



FLUKA
The Standard Output

7th FLUKA Course
Paris, Sept.29-Oct.3, 2008

The FLUKA Standard Output

- FLUKA provides a standard output file that contains plenty of useful information:

(fortran unit 11, *inp###.out* from rfluka)

- **It must be checked at least once when setting up a simulation and always in case of doubts/crashes (together with *inp###.err* and *inp###.log* files)**

- Let's have a look to *ex_3001.out* (editor or flair output viewer:

Process – Files – *select ex_3001.out* , or
fless *ex_3001.out*)

License/version

FileViewer: ex3003.out

File Edit View

ex3003.out

- License/version
- Input echo
- Body data
- Region data
- Body echo
- Region echo
- Nuclear data
- Mulmix output
- Requested products/decays
- Neutron data
- dp/dx
- Blank common
- Media parameters
- EMF-FLUKA
- Fluka particles
- Beam properties
- Particle thresholds
- Termination conditions
- Mult. Coulomb scattering
- EM Showers
- Scoring
- Scattering lengths
- Regions summary
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- Events by region
- Scattering statistics
- Run summary
- Totals/CPU time
- # of stars
- # of secondaries in stars
- # of fissions
- # of decay products
- # of particles decayed
- # of stopping particles
- # of part. from low en. neutrons
- Energy balance

```
*
*
*   !! THIS VERSION IS THE MAIN DEVELOPMENT VERSION OF !!
*   !! FLUKA AND IT IS FOLLOWED BY CERN AND MILAN, IT !!
*   !! IS A STRICTLY PRIVATE ONE. IT SHOULD CONTAIN THE !!
*   !! BEST PHYSICS ... AND A CORRESPONDING LARGE NUM- !!
*   !! BER OF BUGS ..... YOU ARE WARNED !!!!
*
*
*-----*
1
      FLUKA User license:
By downloading and/or using FLUKA, you agree with the
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... other info including disclaimer,
limitations and references.

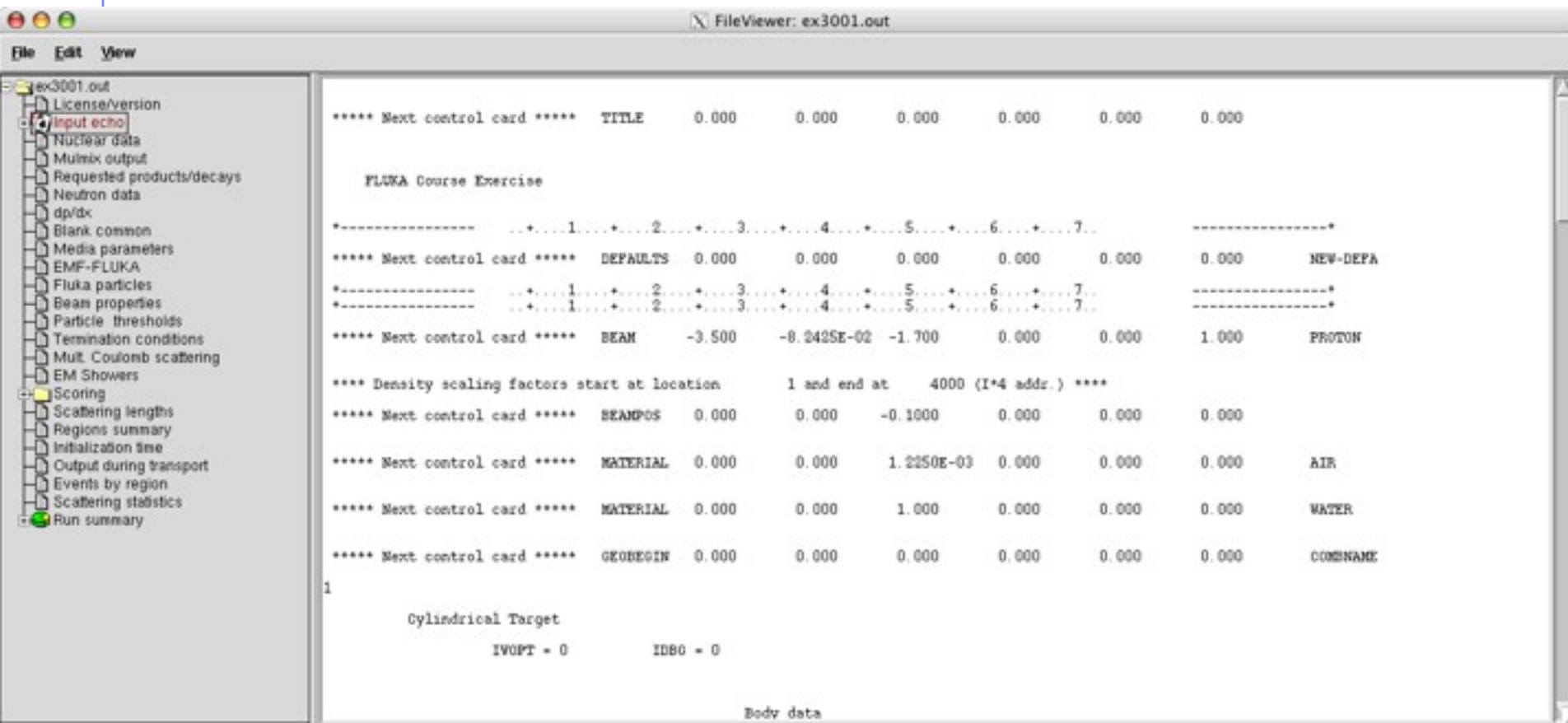
*-----*
1
      !! DOWNLOAD/USE OF THE FLUKA SOFTWARE IMPLIES FULL
      !! ACCEPTANCE OF THE LICENSE AND ASSOCIATED CONDITIONS
      !! INCLUDING THE AUTHOR'S REQUESTS
      !!
*-----*
1
FLUKA2008 Version 1.0 Apr-08 by A. Ferrari DATE: 5/27/ 8 TIME: 14:43:30
*-----*
```

