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Title:	ELA: Event Log Analyzer for MCNP5
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Form 836 (7/06)

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ELA: Event Log Analyzer for MCNP5

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ELA: Event Log Analyzer

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What is an Event Log Analyzer?

ELA is a PERL program with a Graphical User Interface (GUI) that enables an MCNP5 user to interrogate the MCNP5 event log.

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Why use ELA?

In Monte Carlo calculations where variance reduction is needed, the Monte Carlo practitioner may find it necessary to analyze the ensuing particle behavior to determine if the variance reduction technique (VRT) is performing as intended.

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How can this help?

Scores that are much larger than the mean may not have much impact on the mean, but tend to dominate the variance.

The practitioner engaged in variance reduction problems should spend his analysis time disproportionately on ensuring that large scores occur with small probability.

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To be successful in reducing variance:

Focus on understanding the behavior of unusual particles and not typical particles.

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Can't the VRT's handle these issues?

Sometimes the large score is due to a miss-applied variance reduction technique or points to a needed refinement in a variance reduction input parameter.

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How far should the practitioner go?

At times, none of the available VRTs (or adjusting their input parameters) can further improve the sampling that leads to the large score. Variance reduction efforts should cease.

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What is an event log?

The event log provides detailed tracking information as a particle follows a random walk with the aid of the VRTs.

Depending upon the geometry and physics involved in the problem, these random-length event logs can often be quite large.

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Sample Event Log

```
1     event log for particle history no.          1        ijk =        6647299061401
         cell     x         y         z         u         v         w       erg      wgt                        nch  nrn
 source     1  0.000+00  0.000+00  0.000+00  5.085-01  4.733-01  7.193-01 1.400+01 1.000+00   particle= photon          2
    ann     1  2.177+00  2.026+00  3.079+00  4.206-01 -8.641-01 -2.765-01 5.110-01 9.968-01 p npa=     1          1   22
    ann     1  2.177+00  2.026+00  3.079+00 -4.206-01  8.641-01  2.765-01 5.110-01 9.968-01 p npa=     1          1   22
    col     1  2.177+00  2.026+00  3.079+00  5.085-01  4.733-01  7.193-01 1.400+01 9.968-01   z= 13  pp          1   22
    ter     1  2.177+00  2.026+00  3.079+00  5.085-01  4.733-01  7.193-01 1.400+01 9.968-01   pair production          22

  bank      1  2.177+00  2.026+00  3.079+00 -4.206-01  8.641-01  2.765-01 5.110-01 9.968-01 p annihilat            22 22
    sur     2  1.588+00  3.235+00  3.466+00 -4.206-01  8.641-01  2.765-01 5.110-01 9.968-01   surf=     1           23
    col     2  1.090+00  4.258+00  3.794+00 -9.200-01  3.191-01 -2.277-01 3.649-01 9.968-01   z= 13  inc         2   36
    ter     2  1.090+00  4.258+00  3.794+00 -9.200-01  3.191-01 -2.277-01 3.649-01 9.968-01   energy cutoff           36

  bank      1  2.177+00  2.026+00  3.079+00  4.206-01 -8.641-01 -2.765-01 5.110-01 9.968-01 p annihilat            22 36
    sur     2  4.184+00 -2.097+00  1.760+00  4.206-01 -8.641-01 -2.765-01 5.110-01 9.968-01   surf=     1           37
    col     2  6.510+00 -6.876+00  2.306-01  5.012-01  8.111-01  3.016-01 1.986-01 9.968-01   z= 13  inc         3   44
    ter     2  6.510+00 -6.876+00  2.306-01  5.012-01  8.111-01  3.016-01 1.986-01 9.968-01   energy cutoff           44
```

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Event Log Events

- banked events
- splits
- surface crossings
- particle production
- DXTRAN spheres
- collisions
- terminations

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Event Log Track Information

- Position
- Direction
- Energy
- Weight
- Cell Number

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Event Log Facts

- One particle can generate numerous entries.
- In a text editor, this information is one-dimensional and difficult to comprehend.

  Together, these two act as deterrents and the information goes unused.

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How ELA Helps

- Information is presented in a two-dimensional, hierarchical tree.
- Particle information is color coded.
- Weights out of the weight window bounds are flagged.
- Data selected by event.
- Some information filtering.

