MC-TESTER for validating FORTRAN and C++ decay packages and their installations

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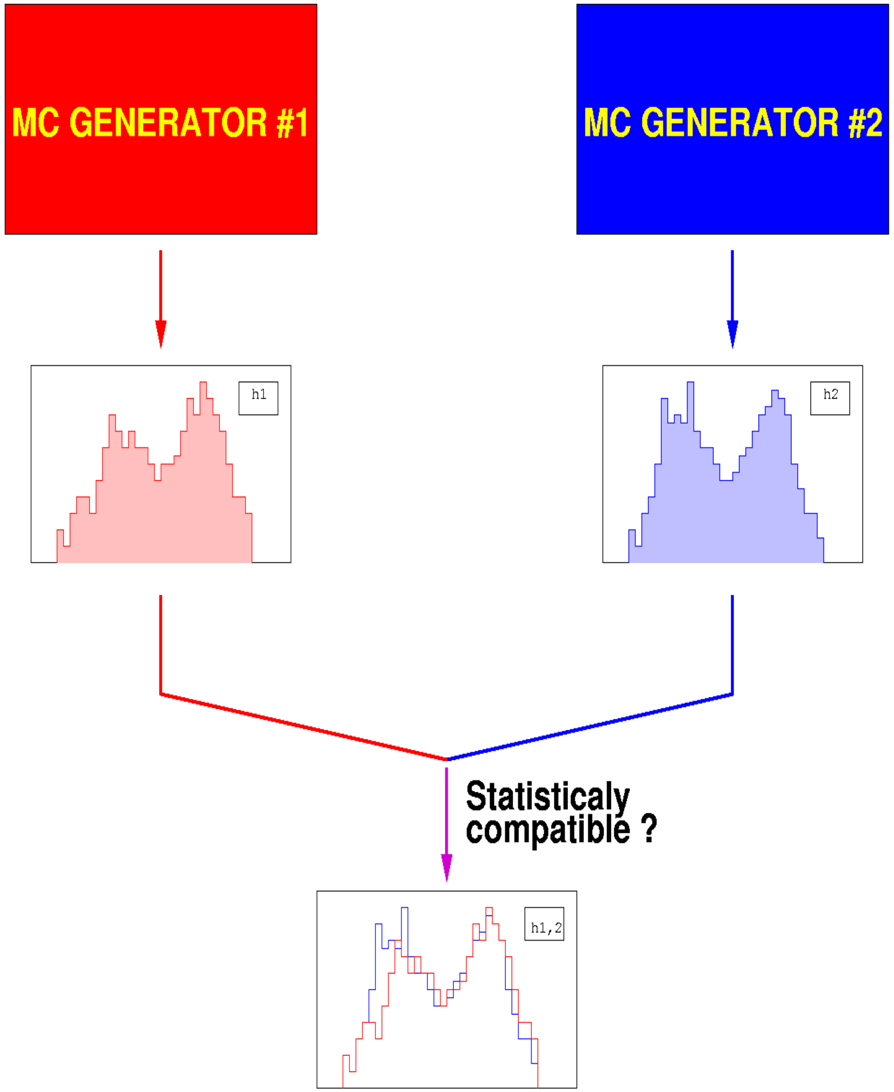
http://cern.ch/Piotr.Golonka/MC/MC-TESTER

Contents:

- **MC-TESTER**: a tool for semi-automatic comparisons of HEP Monte Carlo event generators for particle decays.
- Interfacing to event records
- Live Tutorial

MC-TESTER: why?



- Development of new event generators
- Porting the software to other languages

  i.e. F77-> C++

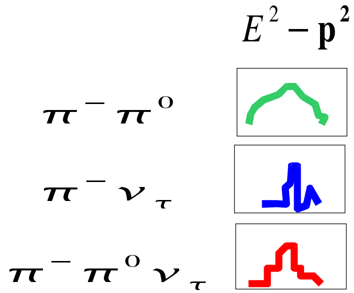
  `photos -> Photos+`

  `tauola -> Tauola+`

- Tests of large installations:
  - bad/double initializations
  - overwriting the variables
  - improper configurations
  - other clashes

