HzTool - A Toolbox for MC/Data Comparisons

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A library of generic FORTRAN routines to allow
easy access to experimental published data distributions
and to calculate the predictions of Monte Carlo generators
for these distributions

More Information and code:
http://www.desy.de/~carli/hztool.html

The Idea

- Developed at HERA, i.e. enviroment where MC have difficulties
   to describe the data, but where MC are needed for precision physics
- common project between ZEUS and H1
- extended to gamma-gamma collisions of LEP (OPAL)
- easily extendable to TEVATRON data

Contains published data in the form of HBOOK-histograms

Allows to easily calculate the MC prediction for the data distributions

It is not always easy to find out

  - the exact cuts which need to be applied

  - the exact definition of an observable

Interface: Experiment and Theory

The Use

- needs HBOOK initialisation
- Hztool-routine called by user-analysis-routine of MC generator

DESY preprint number

```
subroutine user.f
    if (BEGIN)      CALL HZXXXX(1)  ! Histogram initialisation
    if (PROCESS)  CALL HZXXXX(2)  ! Histogram filling
    if (END)         CALL HZXXXX(3)  ! Histogram normalisation
    END
```

Routines can be called in parallel

and in arbitrary order

Results in:

set of histogram in HBOOK subdirectory (call HCDIR("XXXX"))

 ID: Monte Carlo prediction

-ID: data distribution

KUMACS to manipulate or overlay

histograms in complicated cases are provided

The Structure

PHEP-Common

Contains 4-vectors of
all produced particles
and event history

Results

Data and MC histogram in
HBOOK subdirectory unique
for each paper

Tools:
find jets
find charged particles
calculate pseudo-rapidity
calculate thrust, sphericity
calculate jet shape variables
find partons
boost and rotate particles
find kinematics x, Q^2 etc
find largest rapidity gap
normalise histos with non-equidistant bins

Only software in HzTool or
CERN libraries is allowed
code can run independent of other
generators or collaboration code

The Generators

HzTool is interfaced
to all standard generators:
PYTHIA, HERWIG, LEPTO-MEPS, LEPTO-ARIADNE
RAPGAP, CASCADE + some for exotic processes

and to
some NLO programs, e.g. HVQDIS (bottom production in DIS)
DISENT (jet production in DIS)

The Routines

In total 45 histograming routines are available written by about 30 authors

from 45 scientific publication !

Available are:
transverse energy flows and particle spectra in DIS and photoproduction
charged particles multiplicities   --- " ----
strange particle spectra   ----"-----
fragmentation functions   ----"----
leading baryon spectra
diffractive structure functions
jet cross-sections and event shapes (DIS, γp, diffraction)
(...1, 2, 3 jets and event shape in current and target region)
Jet cross-section in $\gamma\gamma$–collisions at LEP
particle spectra   -----"-----

In one run complete overview of hadronic final state
The correct MC can describe all data !
It is easy to tune one data distribution, all is a challenge !

Some Tuning Experiences

HzTool is a great tool to tune MC, since it provides easy access to

data and MC for theorists and experimentalists

However, current MC generators contain many approximations

changing free model parameters of limited models is not very successful

-> was not successful at HERA (except in a few cases)

-> work on correct physics model instead of tuning parameters !

e.g. LO -> NLO

DGLAP --> CCFM

The Future

The idea of HzTool is still pertinent, in particular for searches at LHC

It will be very important to make statements about general understanding

of basic physics processes at these high energies

I see first year as validation phase of our understanding of the production

of basic known particles: jets, W, Z, e, mu, tau, charm, beauty, top etc.

However, HzTool software design is outdated

needs complete OO restructuring using HepMC, CLLIB etc.

and inclusion of TEVATRON data.

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