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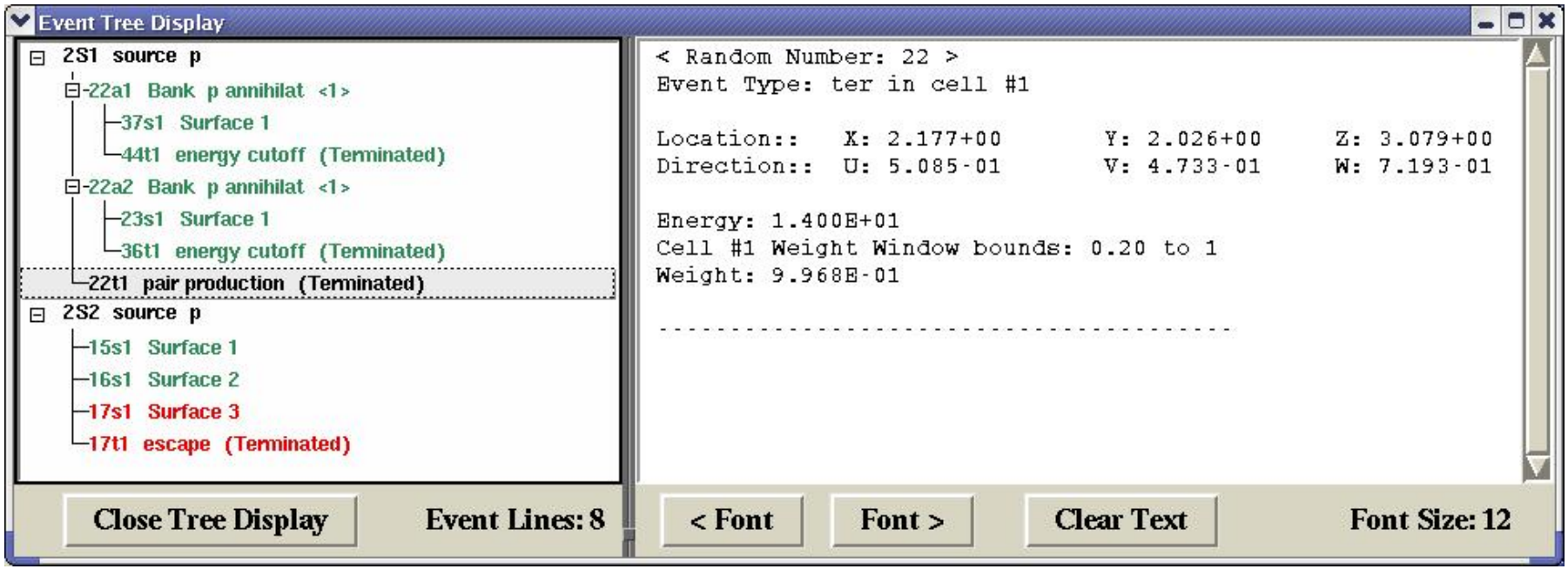
Sample Event Tree Display



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Surface Tallies

For some applications, surface tallies may be the desired means to obtain a result.

ELA has a “Surface Analysis” option that filters event log information by surface.

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Surface Analysis

Query any given surface by particle and event type.

Report the top tracks by weight and how these weights compare to the average weight for tracks in the event log crossing the surface.

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Surface Analysis Advantage

Lets the user quickly find those tracks that are the major contributors to the variance.

Then, the tree can be used to investigate this list of top offenders.

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Sample Surface Analysis Display (top)

Surface Analysis Display

```
*** Particle Type            : p
*** Surface                  : 19
*** Number of Top Weights    : 10
*** Event Type               : ALL

Number of type 'p' banked particles is 512 for ALL event types

***** Distribution of Weights for Surface 19 *****
Number less than (mean - 3*std)                  : 75
Number between (mean - 3*std) & (mean - 2*std)   : 342
Number between (mean - 2*std) & (mean - 1*std)   : 34
Number between (mean - 1*std) & the mean         : 15
Number between the mean & (mean + 1*std)         : 6
Number between (mean + 1*std) & (mean + 2*std)   : 4
Number between (mean + 2*std) & (mean + 3*std)   : 4
Number greater than (mean + 3*std)               : 32

***** Event Log Results: Surface 19 *****
      Mean is 1.793087e-04  +/-  5.492123e-05  (1 Std. Dev.)

***** The TOP 10 Weights ***** for ALL event types
Random Number    Weight      Std. Devs. Above Mean    Energy     Generated
    213624      2.259e-02          408.1            1.059e+00      dxt
    125358      1.020e-02          182.5            3.359e+00      dxt
     75588      9.617e-03          171.8            4.877e+00      dxt
     41800      8.542e-03          152.3            9.911e+00      dxt
    125439      2.282e-03           38.3            2.042e+00      dxt
    162299      1.679e-03           27.3            6.332e+00      dxt
```