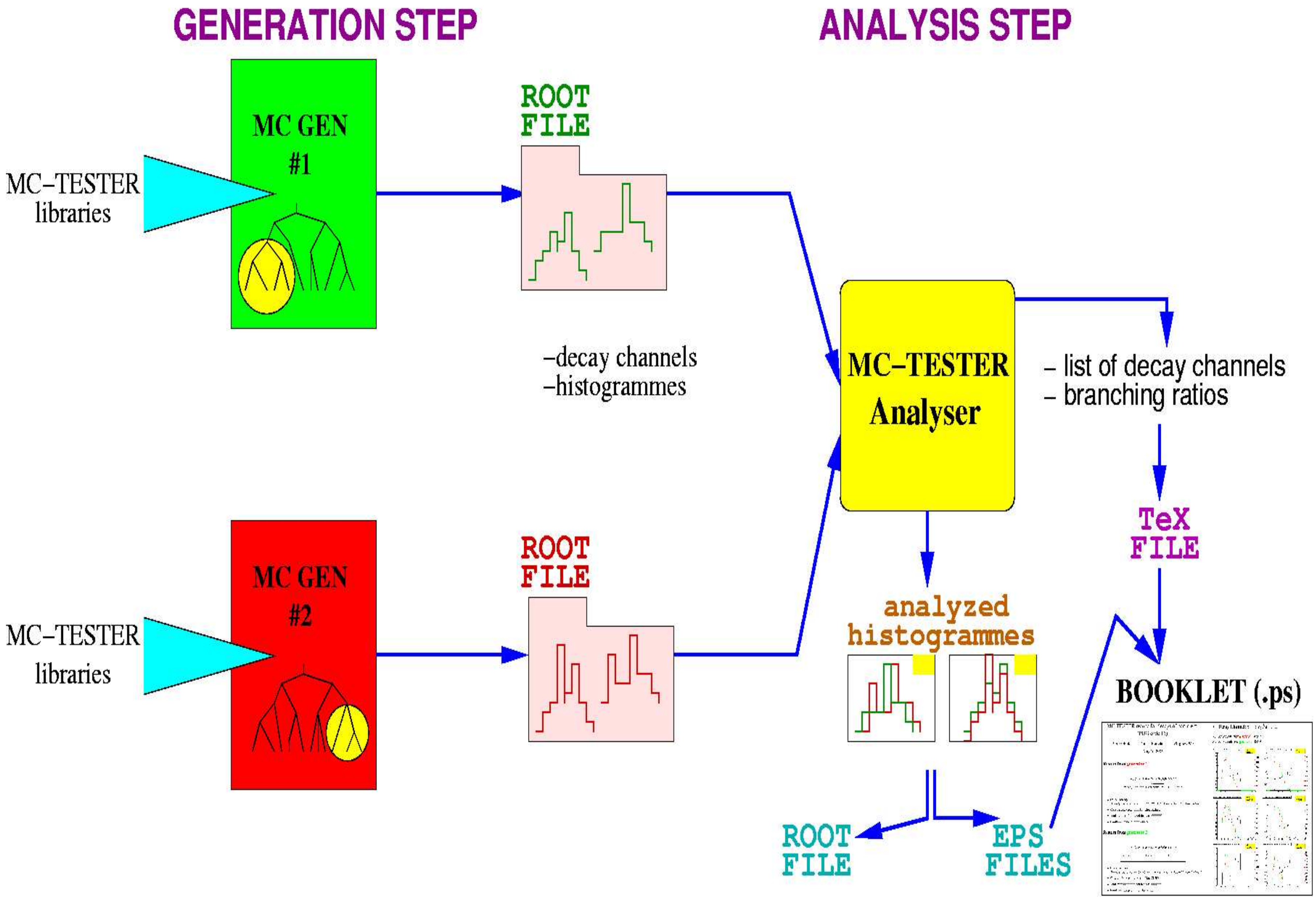
MC-TESTER analysis:

- Analyzes **decays** of defined particle (e.g. τ lepton) generated “on the fly”:
  - Identifies **decay channels** $\tau^- \to \pi^- \pi^0 \nu_\tau$ $\tau^- \to e^- \tilde{\nu}_e \nu_\tau$
  - Within every decay channels, creates histogrammes of all **invariant masses**



  - At the end of a run: calculates **branching ratios**
  - The **histogrammes** and the information about identified decay channel are stored in the intermediate ROOT files
  - The ROOT files with results of generation from two MC generators are **analyzed** in semi-**automatic** way
  - **Booklet** with results is produced

MC–TESTER analysis:



Found decay modes:

