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Present Activity

- HEP: Participation to the ATLAS experiment at CERN
- Materials Science: transport phenomena and physical properties of materials

Research plan at SESAME

1

ATLAS experiment at CERN

- contruction of the ATLAS barrel presampler: tests and qualification of the presampler anodes
  - thickness measurement and high voltage tests
  - resistance, capacitance and leakage current measurement
- offline software
  - XML and Geant4 (C++) geometry description for detector simulation
  - software for data analysis

2

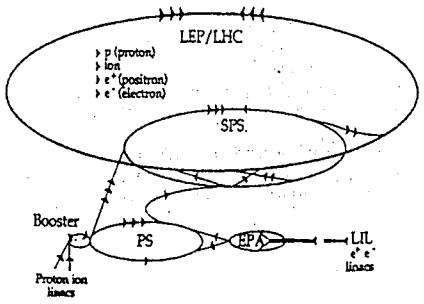

Figure 2.1: The LHC and the injection complex at CERN.

Parameters	Value
Circumference	26.7 km
Dipole field	8.4 T
Injection energy	450 GeV
Collision energy	7.0 TeV
Stored beam energy	332 MJ
Bunch spacing	25 ns
Number of bunchs	2835
Particles per bunch	10^{11}
Circulating current/beam	540 mA
Bunch radius $\sigma_x = \sigma_y$	16 μm
Bunch length σ_z	75 μm
Beam lifetime	22 h
Luminosity	10^{34} cm^{-2} s^{-1}
Luminosity lifetime	10 h

Table 2.1: The LHC performance parameters [2].

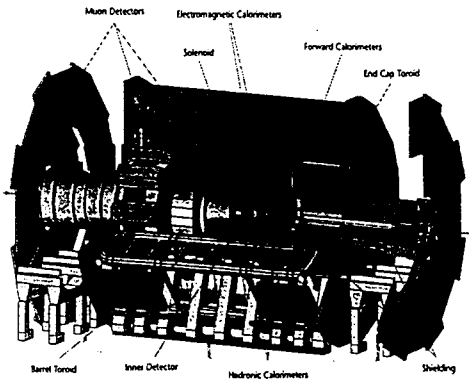

Figure 2.3: The ATLAS detector.

of the ATLAS detector will amount to approximately 7000 tons. ATLAS has two magnet systems, one will provide an axial magnetic field of 2 T in the center of the inner detector and one will provide an average toroidal field of 0.4 T in the muon system. ATLAS includes three principal subdetectors with different functions in the particle identification process:

- the inner detector for the tracking of charged particles near to the collision axis.
- around the inner detector a hermetic calorimeter system that nearly provides a 4π coverage for energy measurement.
- a muon system outside of the calorimeter for detection and measurement of the muons.

Specific details of the electromagnetic calorimeter and the presampler will be pro-

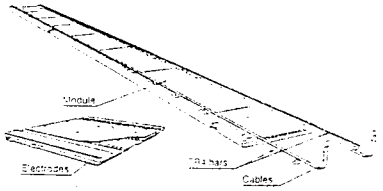

Fig. 3. Perspective view of a presampler sector.

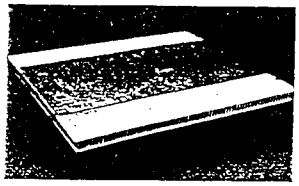

Fig. 4. A presampler module with its motherboard.

circuit board electrodes, separated by about 2 mm liquid argon gaps and polarized with a fixed high voltage of ± 2 kV. The number of electrodes per module type varies in order to keep the liquid gap approximately constant (Table 1). The electrodes are strictly perpendicular to the longitudinal axis except for the electrodes of module types 1 and 2, the closest to the barrel center, which are slanted in order to keep a triangular shape for the signal response [9]. The read-out cells of the required granularity ($\Delta\eta = 0.025$, $\Delta\phi = 0.1$) are obtained by ganging the appropriate number of electrodes in the longitudinal direction in the modules themselves. In the ϕ-direction, each anode is subdivided into two compartments $\Delta\phi = 0.1$ by etching. Thus, on each module, there are 8 cells in η and 2 in ϕ, i.e., 16 in total except for the shorter modules located at the barrel edges where there are only 10 cells (5×2).

4. Electrodes

4.1. Electrode geometry and mechanical measurements

Electrodes are printed circuit boards of two kinds: cathodes, which are (270 ± 30) μm thick double sided boards; and anodes, which are $(530 \pm \frac{70}{30})$ μm thick three-layered boards. A positive high voltage of 2 kV is applied to the external anode layers, and the signal is read out through capacitive coupling to the central anode layer. The anode electrodes thus have to withstand a potential difference of over 2 kV between the outside layers and the internal signal layer. The anodes were obtained as followed: initially the signal layer was etched on one side of a board consisting of 150 μm thick FR4 with 18 μm of copper on each side. The etched side was covered with two layers of prepreg, each nominally 65 μm thick (after curing) and an 18 μm thick copper layer. The prepreg is of standard type 1080, chosen for its high resin content and to match the base material. The curing of the prepreg was done in an autoclave.

The number of electrodes per module varies from 56 to 128 of each kind (Table 1). All electrodes have the same length, 277.5 mm, corresponding to the module width. Since slanted electrodes are needed in modules of types 1 and 2 (see Table 1), each of the two types of electrodes (cathodes and anodes) must have three different sizes : size 1, 2 and 3 with 18.2, 16.9 and 16.5 mm

Transport phenomena

- Study of fast diffusion mechanisms in Pb[Ag, Cu ...], Si[Au, Zn, Cu ...] systems
  - numerical studies: finit differences method
  - Monte Carlo simulations
  - analytical study: asymptotic development

Research plan at SESAME

- previous experimental studies: Pb[noble metal] systems
  - positron annihilation method, microcalorimetry
    - → informations on defects
    - → presence of Guinier-Preston zones and other metastable phases

- more informations can be extracted by using:

  → Mössbauer effect

  → Synchrotron radiation (SESAME)

- electrochemical interfaces:

  → MC simulations

  → chemical techniques

  → synchrotron radiation