First comes the Banner Page, and the license

Header with the FLUKA version and the date of the run

Input echo

- The data cards are parsed in groups, and do not appear in same order as they are inserted in the input file...
- For instance: TITLE is the first to appear, then all comment cards are listed together, followed by the beam related cards, etc. etc.



```
FileViewer: ex3001.out
File Edit View
ex3001.out
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***** Next control card *****  TITLE  0.000  0.000  0.000  0.000  0.000  0.000

      FLUKA Course Exercise

***** Next control card *****  DEFAULTS  0.000  0.000  0.000  0.000  0.000  0.000  0.000  NEW-DEFA
***** Next control card *****  BEAM  -3.500  -8.2425E-02  -1.700  0.000  0.000  1.000  PROTON

**** Density scaling factors start at location 1 and end at 4000 (I*4 addr.) ****
***** Next control card *****  SEAMPOS  0.000  0.000  -0.1000  0.000  0.000  0.000
***** Next control card *****  MATERIAL  0.000  0.000  1.2250E-03  0.000  0.000  0.000  AIR
***** Next control card *****  MATERIAL  0.000  0.000  1.000  0.000  0.000  0.000  WATER
***** Next control card *****  GEORIGIN  0.000  0.000  0.000  0.000  0.000  0.000  COMNAME

1

      Cylindrical Target
      IVOPT = 0      IDBG = 0

      Body data
```

Input echo – *Geometry output*

Followed by the geometry output, if not redirected (see **GEOBEGIN** card).

Echo of the commands is presented, together with interpretation and correspondence between numbers and names

The image shows two side-by-side screenshots of a FileViewer window displaying the output of a simulation. The left window shows the 'Interpreted body echo' output, and the right window shows the 'Interpreted region echo' output. Both windows have a file explorer on the left side showing the directory structure of the output file 'ex3003.out'.

Interpreted body echo

Body n.	1	SPH	BLK	
	0.000000			0.000000
	10000.00			
Body n.	2	RPP	VOI	
	-1000.000			1000.000
	1000.000			-1000.000
Body n.	3	ICC	TARO	
	0.000000			0.000000
	25.00000			
Body n.	4	XYP	zmin	
	0.000000			
Body n.	5	XYP	zMax	
	10.00000			
Body n.	6	XYP	z1cm	
	1.000000			
Body n.	7	XYP	z2cm	
	2.000000			

Interpreted region echo

Region n.	1	ELKHOLE			
	1		-2		
Region n.	2	VAC			
	OR 2		4		
	OR 2		5	-4	-3
	OR 2		-5		
Region n.	3	WATTar			
	3		6	-4	
Region n.	4	Altar			
	3		7	-6	
Region n.	5	PBTar			
	3		5	-7	

1 OPTION 0 WAS USED IN CALCULATING VOLUMES, FOR 5 REGIONS
3: INPUT VOLUMES, ANYTHING ELSE: VOLUMES = 1.0

	VOLUMES (CM**3)				
1 REG	1	2	3	4	5
VOLUME	1.000E+00	1.000E+00	1.000E+00	1.000E+00	1.000E+00
+00					

Nuclear data

```
FileViewer: ex3003.out

File Edit View

ex3003.out
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│   ├── Region data
│   ├── Body echo
│   └── Region echo
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*** Reading evaporation and nuclear data from unit: 14
*** Evaporation: using NNDC (1996) data ***

Starting location in blank common of LVL data: 4490
Last location in blank common of LVL data: 586959

Starting location in blank common of gamma data: 586960
Last location in blank common of gamma data: 689387

:
:
:
**** Atomic mass for 56-Fe : 52.1030807 GeV ****
**** Nuclear mass for 56-Fe : 52.0898285 GeV ****
**** Excess mass for 107-Ag: -0.088405259 GeV ****
**** Cameron E. m. for 107-Ag: -0.0891378522 GeV ****

:
:
:
**** Evaporation from residual nucleus activated ****
**** Deexcitation gamma production activated ****
**** Evaporated "heavies" transport activated ****
**** High Energy fission requested & activated ****
**** Fermi Break Up requested & activated ****
Neutrino generators initialized
LNUNOK, LNUNOK, LNUNOK
P T T
Neutrino
DATE: 4/22/ 8, TIME: 15: 3:2

**** Fluorescence data successfully retrieved from unit 13 ****
```

Information about the basic nuclear data file used in the program

some memory allocation details...

active options for the nuclear model

Material properties

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```

**** Subroutine Mulmix: medium n. 26 ****
Number of elements = 3. Density= 1.225000E-03 (g/cm**3)
0 I Z Pa F_i Rho_i
Index Atomic Atomic Proportion Proportion
Number Weight by Number by weight

1 7.00000 14.0067 0.784754 9.255849E-04
2 8.00000 15.9994 0.210573 2.836954E-04
3 18.0000 39.9480 4.673085E-03 1.571974E-05

ZTILDE, AE103, BLCRA= 7.56380E+00 2.51981E+00 9.97355E-03

**** Warning!!! Least square fit for blcra failed to keep max. rel. Blcra err. below 1% ****
**** Max. error is 1.1 % for beta2 = 0.00358 ****

ZTILDE, AE103, BLCRE= 6.53935E+00 2.51981E+00 1.04506E-02
BLCR, XCC, TPFLUO, XROFLU= 7.83319E+00 2.65738E-05 8.54719E-01 4.25526E-05
BLCCE, XCC, TPEMP0, XROEMP= 8.91162E+00 2.83218E-02 2.24469E+00 9.00128E-02
Particle n.: 1 Ecuta (prim. & sec.) = 0.9583 GeV 0.9583 GeV, Hthasz = 1.0000E+3
0 GeV
Particle n.: 2 Ecuta (prim. & sec.) = 0.9583 GeV 0.9583 GeV, Hthasz = 1.0000E+3
0 GeV
Particle n.: 3 Ecuta (prim. & sec.) = 2.0511E-02 GeV 2.0511E-02 GeV, Hthasz = 1.0000E+3
0 GeV
Particle n.: 4 Ecuta (prim. & sec.) = 2.0511E-02 GeV 2.0511E-02 GeV, Hthasz = 1.0000E+3
0 GeV
Particle n.: 10 Ecuta (prim. & sec.) = 0.1257 GeV 0.1257 GeV, Hthasz = 1.0000E+3
0 GeV
Particle n.: 11 Ecuta (prim. & sec.) = 0.1257 GeV 0.1257 GeV, Hthasz = 1.0000E+3
0 GeV
Particle n.: 13 Ecuta (prim. & sec.) = 0.1596 GeV 0.1596 GeV, Hthasz = 1.0000E+3
0 GeV
Particle n.: 14 Ecuta (prim. & sec.) = 0.1596 GeV 0.1596 GeV, Hthasz = 1.0000E+3
0 GeV
Particle n.: 15 Ecuta (prim. & sec.) = 0.5136 GeV 0.5136 GeV, Hthasz = 1.0000E+3
0 GeV
Particle n.: 16 Ecuta (prim. & sec.) = 0.5136 GeV 0.5136 GeV, Hthasz = 1.0000E+3
0 GeV
Particle n.: 20 Ecuta (prim. & sec.) = 1.217 GeV 1.217 GeV, Hthasz = 1.0000E+3
0 GeV
Particle n.: 21 Ecuta (prim. & sec.) = 1.209 GeV 1.209 GeV, Hthasz = 1.0000E+3
0 GeV

```

Material properties, multiple scattering parameters

the warning is normal!

Radiation Decay

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```
**** Isotope tabulation data start      at location 1080685 and end at 1097830 (I*4 addr.
) ****

No radioactive products/decays requested

Flags for applying biasing to prompt and/or decay radiation:
      Hadr/muon      EM      Low en. Neut.
      Prompt/Decay  Prompt/Decay  Prompt/Decay
Inter./decay length:  T   F      T   F      T   F
Leading Particle   :  T   F      T   F      T   F
Importance and WW  :  T   F      T   F      T   F

EM transport threshold multipliers:      prompt      decay
                                          1.00E+00    1.00E+00
```