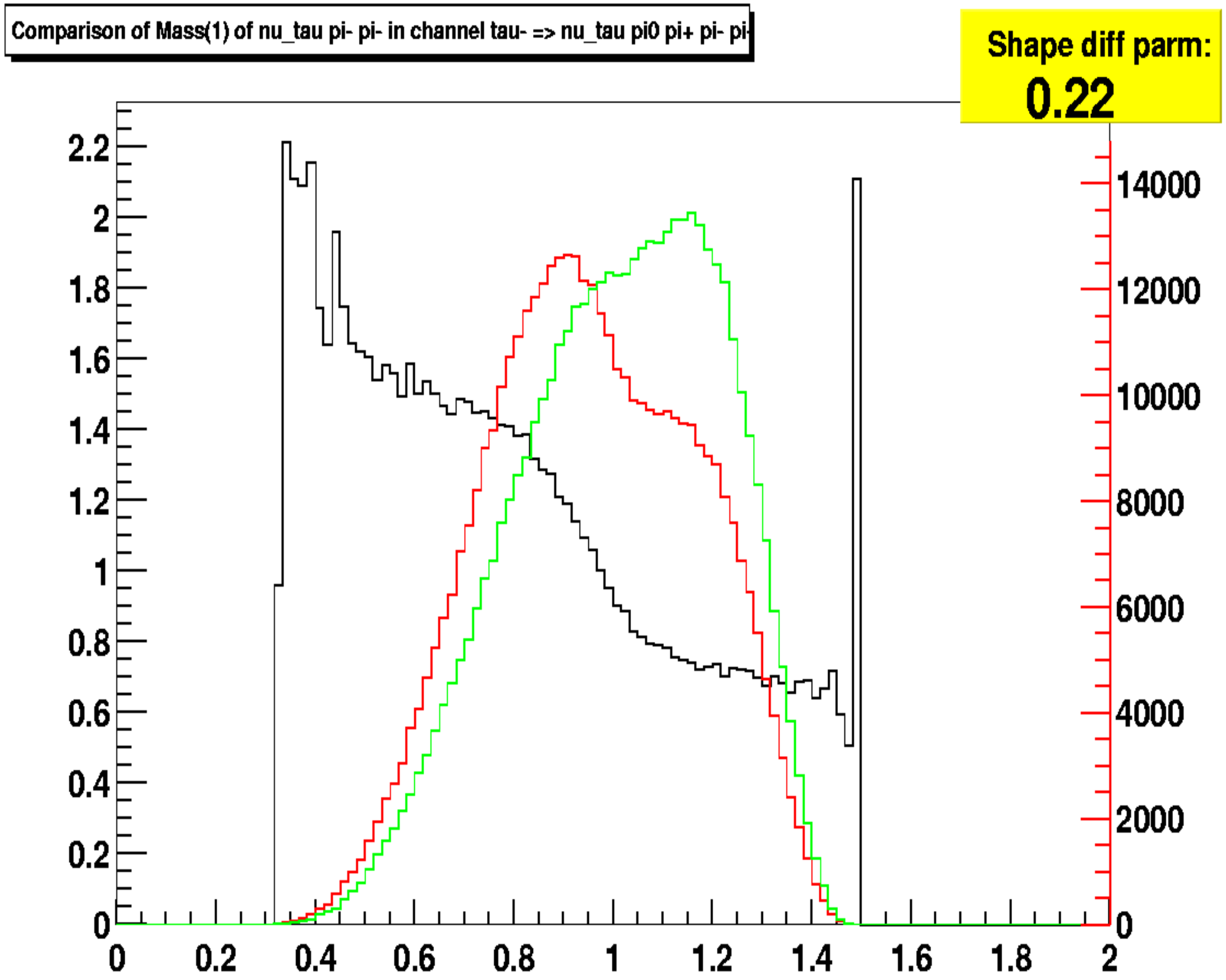
Table of decay modes:

