Monte Carlo Tutorial

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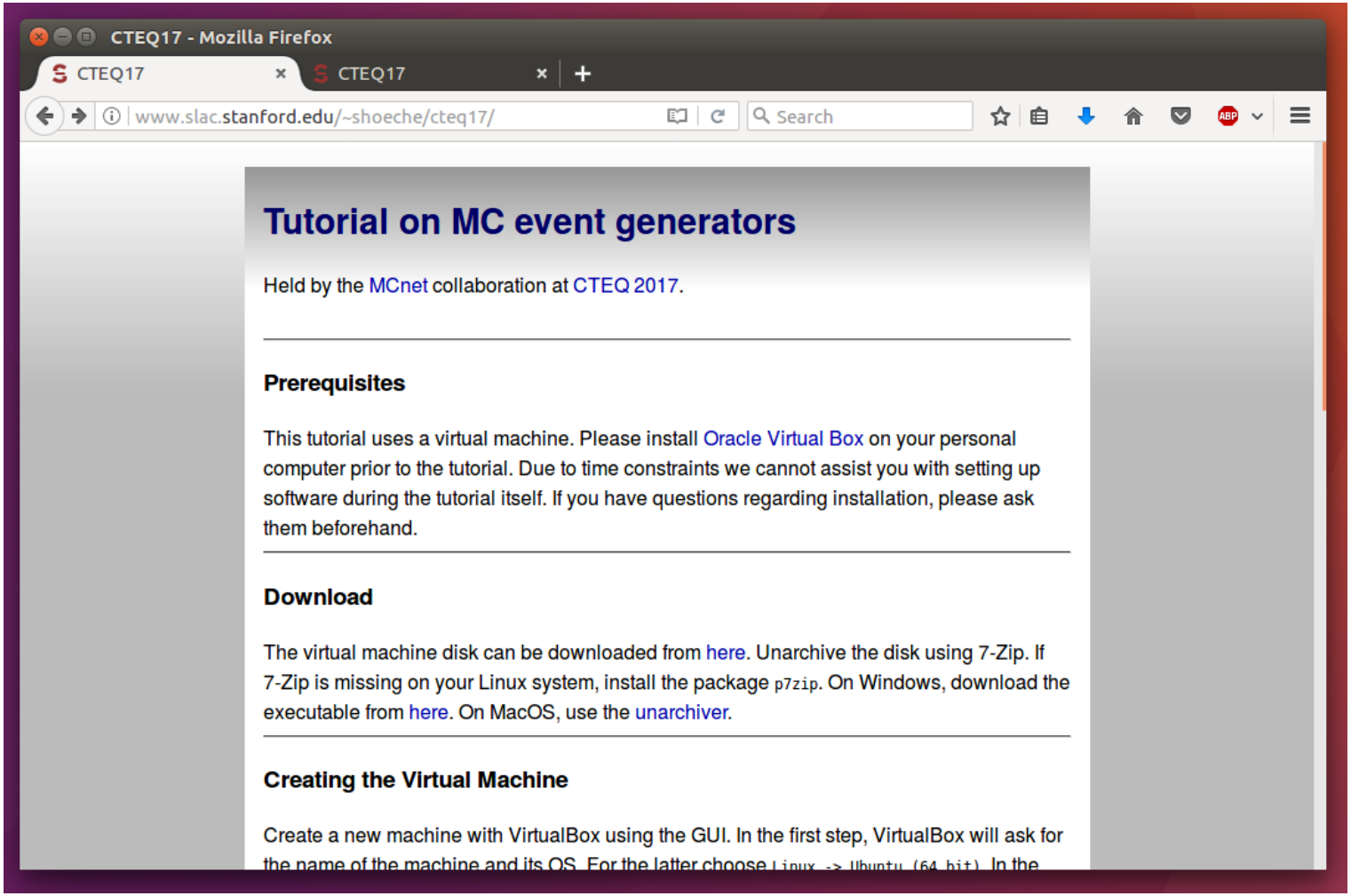
Outline

Welcome to three afternoons of Monte-Carlo tutorials!

Aim: Get a deeper understanding of event generators,
look inside these black boxes and understand their physics,
by developing and running code.

How?
Two days to write a parton shower.
One day to get familiar with HERWIG, PYTHIA or SHERPA.

Tutorials use VM from http://www.slac.stanford.edu/~shoeche/cteq17/



You should have downloaded the VM. Else, ask for a USB stick.

Parton showers are a crucial piece of event generation. They approxmiate multiparton states by performing a cascade of splittings.

Uncertainties in how parton showers are constructed are among the dominant theory issues at colliders. To understand these issues better, the tutorial will guide you in **writing your own parton shower** code, complete with

- ...splitting probabilities and splitting phase space
- ...matrix element corrections and NLO matching
- ...on-the-fly renormalization scale uncertainties

The programming language will be PYTHON. You should form groups of **three** for the first two days.

Day 3: LHC generators

On day 3, we learn how to use the common LHC event generators. You will first learn basic usage. Then, you should assess specific uncertainties for $t\bar{t}$ production at the LHC:

HERWIG	PYTHIA	SHERPA
UE and non-perturbative uncertainties	Shower scale- and kernel uncertainties	Hard process scale uncertainties

Form groups of **three or six** for the third day. Pick one generator. Make sure that each generator is represented once/twice in your group.
At the end, you should have comparisons ready, to discuss in the night cap session.

You can find the instructions online at
http://www.slac.stanford.edu/~shoeche/cteq17/ws/ (possibly outdated!)
or better on the VM:

```
/home/student/tutorials/introduction.pdf
/home/student/tutorials/ps/tutorial.pdf
/home/student/tutorials/mc/sherpa/
/home/student/tutorials/mc/pythia/
/home/student/tutorials/mc/herwig
```

The login/password for the VM are student/2017.
The first thing you should do every time you start the VM is

```
student@cteq:~tutorials$ svn up
```

Summary

Questions anyone? Don't hesitate to ask at any time!

Useful links:
http://www.slac.stanford.edu/∼shoeche/cteq17/

For easy file access, it is often convenient to have a shared folder between your VM and the host system. This may be achieved by

- In your running VM, go to the menu `Devices -> Shared folders` (or something similar) and click "Add" or the "+" symbol
- Select a folder on your HOST computer.
  Call this folder (in the dialog window!) `share_host`.
  Tick the "automount" and "make permanent" boxes.
  Close with "OK".
- Then, open the terminal and go to `/home/student`.
  Exectute the command

```
mkdir -p share
sudo mount -t vboxsf share_host share
```

Your shared folder is now available under `share`.