Info on decay radiation options

Radiation biasing

Neutron data

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```
*** Recoil proton production activated for Xsec mat. # 1 ***
*** (n,p) proton production activated for Xsec mat. # 2 ***
Group cross sections storage starts at 1
Last location used for group xsecs 1244497

**** THE FOLLOWING VALUES ARE FROM
Panini Xsec
0 Number of primary groups (Ngrpn) 72
Number of primary downscatters (Nds) 72
Number of secondary groups (Ngrpg) 22
Number of secondary downscatters (Ndsg) 22
Number of prim+sec groups (Ingp) 94
Table length (Itbl) 97
Loc of within group (sig gg) (Isgg) 4
Number of media (Nxsmed) 129
Number of coefficients (Ncoef) 6
Number of angles (Nansct) 3
1
*** Fluka to low en. xsec material correspondence: printed atomic densities are meaningless when
used in a compound ***
```

Fluka medium number	Name	Xsec medium number	atomic density (at/(cm barn))	Id. 1	Id. 2	Id. 3
1	BLCKHOLE	0	0.0000E+00	0	0	0
2	VACUUM	1000	0.0000E+00	0	0	0
3	HYDROGEN	1	0.0000E+00	1	-2	293
7	NITROGEN	2	0.0000E+00	7	-2	293
8	OKYGEN	3	0.0000E+00	8	16	293
10	ALUMINUM	4	6.0240E-02	13	-2	293
17	LEAD	6	3.2988E-02	82	-2	293
20	ARGON	5	0.0000E+00	18	-2	293

Low-energy neutron info, material correspondence

More info on low-neut cross sections if requested **LOW-NEUT**

Material Parameters – dp/dx

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```
*** dp/dx tab. generated up to 11.74 GeV/c/n ***

**** Nuclear form factor 'a la Kelner' selected ****
**** Standard Coulomb correction selected ****
**** for charged hadron and muon bremsstrahlung ****

***** dp/dx : material number 26 "AIR" *****
***** Gas: actual (Fluka) pressure : 1.0000E+00 atm. *****
***** Average excitation energy : 8.5667E+01 eV, weighted Z *****
***** Sternheimer density effect parameters: *****
***** X0 = 1.8000, X1 = 4.0000, C = -10.5787, A = 0.2 *****

***** Restricted energy loss tabulated in 54 intervals *****
***** Delta ray production activated above 1.0000E-03 GeV *****

***** dE/dx fluctuations activated for this medium, level 1 *****
***** (up to 2I discrete levels, up to 2 K-edges) *****

***** Restricted pair production energy loss added *****
***** Exp. pair production activated above 0.0000E+00 GeV *****

***** Restricted bremsstrahlung energy loss added *****
***** Exp. bremsstrahlung activated above 1.0000E-03 GeV *****

***** dp/dx : material number 27 "WATER" *****
***** Average excitation energy : 7.5319E+01 eV, weighted Z/A : 5.5508E-01 *****
***** Sternheimer density effect parameters: *****
***** X0 = 0.2000, X1 = 2.0000, C = -3.5102, A = 0.4440 n = 3.0000 D0 = 0.0000 *****

***** Restricted energy loss tabulated in 54 intervals *****
***** Delta ray production *****

***** dE/dx fluctuations *****
***** (up to 2I di *****

***** Restricted pair p *****
***** Exp. pair production activated above 0.0000E+00 GeV *****
```

Material-dependent parameters for ionization losses

Check δ -ray and bremsstrahlung threshold (DELTA RAY, PAIR BREM)

Material parameters – *Transport thresholds*

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1 Quantities/Biasing associated with each media:

AIR

Rho =	1.225000E-03	g/cm**3	Rlc=	29890.6	cm
Ae =	1.51100	MeV	Ue =	11737.8	MeV
Ap =	0.333333	MeV	Up =	11737.3	MeV

dE/dx fluctuations activated for this medium, level 1
below the threshold for explicit secondary electron production
(up to 2I discrete levels, up to 2 K-edges)

WATER

Rho =	1.00000	g/cm**3	Rlc=	36.0830	cm
Ae =	1.51100	MeV	Ue =	11737.8	MeV
Ap =	0.333333	MeV	Up =	11737.3	MeV

below the threshold for explicit secondary electron production

Upper limit for e^\pm in MeV

Same for photons

Production threshold for e^\pm in MeV
(Total energy, not just kinetic)

Material parameters – *EMF-FLUKA*

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1 Correspondence of regions and EMF-FLUKA material numbers and names:

Region	EMF	FLUKA			
1	0 VACUUM	1 BLACKHOLE			
Ecut =	0.0000E+00 MeV,	Pcut =	0.0000E+00 MeV,	BIAS = F,	Ray. = F, S(q, Z) = T,
Pz(q, Z) = F					
2	1 AIR	26 AIR			
Ecut =	1.5110E+00 MeV,	Pcut =	3.3333E-01 MeV,	BIAS = F,	Ray. = F, S(q, Z) = T,
Pz(q, Z) = F					
3	2 WATER	27 WATER			
Ecut =	1.5110E+00 MeV,	Pcut =	3.3333E-01 MeV,	BIAS = F,	Ray. = F, S(q, Z) = T,
Pz(q, Z) = F					
4	3 ALUMINUM	10 ALUMINUM			
Ecut =	1.5110E+00 MeV,	Pcut =	3.3333E-01 MeV,	BIAS = F,	Ray. = F, S(q, Z) = T,
Pz(q, Z) = F					
5	4 LEAD	17 LEAD			
Ecut =	1.5110E+00 MeV,	Pcut =	3.3333E-01 MeV,	BIAS = F,	Ray. = F, S(q, Z) = T,
Pz(q, Z) = F					
1					

