RunMC v3.1

C++ object-oriented framework for Monte Carlo models

(for Linux and Windows)

S.Chekanov (ANL)

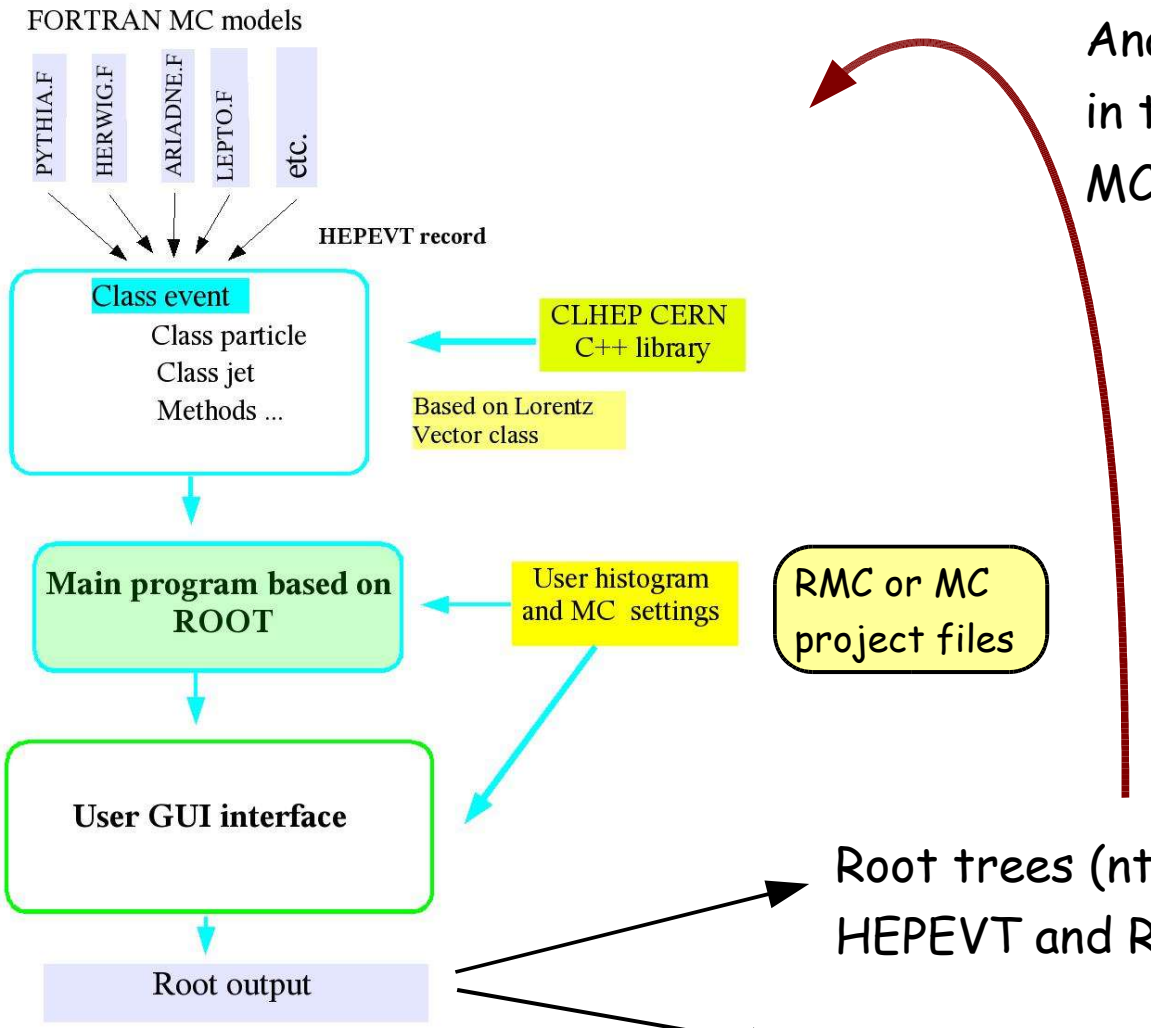
DESY, September 2004

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



Analyse ROOT trees in the same way as MC-model outputs

Main features (v3.1)

- Fill histograms (large number of predefined histograms)
  - Event-based (Q2,x, E(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 filed 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 (Q2,x, etc), SC

