

# Chapter 1

## Charge monitoring

Diamond Beam Monitor

Spatial segmentation

FE-I4

Desc of ATLAS pixel module, functions

Why do we use diamond in combination with FEI4

Construction of 24 modules

Performance results (main part)

source tests

desy testbeam (spacial resol, efficiency, TOT)

Problems, limitations

Commissioning, installation

Comparison between diamond and silicon modules.

## 1.1 Particle physics research

### 1.1.1 CERN

CERN (European Centre for Nuclear Research) is a nuclear research institute housing the largest particle physics laboratory in the world. It straddles the Swiss-French border just outside Geneva. It was established in 1954 to bring a war-torn Europe together by means of fundamental scientific research. Today, it has 22 member state countries and several observer states. More than 10000 scientists, engineers, technicians, students and others from all around the globe work at CERN on many projects in research fields ranging from particle to nuclear physics. The scope is to probe the fundamental structure of the universe and to understand the mechanisms governing it. Therefore CERN's main function is to provide the infrastructure for high-energy physics experiments. These are carried out using large machines called particle accelerators. These instruments boost beams of particles to high energies before making them collide with each other or with stationary targets. The resulting collisions are recorded by particle detectors and later analysed by physicists. To carry out research on the smallest constituents of matter, their dynamics and structure, very high energies are needed. This is why the most powerful accelerators are used for fundamental research.

### 1.1.2 Particle accelerators

A particle accelerator is a machine that accelerates beams of charged particles like protons, electrons, ions etc. It generates electric fields that add kinetic energy to the particles, speeding them up. It then uses magnets to keep them within a defined trajectory. This can be either linear (linear accelerators) or circular (circular or cyclic accelerators). The advantage of the latter ones is that they can accelerate particles many times while keeping them in orbit.

Particle accelerators are used in numerous fields ranging from fundamental and material research, cancer treatment to industrial applications, such as biomedicine and material processing. There are several types of accelerators: electrostatic accelerators, linear accelerators (LINACs), cyclotrons, synchrocyclotrons, synchrotrons, synchrotron radiation sources and fixed-field alternating gradient accelerators (FFAGs).

#### **The Large Hadron Collider**

The Large Hadron Collider or the LHC is the largest

### 1.1.3 The ATLAS experiment

## **1.2 The ATLAS Diamond Beam Monitor**

### **1.2.1 Diamond pixel module**

### **1.2.2 Module assembly and quality control**

### **1.2.3 Installation and commissioning**

### **1.2.4 Performance results**

Source tests

Test beam results

Spatial resolution, efficiency, ToT

### **1.2.5 Limitations**

comparison between diamond and silicon modules