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Sample Surface Analysis Display (bottom)

```
    125157      1.185e-03          18.3              4.923e+00      dxt
    231198      1.003e-03          15.0              9.267e+00      dxt

*****************************************************************************
*****************************************************************************

Details for the top 10 weights for ALL event types

Weight    : 2.259E-02
Cell      : 102
Position  : 5.816+00  1.800+02  4.749+00
Direction : -2.209-02  9.998-01  1.746-04
Energy    : 1.059+00

From Banked RN : 41811                    Banked Generated By : dxt

*****************************************************************************

Weight    : 1.020E-02
Cell      : 102
Position  : 3.815+00  1.800+02  -3.322+00
Direction : -4.867-01  8.561-01  1.738-01
Energy    : 3.359-01

From Banked RN : 125333                    Banked Generated By : dxt

*****************************************************************************
```

< Font | Font > | Clear Text | Close Display | Font Size: 12

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Examples

- Multiple “top events” at the same energy.
- Position & direction show random walk from one cell to another where importances are drastically different.

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The Paradigm

ELA is not a black box. It is a diagnostic tool.

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Odds & Ends

- Works with MCNP Version 5.1.50 onward.
- Not yet released with MCNP5 distribution.
- Have included more detailed instruction on its use in the LANL *Advanced Variance Reduction* class.

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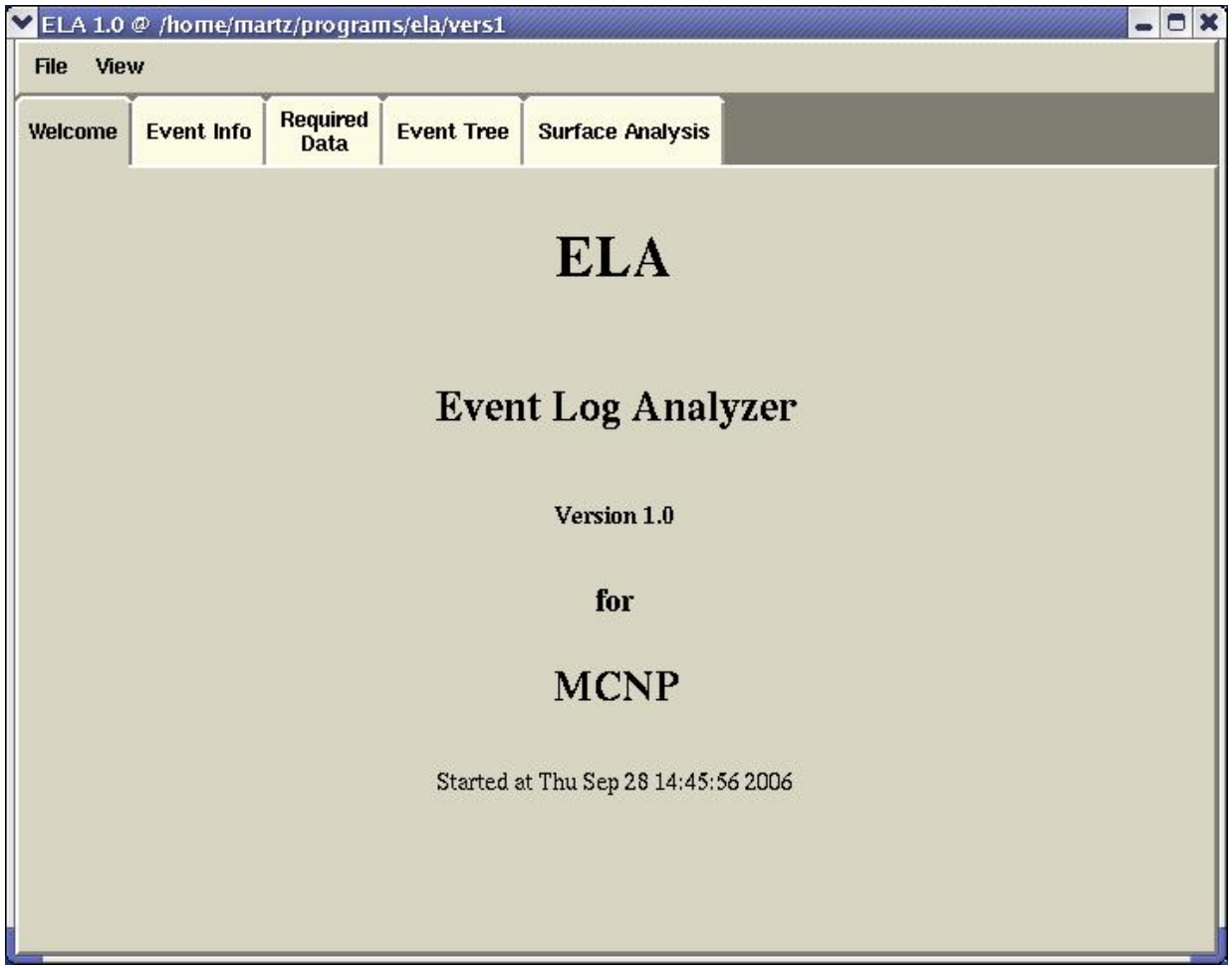

