ATLAS muon reconstruction from a C++ perspective: a road to the Higgs

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Elementary particle physics is the study of the fundamental building blocks of nature and the interactions between them. All matter is constructed out of quarks and leptons, which are subject to one or more of the four fundamental forces. Three of these, viz. electromagnetism and the weak and strong interactions are united into a single theory called the Standard Model. Its definition of mass is based on the spontaneous breaking of the symmetry between the first two of these forces through the so-called Higgs mechanism. This results in the prediction of a new particle, the Higgs boson, which with its predicted mass between 109 and 215 GeV has remained beyond the reach of all current experiments.

Its detection is one of the main goals of a new collider and corresponding detectors that are currently being developed at the European Laboratory for Particle Physics (CERN) near Geneva, Switzerland. In this thesis the reconstruction of muons in one of these detectors called ATLAS is studied.

The development of the reconstruction software has been performed using the full potential of object-orientation (OO) and C++. Its core is formed by AMBER, an ATLAS specific program that is based on a number of general-purpose packages of which the Detector Reconstruction Toolkit (DRT) and the Generic Dataview Library (GDL) are the most important ones. The former defines a number of general reconstruction classes like tracks, track fits and the propagation of tracks through a magnetic field. The dataviews of the GDL are iterator adaptors that can be connected together in any way the user sees fit to form complete dataflow networks.

AMBER's performance has been evaluated in three different environments, from a stand-alone MDT chamber, via the DATCHA test setup to the full muon spectrometer. The results obtained not only agree very well with those of other ATLAS studies, but also make it clear that ATLAS will be capable of detecting the Higgs in most of its mass range through its decay into four leptons.