

Wikiprint Book

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[?Signaling the Arrival of the LHC Era](#)

 Top Quark Physics at the LHC

Authors

- Fabio Maltoni (lecturer)

Lectures

Find the pdf of the 2 x 1h lectures [here](#)

References

- [?QCD and Collider Physics](#) by Keith Ellis, James Stirling, Bryan Webber (Cambridge Monographs, 1996). General introduction QCD. The section on top is an easy and efficient reading to learn the basics.
- [?Top physics at the LHC](#), by Beneke et al. : A complete document, though a bit outdated, that covers many of the interesting studies that will be performed at the LHC. A very useful reference.
- [?Top Physics at the LHC](#), by Werner Bernreuther : A nice and up-to-date overview on top physics at the LHC. It has also a complete reference list that can be used for further studies.
- [?Top mass definition](#), by M. Smith and S.Willenbrock. This is an easy and very clear discussion that it will make you appreciate the subtleties associated to a meaningful definition of a mass of a quark.

Exercises

Decay

- [TopWidth:Top width]: Calculate the width of the top quark.
- [DeadCone:Radiation from heavy quarks]: the dead cone in % $e^+e^- \rightarrow Q\bar{Q}g$ %.
- [TopDecaySpinCorrelations: W+ polarization in top decays].

Production

- [tt:top production] : % $t\bar{t}$ % production and single top at Tevatron vs LHC.
- [scalar:scalar vs fermion top cross sections at hadron colliders] : Compare the production of scalar and fermion heavy color triplets in hadron collisions.
- [SpinCorr:Spin Correlations in top production]

Light material on the heaviest quark

- Movies
 - [?Interactive Flash version](#) Note you may want to zoom in!
 - [?Fast movie \(.avi\) of collision](#)
 - [?Guided movie \(.mov\) of collision](#)
- Review
 - [Secrets of a heavyweight?](#), by Kurt Riesselmann.

Familiarize with Software. [MadGraph](#)

A brief tutorial on Software. [MadGraph](#) / Software. [MadEvent](#) can be found [here?](#).

- Logon to the Software. [MadGraph](#) web site and register: [?http://madgraph.hep.uiuc.edu](http://madgraph.hep.uiuc.edu).
- Familiarize with the code by generating a few processes in QED + QCD trying to guess which diagrams appear.
- Look at the new physics models and check the particle and interactions content.
- Generate events for a few selected processes and look at the plots:
 - ttbar production with decays: pp>tt->bb~mu+e-ve~vm
 - Single top + Higgs: pp>tHj (QCD=0, QED=3, j=gudsc,p=gudscb). Show that there is a large negative interference between the diagrams.

Analysis Tools

- a Fortran-based package: Software. [MadAnalysis](#) ([?Download it here](#))
- a Mathematica-based package: [?Chameleon](#).

MC101

For those interested in Monte Carlo techniques, here is a short Mathematica course with applications to top physics:

- Write the simplest integration function based on the definition of average and error
- Importance sampling via an analytic transformation
- Von Neumann's rejection method : plain and improved
- Phase space for $1 \rightarrow n$ particles
- Vegas
- Top decay : comparison among the various methods
- $qq \rightarrow tt$ production

All exercises are presented and solved this Mathematica Notebook: [mc101.nb](#). Reference: [?Introduction to MC methods](#), by [?Stefan Weinzierl](#)

-- Main.FabioMaltoni - 03 Dec 2008