

LHC Physics (High p_T lectures 3 & 4)

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Lecture 3: Standard Model Physics

- Detector summary, overview of kinematic definitions, cross-sections
- Low p_T processes, multiple interactions and inelastic collisions
- The underlying event
- Jets: definitions and differential cross-sections, multi-jet properties
- Direct photon production
- W and Z boson physics: mass distributions, cross-sections
- Diboson production: $Z\gamma$, $W\gamma$, WW , WZ , ZZ
- Top quark physics: production, decays, selection, cross-sections, mass, properties

Lecture 4: Studying the Higgs boson and searches for new physics

- Higgs field and potential, theoretical constraints, indirect limits
- Higgs production and cross-sections, decays, examples
- Higgs results: signal strength, mass, couplings, spin-parity, width
- Need for a theory beyond the Standard Model
- Supersymmetry: R-parity, the LSP and dark matter, mSUGRA
- Examples of SUSY searches and results
- Extra dimensions: Arkani-Hamed, Dimopoulos, Dvali (ADD) and Randall-Sundrum (RS) models
- Detecting ADD extra dimensions; Warped Extra Dimensions (RS Model)
- Microscopic Black Holes
- Inclusive searches
- Leptoquarks

Reading List

General overview

- CERN website: <https://home.cern/topics/large-hadron-collider>
- LHC Experiment websites: <https://atlas.cern>, <https://cms.cern>, <http://aliceinfo.cern.ch/Public/Welcome.html>

Review articles

- Introduction to LHC physics (Polesello) <http://iopscience.iop.org/article/10.1088/1742-6596/53/1/005>
- Physics Goals and Experimental Challenges of the ProtonProton High-Luminosity Operation of the LHC (Campana, Klute and Wells) <https://www.annualreviews.org/doi/abs/10.1146/annurev-nucl-102115-044812>

Textbooks

- Perspectives on LHC Physics (Kane and Pierce)
- Particle Physics in the LHC era (Barr, Devenish, Walczak and Weidberg)

Other lectures

- CERN academic training lectures (search for LHC) <https://indico.cern.ch/category/72/>
- Lectures on LHC physics (Plehn) <https://arxiv.org/abs/0910.4182>

Recent results

- ATLAS <https://twiki.cern.ch/twiki/bin/view/AtlasPublic>
- CMS <https://cms-results.web.cern.ch/cms-results/public-results/publications/>
- LHCb http://lhcbproject.web.cern.ch/lhcbproject/Publications/LHCbProjectPublic/Summary_all.html