5 Installation and organization

5.1 ALICE experimental area

The ALICE detector will be installed at Point 2 of the LHC accelerator. The Point 2 experimental area was designed for the L3 experiment. The main access shaft, 23 m in diameter, provides a 15×7 m^2 installation passage and space for counting rooms. The counting rooms are separated from the experimental area by a concrete shielding plug (see Fig. 5.1). The experimental cavern is 21.4 m in diameter and will be re-equipped with 2×20 t cranes having a clearance of about 3 m over the L3 magnet.

The L3 magnet provides a 11.6 m long and 11.2 m diameter solenoidal field of up to 0.5 T. The end-caps have a door-like construction. The door frames will support large beams traversing the L3 magnet, from which the ALICE central detectors will be supported.

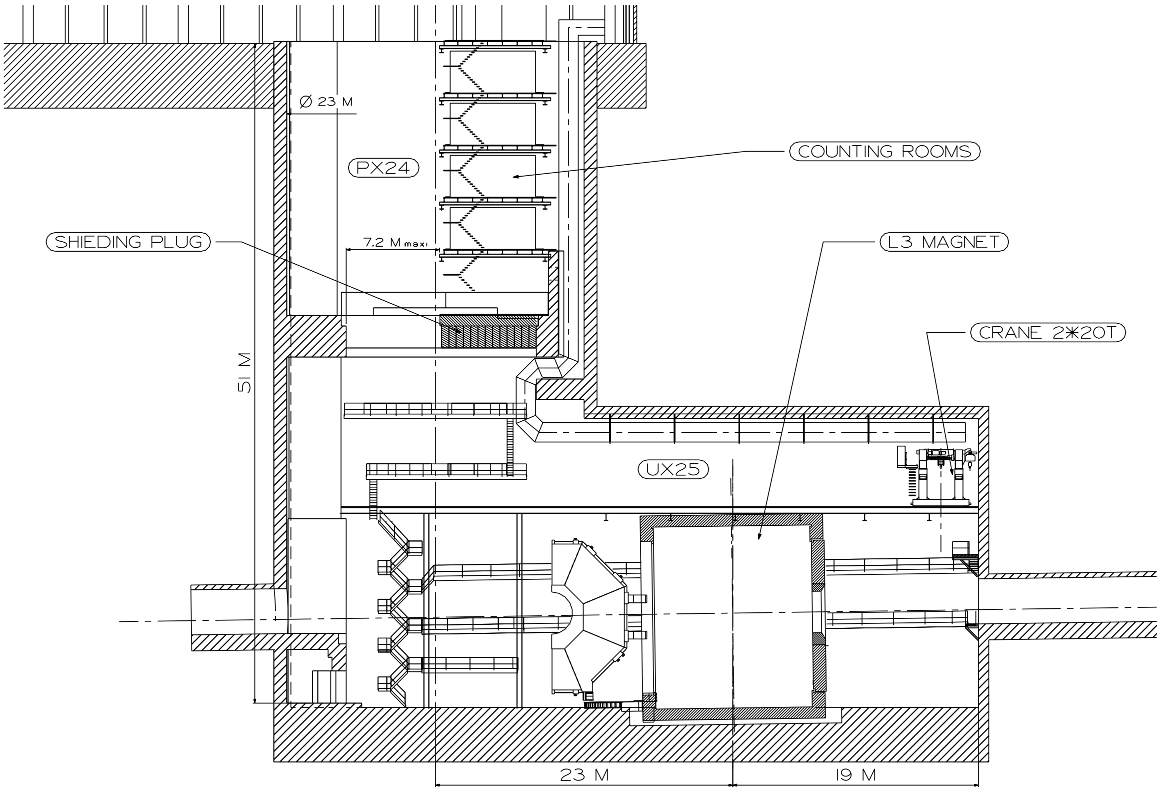


Figure 5.1: General layout of the basic underground structures at point 2, showing the L3 magnet and the counting rooms. PX24 is located at middle-height of the pit.

5.2 Installation and maintenance of the HMPID

The ALICE central detectors will be mounted in a cylindrical space frame construction (see Fig. 5.2), which will be fixed on the large support beams.

