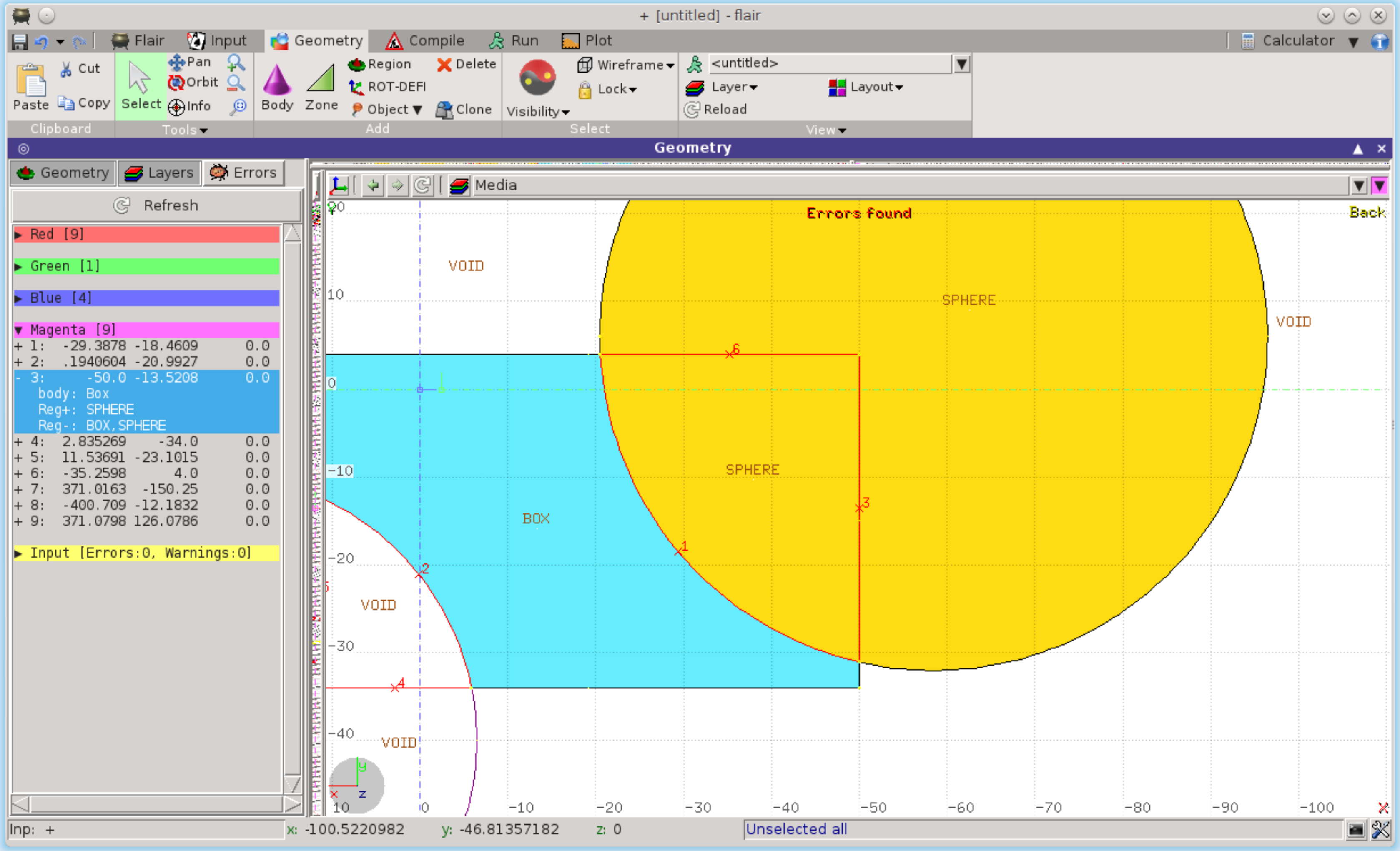
Inp: 14.inp +　x: 0　y: 20.45795796　z: 81.93237881　Unselected all

Presence of errors

Overlapping regions

Missing region definition

Geometry Errors



```
▶ Red  [9]
▶ Green  [1]
▶ Blue  [4]
▼ Magenta  [9]
+ 1:   -29.3878  -18.4609       0.0
+ 2:   .1940604  -20.9927       0.0
- 3:      -50.0  -13.5208       0.0
    body:  Box
    Reg+:  SPHERE
    Reg-:  BOX, SPHERE
+ 4:   2.835269     -34.0       0.0
+ 5:   11.53691  -23.1015       0.0
+ 6:   -35.2598       4.0       0.0
+ 7:   371.0163   -150.25       0.0
+ 8:   -400.709  -12.1832       0.0
+ 9:   371.0798  126.0786       0.0
▶ Input  [Errors:0, Warnings:0]
```

Inp: +   x: -100.5220982   y: -46.81357182   z: 0   Unselected all

Geometry: parentheses expansion

At the initialization of the geometry, you may get this kind of message in the first line of .log file:

```
Subscript out of range on file line 56, procedure rpnorm.f/rpnorm
Attempt to access the 114705-th element of variable tx
```

You have exceeded the maximum expansion limit for parenthesis, set to 100'000

WARNING even with a simple region expression this limit can be reached, especially if you are using infinite bodies!

