

[ATLAS Semivisible Jets]

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Abstract

[ATLAS Semivisible Jets]

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Acknowledgements

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Dedication

Dedicated to my friends and family

Introduction or Preface

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Chapter 1: The Standard Model

The Standard model of particle physics (SM) is the most complete and experimentally validated theory of particle physics. The SM provides a framework describing the set of fundamental particles and the interactions which govern them. It consists of six quarks, six leptons, four force-mediating gauge bosons, and the Higgs boson, as seen in Fig ??.

1.1 Symmetries and Forces

The SM is locally gauge-invariant quantum field theory, a formalism that unites the fundamental principles of quantum mechanics, special relativity, and classical field theory.

Chapter 2: The Large Hadron Collider

The Large Hadron Collider (LHC) is a 27km long circular particle accelerator, located 100m underground near the city of Geneva, Switzerland and spanning the border of France and Switzerland. The LHC is operated by the European Organization for Nuclear Research (CERN), the largest international scientific collaboration in the world. The LHC uses the same tunnel employed by the former Large-Electron-Positron Collider (LEP), as well as some of the LEP infrastructure as part of its injection chain.

The LHC accelerates protons and heavy ions and collides them at four interaction points around the ring, with a design center-of-mass energy per collision of $\sqrt{s} = 14$ TeV. Each interaction point is home to one of four detector experiments, which study the products of the collisions. The largest of these experiments is the *ATLAS* detector, a general purpose detector for studying the SM and searching for physics beyond it. The *CMS* detector is another general purpose detector, designed and operated independently of the *ATLAS* detector, but intended to probe the same range of physics. The *ALICE* experiment is a dedicated heavy ion experiment, and the *LHC – b* experiment is a dedicated *b*-physics experiment.

2.1 Accelerator Physics

2.1.1 The Journey of a Proton

Protons which feed the LHC start as hydrogen gas. The electrons are removed from the hydrogen atoms through the use of strong electric fields. The linear accelerator (LINAC) then accelerates the H^+ ions to an energy of 50 MeV. From here the H^+ ions enter the Proton Synchrotron booster,

The CERN accelerator complex *Complexe des accélérateurs du CERN*

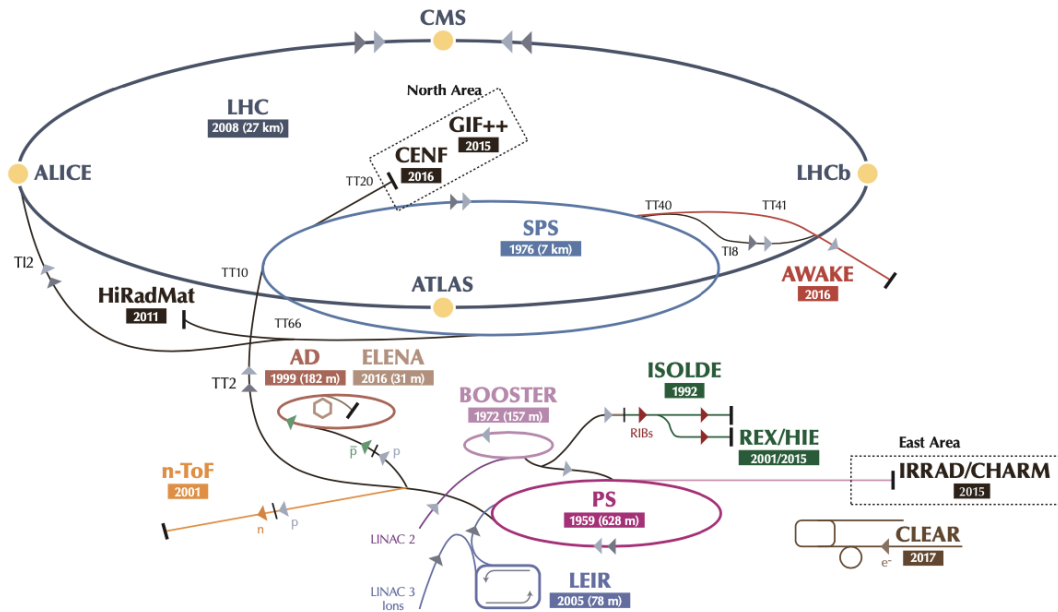


Figure 2.1: The LHC accelerator complex at CERN

where they are accelerated up to 1.4 GeV of energy. Subsequently they pass through the Proton Synchrotron (PS) and the Super Proton Synchrotron (SPS), where they reach energies of 25 GeV and 450 GeV respectively. Finally they are injected into the LHC as two beams traveling in opposite direction, and can be accelerated up to 7 TeV of energy. Due to limitations with the magnet training, the highest energy actually achieved by the LHC beams during Run 2 was 6.5 TeV each, giving a collision center-of-mass energy of $\sqrt{s} = 13$ TeV. Figure ?? shows the full LHC accelerator complex.

Acceleration in the LHC is performed by eight radio frequency cavities located around the ring.

Bunches

Luminosity

Chapter 3: Results

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Chapter 4: Discussion

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Conclusion or Epilogue

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Appendix A: Experimental Equipment

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Appendix B: Data Processing

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