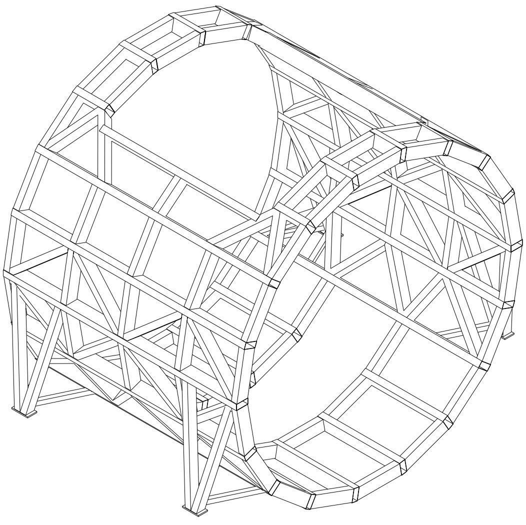


Figure 5.2: Space frame support structure. The openings in the top and bottom are to minimize material in front of the HMPID and PHOS, respectively.

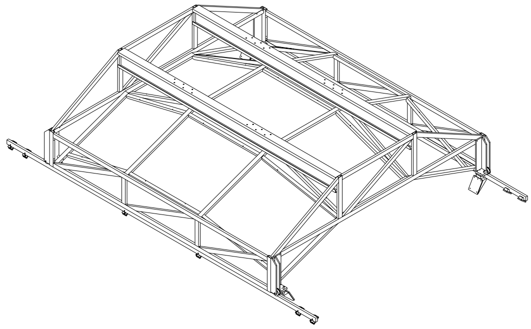


Figure 5.3: Support cradle for the seven HMPID detector modules to roll on top of the space frame.

All seven HMPID modules will be mounted in a support cradle (see Fig. 5.3), which will be fixed on rails at the top of the space frame. The space frame and the support cradle will be equipped with stiffening rods only outside the acceptance area of the HMPID in order to minimize the influence of multiple scattering. To improve access during maintenance and installation operations, a special installation platform (see Fig. 5.4) will be temporarily attached to the space frame and to the magnet, in order to allow the detector to be moved out of the L3 magnet.

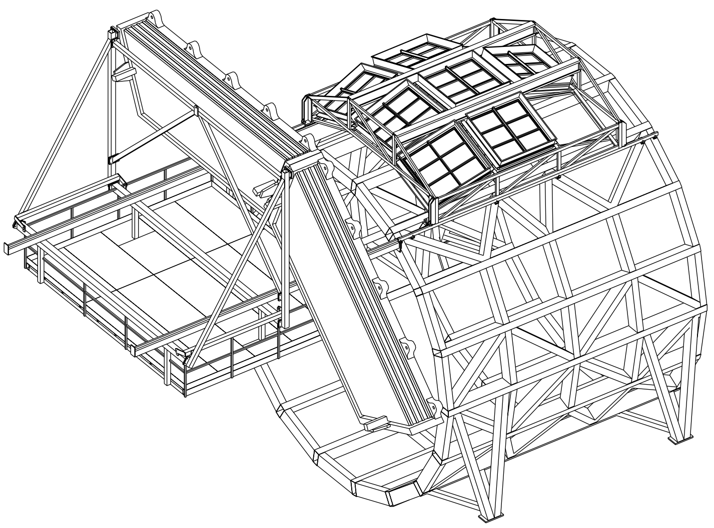


Figure 5.4: Installation platform fixed on the space frame and on the L3 magnet to allow installation and maintenance operations.

All services will be guided through slits between the magnet door and the barrel (see Fig. 5.5). In this way the magnet doors can be opened without removing the services. The HV and LV power supplies will be located in racks in the UX25 experimental area close to the L3 magnet. All power supplies will be remotely controlled from the counting rooms.

The gas and liquid systems have been described in Chapter 3. The gas supply will come from the gas building on the surface. The recirculation and purification unit will be located on the shielding plug in PX24. As described in Section 3.2.10, the liquid radiator system is divided into two parts. The purification system will also be located in PX24, whereas the recirculation system has to be on the same horizontal level as the detector to minimize the hydrostatic pressure in the radiator. As shown in Fig. 5.6 it will be installed on the wall of UX25 outside the L3 magnet. All pipes connecting the detector with the gas and liquid systems will be carried out in stainless steel.

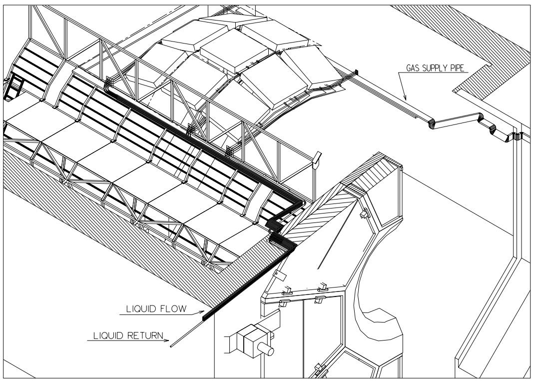


Figure 5.5: Layout of the HMPID services for the detector gas and liquid radiator in the L3 magnet volume.

