Physics Simulation and Event Generation

X-th SERC school, University of Delhi

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The goal of the course is to teach you about event generation and simulation. The strategy to be followed as:

• First one hour or so, you will be given lecture explaining various basic underlying theoretical aspects related with the event generators and the matrix element calculators.

• It will be followed by hands on session during rest of the time. In this session you will be asked to study/simulate some physics processes.

Instead of teaching many softwares, more emphasis is given to make you aware about various physics issues involved while generating and simulating physics events. In order to carry out this exercise, you need following softwares to be installed in your computer/Laptop, which are very easy to install. Nevertheless, I give you some minimum information about the sources and installation procedure.

1. `PYTHIA6:`

   It is a fortran version of `PYTHIA`. To download, go to the web page
   `http://home.thep.lu.se/∼torbjorn/Pythia.html`
   and click "Past", below "Index" at the left toolbar. You will be directed to the `PYTHIA6` page. Then download any version of `PYTHIA 6.4`, for example you can download `PYTHA6.428`, the latest one. Alternatively, you can also go to the "HepForge" and from that page you can download. PYTHIA6 versions are just a very simple fortran code which you need to compile along with your own main driving code. Alternately, you can archive it by making library and then link it while compiling with your main analysis code.

2. `PYTHIA8:`

   It is the C++ version of PYTHIA6. To download and install it, go to the page
   `http://home.thep.lu.se/∼torbjorn/Pythia.html`
   In the first page you will see "Installation". Follow it to download and then for installation.

3. `MadGraph5_aMCNLO`

   Go to the page
   `http://madgraph.hep.uiuc.edu`

   You will be directed to the main MadGraph page. To download it, you need to register first. Please register following: "You may register for a password by clicking here", Once you register, then login with your password, and download `MadGraph5_aMCNLO` by

clicking on it.

Unzip and untar it by executing:

`gunzip MG5_aMC_v2_3.3.tar.gz`

`tar -xvf MG5_aMC_v2_3.3.tar`

`cd MG5_aMC_v2_3.3`

Now you are ready to run by executing,

`./bin/mg5_aMC`

For more adventure, follow other instructions as shown while executing this command. In this directory there is a 'README' file, you can follow that one also. This is a Python based program.

4. `LHAPDF`

   It is a library for all available parton distribution functions(PDFs). Sometimes one needs to interface externally this library to get access of the latest versions of PDF sets to compute the cross sections.

   To download it, go to the page:

   `https://www.hepforge.org/downloads/lhapdf`

   Download any version of 5 or 6 series(recommended 5) by clicking on respective version. Then unzip and untar it as(for example, for version 5.9.1):

   `gunzip lhapdf-5.9.1.tar.gz`

   `tar -xvf lhapdf-5.9.1.tar`

   `cd lhapdf-5.9.1`

   In this directory you will find a file 'INSTALL" which describes very clearly how to install it. Following the "Basic Installation" procedure you can install it easily.

5. Now install the `root`, the popular code which is widely used by various communities. Any version of 5 or 6 will do. For example, use, you can install version 5.34. Installation is easy, well described in the web page

   `root.cern.ch`.

   Avoiding here to describe.

If requires, don't hesitate to contact me: guchait@tifr.res.in