Transport threshold for e^\pm and photons in MeV
(Total energy, not just kinetic)

FLUKA Particles

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```
=== Output before the actual run - Particle properties: ===  
  
=== Transportable Fluka particles: ===  
  
Particle Number      Mass          Mean Life     Charge  Baryon Discard  Decay  PDG id  
                (GeV/c**2)      (s)                number Flag(=1)  Flag  
  
4-HELIUM      -6      3.7273803    1.000E+18     2       4       0       1      9999  
3-HELIUM      -5      2.8083922    1.000E+18     2       3       0       1      9999  
TRITON        -4      2.8089218    1.000E+18     1       3       0       1      9999  
DEUTERON      -3      1.8756134    1.000E+18     1       2       0       1      9999  
HEAVYION      -2      0.0000000    1.000E+18     0       0       0       1      9999  
OPTIPHOT      -1      0.0000000    1.000E+18     0       0       0       1      9999  
RAY           0      0.0000000     0.00         0       0       0       1      9999  
PROTON         1      0.9382723    1.000E+18     1       1       0       1      2212  
APROTON        2      0.9382723    1.000E+18    -1       -1       0       1     -2212  
ELECTRON       3      0.0005110    1.000E+18    -1       0       0       1       11  
POSITRON       4      0.0005110    1.000E+18     1       0       0       1     -11  
NEUTRIE        5      0.0000000    1.000E+18     0       0       1       1       12  
ANEUTRIE       6      0.0000000    1.000E+18     0       0       1       1     -12  
PHOTON         7      0.0000000    1.000E+18     0       0       0       1       22  
  
...and many more  
  
=== Generalised particles (201-233) (for scoring): ===  
  
Generalised particle  Number  
  
ALL-PART            201  
ALL-CHAR            202  
ALL-NEUT            203  
ALL-NEGA            204  
ALL-POSI            205  
NUCLEONS            206  
NUC&PI+-            207  
...  
  
...continues on your screen!
```

Input interpreted summary – *Beam*

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```
*** 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: 4.337961 (GeV/c)
Average beam kinetic energy: 3.500000 (GeV)
Momentum deviation at FWHM (rectangular): 0.0824250 (GeV/c)
Beam hit position: 0.00000000 0.00000000 -0.1000000000 ca
Beam direction cosines: 0.00000000 0.00000000 1.00000000
Beam spot FWHM X-width (Rectangular): 0.0000 ca
Beam spot FWHM Y-width (Rectangular): 0.0000 ca
Beam FWHM angular divergence (Gaussian): 1.7000 (mrad)
The nominal beam position belongs to region: 2(VAC), lattice cell: 0( )
```

Check the starting region

Input interpreted summary – *Thresholds*

FileViewer: ex3003.out

File Edit View

ex3003.out

- License/version
- Input echo
 - Body data
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 - Body echo
 - Region echo
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- Requested products/decays
- Neutron data
- dp/dx
- Blank common
- Media parameters
- EMF-FLUKA
- Fluka particles
- Beam properties
- Particle thresholds
- Termination conditions
- Mult. Coulomb scattering
- EM Showers
- Scoring
 - Scattering lengths
 - Regions summary
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 - Scattering statistics
- Run summary
 - Totals/CPU time
 - # of stars
 - # of secondaries in stars
 - # of fissions
 - # of decay products
 - # of particles decayed
 - # of stopping particles
 - # of part. from low en. neutrons
 - Energy balance

```
*** Particle transport thresholds:

Global cut-off kinetic energy for particle transport: 1.000E-02 GeV
The cut-off kinetic energy is superseded by individual particle thresholds if set

Cut-off kinetic energy for PROTON transport: 1.000E-02 GeV
Cut-off kinetic energy for APROTON transport: 1.000E-02 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 NEUTRINE transport: 0.000E+00 GeV
Cut-off kinetic energy for ANEUTRINE transport: 0.000E+00 GeV
Cut-off kinetic energy for PHOTON transport defined in the Emfcut card
Cut-off kinetic energy for NEUTRON transport: 1.960E-02 GeV
Cut-off kinetic energy for ANEUTRON transport: 1.000E-05 GeV
Cut-off kinetic energy for MUON+ transport: 1.000E-02 GeV
Cut-off kinetic energy for MUON- transport: 1.000E-02 GeV
Cut-off kinetic energy for KAONLONG transport: 1.000E-02 GeV
Cut-off kinetic energy for PION+ transport: 1.000E-02 GeV
Cut-off kinetic energy for PION- transport: 1.000E-02 GeV
Cut-off kinetic energy for KAON+ transport: 1.000E-02 GeV
Cut-off kinetic energy for KAON- transport: 1.000E-02 GeV
Cut-off kinetic energy for LAMBDA transport: 1.000E-02 GeV
Cut-off kinetic energy for ALAMBDA transport: 1.000E-02 GeV
Cut-off kinetic energy for KAONSHRT transport: 1.000E-02 GeV
Cut-off kinetic energy for STONE transport: 1.000E-02 GeV
```