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

dis_strange.rmc Strangeness production (cross sections for K0s, Lambda'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 tunning, 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:

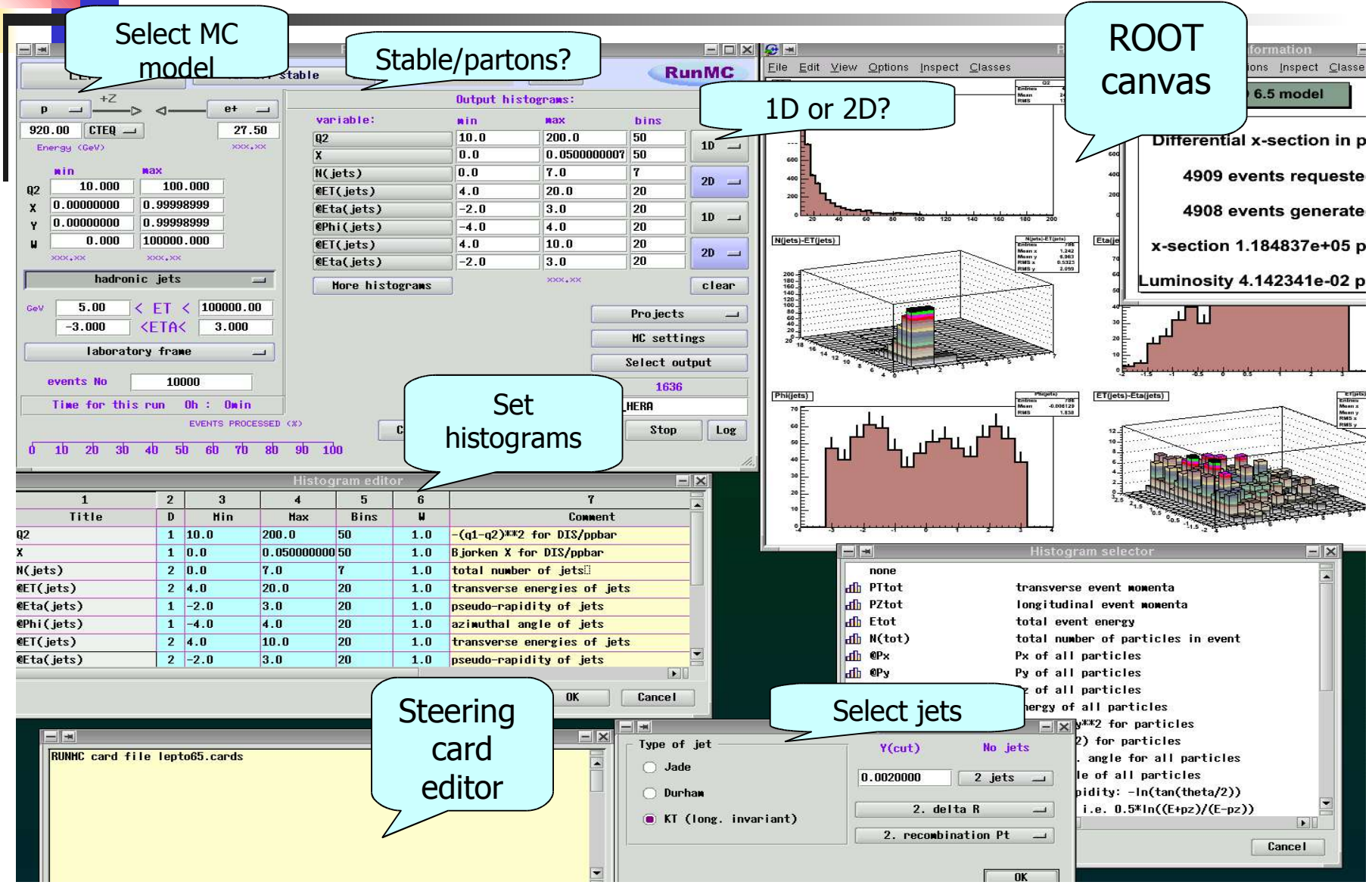
JetWeb – like PowerPoint running on a remote server, user can load/upload files ppt files, but do not have a full control over calculations:

- 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)



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)