



RunMC v3.1

**C++ object-oriented framework for
Monte Carlo models
(for Linux and Windows)**

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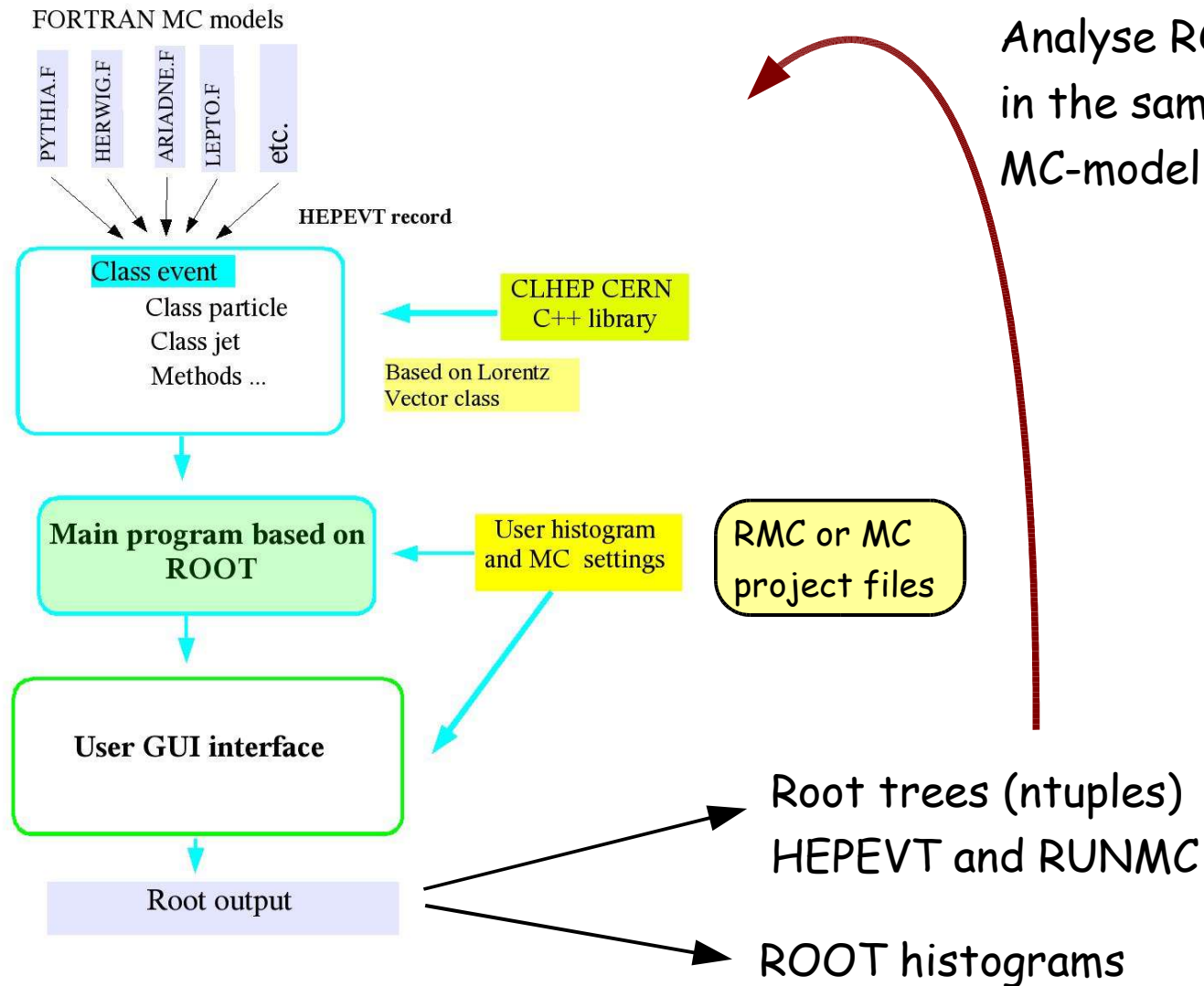
DESY, September 2004

LCG-Generator meeting (CERN)

General concept

- Extending lifetime of FORTRAN Monte Carlo models
 - General idea: Run FORTRAN MC - analyze using C++ classes
- Advantage of FORTRAN models:
 - Large choice of Monte Carlo models developed for HERA
 - see HERA Monte Carlo workshop
 - well tested at HERA/LEP etc experiments
 - Fast
- At the same time:
 - Use modern C++ libraries for LHC (CLHEP based)
 - Fully integrated with ROOT analysis environment
 - Standardization of output record
- Load/unload physics projects:
 - just like *.doc documents for MS Word!

