FLUKA
The Standard Output

Beginners FLUKA Course

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**

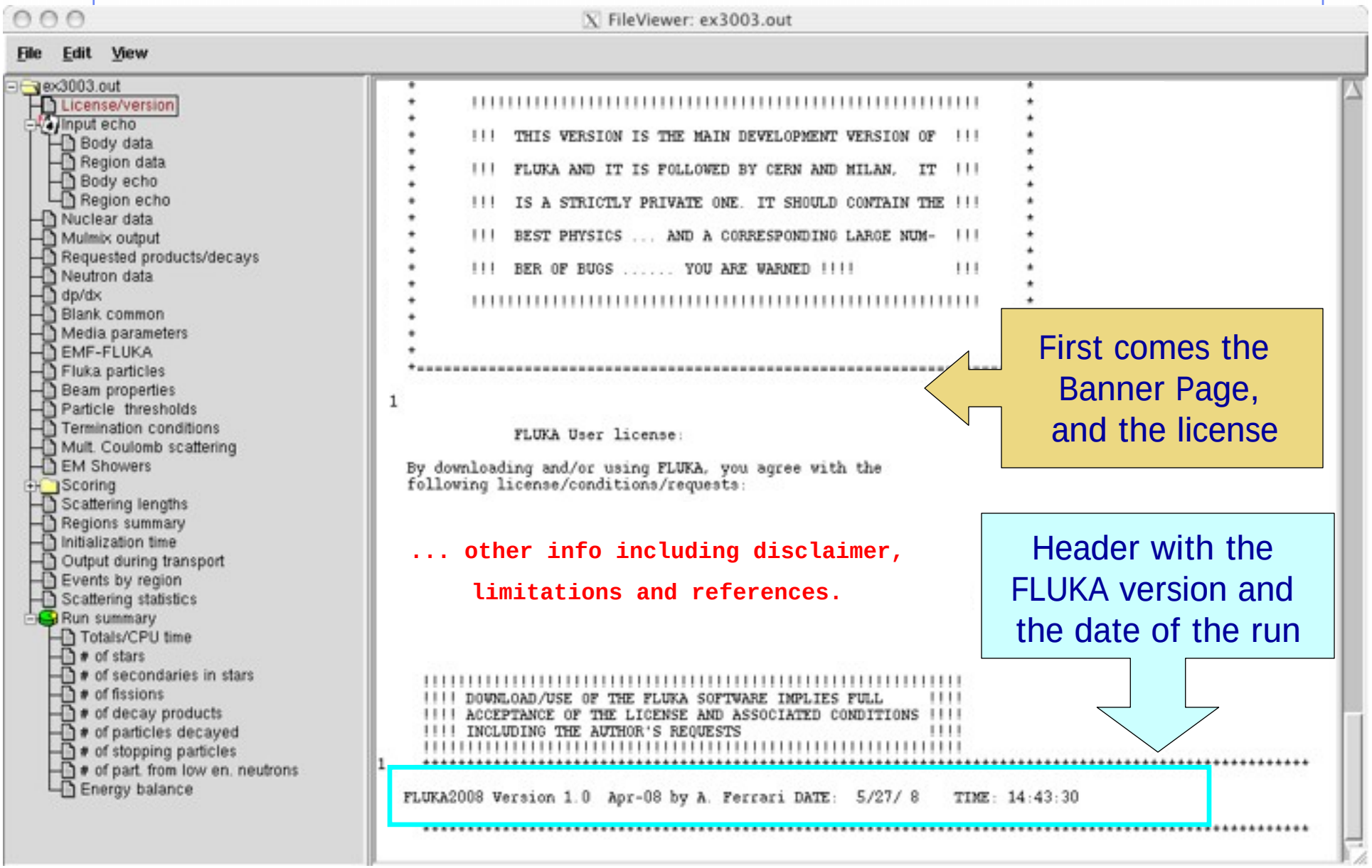
  (together with *inp###.err* and *inp###.log* files)

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

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

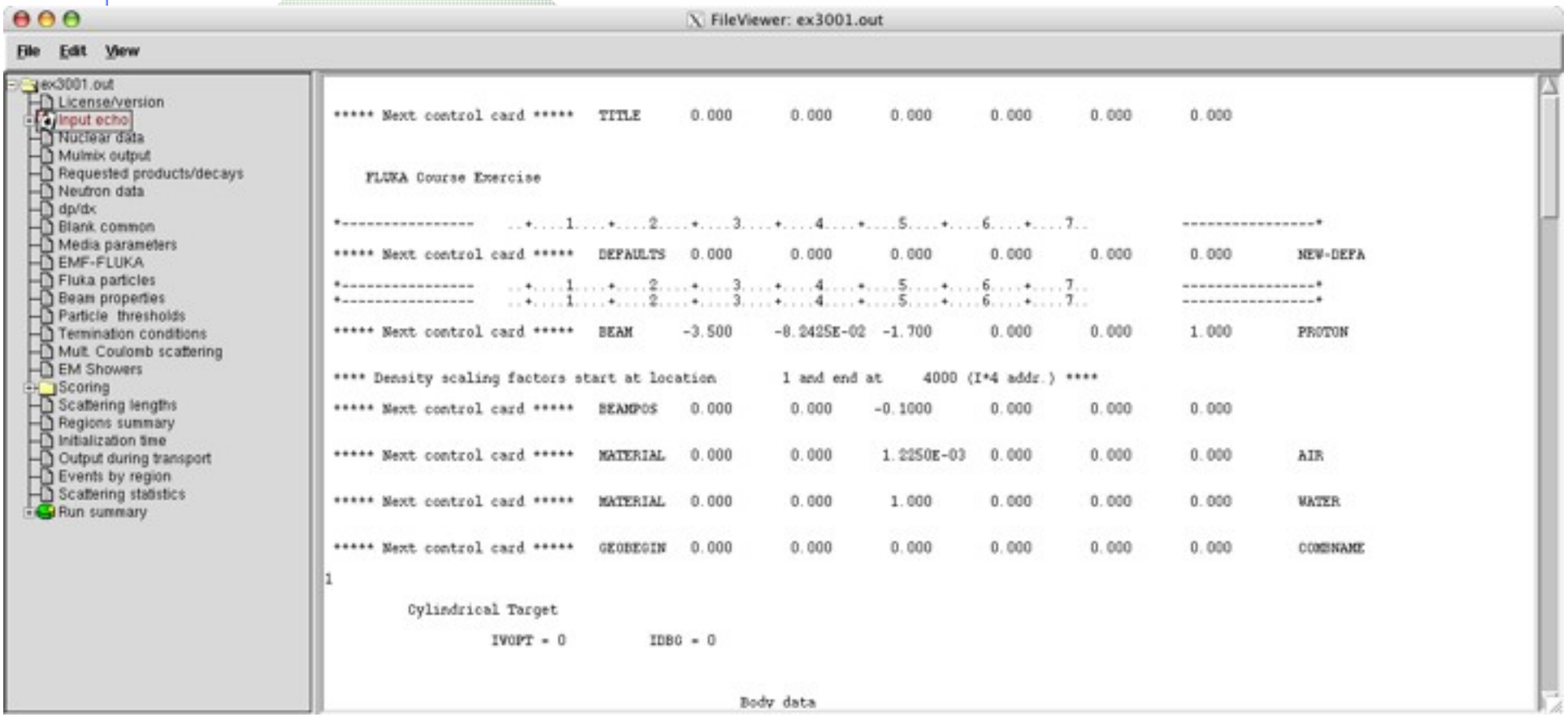
  fless *ex_3001.out*)

License/version



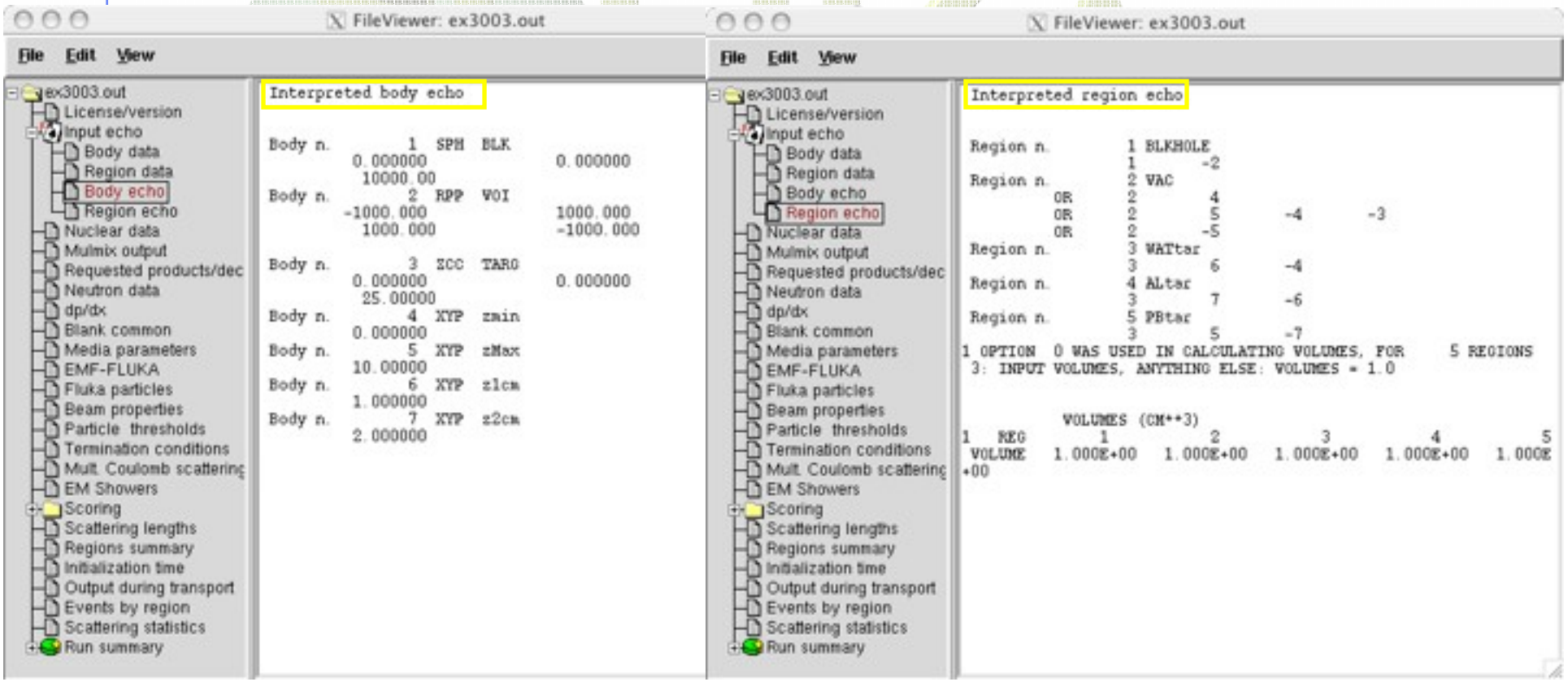
Input echo

- 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.