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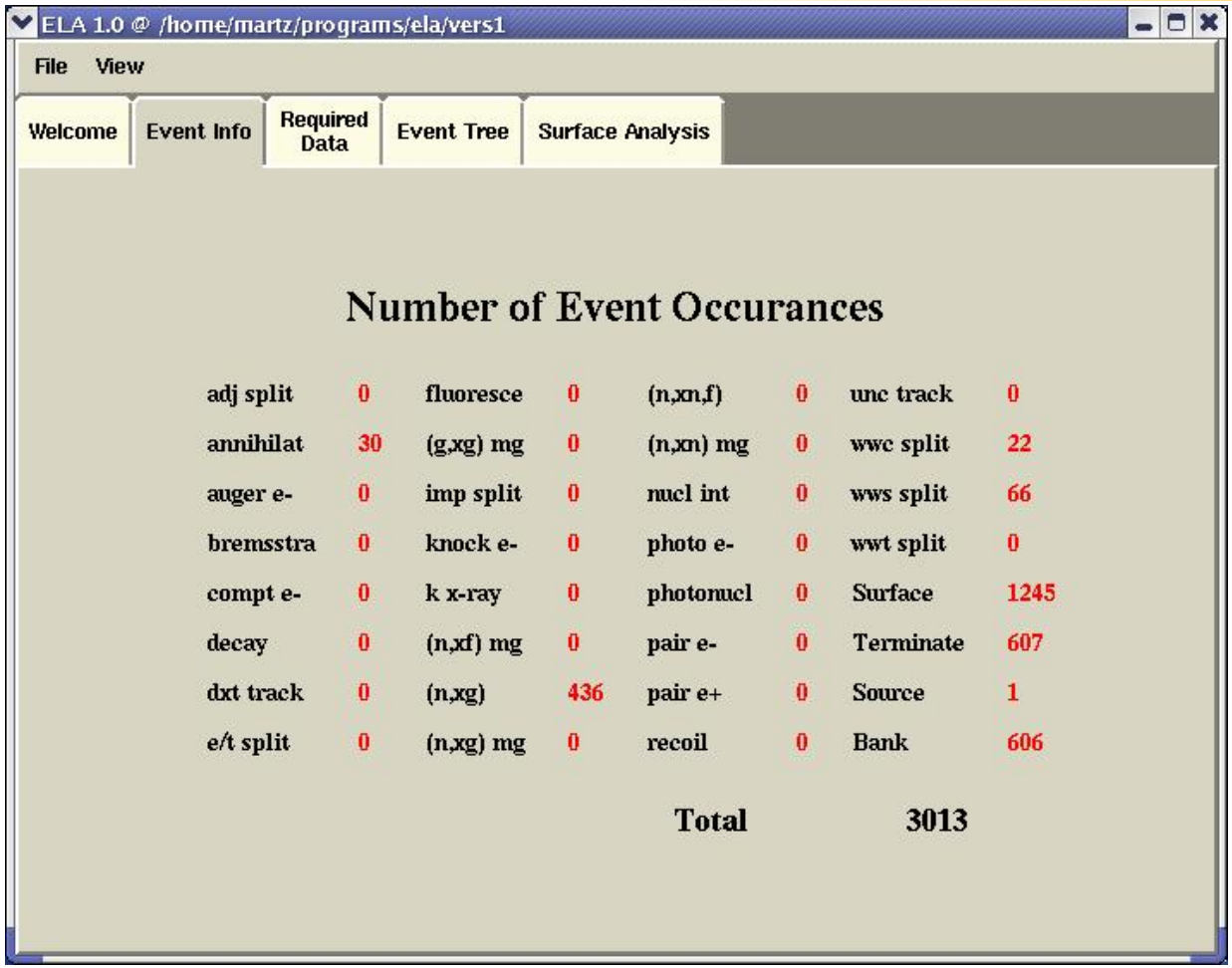

