# MC-TESTER:

## a tool for comparisons of HEP Monte Carlo Generators

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  - history
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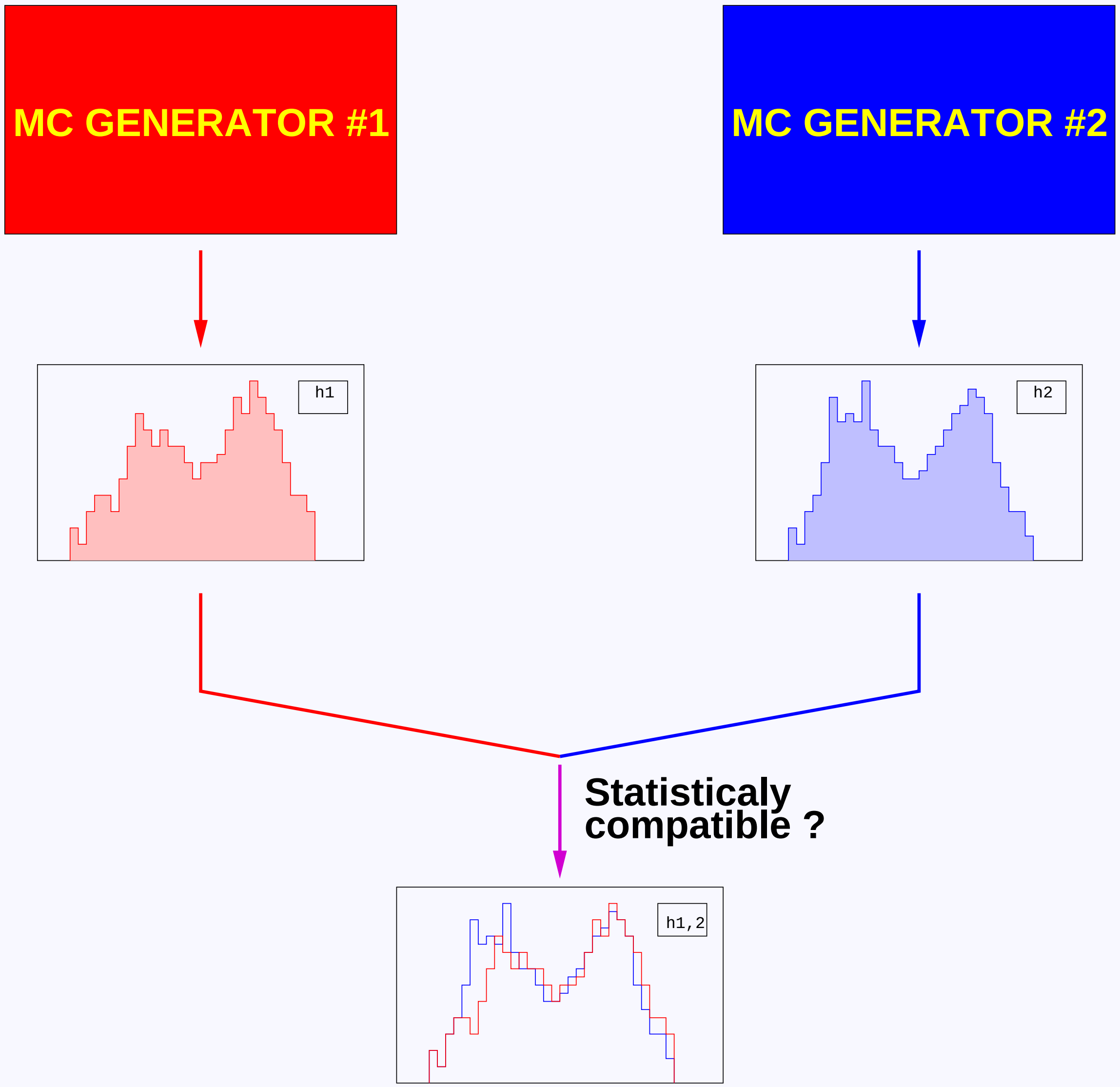
- Example of analysis: 6-fermion final states
- HEPEvent library
- Example of analysis: $\tau$ lepton decay MC generators comparison.
- Future improvements

# Excuses ...

.. for computer-scientist view of Physics...