Input interpreted summary – *TC, MCS, EM*

FileViewer: ex3003.out

File Edit View

ex3003.out

- License/version
- Input echo
 - Body data
 - Region data
 - Body echo
 - Region echo
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- Requested products/decays
- Neutron data
- dp/dx
- Blank common
- Media parameters
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- Beam properties
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- Run summary
 - Totals/CPU time
 - # of stars
 - # of secondaries in stars
 - # of fissions
 - # of decay products
 - # of particles decayed
 - # of stopping particles
 - # of part. from low en. neutrons
 - Energy balance

```
=== Termination conditions: ===
Minimum cpu-time reserved for output:          80.00 sec
Maximum number of beam particles to be followed: 10
Maximum number of stars to be generated: infinite

=== Multiple Coulomb scattering: ===
Moliere Coulomb scattering for primaries: T
Moliere Coulomb scattering for secondaries: T

Hadrons/muons:
Flag for MCS check with boundary normals: F
Flag for Coulomb single scattering(s) at boundaries: F
(# of Coulomb single scattering(s) at boundaries: 1)
Flag for single scatterings below min. (Moliere) energy: F

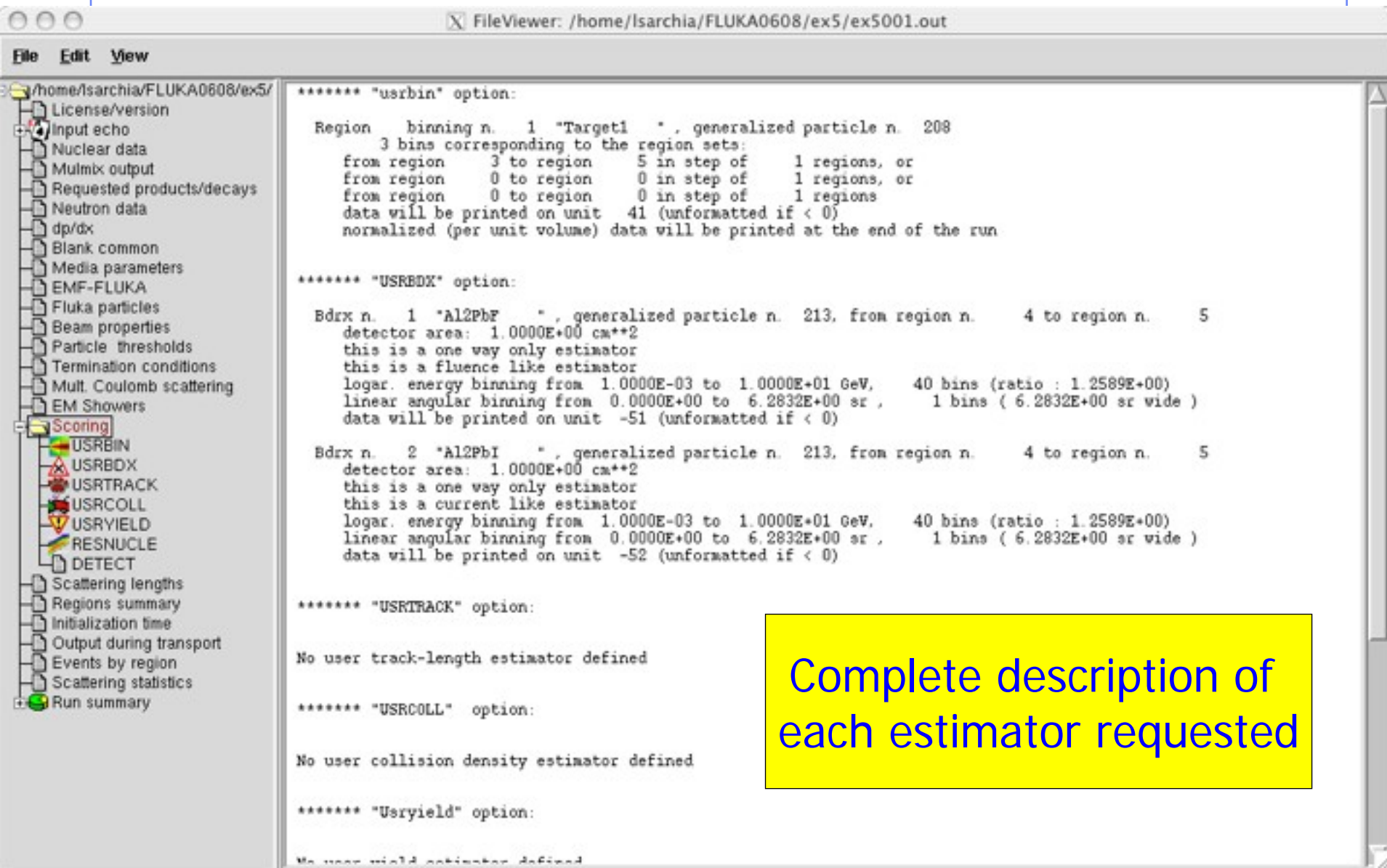
=== Electronmagnetic Showers: ===
EM showers are treated by the EMF (A.Passo',A.Ferrari,P.R.Sala) code

Electrons/positrons:
Flag for MCS check with boundary normals: F
Flag for Coulomb single scattering(s) at boundaries: F
(# of Coulomb single scattering(s) at boundaries: 1)
Flag for single scatterings below min. (Moliere) energy: F

1
```


Scoring

none in ex3, check ex5 output



```
FileViewer: /home/lsarchia/FLUKA0608/ex5/ex5001.out
File Edit View
/home/lsarchia/FLUKA0608/ex5/
  License/version
  Input echo
  Nuclear data
  Mulmix output
  Requested products/decays
  Neutron data
  dp/dx
  Blank common
  Media parameters
  EMF-FLUKA
  Fluka particles
  Beam properties
  Particle thresholds
  Termination conditions
  Mult. Coulomb scattering
  EM Showers
  Scoring
  USRBIN
  USRBDX
  USRTRACK
  USRCOLL
  USRYIELD
  RESNUCLE
  DETECT
  Scattering lengths
  Regions summary
  Initialization time
  Output during transport
  Events by region
  Scattering statistics
  Run summary

***** "usrbin" option:

Region   binning n.   1 "Target1"  , generalized particle n.   208
      3 bins corresponding to the region sets:
from region   3 to region   5 in step of   1 regions, or
from region   0 to region   0 in step of   1 regions, or
from region   0 to region   0 in step of   1 regions
data will be printed on unit   41 (unformatted if < 0)
normalized (per unit volume) data will be printed at the end of the run

***** "USRBDX" option:

Bdrx n.   1 "Al2PbF"  , generalized particle n.   213, from region n.   4 to region n.   5
detector area: 1.0000E+00 cm**2
this is a one way only estimator
this is a fluence like estimator
logar. energy binning from 1.0000E-03 to 1.0000E+01 GeV,   40 bins (ratio : 1.2589E+00)
linear angular binning from 0.0000E+00 to 6.2832E+00 sr ,   1 bins ( 6.2832E+00 sr wide )
data will be printed on unit  -51 (unformatted if < 0)

Bdrx n.   2 "Al2PbI"  , generalized particle n.   213, from region n.   4 to region n.   5
detector area: 1.0000E+00 cm**2
this is a one way only estimator
this is a current like estimator
logar. energy binning from 1.0000E-03 to 1.0000E+01 GeV,   40 bins (ratio : 1.2589E+00)
linear angular binning from 0.0000E+00 to 6.2832E+00 sr ,   1 bins ( 6.2832E+00 sr wide )
data will be printed on unit  -52 (unformatted if < 0)

***** "USRTRACK" option:

No user track-length estimator defined

***** "USRCOLL" option:

No user collision density estimator defined

***** "Usryield" option:

No user yield estimator defined
```

