



# The Les Houches Event File format

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# The Les Houches Event File

- ▶ Past
- ▶ Yesterday
- ▶ Today
- ▶ Future



## 2001, In the beginning there was F77

```
common /HEPRUP/ IDBMUP(2), EBMUP(2), PDFGUP(2), PDFSUP(2),  
+ IDWTUP, NPRUP, XSECUP(MAXPUP), XERRUP(MAXPUP),  
+ XMAXUP(MAXPUP), LPRUP(MAXPUP)  
common /HEPEUP/ NUP, IDPRUP, XWGTUP, SCALUP, AQEDUP, AQCDUP,  
+ IDUP(MAXNUP), ISTUP(MAXNUP), MOTHUP(2,MAXNUP),  
+ ICOLUP(2,MAXNUP), PUP(5,MAXNUP), VTIMUP(MAXNUP),  
+ SPINUP(MAXNUP)
```



## 2006, the first file format

```
<LesHouchesEvents version="1.0">
  <!--
    # optional information in completely free format,
    # except for the reserved endtag (see next line)
  -->
  <header>
    <!-- individually designed XML tags, in fancy XML style -->
  </header>
  <init>
    compulsory initialization information from /HEPRUP/
    # optional initialization information
  </init>
  <event>
    compulsory event information from /HEPEUP/
    # optional event information
  </event>
  (further <event> ... </event> blocks, one for each event)
</LesHouchesEvents>
```

Allows for extra information, but nothing was standardized.



## 2009, Update to version 2

Trying (somewhat prematurely) to standardize XML-tags for additional information, especially for ME/PS matching.

- ▶ `<generator>` Generator name/version
- ▶ `<xsecinfo>` Easy access to cross section information
- ▶ `<cutsinfo>` Information about ME-cuts (MadGraph-like)
- ▶ `<procinfo>` Process info in addition to /HEPRUP/
- ▶ `<mergetype>` Merging scales etc.

Both run information. . .



... and event information

- ▶ `<weight>` Allow for different (named) set of weights.
- ▶ `<clustering>` Basically specify the Feynman diagram.
- ▶ `<pdfinfo>` The values used for this event, eg.  $\mu_F$ .
- ▶ `<group>` Grouping together `<event>`s.



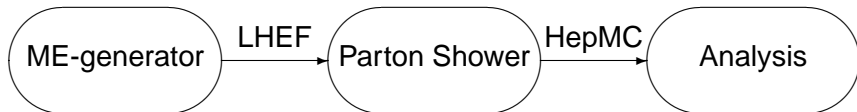
## 2013 (in June in Les Houches)

Not many (anyone?) uses the features of LHEFv2.

We put in too many features before they were actually needed.  
Some of them were not well thought through.

Today, ME/PS matching/merging is state of the art and we know better what we need. So back to the drawing board. . .





We should restrict the stuff to be standardized to information that the Parton Shower can

- ▶ use itself, or
- ▶ pass on through on HepMC.





# HepMC

HepMC is very restrictive. Only predefined information.

The experiments are **very** hesitant to use new versions of HepMC.

In LesHouches we suggested a convention for the names of the weights to enable passing of information to the analysis program.

Unfortunately there is no other place in HepMC to put additional information.



# Future, suggested changes to LHEF<sup>1</sup>

- ▶ `<generator>` More than one allowed to include information from Loop-generators, SUSY parameter calculators, ...
- ▶ `<mergeinfo>` Unclear how the PS should use it.  
*Deprecated*
- ▶ `<clustering>` Not physical, not unique (cf. dipole subtraction). *Deprecated*
- ▶ `<pdfinfo>` Unclear usage, except for factorization scale.  
*Deprecated*
- ▶ `<weight>` OK, but should be closer to the HepMC organization. Lots of information duplicated each event.  
*(Deprecated)*

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<sup>1</sup><http://phystev.in2p3.fr/wiki/2013:groups:tools:lhef3>



## <scales>

New per-event tag with information about different scales used by the MEG in the given event. The scales are given as attributes, and any attribute name is allowed. However, only the following attributes have a pre-defined meaning and if they are missing the value in `SCALUP` is assumed:

- ▶ `muf` The factorization scale in GeV
- ▶ `mur` The renormalization scale in GeV
- ▶ `mups` The suggested parton shower starting scale in GeV



## <weightinfo>

New tag in the `<init>` block, added to define which weights are given in each event. The attributes are (also other attributes are allowed, but they do not have a standardized meaning):

- ▶ `name` Should follow the convention proposed for HepMC.
- ▶ `muf` The factor multiplying the nominal factorization scale for the event for the given weight.
- ▶ `mur` The factor multiplying the nominal renormalization scale for the event for the given weight.
- ▶ `pdf` The LHAPDF code corresponding to the given weight.
- ▶ `pdf2` The LHAPDF code corresponding to the given weight for the second beam if different from `pdf`



## <weightgroup>

Used to group together `<weightinfo>` tags. The only attribute is a name specifying a string which will be combined with the name attribute of the included `<weightinfo>` tags to give the HepMC weight names.



## <weights>

Replaces the old <weight> tag and contains a list of weights for the <event>s given in the order they are defined by the <weightinfo> tags in the <init> block.

If a weight is absent in an event, it should be anyway be included as a zero weight.

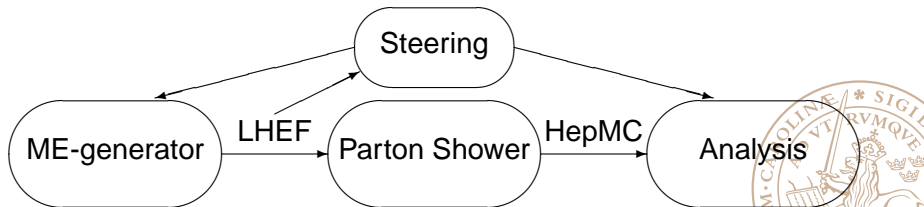
Note that the weight for the nominal event is still given by XWGTUP.



## Additional information

We are still allowed to add additional information to LHEF, but as long as there is no way of conveying that information through HepMC, there is no guarantee that it can be accessed.

Some steering programs may assume that the parton shower generator processes one event at the time and can pass on the relevant information to the analysis program



However, this may not necessarily work, since the parton shower is not guaranteeing that the LHEF event comes out in the same order as they come in.

The best solutions would be to pass the information through HepMC.

How do we do that?





`http://home.thep.lu.se/~leif/LHEF`

Contains a sample C++ class implementing reading/writing LHEF files according to the proposed standard.  
(Will soon move to hepforge)