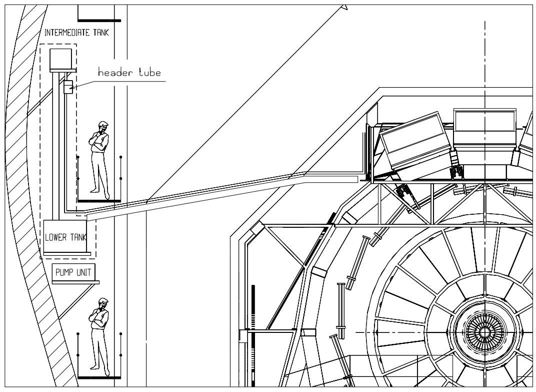


Figure 5.6: Relative position of the liquid radiator recirculation system and the HMPID detector. The difference in height will be optimized to minimize hydrostatic pressure in the radiator.

The overall ALICE planning foresee a pre-assembly phase of all the central detectors to take place in the SKL2 hall at Point 2, between mid 2003 and mid 2004.

This will allow an early preparation of the different detector services, and the installation procedure to be analysed and corrected before integrating the detectors into the L3 magnet.

The different pre-assembly and installation phases for the HMPID detector are as follows (see also Table 5.1).

Pre-assembly phase

i) installation and first commissioning without detectors of the gas and liquid systems,
ii) commissioning of the support cradle and final equipment on the space frame in the UX25 area,
iii) installation and first commissioning of cables and electronic equipment.

Pre-installation in experimental area

i) Calibration of the liquid circulation system using detector modules.
The aim of this operation is to adjust the flow rates of the 21 radiators at their nominal values. The modules have to be located at their final positions on the support cradle because the flow settings are pipe-impedance-dependent. In addition, the cradle has to be tested inside the L3 magnet where the control elements of the liquid circulation are installed. These adjustments can still be done with several detector modules not yet equipped with the CsI photocathodes, to avoid the circulation of protection gas.
ii) Commissioning 'in situ' of the gas and liquid circulation systems.

Final installation

The final installation can start in year 2005, once all detector modules are available with CsI photocathodes. The gas and liquid systems must be operational in the experimental area since the CsI photocathodes have to be flushed permanently with argon. The seven detector modules are mounted on the support cradle equipped with a temporary gas flushing system.

The complete detector and support cradle can now be lowered into the UX25 area and lifted onto the rails of the installation platform. Then the detector will be rolled into its final position on top of the space frame and connected to all the services. After the gas system has been connected to the detector, the temporary gas flushing system will be disconnected, and the final commissioning of the system can be started.

After all the barrel detectors are mounted into the space frame and the cabling is completed, they will be aligned with respect to the LHC beam. The relative positions will be measured by means of photogrammetry.

Maintenance

The maintenance access to the HMPID, once installed inside the L3 magnet, is rather limited and only the perimeter of the support cradle can be reached during a short access. Therefore, during repair or maintenance interventions the complete detector will be moved out onto the installation platform. Although most services (cooling, gas and cables) can be made flexible and absorb the displacement without being disconnected, this is not possible for the liquid C_6F_{14} system. This implies that, once the HMPID is installed on the spaceframe and connected to the C_6F_{14} system, the spaceframe cannot be moved.

5.3 Milestones and construction programme

An overall time schedule for the HMPID is shown in Table 5.1.

During 1999, the programme will be to finalize the digital part of the electronics, once the evaluation of the ASIC prototypes is completed, and to carry out the optimization programme of the CsI processing using the improved evaporation station (Section 3.1.5) and the ASSET system (Section 2.1.1.6).

As from the beginning of year 2000, the main orders should be placed (quartz, mechanics) in order to start the production of the modules staged over two years. It is envisaged to interleave testing periods after the construction of each module to allow the implementation of possible modifications. For the same reason, orders of components should be staged as well.

