CEDAR

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Abstract
The CEDAR collaboration is developing a set of tools for tuning and validating theoretical models by comparing the predictions of event generators with data from particle physics experiments. CEDAR is also constructing resources to provide access to well defined versions of high-energy physics software and support for software developers. Here we give an overview of the CEDAR project and its status and plans.

1 Introduction

Despite the success of the Standard Model in accurately describing a wide range of phenomena in high-energy particle physics, there are aspects of high-energy collisions where technical difficulties in the relevant calculations make it hard to attain a good understanding This is particularly true where non-perturbative QCD is involved, as in the description of hadronic collisions, where the final state is influenced by the parton distribution functions (PDFs) of the colliding beams, by multiple soft interactions leading to an "underlying event" and by hadronisation of the outoing partons.

These theoretical uncertainties can limit the precision of new measurements, as well as hindering the planning of future experiments. Building accurate models of hadronic processes is important for these reasons as well as for the insight they may offer into the fundamental physics involved. However, the models that are constructed typically have a number of parameters that can be varied, constrained only by how well the resulting predictions agree with experiment.

Tuning these free parameters and testing the models against experimental data is a difficult task because the data are so varied, involving different beam particles, different regions of phase space and complex observables. Changing a single parameter in a model can affect the predictions for different measurements in very different ways, and tuning to a limited set of data may result in a contradiction with other data not taken into account.

It is thus important to compare models simultaneously with as wide a range as possible of experimental results, and the aim of CEDAR [1] is to simplify this task.

The rest of this contribution will describe in turn the projects making up CEDAR.

2 HZTool and Rivet

The first requirement is for a library of routines to enable, for each experimental measurement of interest, a comparable prediction to be produced from any given Monte Carlo generator. This role is currently filled by the Fortran library HZTool, described in more detail in another contribution to these proceedings [2]. The HZTool library is being maintained by CEDAR, with subroutines for various measurements contributed by a number of authors within and outside the CEDAR collaboration. A number of HERA routines were written within this workshop.

Work is underway to build a replacement for HZTool, to be called Rivet (Robust Independent Validation of Experiment and Theory). This will use an object-oriented design, implemented in C++, together with standard interfaces (such as HepMC [3] and AIDA [4]) to make the new framework more flexible and extensible than the Fortran HZTool. For example, it will be easier to incorporate new Monte Carlo generators into Rivet than into HZTool.

3 JetWeb

JetWeb [5] provides a web interface to HZTool, along with a relational database of both experimental data and model predictions generated using HZTool. The core of JetWeb is a set of Java servlets that manipulate an object model representing data and predictions. A user can use a web form to specify a model and choice of parameters, and the data they wish to compare to this model. If this model and parameter set are already in the database, a set of comparison plots and statistics is returned. Otherwise the user may request a set of Monte Carlo jobs to be run using their specified model, and the results will be added to the database.

The existing JetWeb database has been frozen, although it can still be searched, while the design and functionality are improved. JetWeb is being adapted to use the data already stored in HEPDATA rather than duplicating this in its own database, and to make the addition of further Monte Carlo models (beyond the currently supported HERWIG [6] and PYTHIA [7]) easier.

4 HEPDATA

HEPDATA [8] is a well established and widely used source of scattering data from HEP experiments. As part of CEDAR it has been converted from the existing hierarchical structure to a relational database using MySQL. The next steps in this part of the CEDAR project will provide front ends so that the data in the relational database can be accessed through a searchable web interface and also directly by JetWeb and other users.

5 HepML

In order to simplify the transfer of data between different parts of the CEDAR project and other software frameworks, an XML schema [9] is being developed to specify particle reactions and experimental results (as provided by HEPDATA) as well as generator programs and parameters.

This schema is separate from the HepML developed within the MCDB project [10], which is designed primarily as a format for event records. It may be that some parts of the schemas can be unified later or become parts of a more general schema.

6 HepCode

HepCode [11] aims to provide access to well defined versions of Monte Carlo programs, parton distribution functions and other high-energy physics calculation programs. Currently it is simply a list of codes with details for each of the processes calculated, the order of the calculation, the authors and the programming language used, along with a link to further information where this is available.

HepCode will eventually feature a search facility so that users can find a set of available programs simply by entering the details of a particular scattering process. It may also be possible to have links from matching data records in HEPDATA or from papers in bibliographic databases such as SPIRES.

7 HepForge

CEDAR also provides a development environment, HepForge, for authors of HEP software, including Monte Carlo generators. In addition to the core CEDAR projects (HZTool, HZSteer, JetWeb, HepML) other projects using HepForge are fastNLO [12], Herwig++ [13], Jimmy [14], KtJet [15], LHAPDF [16], RunMC [17] and ThePEG [18].

Facilities provided to developers include a code repository (using CVS or Subversion), a bug tracker (using Trac), a wiki for documentation and communication between project contributors, and mailing lists for project discussions, queries and announcements.

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