Decay channel	Branching Ratio ± Rough Errors Generator #1	 Generator #2	Max. shape dif. param.
$\tau^- \to \nu_\tau \pi^0 \pi^-$	25.3683 ± 0.0159%	25.3085 ± 0.0159%	0.04375
$\tau^- \to e^- \tilde{\nu}_e \nu_\tau$	17.8479 ± 0.0134%	18.1093 ± 0.0135%	0.00000
$\tau^- \to \mu^- \tilde{\nu}_\mu \nu_\tau$	17.3866 ± 0.0132%	17.6326 ± 0.0133%	0.00000
$\tau^- \to \nu_\tau \pi^-$	11.0768 ± 0.0105%	11.1765 ± 0.0106%	0.00000
$\tau^- \to \nu_\tau \pi^0 \pi^0 \pi^-$	9.1865 ± 0.0096%	9.1171 ± 0.0095%	0.09413
$\tau^- \to \nu_\tau \pi^+ \pi^- \pi^-$	8.9837 ± 0.0095%	8.8828 ± 0.0094%	0.09368
$\tau^- \to \nu_\tau \pi^0 \pi^+ \pi^- \pi^-$	4.2973 ± 0.0066%	4.5319 ± 0.0067%	0.30310
$\tau^- \to \nu_\tau \pi^0 \pi^0 \pi^0 \pi^-$	1.0765 ± 0.0033%	1.0090 ± 0.0032%	0.00724
$\tau^- \to \nu_\tau K^-$	0.7202 ± 0.0027%	0.7138 ± 0.0027%	0.00000
$\tau^- \to \nu_\tau \pi^0 \pi^0 \pi^+ \pi^- \pi^-$	0.4990 ± 0.0022%	0.0897 ± 0.0009%	0.00000
$\tau^- \to \nu_\tau \pi^0 K^-$	0.4785 ± 0.0022%	0.46[illegible] ± 0.0021%	0.00000
$\tau^- \to \nu_\tau K^0_L \pi^-$	0.4624 ± 0.0022%	0.4444 ± 0.0021%	0.00000
$\tau^- \to \nu_\tau \pi^- K^0_S$	0.4610 ± 0.0021%	0.4449 ± 0.0021%	0.00000
$\tau^- \to \nu_\tau \pi^+ \pi^- K^-$	0.3902 ± 0.0020%	0.5051 ± 0.0022%	0.52330
$\tau^- \to \nu_\tau \pi^0 \pi^- \eta$	0.1707 ± 0.0013%	0.1696 ± 0.0013%	0.00000
$\tau^- \to \nu_\tau \pi^- K^+ K^-$	0.1704 ± 0.0013%	0.1509 ± 0.0012%	0.07360
$\tau^- \to \nu_\tau \pi^0 K^0_L \pi^-$	0.1605 ± 0.0013%	0.2745 ± 0.0017%	0.92850
$\tau^- \to \nu_\tau \pi^0 \pi^- K^0_S$	0.1592 ± 0.0013%	0.2734 ± 0.0017%	0.93657
$\tau^- \to \nu_\tau \gamma \pi^0 \pi^-$	0.1559 ± 0.0012%	0.1303 ± 0.0011%	0.00000
$\tau^- \to \nu_\tau K^0_L \pi^- K^0_S$	0.1510 ± 0.0012%	0.0763 ± 0.0009%	0.00270
$\tau^- \to \nu_\tau K^0_L K^-$	0.1289 ± 0.0011%	0.0508 ± 0.0007%	0.00000
$\tau^- \to \nu_\tau K^0_S K^-$	0.1287 ± 0.0011%	0.0507 ± 0.0007%	0.00000
$\tau^- \to \nu_\tau \pi^0 \pi^0 \pi^0 \pi^+ \pi^- \pi^-$	0.1094 ± 0.0010%	0.0506 ± 0.0007%	0.00000
$\tau^- \to \nu_\tau \pi^+ \pi^+ \pi^- \pi^- \pi^-$	0.0803 ± 0.0009%	0.0401 ± 0.0006%	0.00000
$\tau^- \to \nu_\tau \pi^0 \pi^0 K^-$	0.0792 ± 0.0009%	0.0504 ± 0.0007%	0.29190
$\tau^- \to \nu_\tau K^0_L K^0_L \pi^-$	0.0760 ± 0.0009%	0.0372 ± 0.0006%	0.00854
$\tau^- \to \nu_\tau \pi^- K^0_S K^0_S$	0.0756 ± 0.0009%	0.0378 ± 0.0006%	0.01189
$\tau^- \to \nu_\tau \pi^0 K^0_L K^-$	0.0507 ± 0.0007%	0.0763 ± 0.0009%	0.85321
$\tau^- \to \nu_\tau \pi^0 K^0_S K^-$	0.0498 ± 0.0007%	0.0746 ± 0.0009%	0.87506
$\tau^- \to \nu_\tau \pi^0 \pi^+ \pi^+ \pi^- \pi^- \pi^-$	0.0186 ± 0.0004%	0.0293 ± 0.0005%	0.00000