Crashes during tracking: geometry

- Typical message due to errors in geometry

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

Did you debug your geometry????????

- Look in the .err/.out files to better direct your debugging

- Consider also the use of the RAY particle to trace and analyze your geometry

Crashes during tracking: geometry

```
Geofar: Particle in region 3 (cell # 0) in position
1.000000000E+00 0.000000000E+00 1.000000000E+00 is now causing
trouble, requesting a step of 6.258867675E-07 cm to direction -
2.285059979E-01 -9.412338141E-01 2.487245789E-01, error count:
0 [...skipped...] Particle index 3 total energy 5.189748600E-04
GeV Nsurf 0 We succeeded in saving the particle: current region
is n. 2 (cell # 0)
```

- GEOFAR errors (.out file) during tracking point to:
  - errors in the geometry
  - numerical precision errors
  - perpendicularity of the REC and BOX axes (use maximum precision)
- FLUKA will always try to “save” the problematic particles: anyway it will stop the run in case of too many issues.
- The problematic point is given by position + step * direction
- LATTICEs are VERY sensitive to numerical precision: use as many digits as possible to ensure a proper description of the lattice, the related transformation and the prototype

Tip: To find the position

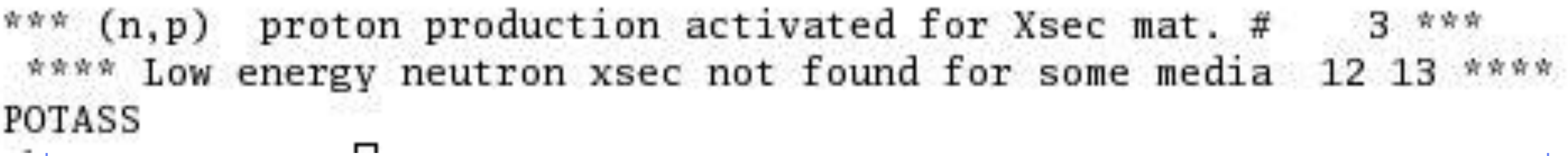
- Either you do the math: position + step * direction

OR

- In flair (geometry editor)
  - Open the projection dialog [o]
  - Origin: Enter the X,Y,Z coordinates of the position
  - Basis: Enter as U vector the directory
  - Move: enter as +U: the step

And you will end up in the error location

LOW-MAT errors



```
*** (n,p)  proton production activated for Xsec mat. #    3 ***
 **** Low energy neutron xsec not found for some media  12 13 ****
POTASS
```

The name of a material breaks the correspondence with the low energy neutron cross section library available in FLUKA
(see manual chapter 10)

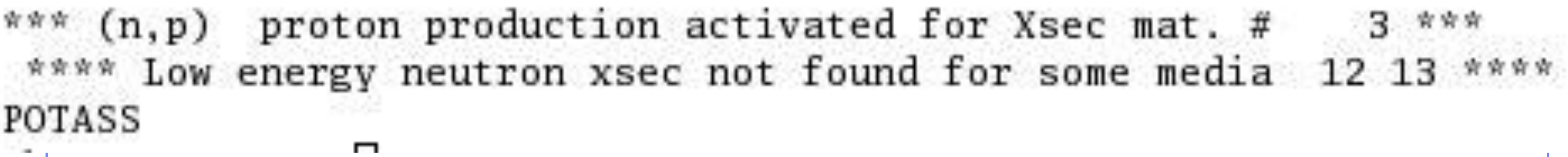
In the given example POTASS is specified in the SDUM of the LOW-MAT card, instead of POTASSIU

Check the use of LOW-MAT cards in the manual, particularly material names and parameters

NB: Do you really need LOW-MAT?
This card is necessary only in a limited amount of cases, and can be easily misinterpreted by non expert user

Again: read the manual!

LOW-MAT errors



```
*** (n,p)  proton production activated for Xsec mat. #    3 ***
 **** Low energy neutron xsec not found for some media  12 13 ****
POTASS
```

- WARNING: the default temperature has changed with respect to older FLUKA distributions:
  - New library with 260 groups: **296 K**
  - Old library with 72 groups: **293 K**

- When an error is printed, FLUKA reports the SDUM of the LOW-MAT card concerned

  If the SDUM is empty, you will see nothing in the output

It runs, but…

…something seems wrong…

…you do not understand the results

LOOK in the output file!

what?

everything, of course!

a few examples follow, you’ll find out more on your own

RANDOMIZ card

You run several cycles and the statistical errors appears to be ZERO

Most probably you are starting the same histories on every cycle

This is a typical error if the RANDOMIZe card does not exist!