General concept





Main features (v3.1)

- Fill histograms (large number of predefined histograms)
 - Event-based ($Q^2, x, E(\text{tot})$ etc)
 - Single particle densities (pt, eta, etc)
 - Two-particle densities (invariant masses)
- “project” files can be saved and restored
- Cross section calculations or automatic normalization to events
- Status bar, automatic checks of the settings, different presentation styles etc.
- 1D and 2D histograms can be viewed during event generation
- One can stop the run at any time (just press “Stop“!).
 - all inputs will be saved



Main features (v3.1)

- Different types of event record:
 - all HEPEVT, stable, stable charged, partons
- Cuts (in Et and eta for particles or jets)
 - can be set via RunMC GUI
- Ntuple/Tree analyzer:
 - Ntuples can be analyzed exactly as for MC jobs!
- Steering-card editor (spreadsheet-like)
- Histogram editor (spreadsheet-like)

RunMC input parameters

- Via RUNMC GUI (no need steering cards)
 - Simple to use
 - Default MC parameters for fully inclusive events
- More complicated settings can be done via steering cards
 - No need to recompile to package
 - Use "steering card" editor (spreadsheet-like);
 - Some parameter setting are still missing (for HERWIG)
- Use user initialization subroutines in proj/ini directory
 - set parameters and recompile the project (now - dummy functions)
 - allows maximum flexibility

RunMC outputs

- ROOT based histogram file (8 can be defined via RunMC GUI)
 - Up to 200 histograms using "project file"
 - Use various types of presentations (plain, color etc)
 - Select automatic normalization
 - Normalized to the number of events
 - Differential cross section
- ROOT ntuples/trees (compressed!) - copy of HEPEVT record
 - Use for "offline" analysis
- Reduced event "RunMC" ROOT tree:
 - only final-state hadrons with reduced information on events
 - good for most physics analysis

Main features (v 3.1)

- run most recent versions of Monte Carlo models:
 - PYTHIA 6.2
 - HERWIG 6.5
 - ARIADNE 4.12
 - LEPTO 6.5 (DIS only)
 - LEPTO 6.5 & ARIADNE PS (DIS only)
 - AROMA 2.2 (heavy flavor in DIS)
 - CASCADE 1.2
 - + Ntuple (ROOT tree) analyzer (HEPEVT or RUNMC event records)
- Multiplatform (Linux and Windows/Cygwin)

Physics analysis packages

- Included and interfaced with RunMC:
 - HepLorentzVector (part of the RunMC event class)
 - Breit-frame calculations (HCM is not supported yet)
 - Event shape calculations (C++ library by M.Iwasaki)
 - Also contains JADE & DURHAM algorithms
 - KTjet C++ library (J.Butterworth, J.Couchman, B.Cox, W.Waugh)

Still not well tested

Loadable physics analysis projects (RMC)

RMC project file- compressed and packed directory \$RUNMC/proj with:

- control.cards for MC and/or initialization files
- RunMC GUI input file (*MC file)
- user-defined calculations
- histogram definition etc ..

RunMC can load/unload the RMC files and compile them automatically

Presently available:

default.rmc No any MC settings and physics calculations. Only dummy functions

dis_kinematics.rmc Some DIS kinematic variables for HERA (Q^2, x , etc), SC

charm_dis.rmc Studies of D^* cross sections in DIS (HERA), SC

dis_strange.rmc Strangeness production (cross sections for K^0 s, Λ 's etc), SC

jets_HERA.rmc Jets at HERA using longitudinally-invariant KT algorithm (Breit frame), SC

jets_LHC.rmc Jets at LHC using the longitudinally-invariant KT algorithm (Lab. frame), SC

invariant_mass.rmc Look at invariant masses of two particles in e^+e^- , SC

event_shapes.rmc Event shape studies, SC

<http://www.desy.de/~chekanov/runmc>

Loadable physics analysis projects (RMC)

Do you need another output, event record, MC tuning, histogram file, external calculations (except for those included to RunMC)?

