

# DRAFT

## General facilities required in Building 186 at CERN for ATLAS SCT activities

### The ATLAS SCT Institutes

## 1 Introduction

This document addresses the facilities required at CERN for the ATLAS SCT project, available for use by all SCT institutes, to carry out the agreed programme. Such facilities are needed to meet development targets and milestones for detectors and modules during the final tests and a continuing period of device assessments and overall combined systems evaluations.

The programme will include :

1. measurements in the H8 beam line at the SPS, with modules both in stand-alone mode and as part of combined multi-detector arrangements
2. a continuing programme of irradiation studies at the PS with CERN-based storage and device measurements required before, after and between periods of irradiation
3. a programme of laboratory tests of assemblies of multiple modules, leading to more complete overall systems tests of fully populated segments of both the barrel and forward sub-structures, incorporating parts of the final SCT powering, cooling, monitoring and data-readout systems.

It should be noted that the requirements requested from CERN that relate directly to the role of the CERN ATLAS group in module production, and for facilities needed in later years for SCT assembly, commissioning, installation and maintenance of the complete detector are not the subject of this document. In addition, the assembly of the SCT as part of the complete Inner Detector at the pit is being addressed elsewhere. Therefore the outcome of these separate negotiations could result in the SCT floor space request for Building 186 needing to be increased for the final assembly stages.

## 2 The programme and timetable

The scenario of activities for which facilities are needed in Building 186:

(1) For the H8 test-beam programme :

- During Summer 1998:

An assembly of final prototype modules must be available within the TSP programme to be used in a 4 plane structure together with elements of TRT and Pixel structures to study the overall performance of the ID tracking scheme. Initial in-line tests will also be made with both barrel and forward modules.

The requested laboratory will provide support for the preparation of this work. It will also be the base for commissioning the data acquisition, slow control, high and low voltage, and cooling systems associated with this sub-set of modules. Such pre-assembly and installation of commissioned systems will also contribute to more efficient use of beam time in H8.

The activity will continue naturally with the incorporation of a subset of initial Module-0s into this assembly later in the year, as part of the investigations into multiple-module operation. It is envisaged to operate together around twenty such modules before the end of the 1998 H8 running period, with some having previously been irradiated to high doses at the PS.

- During Summer 1999:

The H8 activities will continue, with particular emphasis on combined operation of module systems in a magnetic field, and with upfront scattering targets. It will also be necessary to extend cooling schemes and make systematic studies on the elements of the final SCT monitoring and data-acquisition systems with high readout rates. Again, preparation in the laboratory in Building 186 will be essential.

- Into year 2000 and beyond:

During the autumn of 1999 several module construction centres will be moving into large scale production. By that time and through 2000 significant numbers of modules, both barrel and forward, will be required at CERN to form part of SCT barrel test-layers and forward structures, for combined inner detector and calorimeter tests in H8. Again the facilities in Building 186 will be important in ensuring that this work can be carried out efficiently and when required.

(2) For detector and module irradiation at the PS:

- During 1998:

The PS has provided and continues to provide the vital irradiation source for studies in the SCT programme. Currently irradiation of candidate detectors continues, and during 1998 the need will continue

to irradiate significant numbers of detectors from the manufacturers then committed to orders of large numbers of final devices. Complete final prototype modules, and subsequent Module-0s will be irradiated, stored and measured at CERN.

This work will require cooling facilities both in the PS beamline and in the laboratory. Coolant temperatures typically below  $-10^{\circ}\text{C}$  have to be controlled and monitored over long periods of time.

- Year 1999 and beyond:

As detector delivery continues and final modules are constructed both sets of items will continue to need to have samples irradiated to guarantee that overall device quality is maintained. We envisage that such a programme will continue over several years and through the construction period.

### (3) For systems tests

- During 1998:

Tests of systems have the goal of ensuring that the large scale operation of the complete SCT will be successful. This activity will be carried out in the laboratory at CERN, using much common infrastructure with that required for the H8 tests and the PS irradiation programme. It will however have a timetable unaffected by CERN machine operation, and be available for use most of the time.

By the Spring of 1998 several modules of final prototype design are planned to be constructed with SCT final front-end readout. This set of devices will form the basis of initial multi-module tests, where the electrical performance will be established for a sub-system assembly on a prototype cooled structure.

By Autumn 1998 Module-0s will be used to study an assembly of cooled devices, coming from across the SCT production centres, and to include irradiated modules. These could be placed on a prototype cylinder and equipped with SCT prototype cabling, power supplies, control system and readout. This will allow the first genuine systems test, and not only require an inert atmosphere, but also need the capability of systematic temperature cycling over at least a  $40$  to  $50^{\circ}\text{C}$  range.