Verify the existence of RANDOMIZe card and that WHAT(1)=1.0

You get the following message in the *.out file

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

Most probably the error occurred during the previous cycle which didn’t generate a random number seed

Cards defining the beam

The total/partial energy balance does not meet expectations

- Remember that for HEAVY IONS the kinetic Energy or Momentum in the BEAM card is given PER NUCLEON, while in all other cards the energy is the total kinetic one: check the numbers in the beam section of the .out file
- Check if you selected Energy or Momentum in BEAM
- Verify that your primary source BEAMPOS is **NOT defined on a surface boundary**, but always inside a region
- If a SOURCE routine is defined, the standard FLUKA source is NOT CALLED
  - You have to define all the concerned distributions (position, momentum etc...)
  - You need a BEAM card to define the maximum energy of your problem

MATERIAL / COMPOUND cards

The total/partial energy balance does not meet your expectations or particle fluences show discontinuities

please check:

- the density is defined for all MATERIALs
- Z and A are given in case of a specific isotope
- mixing fractions (and signs!) in COMPOUND cards
- recursion in COMPOUND cards
- Formatting (the NAME-based format is preferred…)

Geometry induced weird results

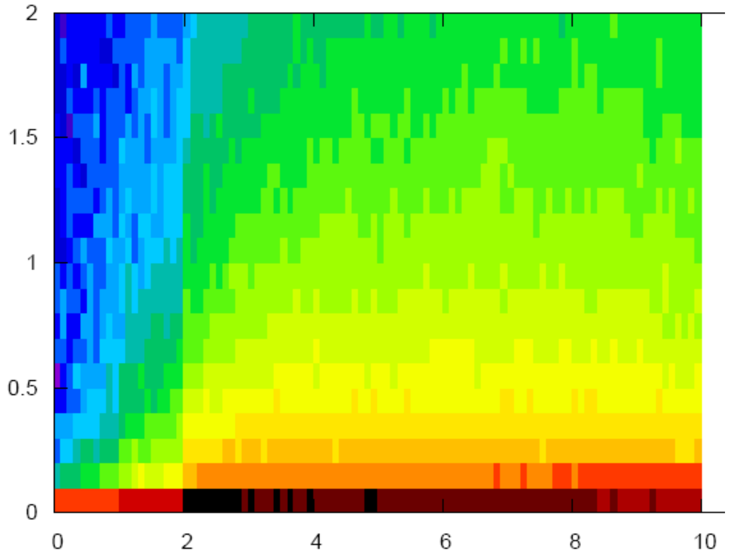
Possible symptoms:

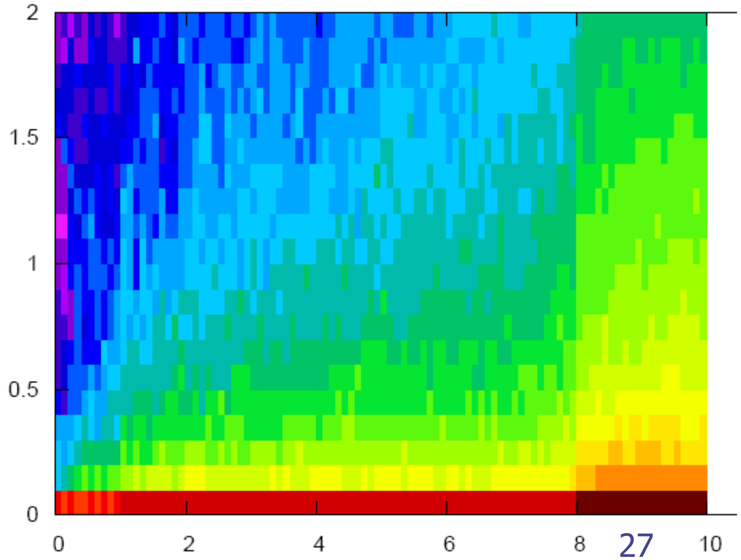
- the energy/fluence among different regions is not as expected
- problems with boundary-crossing estimators (low fluences, empty data…)

Did you debug your geometry????????

Overlapping regions are NOT detected by FLUKA at initialization, and do NOT cause run-time errors.

Example: in “our” target, make targs2 overlap with targs3





Preprocessor

Preprocessor directives are very powerful, but pay attention to nesting:

- every #if directive must have its closing #endif directive;
- Up to 10 nested levels are allowed;
- Up to 40 variables can be defined;

Heavy Ions

You have a heavy ion beam and no reaction products

Did you link the interaction generators with ldpmqmd?

Look for initialization message like “RQMD initialized” and “DPMJET-3 initialized” in the .out file to control

Merging cycles from different jobs

- Verify that you merge cycles for which the .inp files differ only by the RANDOMIZ card and/or number of primaries

- It is a good habit to remove the files before starting a run:
  - Flair offers this possibility to “Clean” the generated files from each process
    Hit the button “Clean” before a run
  - It’s good to develop the habit to remove the output files from test runs

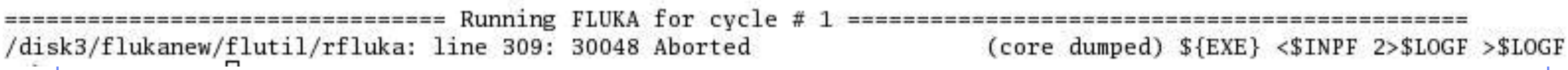
FLUKA users and the manual

The identification of the solution to all the problems shown so far, imply that a FLUKA user lives symbiotically with the Manual....

Now
PANIC

Run time errors with exceptions

You get a message on terminal like:



```
================================ Running FLUKA for cycle # 1 =============================================
/disk3/flukanew/flutil/rfluka: line 309: 30048 Aborted                 (core dumped) ${EXE} <$INPF 2>$LOGF >$LOGF
```

The temporary fluka_##### subdir remains there, with the *.log, *.out, *.err files, a core.* file and the last random seed

The last random seed allows to restart the run from the configuration occurring at maximum 5 minutes of CPU-time before the error!