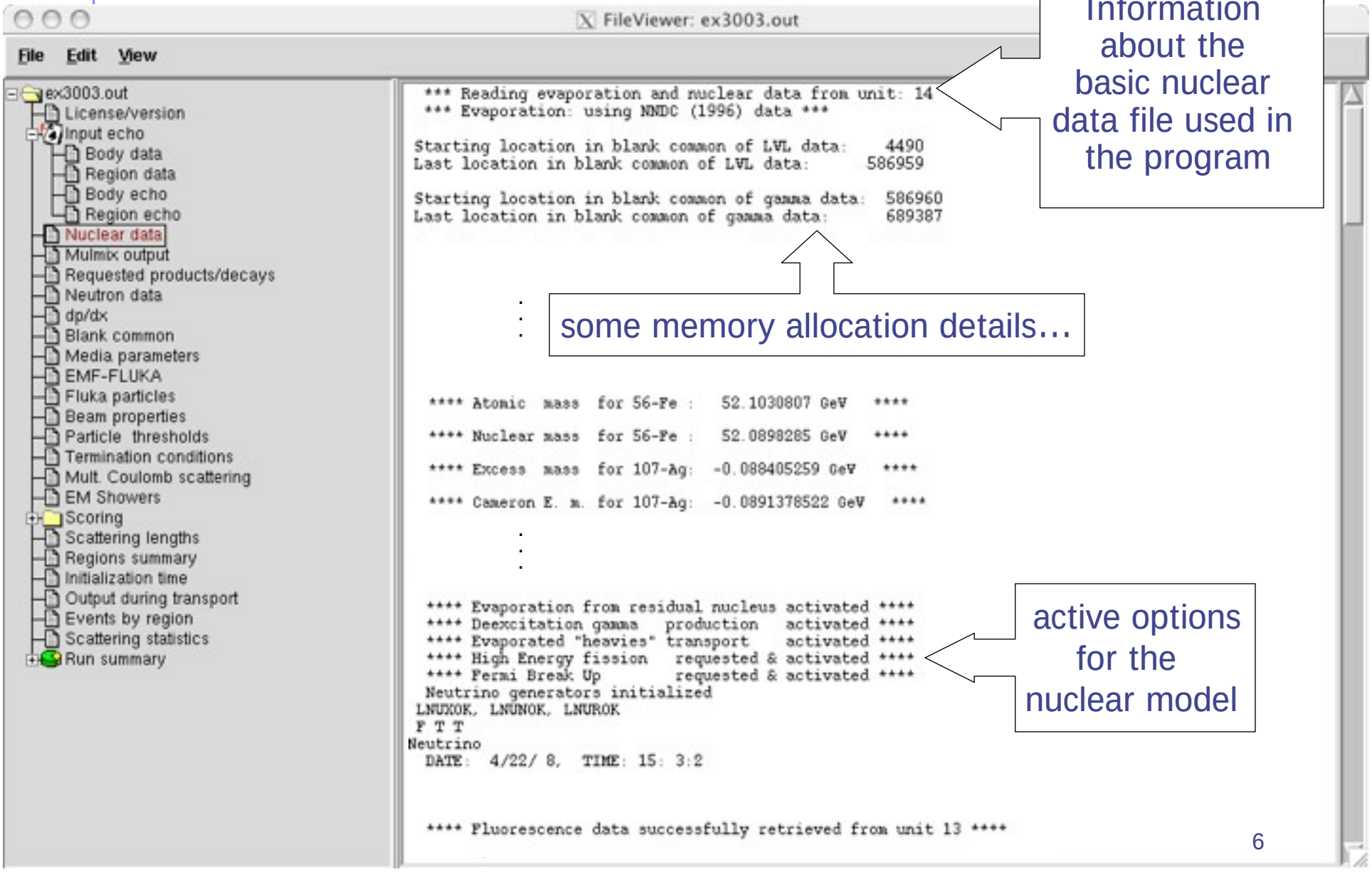


Input echo – *Geometry output*

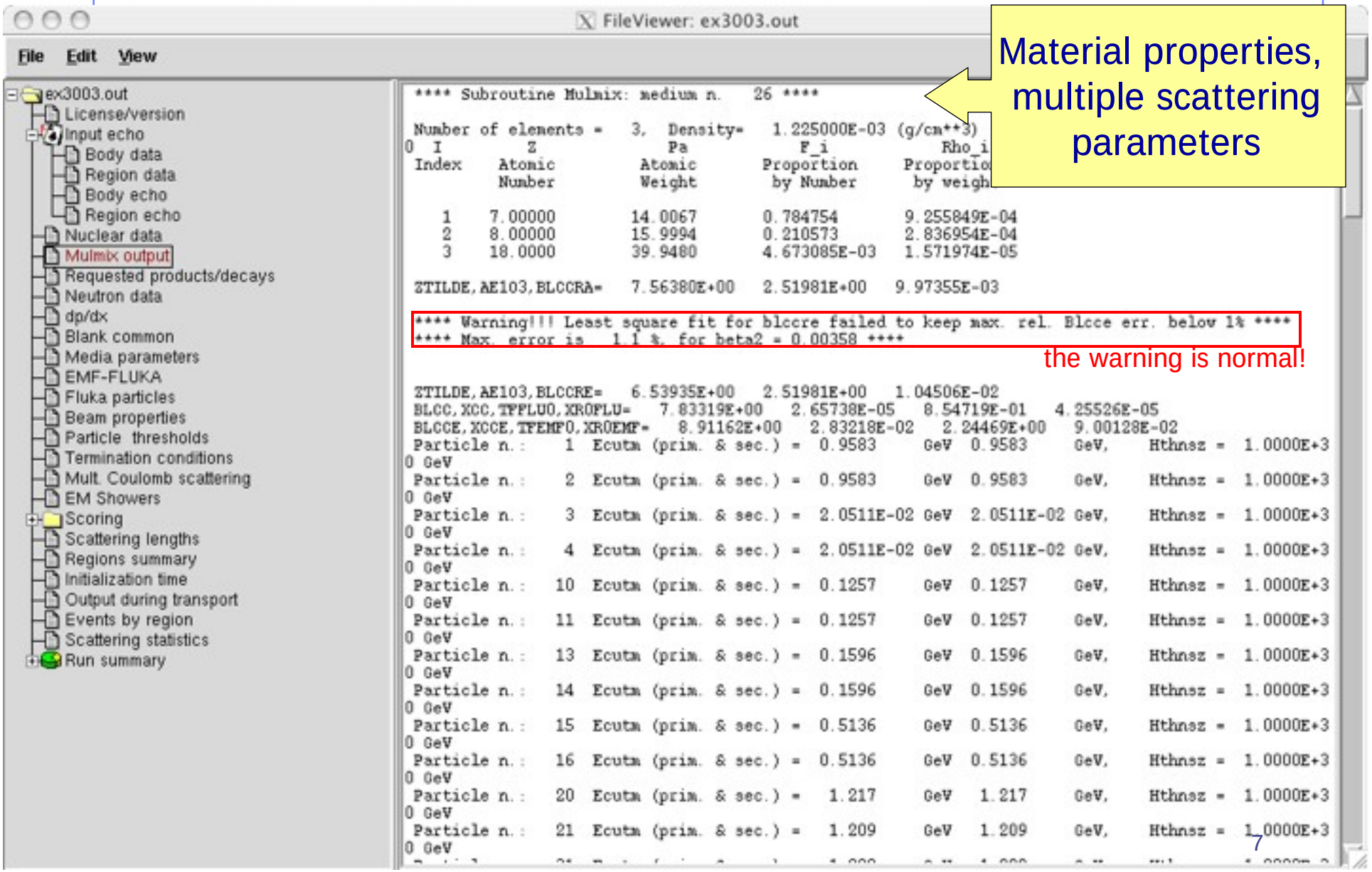
Followed by the geometry output, if not redirected (see GEOBEGIN card).
Echo of the commands is presented, together with interpretation and correspondence between numbers and names