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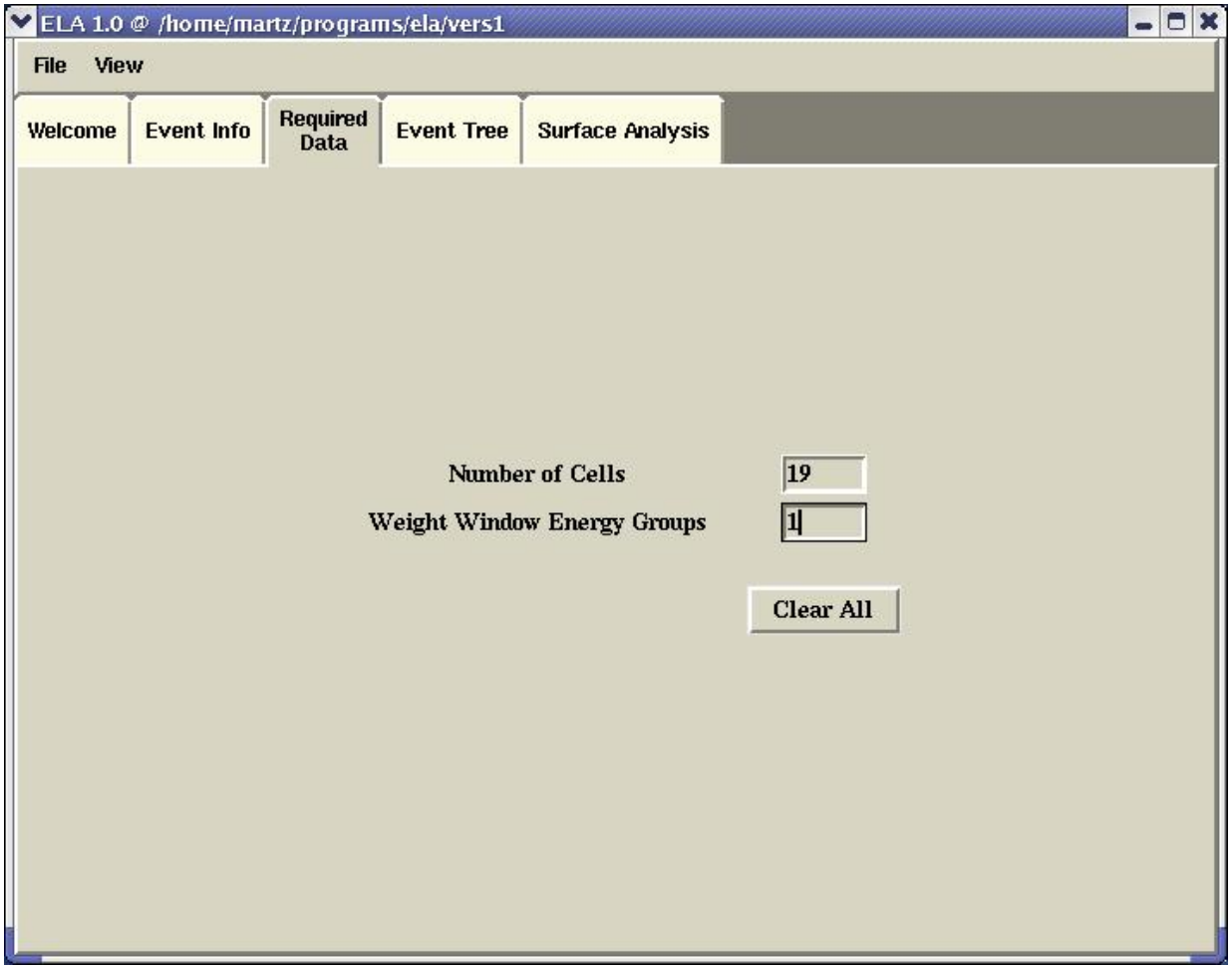