The GNU debugger (gdb) can help in spotting the problem

Run time errors with exceptions

Suggestions:

1. Check the end of *.out / *.err files or the beginning of the *.log file:
   - they may contain important information for you or for the experts
   - the code has many internal checks, and some error conditions are recorded

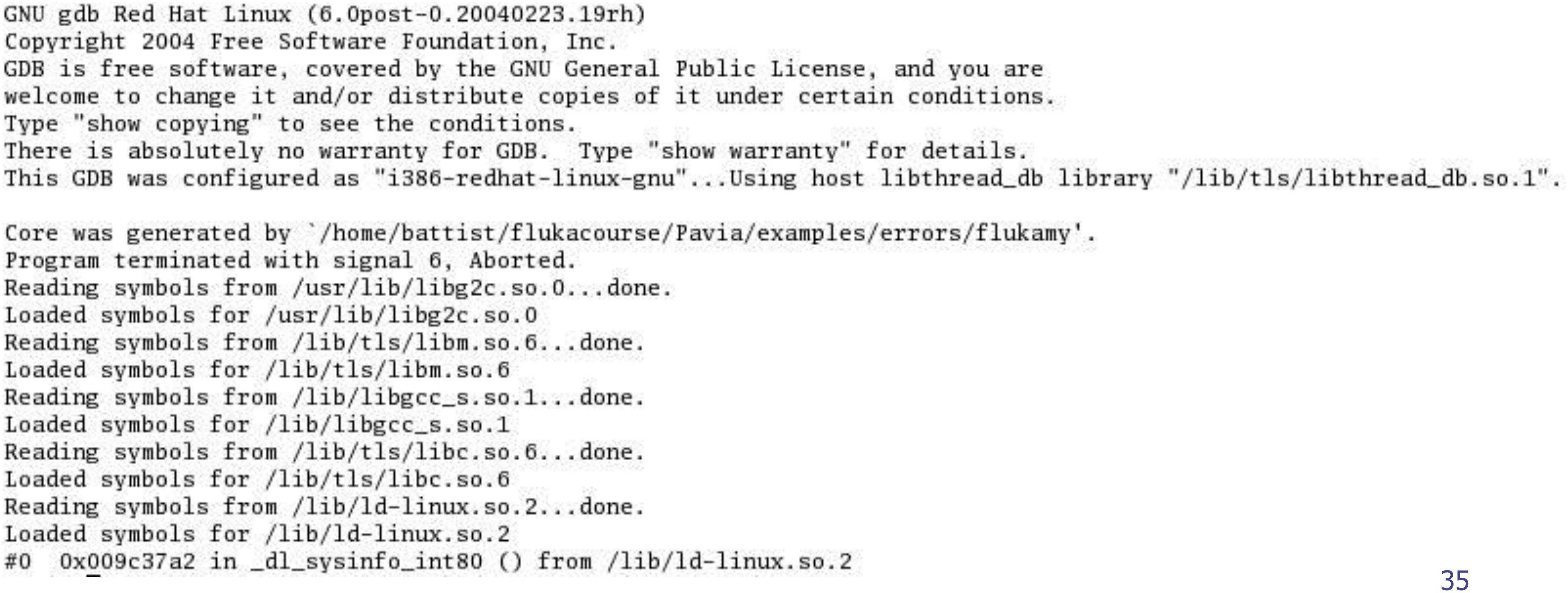
2. If you use your own user routines, please check them:
   - with the hints found at the beginning of the *.log file
   - with the help of the gdb debugger

3. Maybe there is a very well hidden geometry problem

gdb: How To

How to run it:

- from terminal:
  `cd fluka_####`
  `gdb $FLUPRO/flukahp core.*`
- from FLAIR:
  double click on the core file from the “Output Files” Frame;