Similarity coefficients: T1=1.881148 , T2=4.510389

- Decay channel
- Branching ratio for generator #1 and #2
- Rough statistical errors of branching ratios
- Maximal "Shape Difference Parameter"
- Similarity Coefficients

Example of histogrammes:



- Histogrammes of invariant mass from generator #1 and #2
- Ratio of the two histogrammes
- **Shape Difference Parameter** value

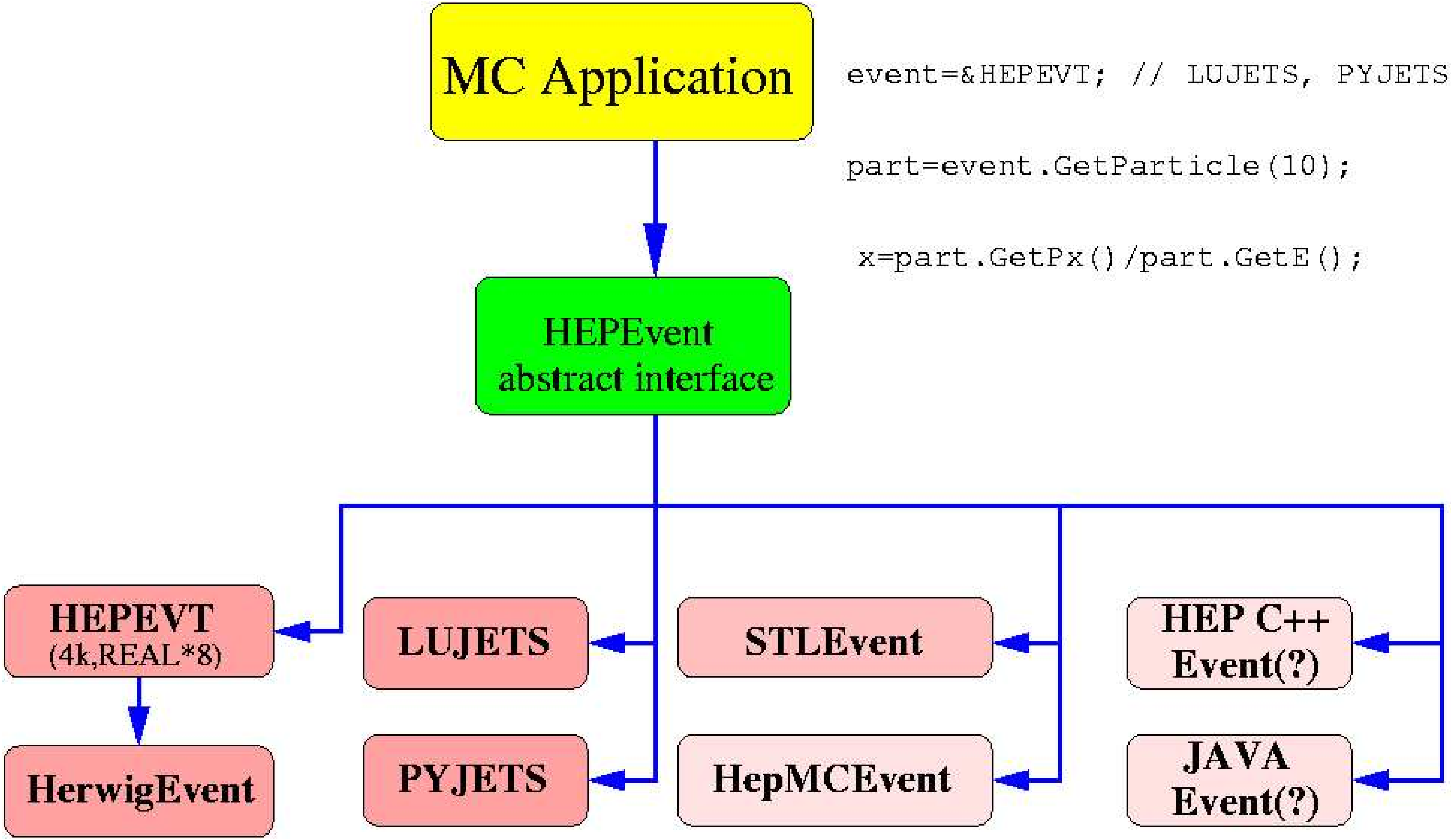
MC-TESTER Requirements:

- ROOT package: http://root.cern.ch
- gcc/g++: 2.95, 2.96, 3.2 (RedHat 6/7/8/9)
- LaTeX
- Ghostscipt (gv)
- Around 100 MB of disk workspace
- Compared generators store events in one of supported event records ...