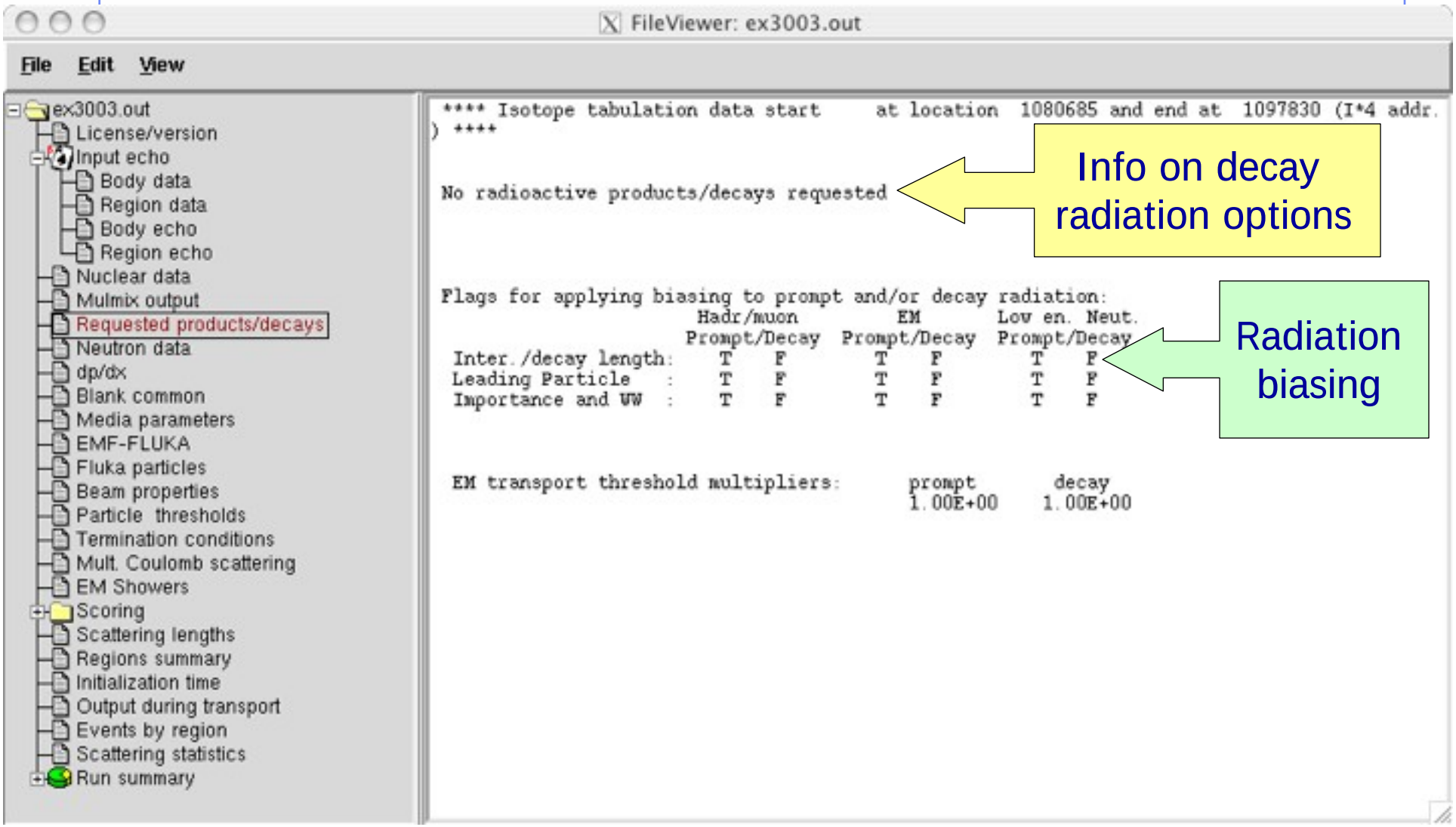
Nuclear data



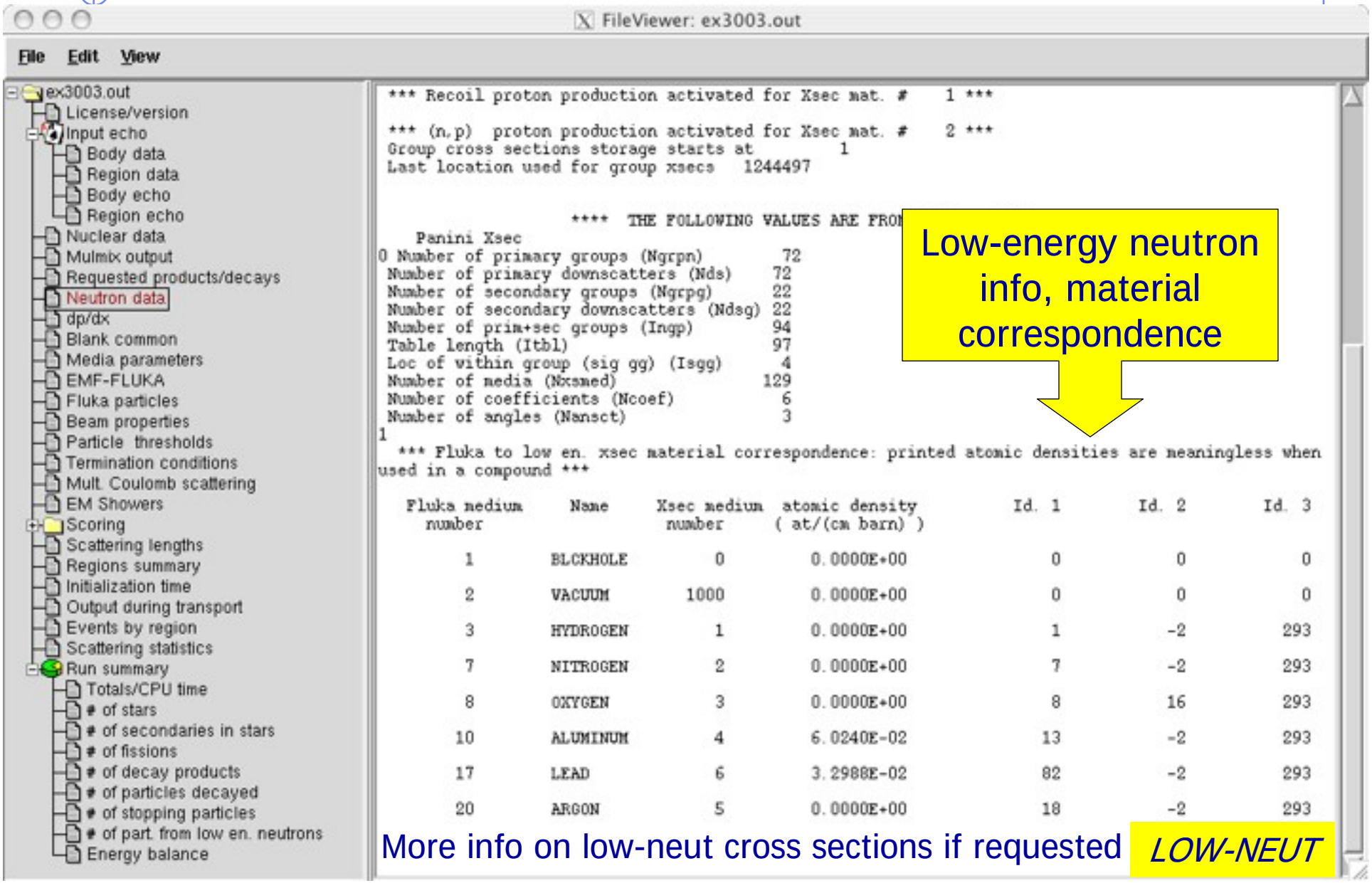
Material properties



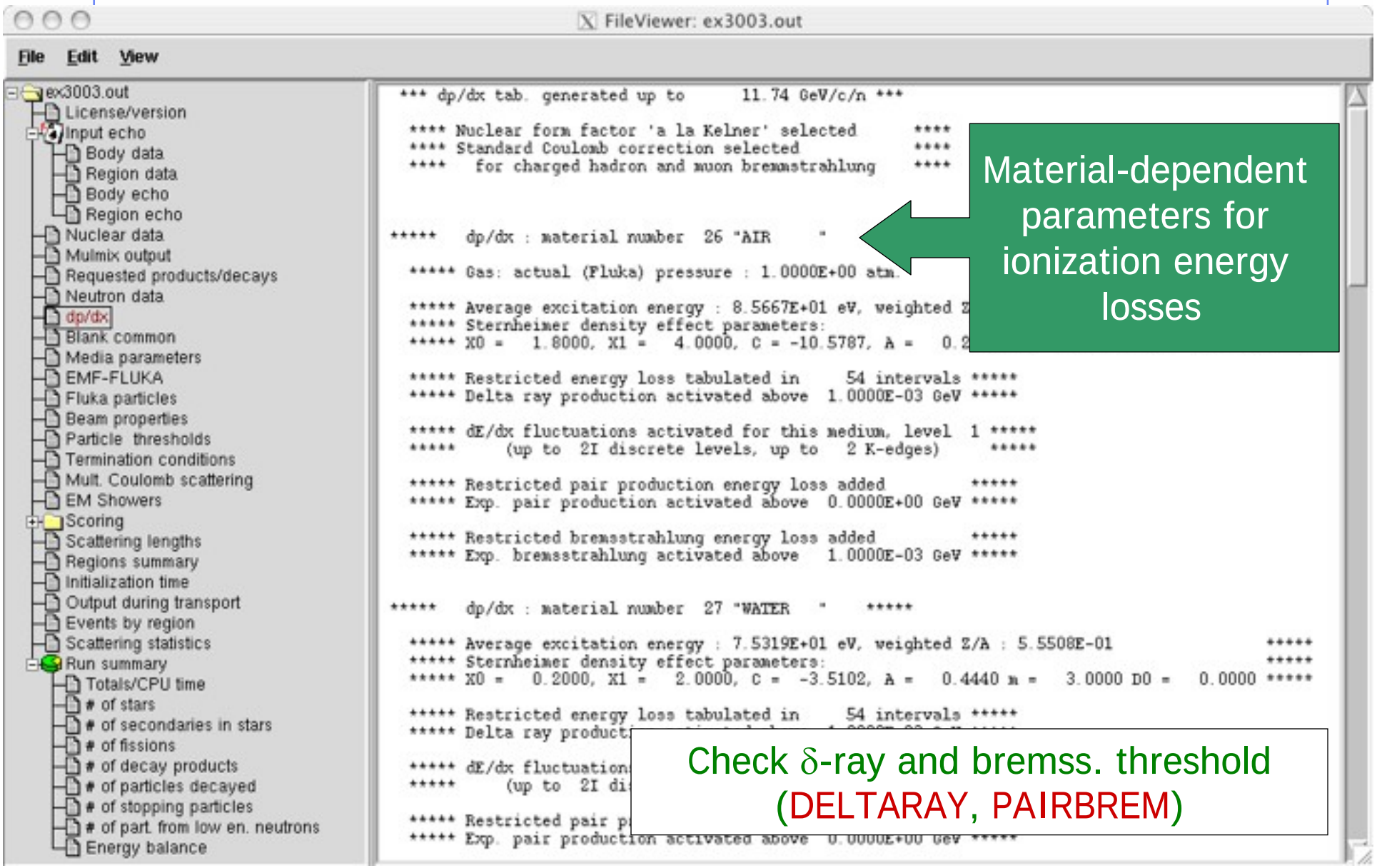
Radiation Decay



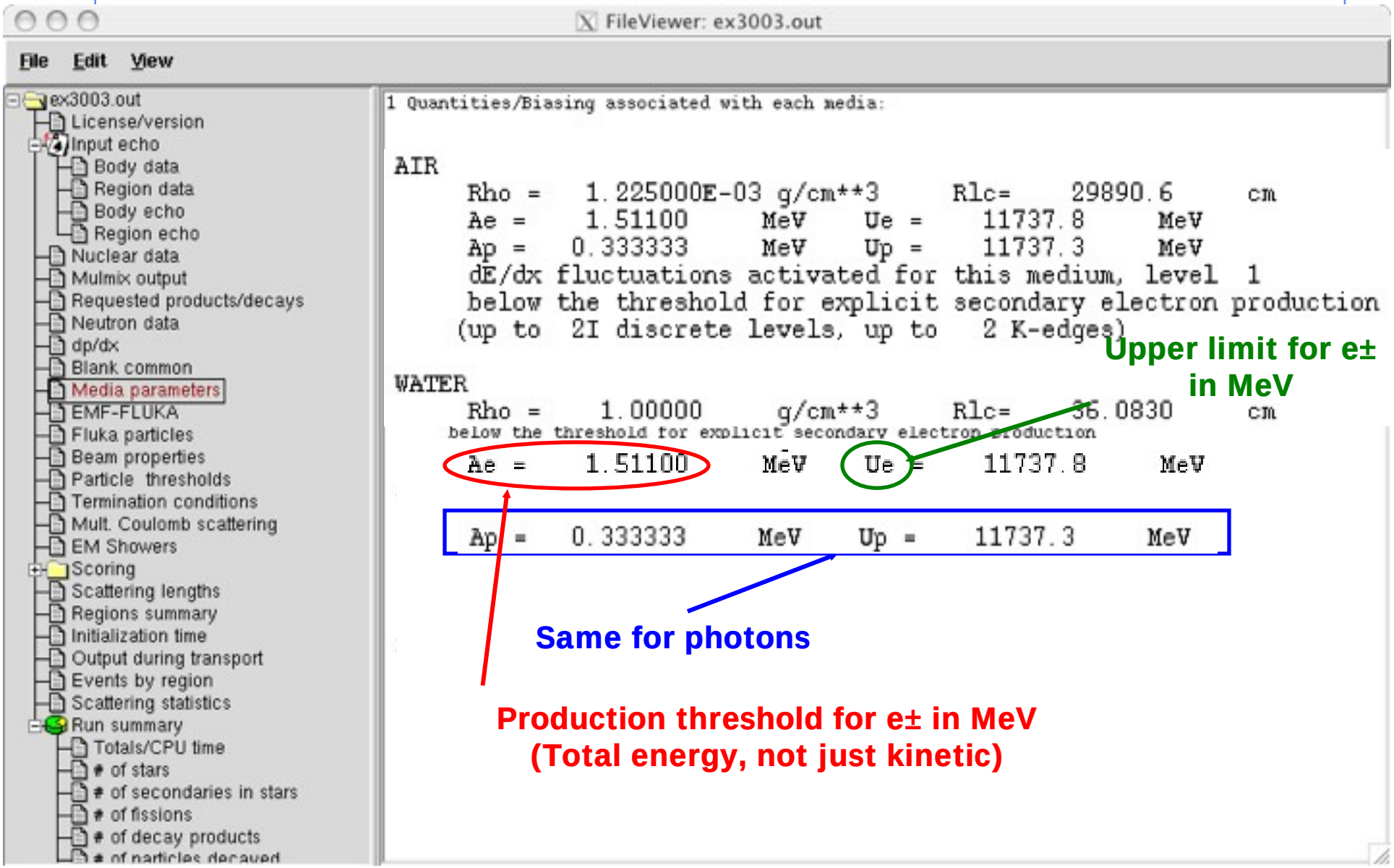
Neutron data



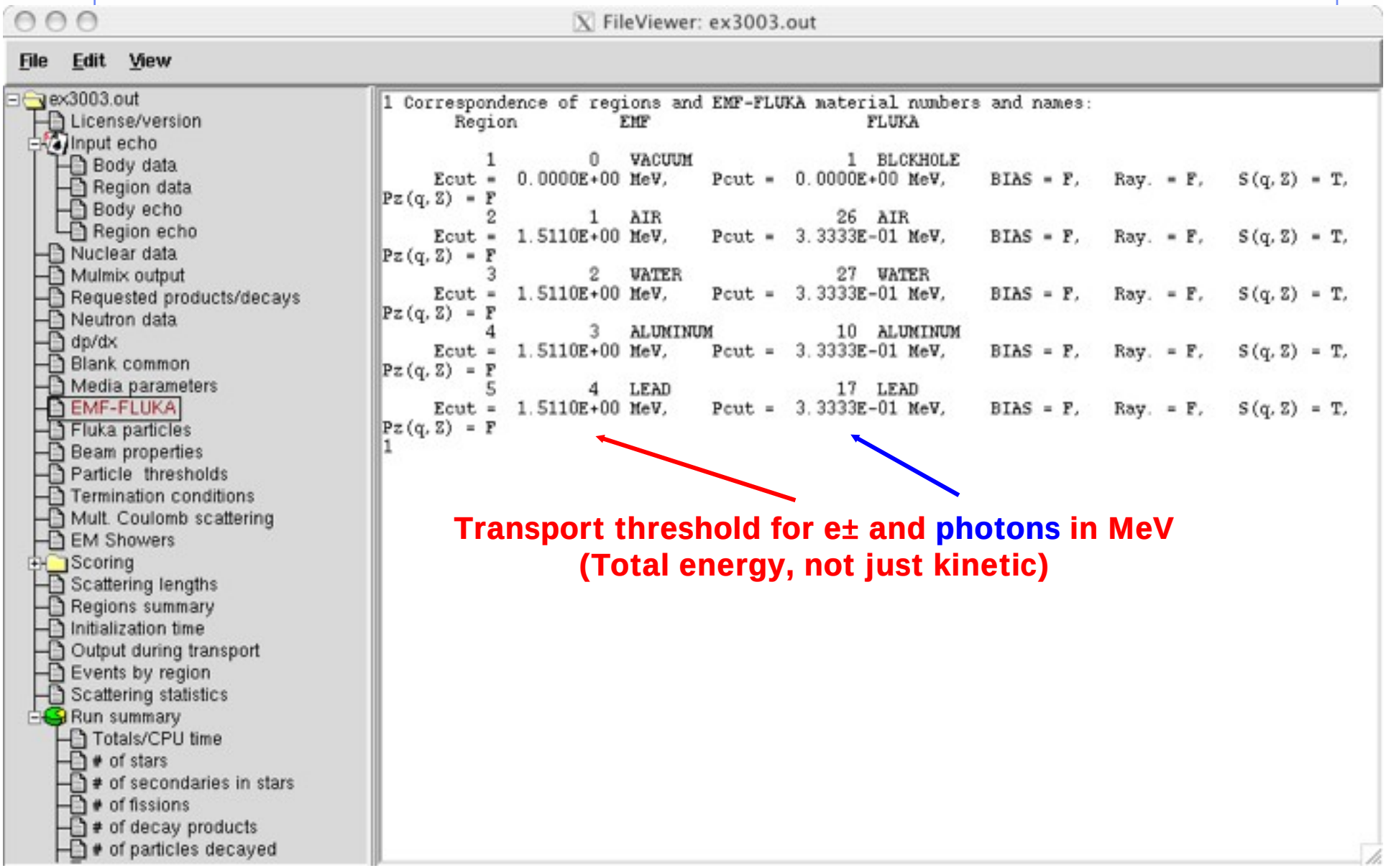
Material Parameters – *dp/dx*



Material parameters – *Transport thresholds*