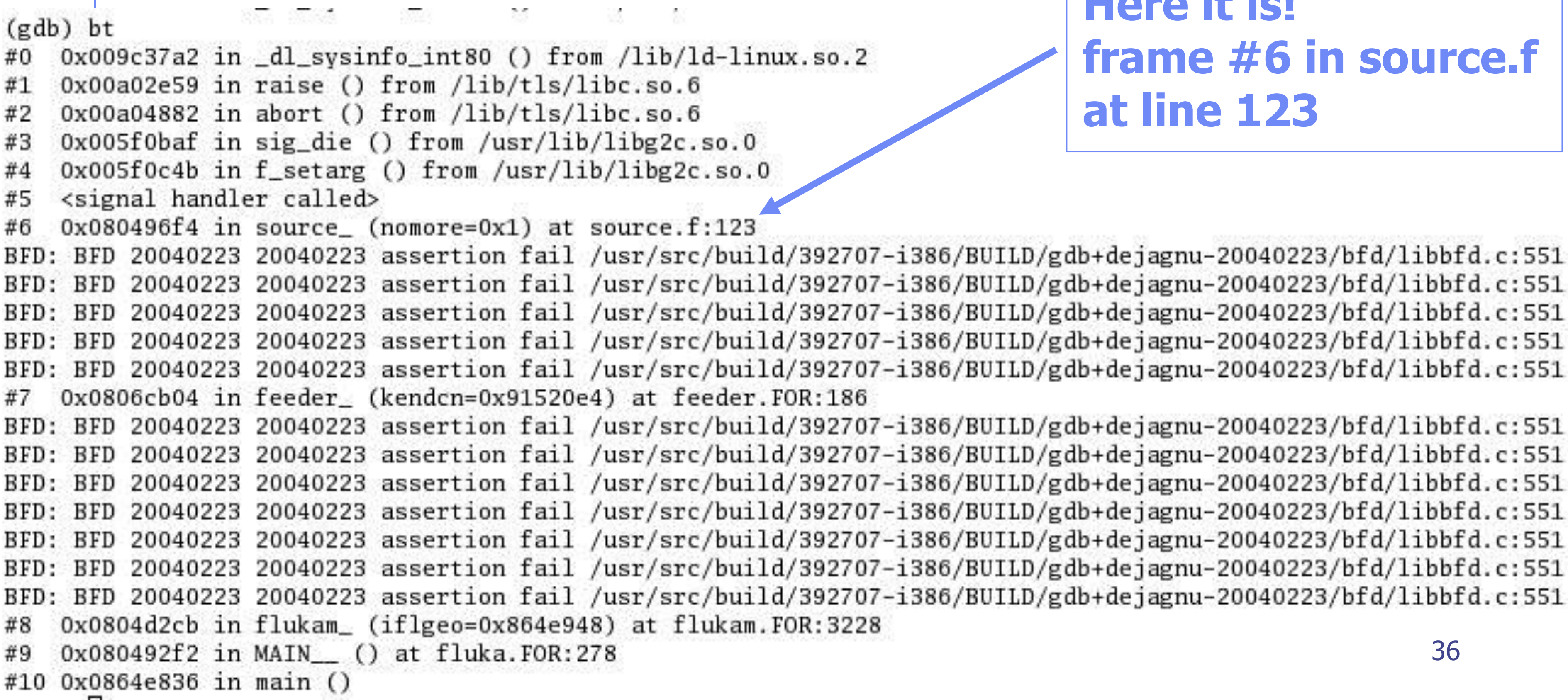


```
GNU gdb Red Hat Linux (6.0post-0.20040223.19rh)
Copyright 2004 Free Software Foundation, Inc.
GDB is free software, covered by the GNU General Public License, and you are
welcome to change it and/or distribute copies of it under certain conditions.
Type "show copying" to see the conditions.
There is absolutely no warranty for GDB.  Type "show warranty" for details.
This GDB was configured as "i386-redhat-linux-gnu"...Using host libthread_db library "/lib/tls/libthread_db.so.1".

Core was generated by `/home/battist/flukacourse/Pavia/examples/errors/flukamy'.
Program terminated with signal 6, Aborted.
Reading symbols from /usr/lib/libg2c.so.0...done.
Loaded symbols for /usr/lib/libg2c.so.0
Reading symbols from /lib/tls/libm.so.6...done.
Loaded symbols for /lib/tls/libm.so.6
Reading symbols from /lib/libgcc_s.so.1...done.
Loaded symbols for /lib/libgcc_s.so.1
Reading symbols from /lib/tls/libc.so.6...done.
Loaded symbols for /lib/tls/libc.so.6
Reading symbols from /lib/ld-linux.so.2...done.
Loaded symbols for /lib/ld-linux.so.2
#0  0x009c37a2 in _dl_sysinfo_int80 () from /lib/ld-linux.so.2
```

gdb: How To

Basic commands:

- **bt**, to list the functions which led to the current one and the crash
- **f**, to switch to a given frame (i.e. interrupted function)
- **p**, to print the value of a given variable



```
(gdb) bt
#0  0x009c37a2 in _dl_sysinfo_int80 () from /lib/ld-linux.so.2
#1  0x00a02e59 in raise () from /lib/tls/libc.so.6
#2  0x00a04882 in abort () from /lib/tls/libc.so.6
#3  0x005f0baf in sig_die () from /usr/lib/libg2c.so.0
#4  0x005f0c4b in f_setarg () from /usr/lib/libg2c.so.0
#5  <signal handler called>
#6  0x080496f4 in source_ (nomore=0x1) at source.f:123
BFD: BFD 20040223 20040223 assertion fail /usr/src/build/392707-i386/BUILD/gdb+dejagnu-20040223/bfd/libbfd.c:551
BFD: BFD 20040223 20040223 assertion fail /usr/src/build/392707-i386/BUILD/gdb+dejagnu-20040223/bfd/libbfd.c:551
BFD: BFD 20040223 20040223 assertion fail /usr/src/build/392707-i386/BUILD/gdb+dejagnu-20040223/bfd/libbfd.c:551
BFD: BFD 20040223 20040223 assertion fail /usr/src/build/392707-i386/BUILD/gdb+dejagnu-20040223/bfd/libbfd.c:551
BFD: BFD 20040223 20040223 assertion fail /usr/src/build/392707-i386/BUILD/gdb+dejagnu-20040223/bfd/libbfd.c:551
#7  0x0806cb04 in feeder_ (kendcn=0x91520e4) at feeder.FOR:186
BFD: BFD 20040223 20040223 assertion fail /usr/src/build/392707-i386/BUILD/gdb+dejagnu-20040223/bfd/libbfd.c:551
BFD: BFD 20040223 20040223 assertion fail /usr/src/build/392707-i386/BUILD/gdb+dejagnu-20040223/bfd/libbfd.c:551
BFD: BFD 20040223 20040223 assertion fail /usr/src/build/392707-i386/BUILD/gdb+dejagnu-20040223/bfd/libbfd.c:551
BFD: BFD 20040223 20040223 assertion fail /usr/src/build/392707-i386/BUILD/gdb+dejagnu-20040223/bfd/libbfd.c:551
BFD: BFD 20040223 20040223 assertion fail /usr/src/build/392707-i386/BUILD/gdb+dejagnu-20040223/bfd/libbfd.c:551
BFD: BFD 20040223 20040223 assertion fail /usr/src/build/392707-i386/BUILD/gdb+dejagnu-20040223/bfd/libbfd.c:551
BFD: BFD 20040223 20040223 assertion fail /usr/src/build/392707-i386/BUILD/gdb+dejagnu-20040223/bfd/libbfd.c:551
#8  0x0804d2cb in flukam_ (iflgeo=0x864e948) at flukam.FOR:3228
#9  0x080492f2 in MAIN__ () at fluka.FOR:278
#10 0x0864e836 in main ()
```