MC-TESTER: user's point of view

- Implemented in C++, with FORTRAN interface
- 2 dynamic (.so)/static(.a) libraries: libHEPEvent, libMCTester + ROOT libraries
- Parameters controlled by ROOT/C++ macro file **SETUP.C** (interpretted at runtime) or from F77 code
- Output file from generation step contains compressed histogrammes (reasonable size)

Event data access: HEPEvent library



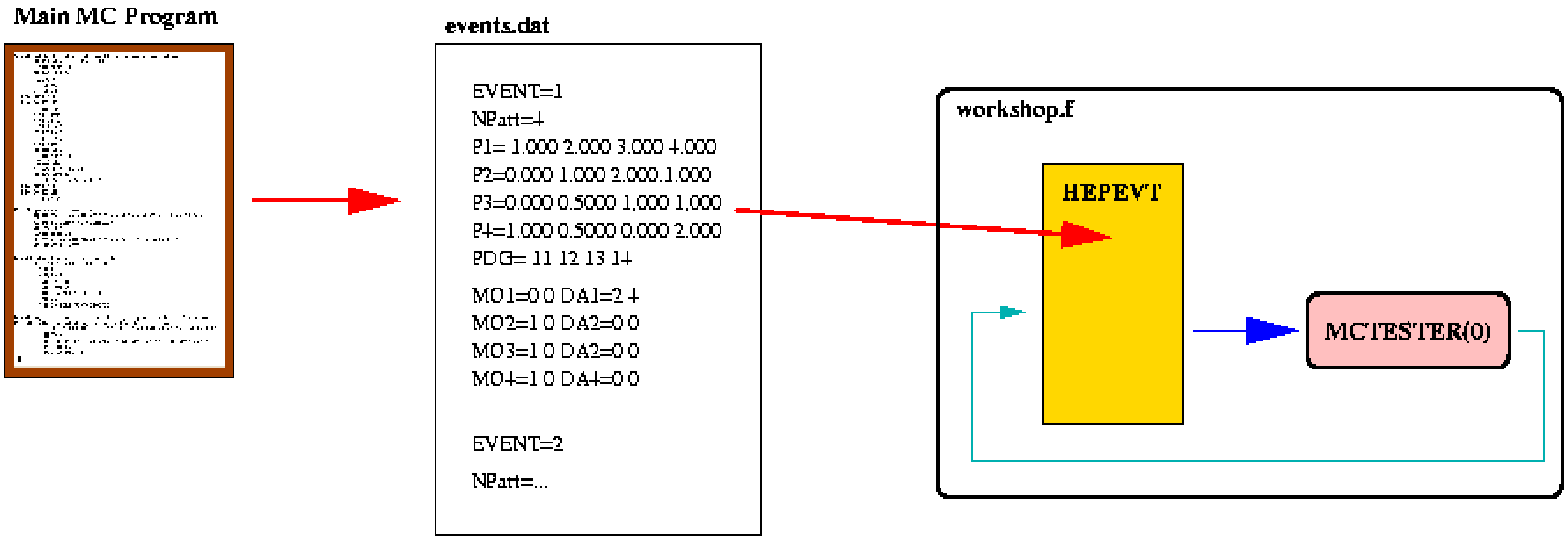

```
event=&HEPEVT; // LUJETS, PYJETS, ...

part=event.GetParticle(10);

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

Event data access (II): Text files

- Events may be stored in ASCII files:
  - 4-vectors, PDG code, mother-daughter relationship
- Decicated program (`workshop.f`) reads the file, fills HEPEVT and calls MC-TESTER
- Technique may be used for “FIFO” parallel processing



Succesfully used with:

- TAUOLA (demo included in distribution)
- Pythia 5.X (demo included in distribution)
- Herwig (Borut Kersevan)
- KK (Swagato Barnjee, BaBar)
- Eett6f (Linear Colliders)
- AMEGIC++
- MadGraph
- GRACE

Status and availability:

MC-TESTER homepage:

http://cern.ch/Piotr.Golonka/MC/MC-TESTER

- Version 1.1 released on July 8, 2003
- Documentation (CERN-TH/LANL/LC note)
- Contact with authors:

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Tutorial...

use of MC-TESTER in F77 environment