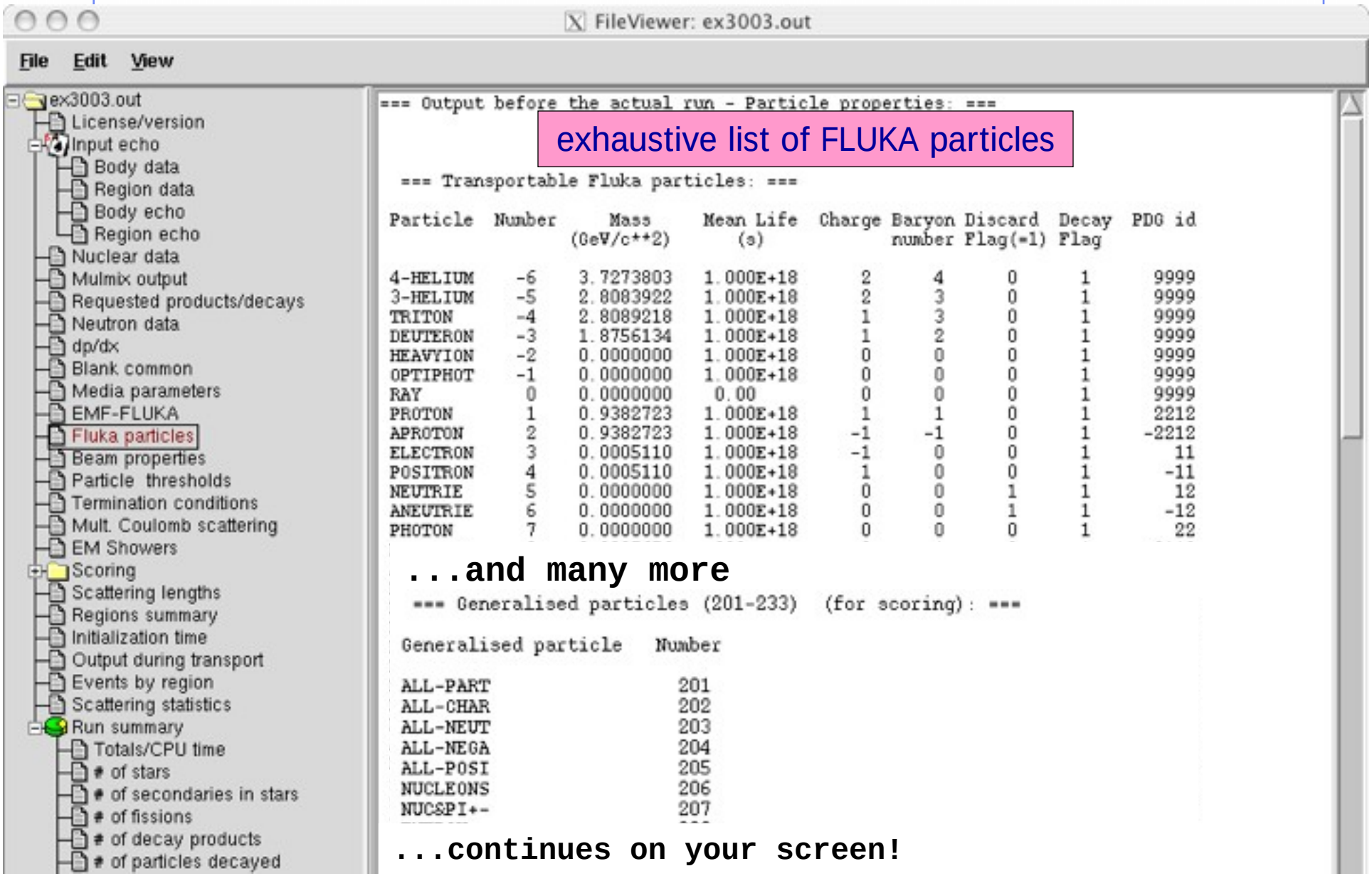


Material parameters – *EMF-FLUKA*



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

FLUKA Particles



Input interpreted summary – *Beam*

FileViewer: ex3003.out

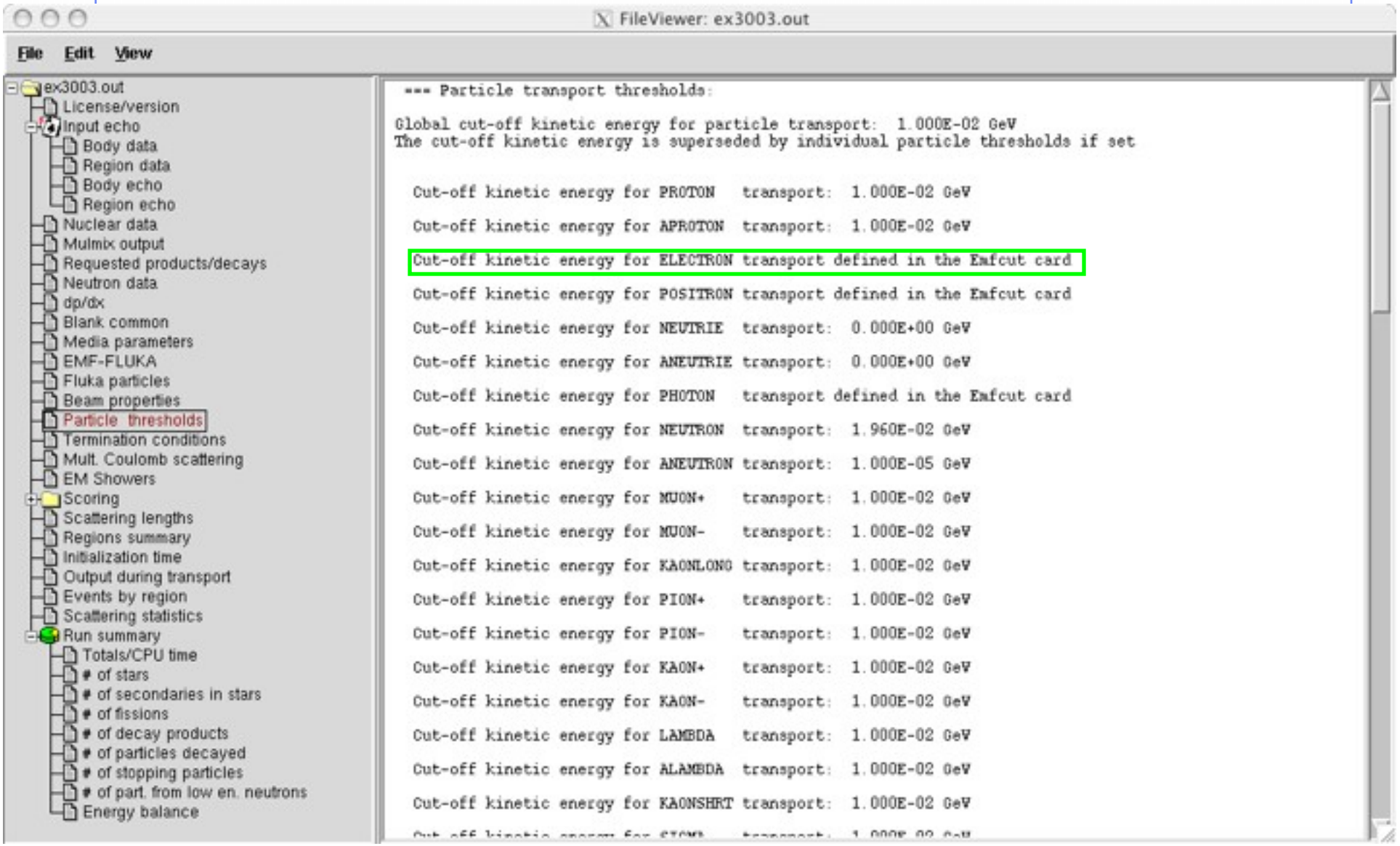
File Edit View

- 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

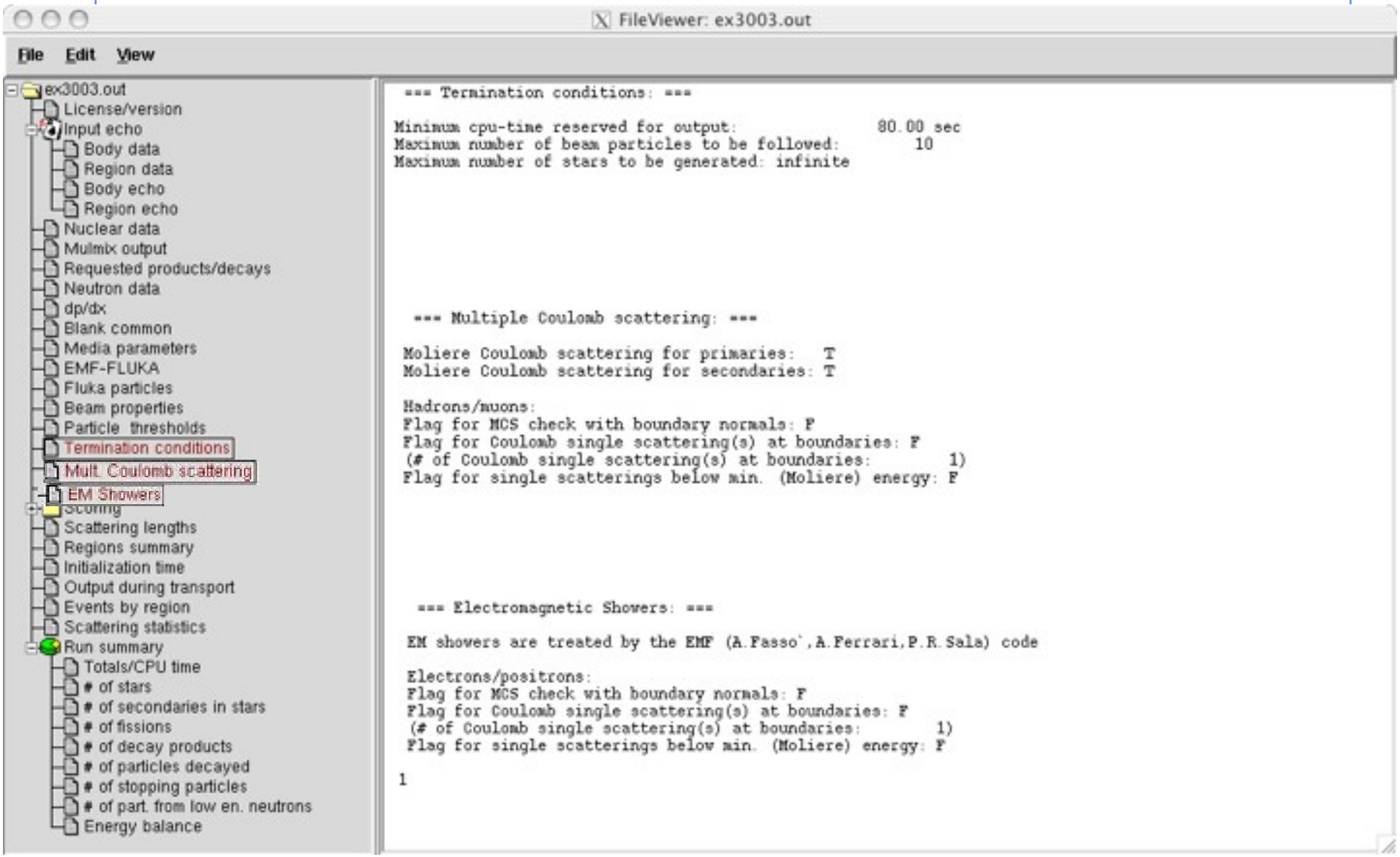
```
=== Output before the actual run - Beam properties ===


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     -0.100000000      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 (Gaussian    ):            1.7000  (mrad)
  The nominal beam position belongs to region:       2(VAC     ), lattice cell:       0(        )
```