Here it is!
frame #6 in source.f
at line 123

Reading errors

- On Unit 14: your nuclear.bin file might be corrupted or missing (check all your binary files in $FLUPRO) or doesn't match the FLUKA distribution

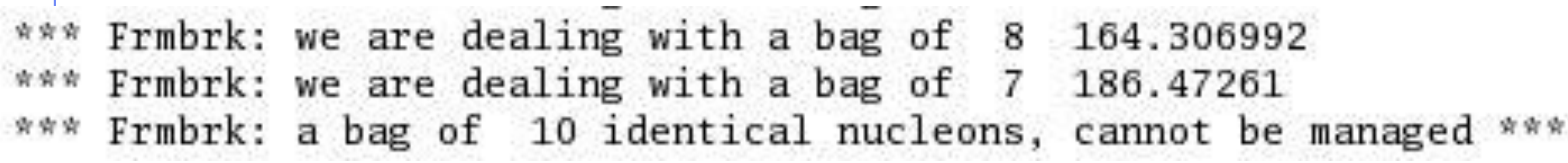
- On Unit 1: leads to a problem with the random seed.

  It typically happens when you start the simulation with a rfluka command with option –N n with n>0: check for the existence of ran***n in the directory where you issue rfluka!

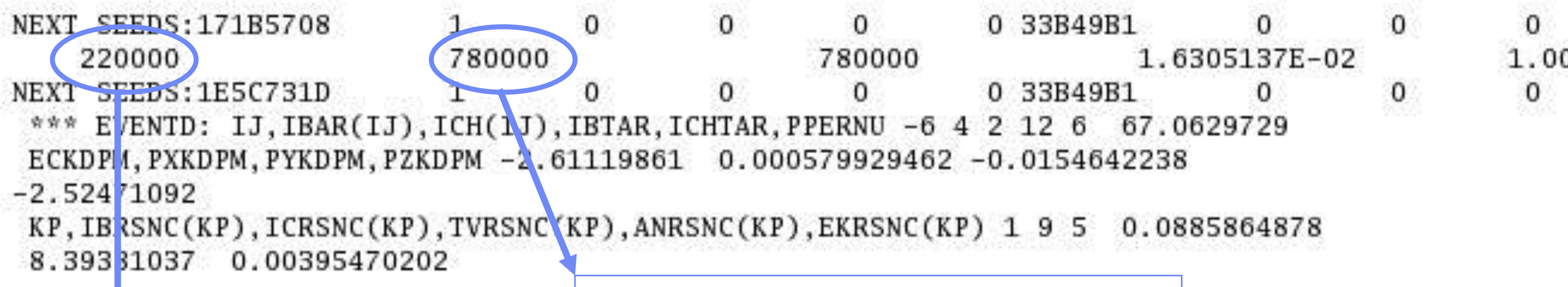
The *.err file

The *.err file will report errors, but also a lot of warning messages which have a meaning mostly for the developers.

For instance: the following messages are not errors!



```
*** Frmbrk: we are dealing with a bag of  8  164.306992
*** Frmbrk: we are dealing with a bag of  7  186.47261
*** Frmbrk: a bag of  10 identical nucleons, cannot be managed ***
```