Complete description of each estimator requested

Materials – *Scattering lengths*

FileViewer: /home/lsarchia/FLUKA0608/ex5/ex5001.out

File Edit View

/home/lsarchia/FLUKA0608/ex5/ex5001.out

- License/version
- Input echo
- Nuclear data
- Multix output
- Requested products/decays
- Neutron data
- dp/dx
- Blank common
- Media parameters
- EMF-FLUKA
- Fluka particles
- Beam properties
- Particle thresholds
- Termination conditions
- Mult. Coulomb scattering
- EM Showers
- Scoring
 - USRBIN
 - USRBDX
 - USRTRACK
 - USRCOLL
 - USRFIELD
 - RESNUCLE
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 - Scattering lengths
- Regions summary
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- Scattering statistics
- Run summary

=== Material compositions: ===

Material Number&Name	Atomic Number	Atomic Weight	Density g/cm**3	Inelastic Scattering Length for PROTON at Beam energy cm	Elastic Scattering Length for PROTON at Beam energy cm	Radiation Length cm	Inelastic Scattering Length for neutrons at Threshold Momentum cm
1 BLACKHOLE	0.000	0.000	0.000	0.1000E+31	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	0.1000E+31
3 HYDROGEN	1.000	1.008	0.8370E-04	0.7040E+06	0.418E+07	0.7532E+06	0.6496E+09
4 HELIUM	2.000	4.003	0.1660E-03	0.3506E+06	0.310E+07	0.5682E+06	0.6024E+34
5 BERYLLIUM	4.000	9.012	1.848	19.41	65	16.98	17.82
6 CARBON	6.000	12.01	2.267	23.68	75	23.68	24.01
7 NITROGEN	7.000	14.007	1.947	20.44	75	23.68	24.01
8 OXYGEN	8.000	16.003	1.932	19.32	13.14	0.3344	7.014
9 MAGNESIUM	12.000	24.305	1.738	17.38	18.79	0.4752	9.847
10 ALUMINUM	13.000	26.982	2.700	27.00	22.54	0.5612	12.05
11 IRON	26.000	55.845	7.874	78.74	15.03	0.4094	7.382
12 COPPER	29.000	63.546	8.960	89.60	212.4	28.56	47.49
13 SILVER	47.000	107.868	10.491	104.91	0.1186E+06	0.1178E+05	0.3734E+05
14 SILICON	14.000	28.086	2.329	23.29	97.58	28.56	47.49
15 GOLD	79.000	197.040	19.32	19.32	20.90	1.206	14.35
16 MERCURY	80.000	200.6	13.55	13.55	13.00	0.3504	6.169
17 LEAD	82.000	207.2	11.35	11.35	43.52	3.560	15.05
18 TANTALUM	73.000	180.9	16.65	16.65	22.83	1.424	8.396
19 SODIUM	11.000	22.99	0.9710	97.58	0.1780E+06	0.2989E+05	0.3174E+05
20 ARGON	18.000	39.95	0.1660E-02	0.6692E+05			
21 CALCIUM	20.000	40.08	1.550	71.72			
22 TIN	50.000	118.7	7.310	20.90			
23 TUNGSTEN	74.000	183.8	19.30	9.055			
24 TITANIUM	22.000	47.87	4.540	25.79			
25 NICKEL	28.000	58.69	8.902	13.87			
26 AIR	7.262	14.55	0.1225E-02	0.6817E+05			

Material Number Atomic content Partial Densities


NITROGEN	7	0.78475	0.92558E-03
OXYGEN	8	0.21057	0.28370E-03
ARGON	20	0.46731E-02	0.15720E-04

27 WATER 3.333 6.005 1.000 81.49

Material	Number	Atom content	Partial Densities
HYDROGEN	3	0.66667	0.11190
OXYGEN	8	0.33333	0.88810

Data related to the beam particle type specified in the BEAM card

Compounds interpreted composition



Regions summary

FileViewer: /home/lsarchia/FLUKA0608/ex5/ex5001.out

File Edit View

/home/lsarchia/FLUKA06

- License/version
- Input echo
- Nuclear data
- Mulmix output
- Requested products/di
- Neutron data
- dp/dx
- Blank common
- Media parameters
- EMF-FLUKA
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- Beam properties
- Particle thresholds
- Termination conditions
- Mult. Coulomb scatteri
- EM Showers
- Scoring
 - Scattering lengths
 - Regions summary**
 - Initialization time
 - Output during transpor
 - Events by region
 - Scattering statistics
- Run summary

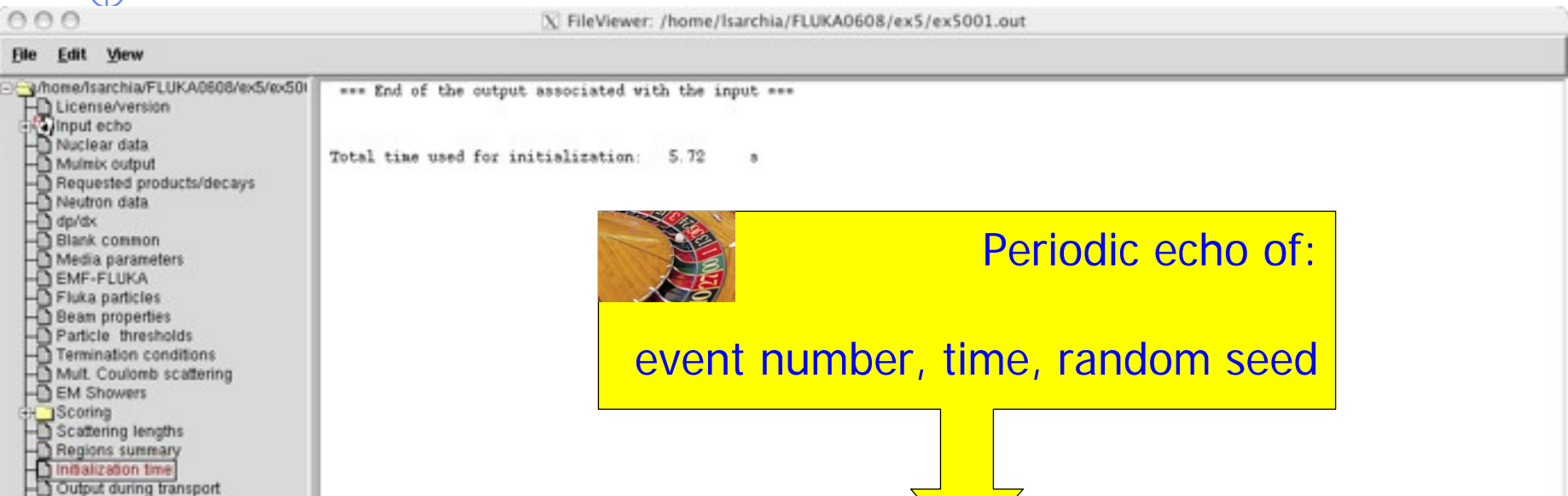
```
=== Regions: materials and fields ===  
Region N. and Name Material N. and Name Magn./El. Field (on/off)  
Minimum and Maximum step size (cm)  
1 BLKHOLE 1 BLCKHOLE OFF 0.00000E+00 9.99852E+04  
2 INAIR 26 AIR OFF 0.00000E+00 9.99852E+04  
3 TARGS1 27 WATER OFF 0.00000E+00 9.99852E+04  
4 TARGS2 10 ALUMINUM OFF 0.00000E+00 9.99852E+04  
5 TARGS3 17 LEAD OFF 0.00000E+00 9.99852E+04
```