# MC-TESTER: why?



# MC-TESTER: history

- *TAUOLA*: $\tau$ lepton decay Monte-Carlo library by Z. Was:
  - testing phase: checking for inconsistencies in invarant mass distribution
  - "visual":

    inconsistencies in shape of histogrammes,
    difference between shape of their division and flat distribution
  - performed for all possible mass invariants in every decay channel
  - hundreds of histogrammes to be compared!

# MC-TESTER incarnation

- authors: ***P. Golonka, T. Pierzchala, Z. Was***
- development: November 2000 - July 2002
- version 1.0 released: September 2002
- documentation: hep-ph\0210252:
  *"MC-TESTER: a universal tool for comparisons of Monte Carlo predictions for particle decays in high energy physics"*

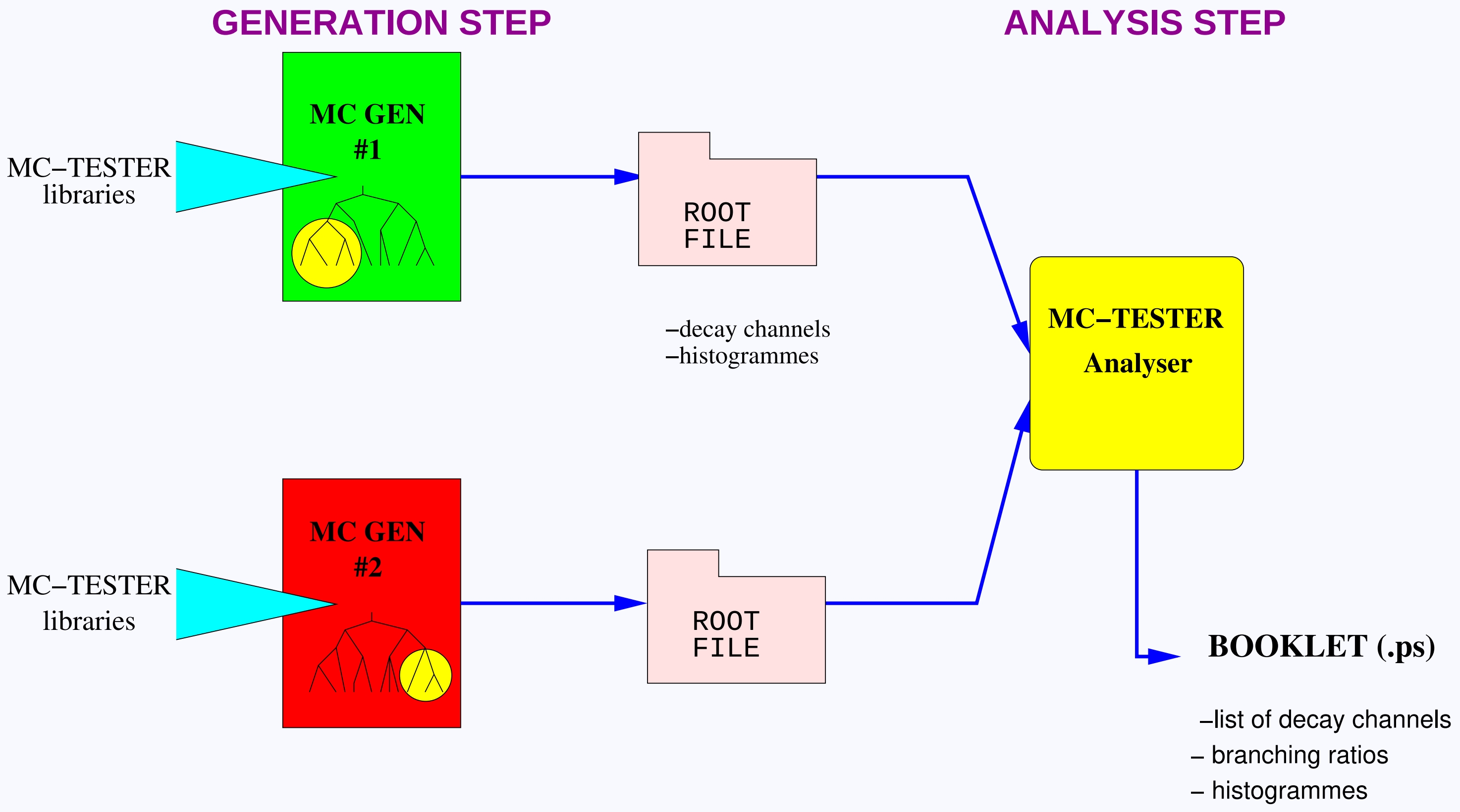
# MC-TESTER features:

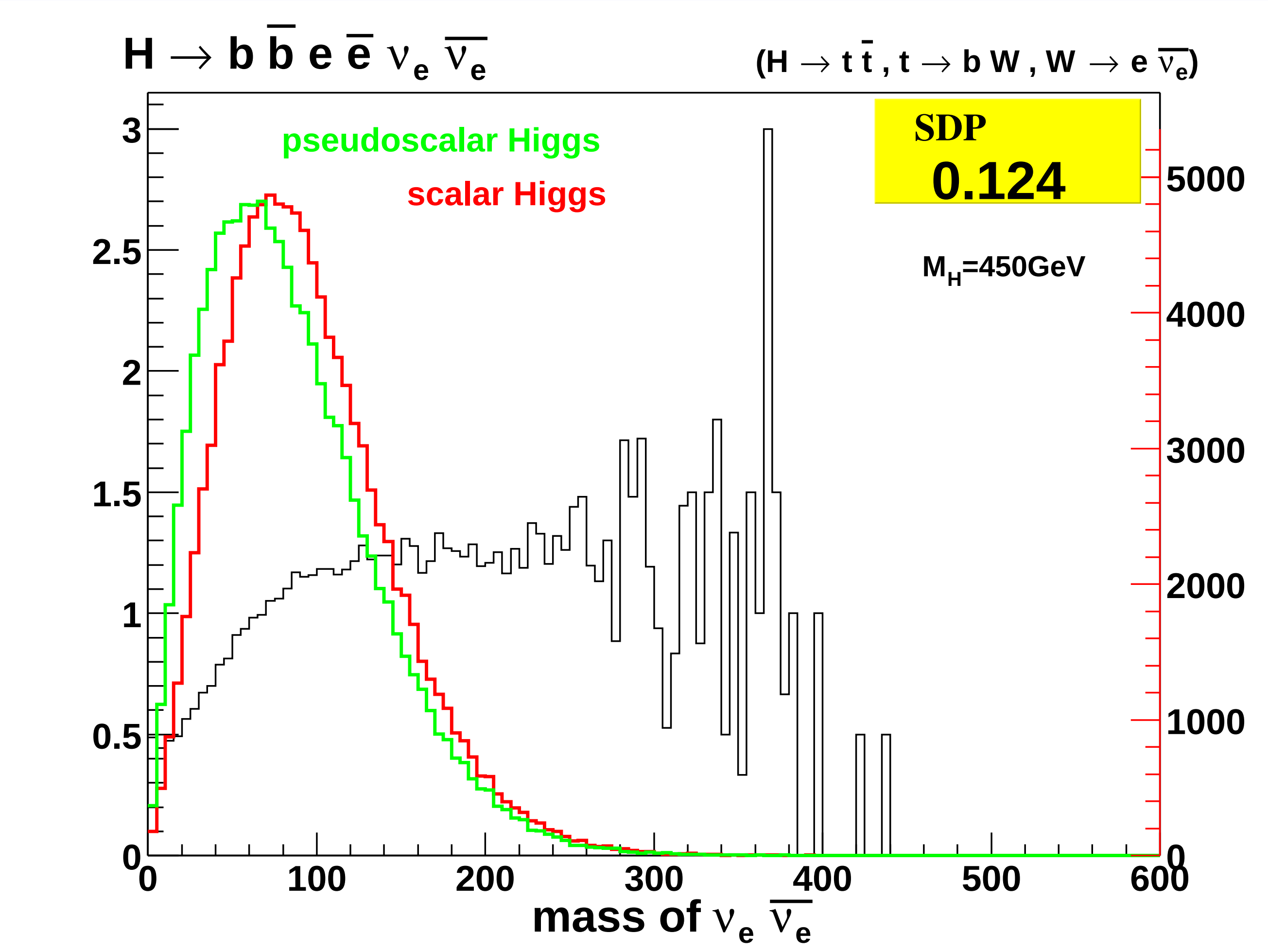
- works on decay trees produced by two (or more) HEP MC event generators
- uses all supported event records (see further slides)
- identifies decay channels of given particle ($\tau$, *H, etc)*
- creates/analyzes histogrammes of all invariant masses for every decay channels
- produces plots of histogrammes
- determines statistical compatibility for every two histogrammes: calculates "Shape Difference Parameter" (SDP)
- 3 pre-defined algorithms for SDP; user-provided as well