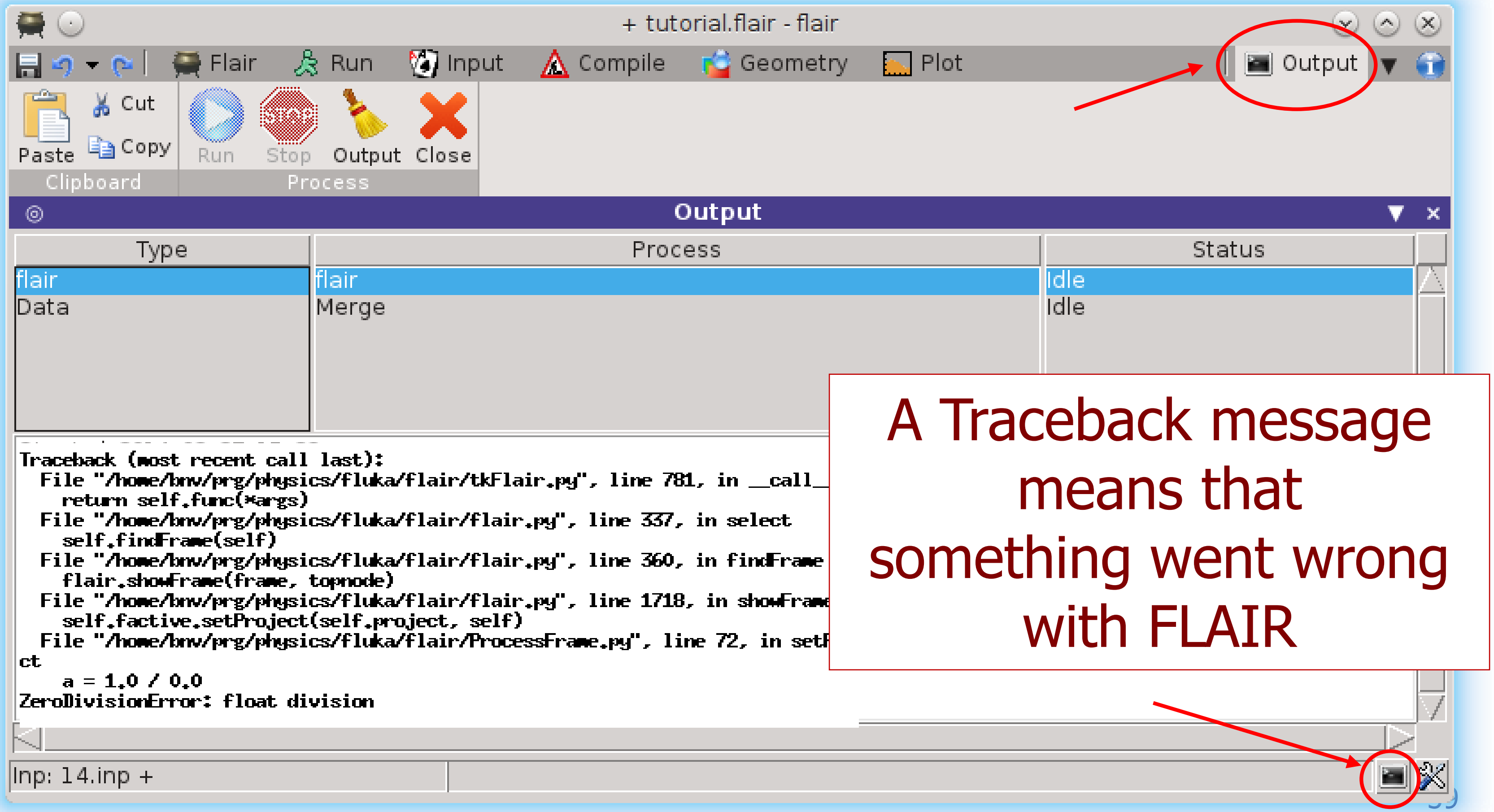
```
NEXT SEEDS:171B5708        1        0        0        0        0 33B49B1        0        0        0
   220000                  780000                     780000                  1.6305137E-02         1.00
NEXT SEEDS:1E5C731D        1        0        0        0        0 33B49B1        0        0        0
 *** EVENTD: IJ,IBAR(IJ),ICH(IJ),IBTAR,ICHTAR,PPERNU -6 4 2 12 6  67.0629729
 ECKDPM,PXKDPM,PYKDPM,PZKDPM -2.61119861  0.000579929462 -0.0154642238
-2.52471092
 KP,IBRSNC(KP),ICRSNC(KP),TVRSNC(KP),ANRSNC(KP),EKRSNC(KP) 1 9 5  0.0885864878
 8.39331037  0.00395470202
```

No. of events simulated so far

No. of events remaining to be simulated

Flair output window

- The output window of FLAIR contains all messages from FLAIR, FLUKA, processing, and plotting tools
- Always consult it in case of problem or doubts



Type	Process	Status
flair	flair	Idle
Data	Merge	Idle

```
Traceback (most recent call last):
  File "/home/bnv/prg/physics/fluka/flair/tkFlair.py", line 781, in __call_
    return self.func(*args)
  File "/home/bnv/prg/physics/fluka/flair/flair.py", line 337, in select
    self.findFrame(self)
  File "/home/bnv/prg/physics/fluka/flair/flair.py", line 360, in findFrame
    flair.showFrame(frame, topnode)
  File "/home/bnv/prg/physics/fluka/flair/flair.py", line 1718, in showFram
    self.factive.setProject(self.project, self)
  File "/home/bnv/prg/physics/fluka/flair/ProcessFrame.py", line 72, in setP
ct
    a = 1.0 / 0.0
ZeroDivisionError: float division
```