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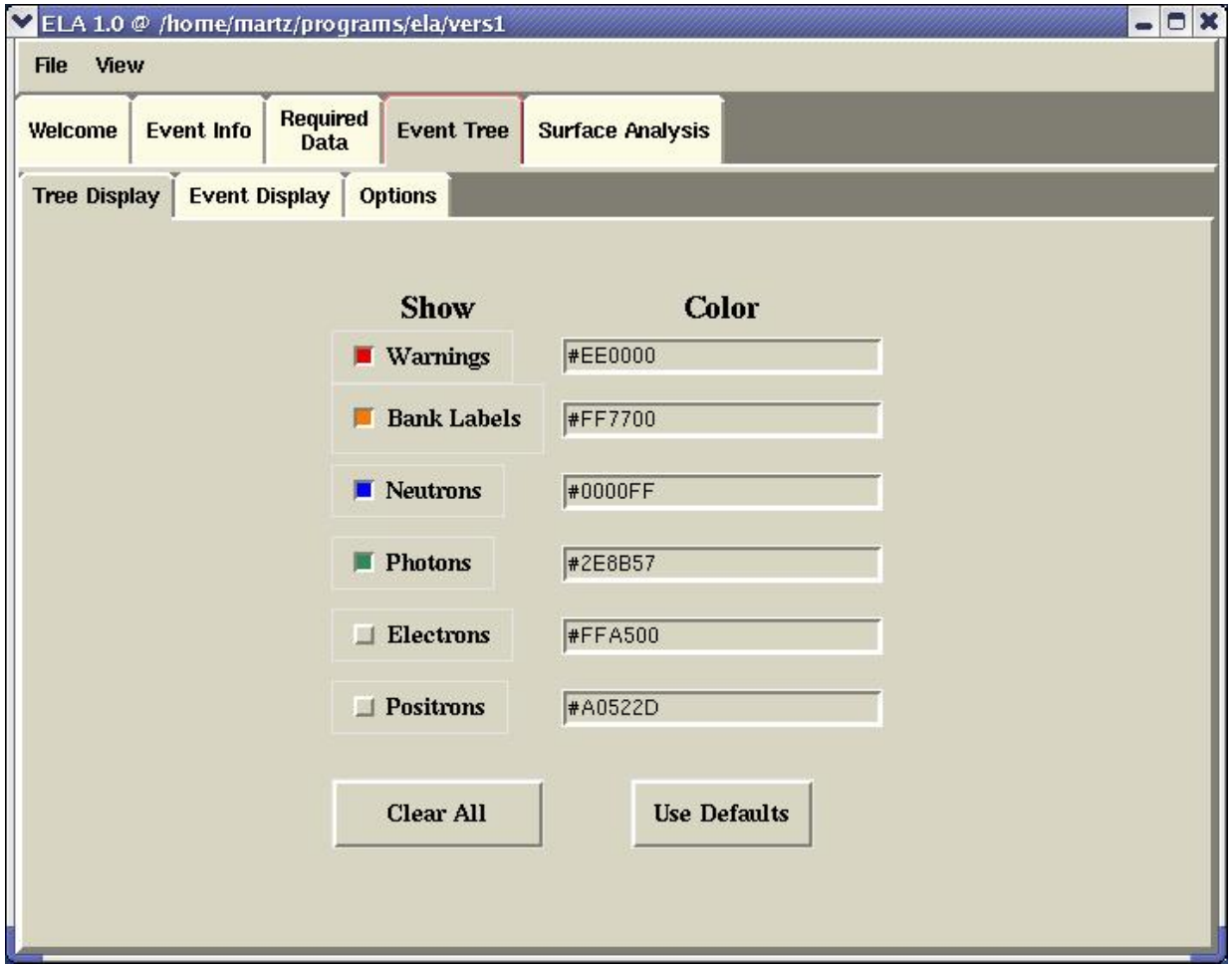