# MC-TESTER -aided analysis:

- For two (or more) MC generators (simulation systems), calls to MC-TESTER needs to be inserted to code, libraries linked
- Each simulation needs to be run, producing decay trees.
- Each decay tree is analysed by MC-TESTER routine, information/histogrammes of invariant masses stored in files.
- MC-TESTER analysis step: data files from two production runs are analysed: histogrammes for all matching decay channels analysed, plotted, SDP calculated
- booklet with the results of analysis is produced.

# MC–TESTER analysis:





H → b b̄ e ē ν_e ν̄_e
(H → t t̄ , t → b W , W → e ν̄_e)
pseudoscalar Higgs
scalar Higgs
SDP
0.124
M_H=450GeV
0
0.5
1
1.5
2
2.5
3
0
1000
2000
3000
4000
5000
0
100
200
300
400
500
600
mass of ν_e ν̄_e

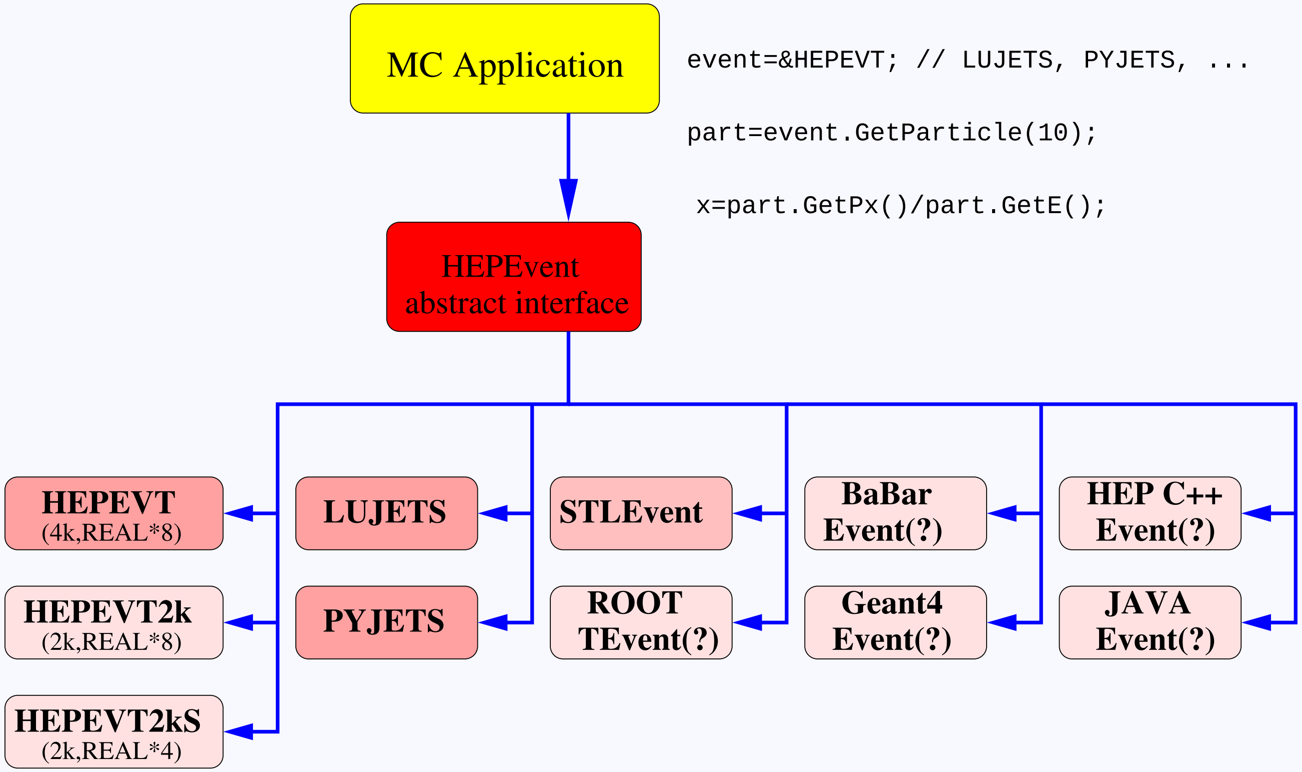
## MC-TESTER requirements:

- ROOT library
- LaTeX
- Linux system with g77 and g++ compilers.(RedHat 6.1, 7.2, 8.0 tested)
- A few tens of MB of disk space.
- Event records supported by HEPEvent library (see next slide).

WARNING: decay channels with large multiplicities ( >7 )produces thousands of histogrammes! Analysis may take long time, intermediate data files and booklet may be large. There may exist problems with memory allocation.

# HEPEvent library.

- Unified, C++ access to various HEP MC Event Record in F77
- First implementation: “Photos+”
- Currently Supports:
  - HEPEVT
  - LUJETS (i.e. Pythia 5)
  - PYJETS (i.e. Pythia 6)
  - Experimental C++ event structures
- In future:
  - C++, Java(?) event records.
  - simplified access to various “flavours” of F77 event records (precision, number of entries)




```
event=&HEPEVT; // LUJETS, PYJETS, ...

part=event.GetParticle(10);

 x=part.GetPx()/part.GetE();
```