Check the starting region

Input interpreted summary – *Thresholds*



Input interpreted summary – *TC, MCS, EM*



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
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```
******* "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:
```

Complete description of each estimator requested

Materials – *Scattering lengths*

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

File Edit View

/home/lsarchia/FLUKA0608/ex5/ex5001.(
- 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
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- Run summary

=== 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	Inelastic Scattering Length for neutrons at Threshold Momentum
			g/cm**3	cm	cm	cm	cm
1 BLCKHOLE	0.000	0.000	0.000	0.1000E+31	[illegible]+31	0.1000E+31	0.1000E+31
2 VACUUM	0.000	0.000	0.000	0.1000E+31	000E+31	0.1000E+31	0.1000E+31
3 HYDROGEN	1.000	1.008	0.8370E-04	0.7040E+06	418E+07	0.7532E+06	0.6496E+09
4 HELIUM	2.000	4.003	0.1660E-03	0.3506E+06	310E+07	0.5682E+06	0.6024E+34
5 BERYLLIU	4.000	9.012	1.848	39.41	65	35.28	17.02
6 CARBON	6.000	12.0					
7 NITROGEN	7.000	14.0					
8 OXYGEN	8.000	16.0					
9 MAGNESIU	12.00	24.3					
10 ALUMINUM	13.00	26.9					
11 IRON	26.00	55.8					
12 COPPER	29.00	63.5					
13 SILVER	47.00	107.					
14 SILICON	14.00	28.09	2.329	43.04	86.54	9.370	20.21
15 GOLD	79.00	197.0	19.32	9.239	13.14	0.3344	7.014
16 MERCURY	80.00	200.6	13.55	13.25	18.79	0.4752	9.847
17 LEAD	82.00	207.2	11.35	15.97	22.54	0.5612	12.05
18 TANTALUM	73.00	180.9	16.65	10.44	15.03	0.4094	7.382
19 SODIUM	11.00	22.99	0.9710	97.58	212.4	28.56	47.49
20 ARGON	18.00	39.95	0.1660E-02	0.6692E+05	0.1186E+06	0.1178E+05	0.3734E+05
21 CALCIUM	20.00	40.08	1.550	71.72	127.0	10.42	36.21
22 TIN	50.00	118.7	7.310	20.90	31.44	1.206	14.35
23 TUNGSTEN	74.00	183.8	19.30	9.055	13.00	0.3504	6.169
24 TITANIUM	22.00	47.87	4.540	25.79	43.52	3.560	15.05
25 NICKEL	28.00	58.69	8.902	13.87	22.83	1.424	8.396
26 AIR	7.262	14.55	0.1225E-02	0.6817E+05	0.1780E+06	0.2989E+05	0.3174E+05

Material	Number	Atom 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

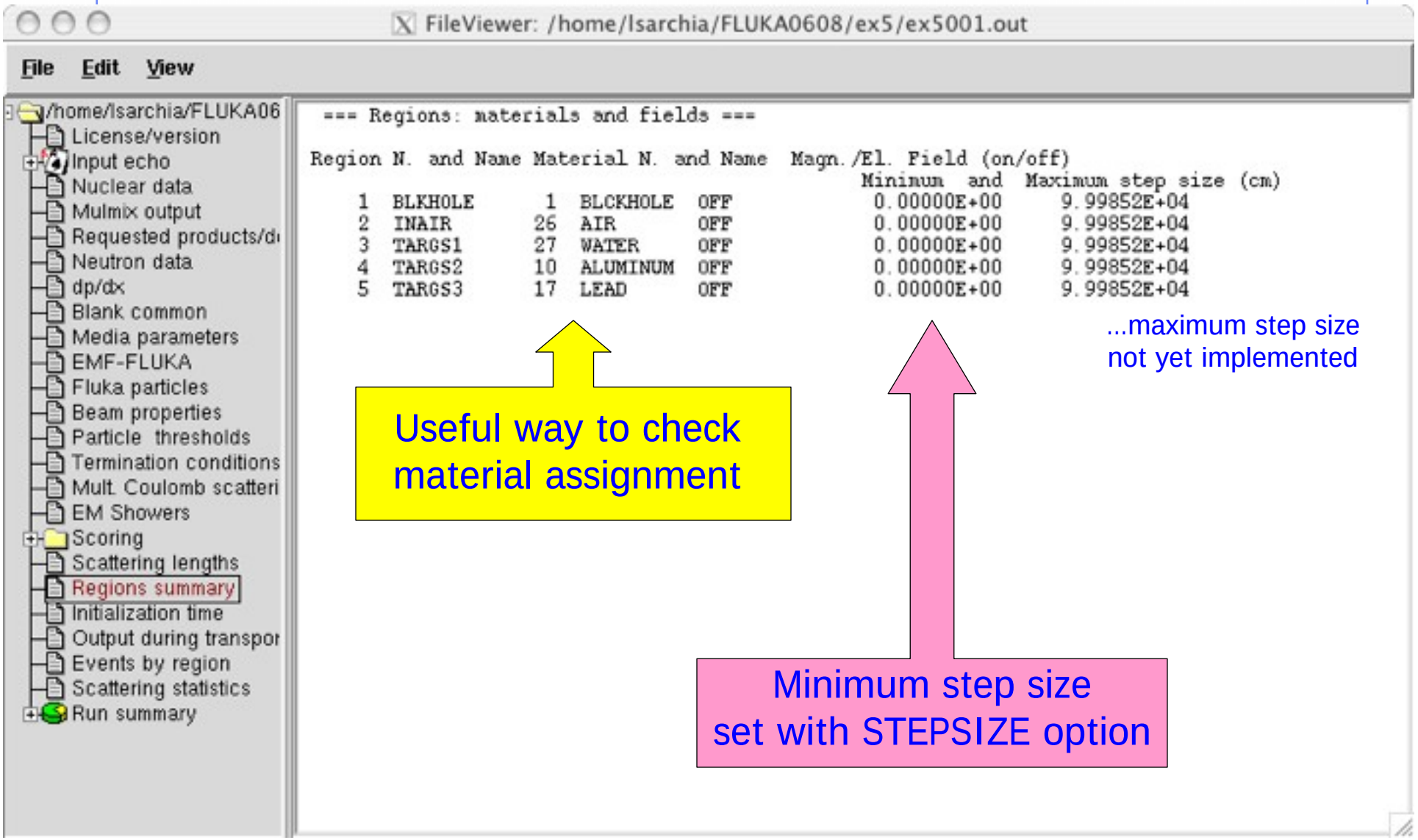
27 WATER	3.333	6.005	1.000	81.49

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



Runtime Info – *Output associated with the run*

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

File Edit View

/home/lsarchia/FLUKA0608/ex5/ex50
- 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
- Scattering lengths
- Regions summary
- Initialization time
- Output during transport