Useful way to check material assignment

Minimum step size set with STEPSIZE option

...maximum step size not yet implemented

Runtime Info – *Output associated with the run*



FileViewer: /home/lsarchia/FLUKA0608/ex5/ex5001.out

File Edit View

/home/lsarchia/FLUKA0608/ex5/ex501

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	181CD 3039	0	5
1	9999	9999	3.1994820E-02	1.0000000E+30	
NEXT SEEDS: 24F7	0	0	181CD 3039	0	
200	9800	9800	9.4485593E-03	1.0000000E+30	363
NEXT SEEDS: 358D09	0	0	181CD 3039	0	
400	9600	9600	9.6310341E-03	1.0000000E+30	733
NEXT SEEDS: 6D5263	0	0	181CD 3039	0	
600	9400	9400	9.4968883E-03	1.0000000E+30	1040
NEXT SEEDS: A24DB0	0	0	181CD 3039	0	
800	9200	9200	9.5422989E-03	1.0000000E+30	1327
NEXT SEEDS: DA74CD	0	0	181CD 3039	0	
1000	9000	9000	9.5565476E-03	1.0000000E+30	1692
NEXT SEEDS: 110259A	0	0	181CD 3039	0	
1200	8800	8800	9.8909954E-03	1.0000000E+30	2070
NEXT SEEDS: 1528582	0	0	181CD 3039	0	
1400	8600	8600	1.0159884E-02	1.0000000E+30	2460
NEXT SEEDS: 1959EFF	0	0	181CD 3039	0	
1600	8400	8400	1.0267189E-02	1.0000000E+30	2799
NEXT SEEDS: 1D5A948	0	0	181CD 3039	0	
1800	8200	8200	1.0121794E-02	1.0000000E+30	3140
NEXT SEEDS: 208385B	0	0	181CD 3039	0	
2000	8000	8000	1.0115962E-02	1.0000000E+30	3479
NEXT SEEDS: 241A206	0	0	181CD 3039	0	
2200	7800	7800	1.0115280E-02	1.0000000E+30	3805

License/version
Input echo
Nuclear data
Mix output
Requested products/decays
Neutron data
dp/dx
Blank common
Media parameters
EMF-FLUKA
Fluka particles
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Particle thresholds
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EM Showers
Scoring
Scattering lengths
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Initialization time
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Run summary

Results – *Scoring*

Results of SCORE options for all region:

very useful for debugging and for cross-check with estimators

FileViewer: /home/lsarchia/FLUKA0608/ex5/ex5001.out

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	ELKHOLE	1.000000000E+00	0.000000000E+00	0.000000000E+00	2.952010062E+00		5.917832799E-02	
2	INAIR	1.000000000E+00	7.110000000E-02	8.400000000E-03	8.810405276E-03		1.656213307E-03	
3	TARGS1	1.000000000E+00	1.820000000E-02	1.200000000E-02	3.402603794E-03		2.095980620E-04	
4	TARGS2	1.000000000E+00	4.680000000E-02	2.700000000E-02	8.117056983E-03		8.733151927E-04	
5	TARGS3	1.000000000E+00	1.542600000E+00	3.834000000E-01	3.883824258E-01		1.237258076E-01	

**** Next control card **** STOP 0.000 0.000 0.000 0.000 0.000

The volume is not automatically evaluated,
you have to specify it in the geom. description

inelastic interactions of primary particles

Results – *Statistics of Coulomb scattering*

FileViewer: /home/lsarchia/FLUKA0608/ex5/ex5001.out

File Edit View

/home/lsarchia/FLUKA0608/

- License/version
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- Neutron data
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```
**** Total number of not-performed scatterings in FLUKA:      9134
**** Total number of scatterings with no LDA in FLUKA:      122127
**** Ratio of rejected/accepted samplings from the Moliere's distribution in FLUKA:      0.0000
**** ( Total multiple scatterings: 9.1518E+05; Total single scatterings: 0.0000E+00 )

**** Total number of not-performed scatterings in EMF :      1448
**** Total number of scatterings with no LDA in EMF :      8570
**** Ratio of rejected/accepted samplings from the Moliere's distribution in EMF :      0.0000
**** ( Total multiple scatterings: 3.9907E+06; Total single scatterings: 0.0000E+00 )
```

Results – *Statistics of the run*

FileViewer: /home/lsarchia/FLUKA0608/ex5/ex5001.out

File Edit View

/home/lsarchia/FLUKA0608/ex5/ex5001.out


- License/version
- Input echo
- Nuclear data
- Mulmix output
- Requested products/decays
- Neutron data
- dp/dx
- Blank common
- Media parameters
- EMF-FLUKA
- Fluka particles
- Beam properties
- Particle thresholds
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 - Initialization time
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 - Scattering statistics
- Run summary
 - Totals/CPU time
 - # of stars
 - # of secondaries in stars
 - # of fissions
 - # of decay products
 - # of particles decayed
 - # of stopping particles
 - # of part. from low en. neutrons
 - Energy balance

```
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    86 out of    40000 available

Total number of inelastic interactions (stars):          16787
Total weight of the inelastic interactions (stars):    1.678700E+04