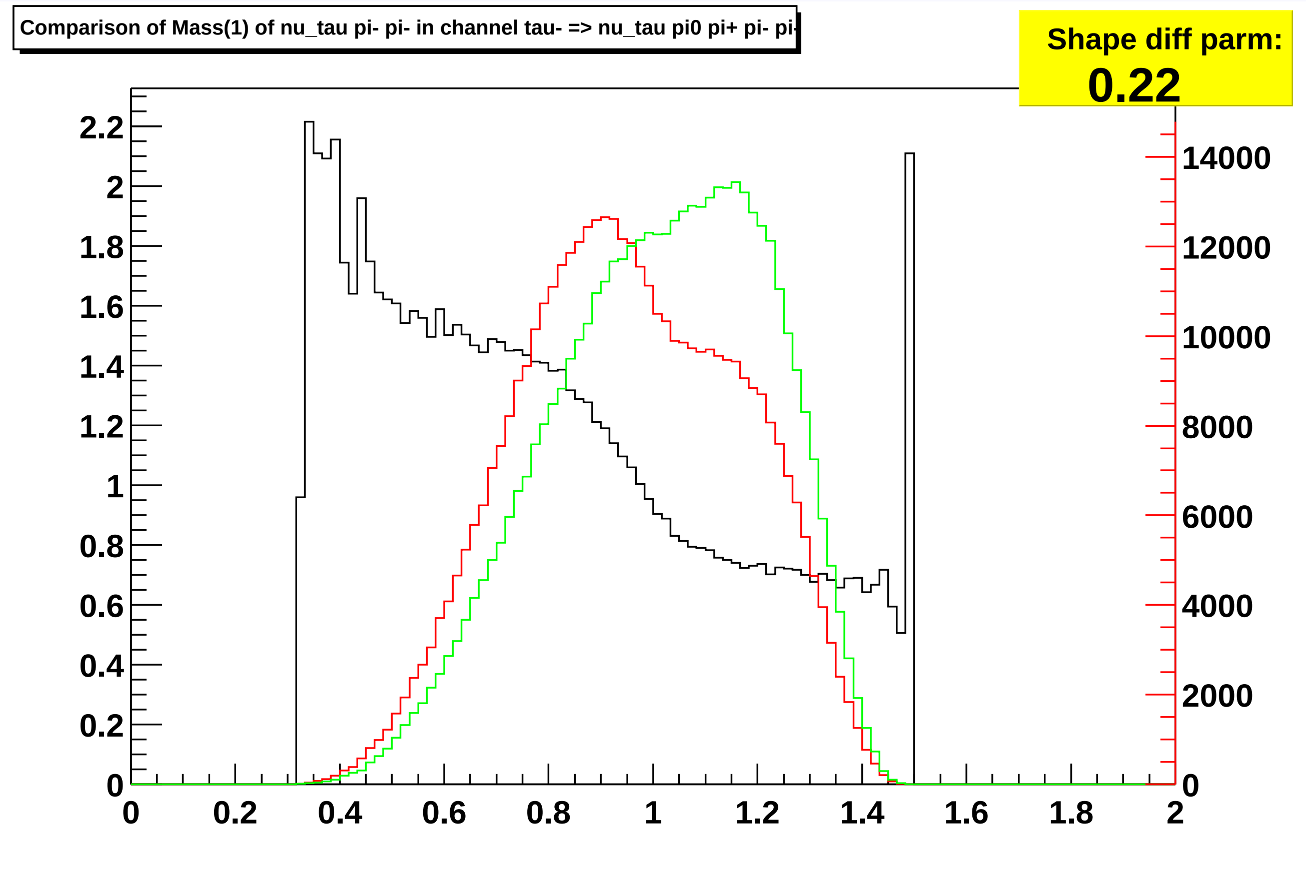
# Example:

$\tau$ lepton decay generators comparison:

- two versions of TAUOLA library with different initializations:
  - CLEO
  - ALEPH
- PYTHIA

*Task:* identify and compare the decay channels of the $\tau$ lepton produced by these generators.

# Ex: single plot



## Accesibility:

- The program and the documentation are available from the webpage: `http://cern.ch/Piotr.Golonka/MC/MC-TESTER`

# Future extensions:

- Support for other event record standards
  C++
  JAVA

- Support for other parameters (e.g accolinearity)
- Limit on depth of analysed decay tree
- Switch off analysis of decays of certain particles (e.g. $\pi_0$)

# Conclusions and outlook

- MC-TESTER may be a useful tool for analysis performed for linear colliders studies
- It easily integrates with already existing Monte Carlo environments
- Support for all major event record standards is provided
- It may help to find observables for physics studies

# Acknowledgments

- **Malgorzata Worek**, for providing the Higgs decay library
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