```
 *** End of the output associated with the input ***


Total time used for initialization:    5.72      s
```

Periodic echo of:

event number, time, random seed

FileViewer: /home/lsarchia/FLUKA0608/ex5/ ut

File Edit View

/home/lsarchia/FLUKA0608/ex5/ex50
- License/version
- Input echo
- Nuclear data
- Mulmix output
- Requested products/decays
- Neutron data
- dp/dx
- Blank common
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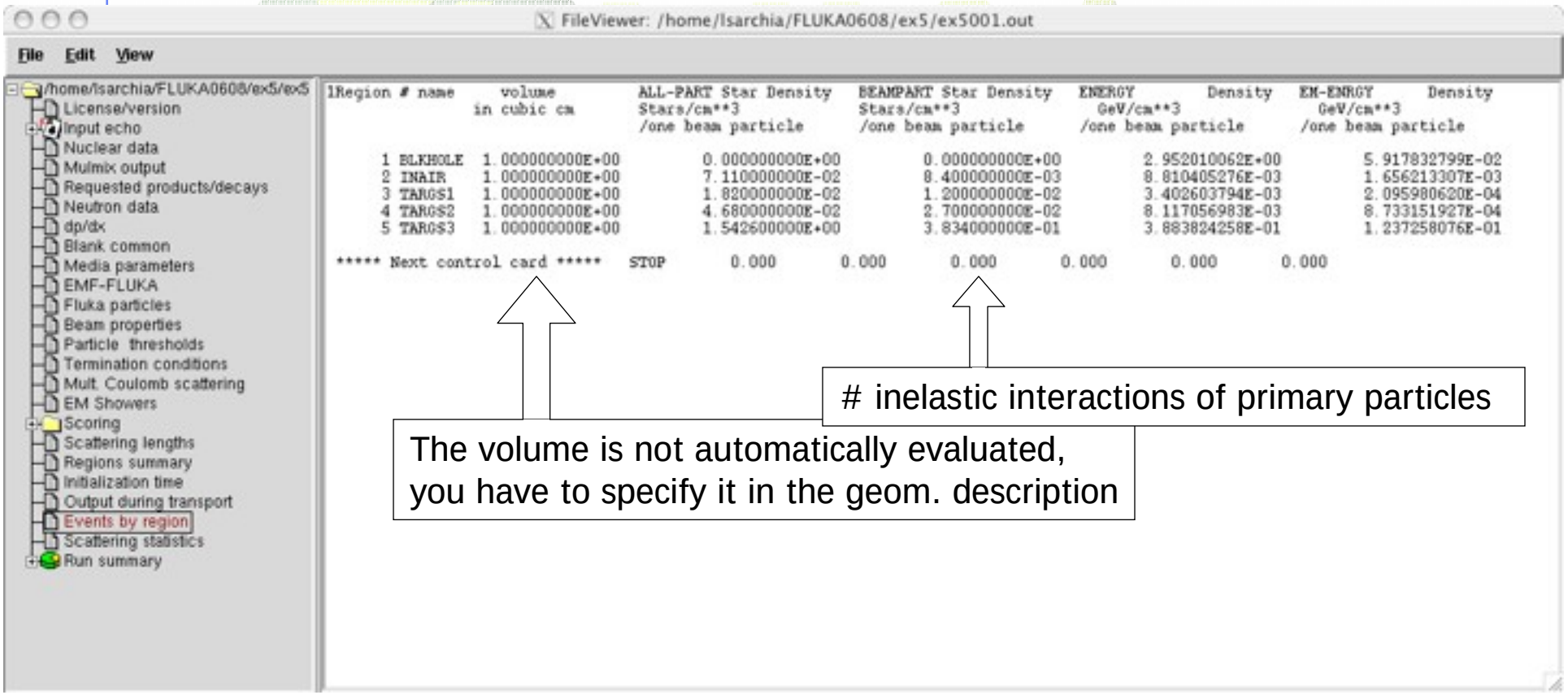
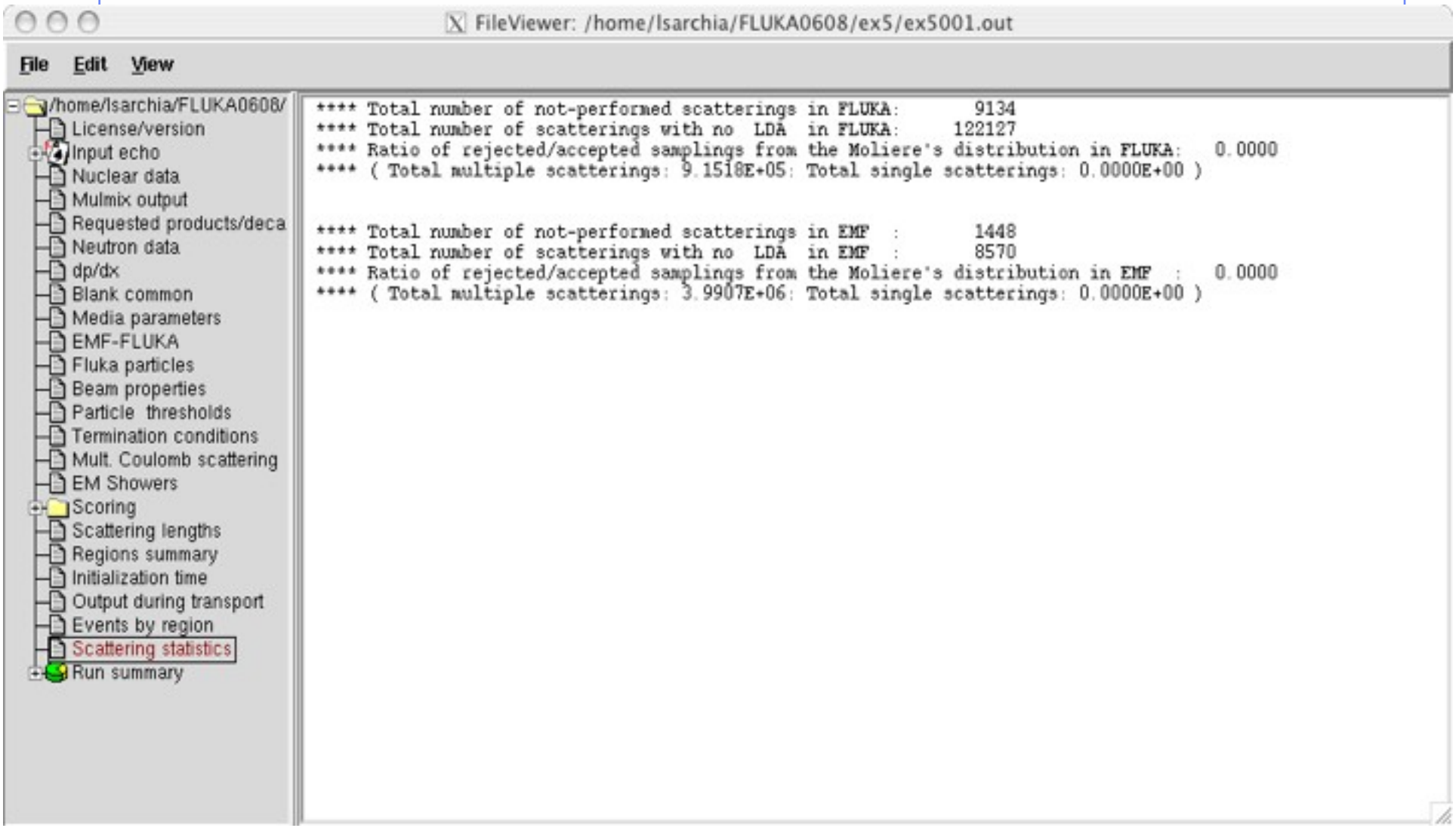
NUMBER OF BEAM PARTICLES HANDLED	NUMBER OF BEAM PARTICLES LEFT	APPROXIMATE NUMBER OF BEAM PARTICLES THAT CAN STILL BE HANDLED	AVERAGE TIME USED BY A BEAM PARTICLE	TIME LEFT (RESERVED 10000.0 SECONDS FOR PRINTOUT)	NUMBER OF STARS CREATED
NEXT SEEDS: 0 0 0	0 0 0	0 0 0	181CD 3039 0	0	
1	9999	9999	3.1994820E-02	1.0000000E+30	5
NEXT SEEDS: E4F7 0 0	0 0 0	0 0 0	181CD 3039 0	0	
200	9800	9800	9.4485593E-03	1.0000000E+30	363
NEXT SEEDS: 358D09 0 0	0 0 0	0 0 0	181CD 3039 0	0	
400	9600	9600	9.6310341E-03	1.0000000E+30	733
NEXT SEEDS: 6D5E63 0 0	0 0 0	0 0 0	181CD 3039 0	0	
600	9400	9400	9.4968883E-03	1.0000000E+30	1040
NEXT SEEDS: A24DB0 0 0	0 0 0	0 0 0	181CD 3039 0	0	
800	9200	9200	9.5422989E-03	1.0000000E+30	1327
NEXT SEEDS: DA74CD 0 0	0 0 0	0 0 0	181CD 3039 0	0	
1000	9000	9000	9.5565476E-03	1.0000000E+30	1692
NEXT SEEDS: 110259A 0 0	0 0 0	0 0 0	181CD 3039 0	0	
1200	8800	8800	9.8909954E-03	1.0000000E+30	2070
NEXT SEEDS: 1528582 0 0	0 0 0	0 0 0	181CD 3039 0	0	
1400	8600	8600	1.0159884E-02	1.0000000E+30	2460
NEXT SEEDS: 1959EFF 0 0	0 0 0	0 0 0	181CD 3039 0	0	
1600	8400	8400	1.0267189E-02	1.0000000E+30	2799
NEXT SEEDS: 1D5A948 0 0	0 0 0	0 0 0	181CD 3039 0	0	
1800	8200	8200	1.0121794E-02	1.0000000E+30	3140
NEXT SEEDS: 208385B 0 0	0 0 0	0 0 0	181CD 3039 0	0	
2000	8000	8000	1.0115962E-02	1.0000000E+30	3479
NEXT SEEDS: 241AE06 0 0	0 0 0	0 0 0	181CD 3039 0	0	
2200	7800	7800	1.0115280E-02	1.0000000E+30	3805

Results – *Scoring*

Results of SCORE options for all region:
very useful for debugging and for cross-check with estimators



Results – *Statistics of Coulomb scattering*



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
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  - EMF-FLUKA
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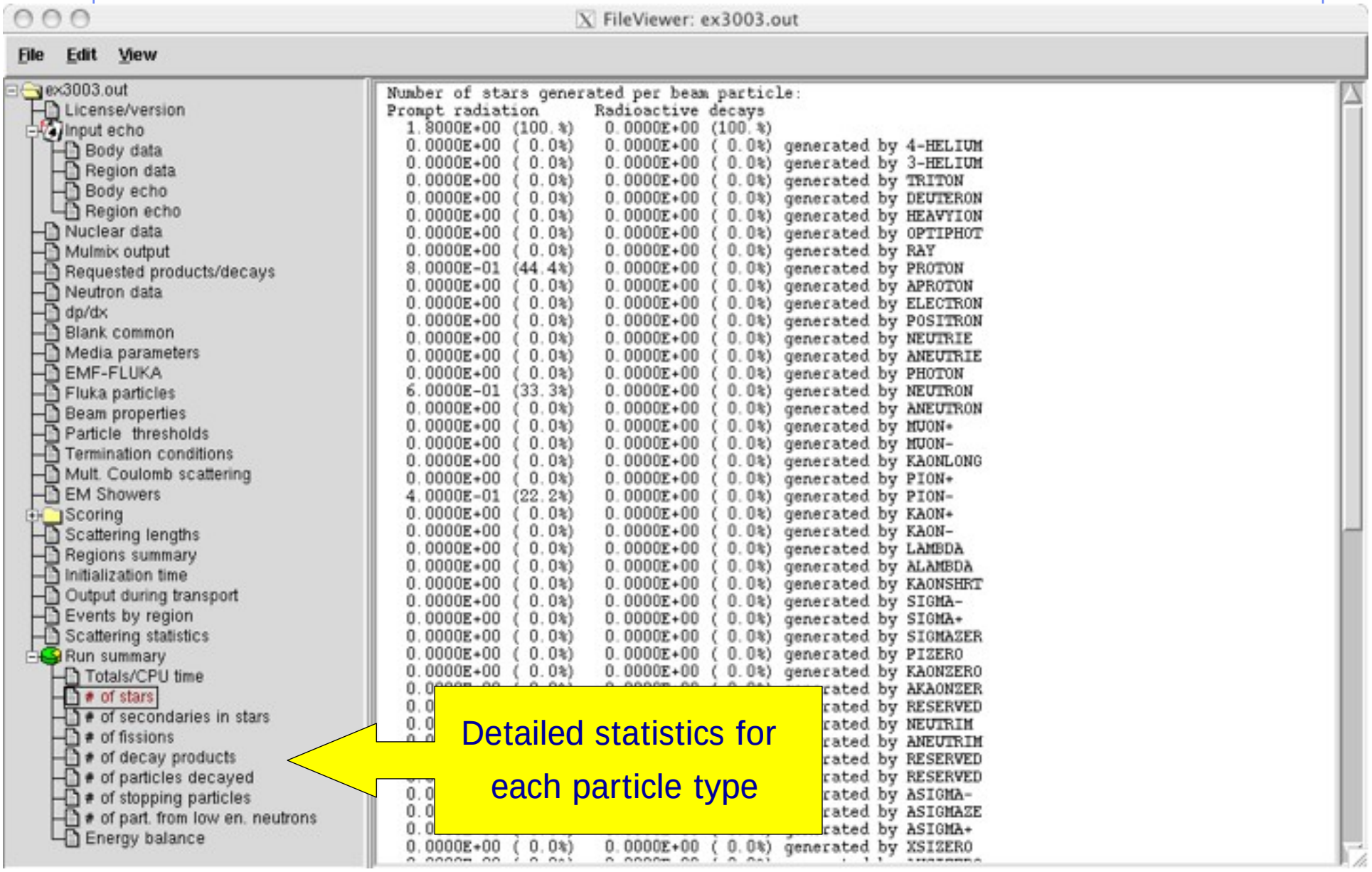
  - Run summary
    - Totals/CPU time
    - # of stars
    - # of secondaries in stars
    - # of fissions
    - # of decay products
    - # of particles decayed
    - # of stopping particles
    - # of part. from low en. neutrons
    - Energy balance

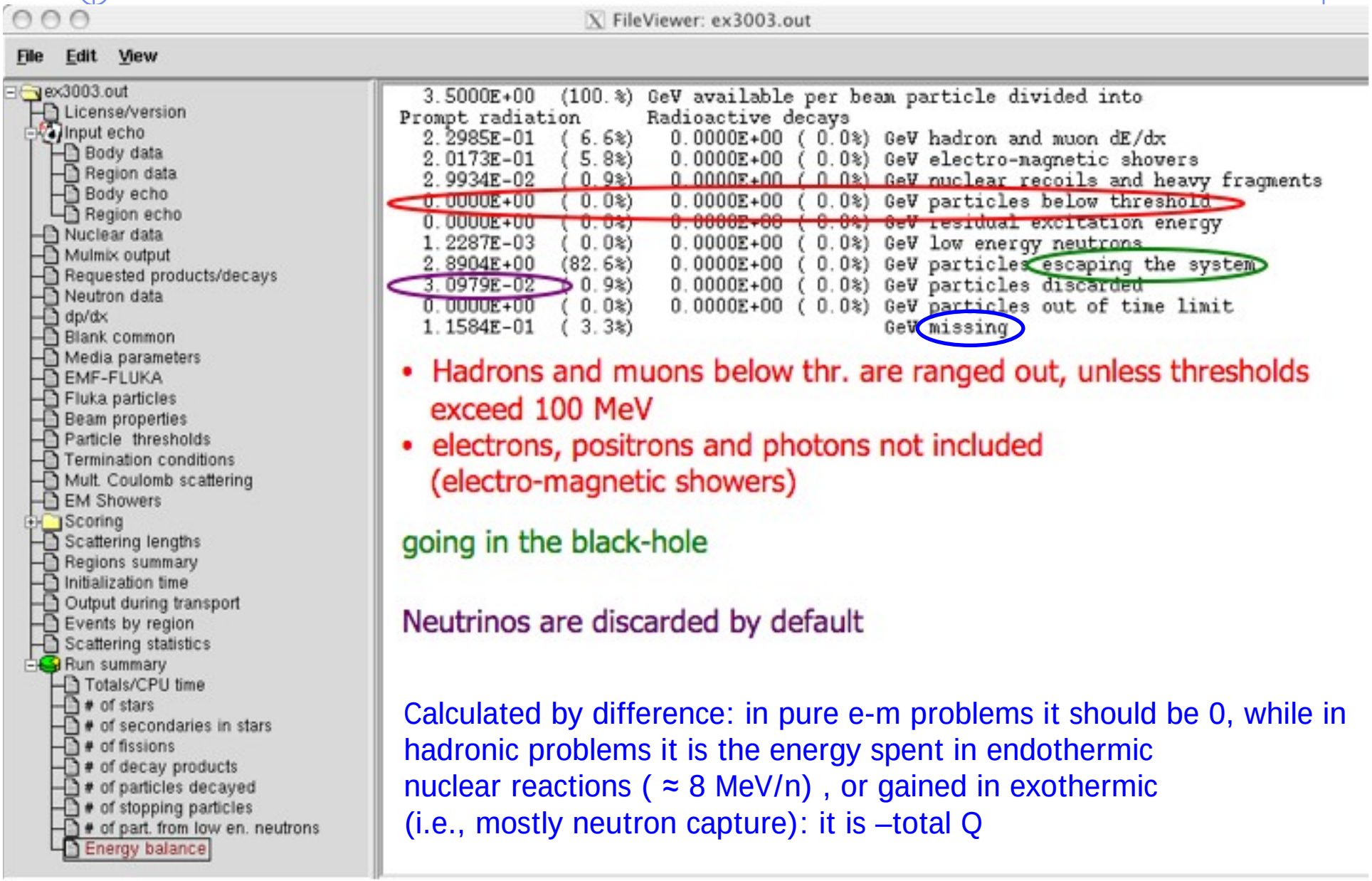
```
Total number of primaries run:          10000 for a weight of: 1.000000E+04
!!! Please remember that all results are normalized  per unit weight !!!
The main stack maximum occupancy was          86 out of      40000 available