A Traceback message means that something went wrong with FLAIR

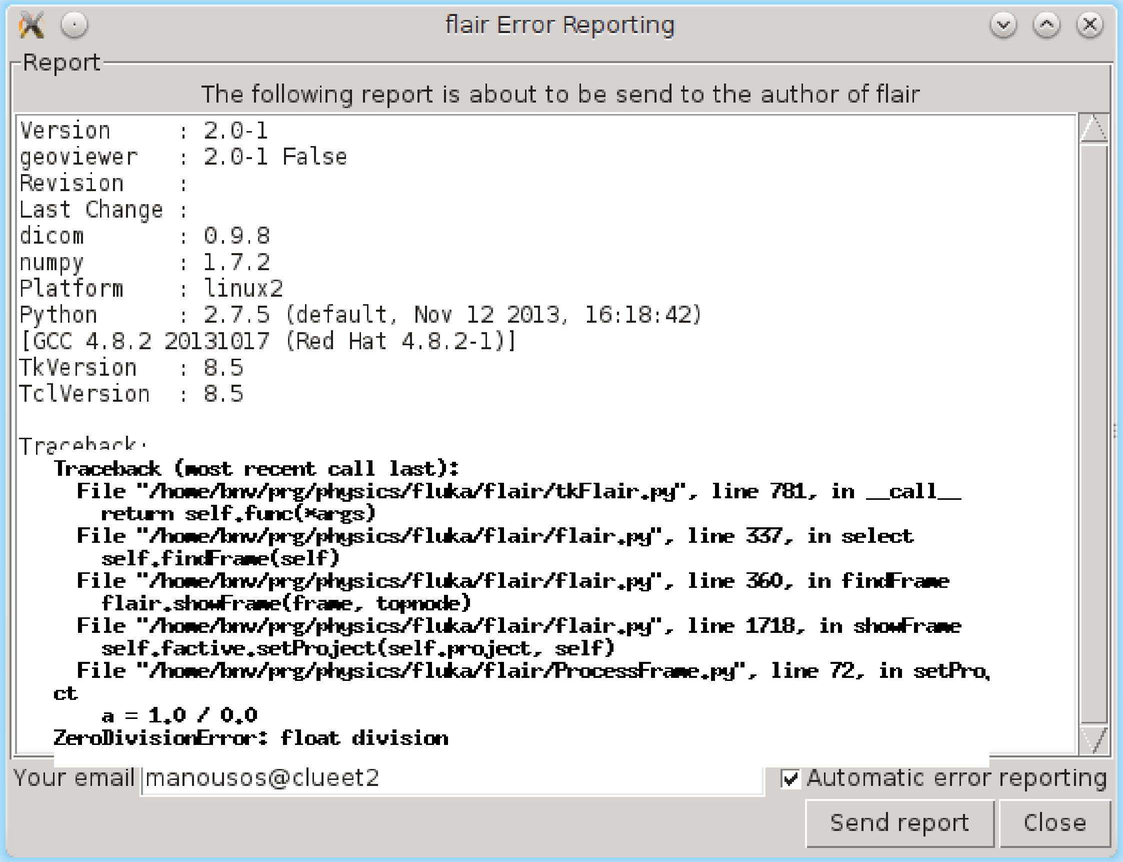
Flair Error Report

- In case of Traceback, when closing the program or after too many messages, FLAIR will propose to send the Traceback message to the authors for further investigation

Please send this report unless you know the reason for the problem, e.g. opening a problematic .inp, non existing directory etc…

It will be good to provide also a small description on how to reproduce the problem

The text box can be edited



The following report is about to be send to the author of flair

```
Version     : 2.0-1
geoviewer   : 2.0-1 False
Revision    :
Last Change :
dicom       : 0.9.8
numpy       : 1.7.2
Platform    : linux2
Python      : 2.7.5 (default, Nov 12 2013, 16:18:42)
[GCC 4.8.2 20131017 (Red Hat 4.8.2-1)]
TkVersion   : 8.5
TclVersion  : 8.5

Traceback:
  Traceback (most recent call last):
    File "/home/bnv/prg/physics/fluka/flair/tkFlair.py", line 781, in __call__
      return self.func(*args)
    File "/home/bnv/prg/physics/fluka/flair/flair.py", line 337, in select
      self.findFrame(self)
    File "/home/bnv/prg/physics/fluka/flair/flair.py", line 360, in findFrame
      flair.showFrame(frame, topnode)
    File "/home/bnv/prg/physics/fluka/flair/flair.py", line 1718, in showFrame
      self.factive.setProject(self.project, self)
    File "/home/bnv/prg/physics/fluka/flair/ProcessFrame.py", line 72, in setPro
  ct
      a = 1.0 / 0.0
  ZeroDivisionError: float division
```

Your email manousos@clueet2

☑ Automatic error reporting

FLUKA bug?

If your crash does not fall in any of the previous categories, and you do not understand what happens, prepare a report with (possibly) the gdb results and send it to fluka-discuss@fluka.org together with a tar file containing:

- .inp, .out, .log, .err files
- user routines (if any)
- additional auxiliary files (if any)
- last random seed (ran* file in fluka_####)
- and any other possible useful information

Remember

- In case of technical problems, your best allies are:
  1. the FLUKA manual
  2. error messages at the end of .out/.err files, and at the beginning of .log file

- In case of doubts on the results:
  1. read the FAQ of FLUKA
  2. search for a similar problem in the FLUKA discussion list
  3. if you really cannot understand the issue, or if you need to ask about physics related problems, write to:

     fluka-discuss@fluka.org