- ▶ Make a new RMC file and load it to RunMC

(and sent to chekanov@mail.desy.de to put on the RunMC web)

Comparison with JetWeb

Main difference:

JetWeb - like PowerPoint running on a remote server, user can load/upload files ppt files, but do not have a full control over calculations:

- current focus - jets and heavy flavor production (RunMC - no restriction)
- only PYTHIA and HERWIG (6 models in RunMC)
- includes data for tunings (RunMC requires external data)

RunMC - is designed to run on every desktop, but RMC files can be copied/shared between users:

- full flexibility and control over program
- no heavy maintenance (but RMC files should be "certified" by someone!)
- less power compared to JetWeb for MC tuning

RunMC GUI (based on T.Hirabayashi GUI classes)

The screenshot shows the RunMC GUI interface with several callouts and data elements:

- Select MC model:** A callout pointing to the '6.5 model' selection in the top right.
- Stable/partons?:** A callout pointing to the 'Stable' radio button in the top left.
- 1D or 2D?:** A callout pointing to the histogram type selection (1D or 2D) in the 'Output histograms' table.
- Set histograms:** A callout pointing to the 'Histogram editor' window at the bottom.
- Steering card editor:** A callout pointing to the 'RUNMC card file lept065.cards' editor at the bottom left.
- Select jets:** A callout pointing to the 'Type of jet' selection (Jade, Durham, KT) in the bottom right.
- ROOT canvas:** A callout pointing to the ROOT plot area on the right side.

Output histograms table:

variable:	min	max	bins	
Q2	10.0	200.0	50	1D
X	0.0	0.0500000007	50	1D
N(jets)	0.0	7.0	7	2D
@ET(jets)	4.0	20.0	20	1D
@Eta(jets)	-2.0	3.0	20	1D
@Phi(jets)	-4.0	4.0	20	1D
@ET(jets)	4.0	10.0	20	2D
@Eta(jets)	-2.0	3.0	20	2D

Histogram editor table:

Title	D	Min	Max	Bins	W	Comment
Q2	1	10.0	200.0	50	1.0	-(q1-q2)**2 for DIS/ppbar
X	1	0.0	0.0500000007	50	1.0	Bjorken X for DIS/ppbar
N(jets)	2	0.0	7.0	7	1.0	total number of jets
@ET(jets)	2	4.0	20.0	20	1.0	transverse energies of jets
@Eta(jets)	1	-2.0	3.0	20	1.0	pseudo-rapidity of jets
@Phi(jets)	1	-4.0	4.0	20	1.0	azimuthal angle of jets
@ET(jets)	2	4.0	10.0	20	1.0	transverse energies of jets
@Eta(jets)	2	-2.0	3.0	20	1.0	pseudo-rapidity of jets

ROOT Canvas Text:

Differential x-section in p
 4909 events requested
 4908 events generated
 x-section 1.184837e+05 pb
 Luminosity 4.142341e-02 pb^-1

Histogram selector list:

- none
- PTtot: transverse event momenta
- PZtot: longitudinal event momenta
- Etot: total event energy
- N(tot): total number of particles in event
- @Px: Px of all particles
- @Py: Py of all particles
- @pz: pz of all particles
- energy of all particles
- energy**2 for particles
- angle for all particles
- angle of all particles
- rapidity: -ln(tan(theta/2))
- i.e. 0.5*ln((E+pz)/(E-pz))

If you do not like GUI

- Just run executables for each MC in shell
- Functionality is the same:

Example of the bash script to run PYTHIA in background:

```
#!/bin/bash
# Link RunMC file
if [ -x ".analmc.ln" ]
then
rm -f ".analmc.ln"
fi
ln -s pythia6.mc .analmc.ln
# allow run
cat > $RUNMC/pipes/pipe_runmc.stop <<!
0
!
#
analmc.pythia6 > pythia6.log &
```

Can be stopped at any time
replacing "0" by "1" in the pipe file
\$RUNMC/pipes/pipe<date>.stop

Note:
pipe_runmc should be defined in
pythia6.mc file



Summary

RunMC version (v3.1) and user manual (v1.4):

<http://www.desy.de/~chekanov/runmc>

Can be done in future:

- add RAPGAP model
- HzTOOL can be converted to use with RunMC
(as RMC project modules)