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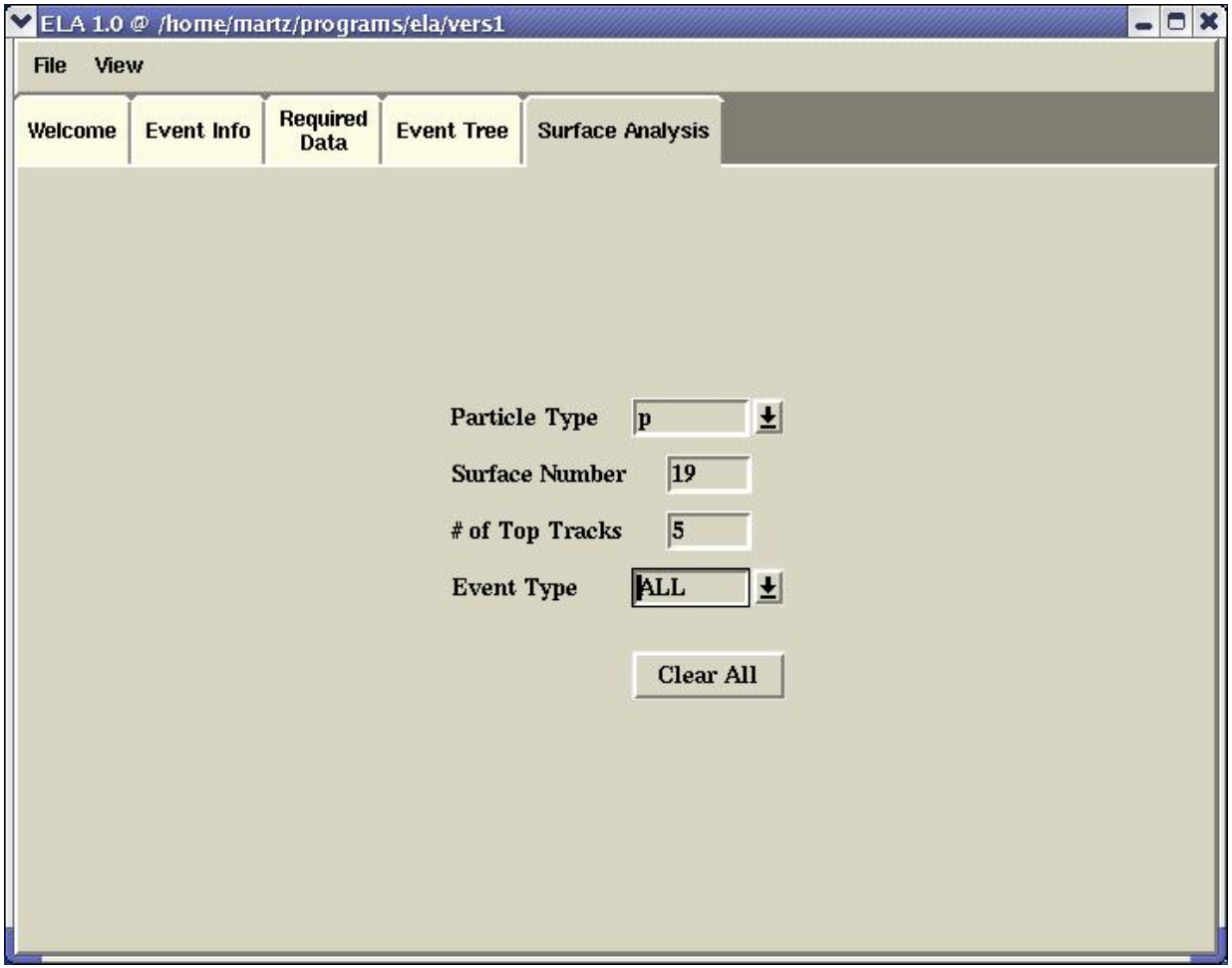

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Conclusion

Provided a useful tool to Monte Carlo practitioners so that they can make better use of the MCNP event log in tuning their problems that use variance reduction.