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!

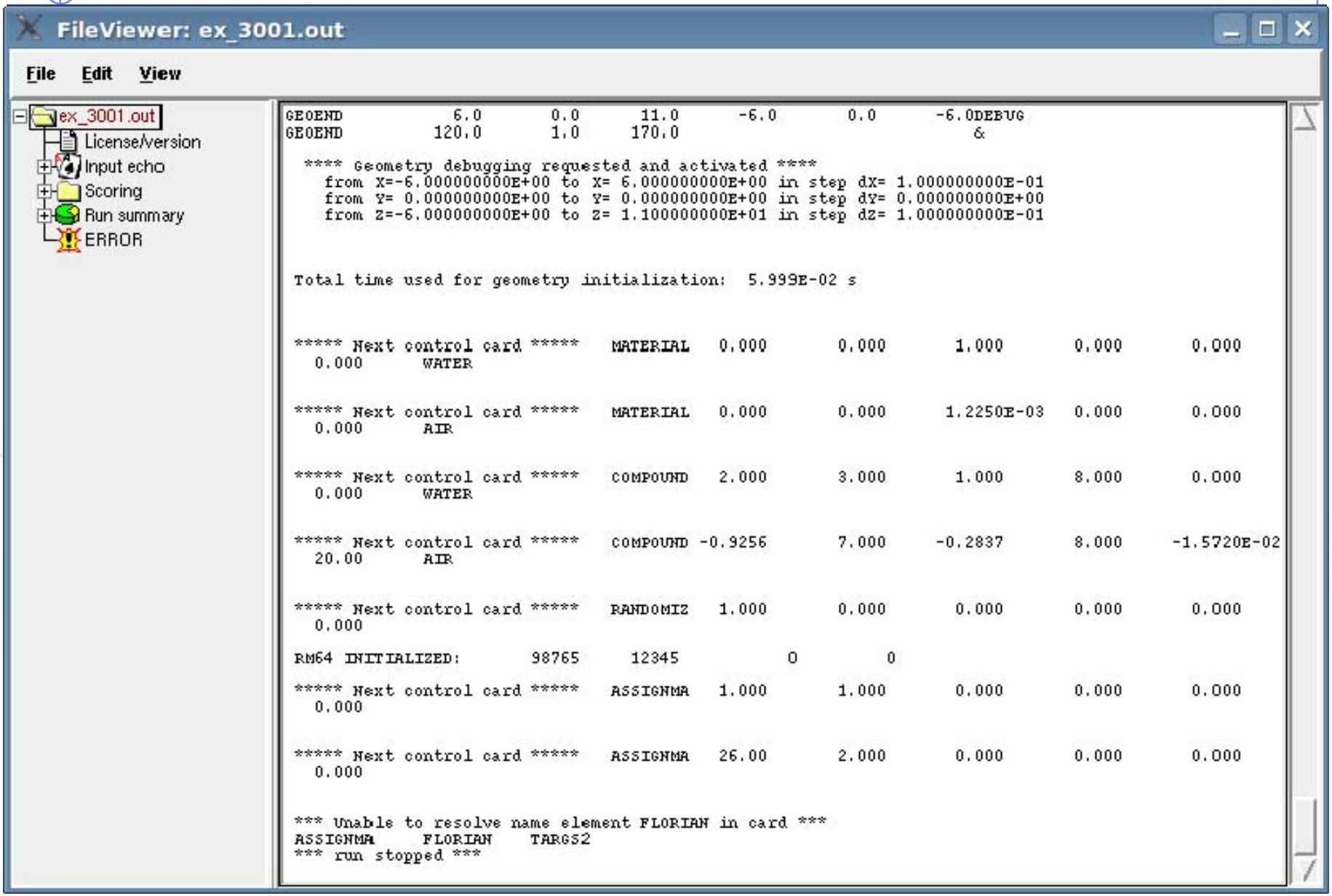
Run summary: *detailed statistics*



Energy Balance



Error message



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.