Total number of low energy neutron interactions:          183327
Total weight of the low energy neutron interactions:    1.833582E+05

Total CPU time used to follow all primary particles:     9.750E+01 seconds of:
Average CPU time used to follow a primary particle:    9.750E-03 seconds of:
Maximum CPU time used to follow a primary particle:    9.499E-02 seconds of:
Residual CPU time left:                                1.000E+30 seconds of:
```



CPU time is not real time!

Run summary: *detailed statistics*

FileViewer: ex3003.out

File Edit View

ex3003.out

- License/version
- Input echo
- Body data
- Region data
- Body echo
- Region echo
- Nuclear data
- Mulmix output
- Requested products/decays
- Neutron data
- dp/dx
- Blank common
- Media parameters
- EMF-FLUKA
- Fluka particles
- Beam properties
- Particle thresholds
- Termination conditions
- Mult. Coulomb scattering
- EM Showers
- Scoring
 - Scattering lengths
 - Regions summary
 - Initialization time
 - Output during transport
 - Events by region
 - Scattering statistics
- Run summary
 - Totals/CPU time
 - # of stars
 - # of secondaries in stars
 - # of fissions
 - # of decay products
 - # of particles decayed
 - # of stopping particles
 - # of part. from low en. neutrons
- Energy balance

Number of stars generated per beam particle:

Prompt radiation		Radioactive decays		
1.8000E+00 (100.%)	0.0000E+00 (0.0%)	0.0000E+00 (100.%)	0.0000E+00 (0.0%)	generated by 4-HELIUM
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by 3-HELIUM
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by TRITON
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by DEUTERON
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by HEAVYION
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by OPTIPHOT
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by RAY
8.0000E-01 (44.4%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by PROTON
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by APROTON
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by ELECTRON
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by POSITRON
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by NEUTRIE
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by ANEUTRIE
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by PHOTON
6.0000E-01 (33.3%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by NEUTRON
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by ANEUTRON
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by MUON+
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by MUON-
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by KAONLONG
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by PION+
4.0000E-01 (22.2%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by PION-
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by KAON+
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by KAON-
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by LAMBDA
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by ALAMBDA
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by KAONSHRT
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by SIGMA-
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by SIGMA+
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by SIGMAZER
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by PIZERO
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by KAONZERO
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by AKAONZER
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by RESERVED
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by NEUTRIM
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by ANEUTRIM
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by RESERVED
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by RESERVED
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by ASIGMA-
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by ASIGMAZE
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by ASIGMA+
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	generated by XSIZERO

Detailed statistics for each particle type

Energy Balance

FileViewer: ex3003.out

File Edit View

ex3003.out

- License/version
- Input echo
 - Body data
 - Region data
 - Body echo
 - Region echo
- Nuclear data
- Mulmix output
- Requested products/decays
- Neutron data
- dp/dx
- Blank common
- Media parameters
- EMF-FLUKA
- Fluka particles
- Beam properties
- Particle thresholds
- Termination conditions
- Mult. Coulomb scattering
- EM Showers
- Scoring
 - Scattering lengths
 - Regions summary
 - Initialization time
 - Output during transport
 - Events by region
 - Scattering statistics
- Run summary
 - Totals/CPU time
 - # of stars
 - # of secondaries in stars
 - # of fissions
 - # of decay products
 - # of particles decayed
 - # of stopping particles
 - # of part. from low en. neutrons
 - Energy balance**

3.5000E+00 (100.%) GeV available per beam particle divided into		Radioactive decays		
Prompt radiation				
2.2985E-01 (6.6%)	0.0000E+00 (0.0%)	GeV hadron and muon dE/dx		
2.0173E-01 (5.8%)	0.0000E+00 (0.0%)	GeV electro-magnetic showers		
2.9934E-02 (0.9%)	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		
1.2287E-03 (0.0%)	0.0000E+00 (0.0%)	GeV low energy neutrons		
2.8904E+00 (82.6%)	0.0000E+00 (0.0%)	GeV particles escaping the system		
3.0979E-02 (0.9%)	0.0000E+00 (0.0%)	GeV particles discarded		
0.0000E+00 (0.0%)	0.0000E+00 (0.0%)	GeV particles out of time limit		
1.1584E-01 (3.3%)		GeV missing		

- Hadrons and muons below thr. are ranged out, unless thresholds exceed 100 MeV
- electrons, positrons and photons not included (electro-magnetic showers)

going in the black-hole

Neutrinos are discarded by default

Calculated by difference: in pure e-m problems it should be 0, while in hadronic problems it is the energy spent in endothermic nuclear reactions ($\approx 8 \text{ MeV/n}$), or gained in exothermic (i.e., mostly neutron capture): it is $-\text{total } Q$

Error message

```
FileViewer: ex_3001.out
File Edit View
ex_3001.out
  License/Version
  Input echo
  Scoring
  Run summary
  ERROR

GEOEND      6.0      0.0      11.0     -6.0      0.0      -6.0
GEOEND     120.0     1.0     170.0          &

**** Geometry debugging requested and activated ****
    from X=-6.000000000E+00 to X= 6.000000000E+00 in step dx= 1.000000000E-01
    from Y= 0.000000000E+00 to Y= 0.000000000E+00 in step dy= 0.000000000E+00
    from Z=-6.000000000E+00 to Z= 1.100000000E+01 in step dz= 1.000000000E-01

Total time used for geometry initialization: 5.999E-02 s

***** Next control card *****
0.000  WATER  MATERIAL  0.000  0.000  1.000  0.000  0.000

***** Next control card *****
0.000  AIR  MATERIAL  0.000  0.000  1.2250E-03  0.000  0.000

***** Next control card *****
0.000  WATER  COMPOUND  2.000  3.000  1.000  8.000  0.000

***** Next control card *****
20.00  AIR  COMPOUND -0.9256  7.000  -0.2837  8.000  -1.5720E-02

***** Next control card *****
0.000  RANDOMIZ  1.000  0.000  0.000  0.000  0.000

RM64 INITIALIZED: 98765 12345 0 0

***** Next control card *****
0.000  ASSIGNMA  1.000  1.000  0.000  0.000  0.000

***** Next control card *****
0.000  ASSIGNMA  26.00  2.000  0.000  0.000  0.000

*** Unable to resolve name element FLORIAN in card ***
ASSIGNMA  FLORIAN  TARGS2
*** run stopped ***
```

Tips and tricks



You can always **CTRL-F** or **Edit – Find** for a specific word in a selected section or in the whole output file.