- During 1999:

In the Spring of 1999 a significant number of Module-0s, and further cabling, powering and final readout schemes will have been produced. Using an advanced cooling and control system, from 10% to 25% of a geometric barrel can be constructed with production-line modules from across the collaboration. Sub-structures of forward module assemblies

will also be produced. Full operational tests will then need to be carried out in the laboratory, including full temperature cycling of this system between  $-20^{\circ}\text{C}$  and  $+50^{\circ}\text{C}$  in a controlled manner in an inert atmosphere.

- During 2000 and beyond:

The details of such laboratory-based studies beyond 2000 cannot at this stage be predicted, but it is clear that as more complete overall systems of the SCT are constructed the facilities at CERN will play an important role in allowing optimization of the programme to guarantee that the SCT is completed within schedule.

In summary, it is therefore requested that the area in Building 186 become available within the next few months so that it can begin to form part of the approved SCT activities at CERN well before it begins its vital role in the spring of 1998.

### 3 The necessary facilities

To achieve this ambitious programme at CERN over the next few years, where there will be close collaboration of activities across the whole SCT community it is necessary to have a clean working area of  $200\text{m}^2$ , with dimensions 10m by 20m, and to have an adjacent normal laboratory of  $100\text{m}^2$  area, preferably with dimensions of 10m by 10m. Such potential areas, already partially equipped with the necessary air-conditioning facilities exist in Building 186. These are not currently used for semiconductor work, and we suggest that they be considered as the way of providing the facilities we request.

The two areas combined will provide:

- (a) a dedicated clean area for the ATLAS SCT activities and devices
- (b) that is self-contained for security of devices and infrastructure,
- (c) that has sufficient size to allow SCT segment structures to be built for systems tests, and for layered structures to be assembled,
- (d) that is conveniently situated for access to automatic bonding machine(s), with their appropriate personnel,
- (e) that has adequate clear bench-top working surfaces, with vacuum line outlets, at least two high quality microscopes, and at least one good quality manual probe station and metering for CV characteristics and current monitoring,

- (f) that has a number of cold inert gas storage units [these could be adapted commercial freezers], and be suitable for initial multi-module assembly storage and test, and be able to store significant sub-assemblies of irradiated modules,
- (g) that can accommodate sufficient racks for power supplies and readout units for up to 25% of a single SCT barrel, together with cooling plant infrastructure,
- (h) that is equipped with necessary networking and PC facilities for communications of data and information both within and outside CERN,
- (i) that contains the necessary equipment for making suitable mechanical and thermal measurements of multi-module assemblies.

## 4 Use of the facilities

Needs exist for support in bonding and assembly of both barrel and forward modules to form part of the three ongoing activities outlined previously, of H8 beam tests, PS irradiation studies and multi-module systems tests.

In the years from 1998 through to 2002 this programme can be expected to result in more than 10% of all SCT modules passing through CERN as some part of the test and assessment programme, and some significant fraction of this total being present at the same time when the main systems tests are taking place. This makes it essential to have professional support facilities and strict security and storage at CERN. These can be achieved by the provision of a clean and secure area in Building 186. This will allow good access to CERN general wire-bonding facilities and give adequate space for significant fractions of the SCT assembly to be studied if necessary.

Such an area and its facilities would also be fully accessible to the CERN-based module construction centre, to complement its separate and dedicated production area.

During these years many irradiated ATLAS SCT detectors and modules will require cold and controlled storage at CERN, and need to be equipped with readout and undergo source measurements. The area in Building 186 will also provide the facilities for this work.

Basic infrastructure and equipment is requested from CERN to support this programme. However the ATLAS SCT groups will wherever possible provide additional monitoring and measuring equipment to be at CERN to complement this permanent infrastructure, particularly for dedicated periods of H8 beam tests, preparation and evaluation of irradiated devices and various stages of the systems tests.

## 5 Summary of request

This document has outlined the ATLAS SCT activities planned at CERN by the institutes, across the project, to allow all the necessary aspects of beam tests, irradiation studies and overall systems tests to be carried out.

The requested facilities are vital to the successful evolution of the ATLAS SCT project and will contribute to:

- maximising the efficiency and effectiveness of the studies in the H8 beam-line,
- the safe preparation, execution and storage of irradiated detectors and modules within the long term programme at the PS, and
- allowing the necessary early systems evaluations of valuable devices to be made in a coherent programme in a secure laboratory. This will maximise the collaborative use of the existing and limited amount of final SCT infrastructure over that period within studies that are very necessary in order to guarantee the successful implementation of the overall SCT project.

To carry out these activities we request a total area in Building 186 of 300m<sup>2</sup>, as two contiguous but separate laboratories, and for these to be equipped initially with the necessary infrastructure that will allow an active programme to be underway by early 1998, with the full commitment of the ATLAS SCT institutes.