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## **Part 1**

8

**Experimental setup: Collider, detector and**

9

**algorithms**



## 1.1 The Large Hadron Collider

The Large Hadron Collider (LHC) [1, 2] is a particle accelerator installed in the former LEP [3] tunnel at CERN [4]. It is 26.7 km in circumference and consists out of two separate rings, which are, in periods of operation, inhabited by two counter-circulating beams. At the interaction points of the two beams, either proton-proton collisions or heavy ion collisions take place. In this thesis, only collision data from the year 2012 is analysed. Thus all machine values cited in the following chapters and paragraphs refer to the setup in 2012.

The beams are separated into bunches which rotate with a bunch spacing of 50 ns corresponding to a collision frequency of 20 MHz. Before the bunches are actually filled into the LHC rings they are pre-accelerated in other accelerators, which are (in the order they are actually passed by the protons) Linac2, Proton Synchrotron Booster (PSB), Proton Synchrotron (PS), Super Proton Synchrotron (SPS). The injector chain and the LHC ring with its experiments is visualised in Fig 1.1.1.

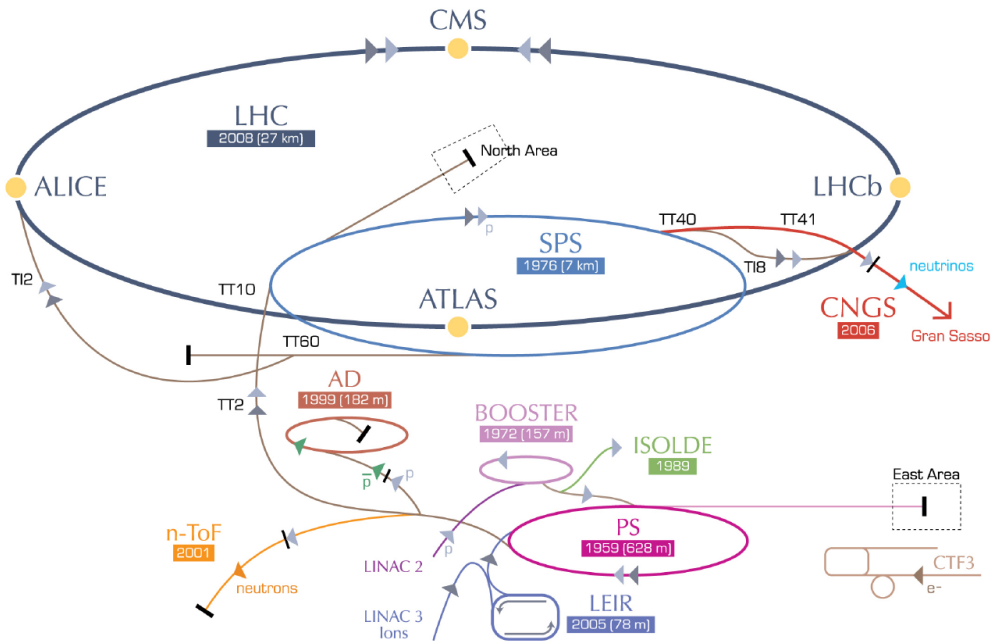


Figure 1.1.1: Visualisation of the LHC with its experiments and the injector chain.

24 In the LHC, the beams are kept on the circuit with the help of a magnetic field of  
25 4.76 T. Further quadrupole and sextupole magnets squeeze and focus the bunches. They  
26 have a spread of roughly 8 cm length and a Gaussian shape radius of  $20\text{ }\mu\text{m}$  RMS at the  
27 interaction point.

- 28 • luminosit - integrated luminosity
- 29 • the number of produced events for a cerntail process is given by the cross section  
30 times integrated luminosity
- 31 • luminosity is machine dependent and for the LHC
- 32 • All experiments
- 33 • lumi plot
- 34 • pileup plot

## 35 1.2 CMS

36 CMS is a experiment at the LHC

## 37 1.3 Event reconstruction and particle identification

38 Event reconstruction relies on very complicated algorithms bla

## 39 1.4 Event simulation

## Bibliography

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- [2] O. S. Bruning, P. Collier, P. Lebrun et al., “LHC Design Report Vol.1: The LHC Main Ring”,.
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