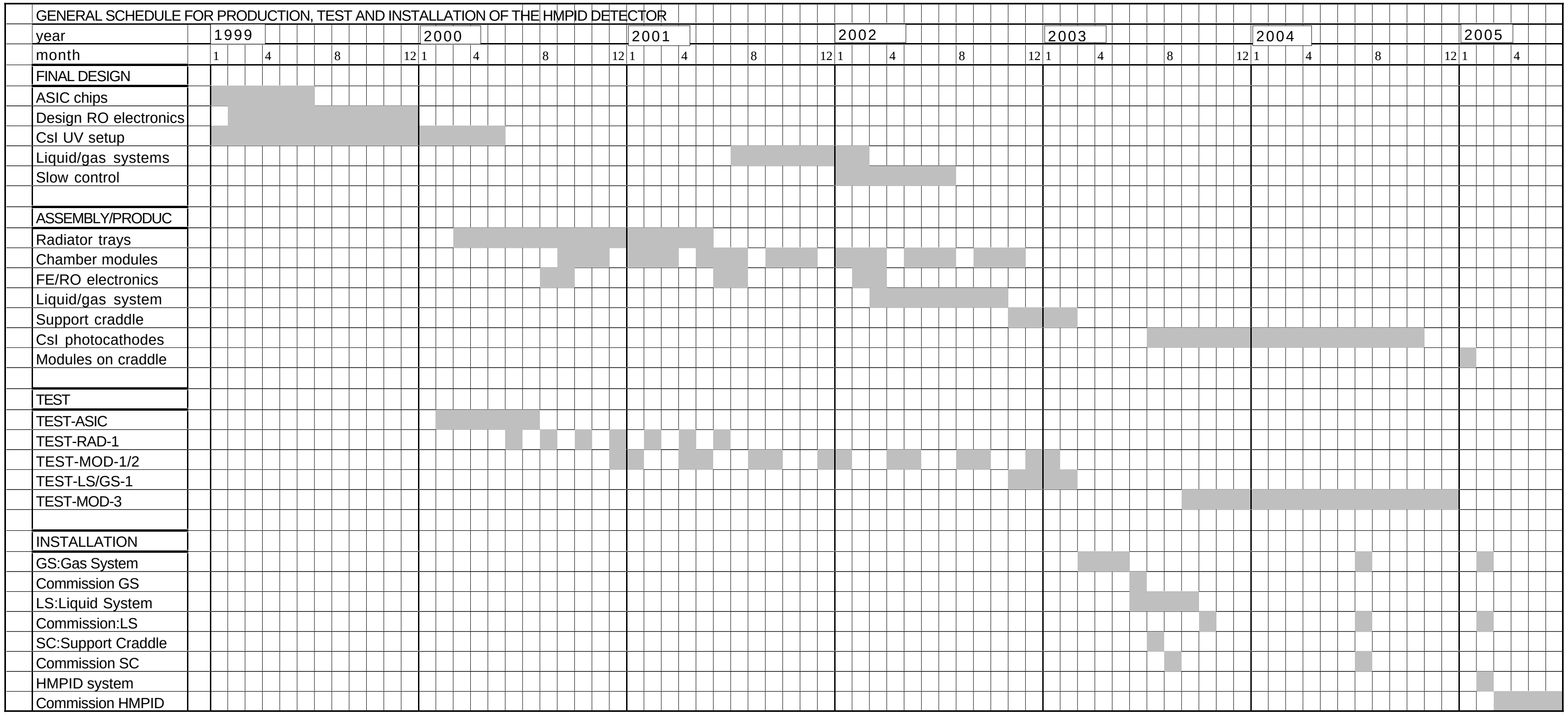
The final design, testing, and production of the auxiliary systems will be carried out in parallel with the construction of the modules.

Once the detector modules are commissioned, the production of the CsI photocathodes can be launched. This production has to respect the estimated time duration, i.e. 16 months, and should be completed as close as possible to the start of the experiment in order to avoid any unnecessary standby periods of the photocathodes that could initiate ageing. It is foreseen to have the modules equipped with CsI PCs and tested by the end of 2004 ready for final installation at the beginning of 2005.

Table 5.1 is based on the following technical milestones:

- end 1999:
  finalize the ASIC design and the readout electronics
  finalize the CsI PC optimization programme
- middle 2001:
  all radiator trays produced and tested
- beginning 2002:
  finalize the gas and liquid system design

Table 5.1: General schedule for production, test, and installation of the HMPID detector



- end 2002:
  all chamber modules produced and tested without photocathodes
  auxiliary systems ready
- middle 2003:
  start the production of the CsI photocathode
- end 2004:
  all modules tested with photocathodes
  liquid circulation commissioned
- beginning 2005:
  commissioning the detector in ALICE

5.4 Safety aspects

The HMPID has been the subject of a recent Initial Safety Discussion (Ref. TIS/GS/WW/98–034). The outcome of this ISD was that the concept of the detector did not include any major safety risks. However, the operating gas will be flammable CH_4 with a total mass of 1.3 kg inside the detector. As discussed in Chapter 2, it is not possible to replace this gas since it provides the necessary photoelectron yield under stable operational conditions. The experimental zone will be equipped with a flammable-gas detection system. Two systems currently exist in the LEP point 2 area:

1) The standard industrial pelister type, which is used to monitor the surface gas buildings, the gas racks on the plug PX24, and also in the underground area UX25.
2) The SDN air sampling system, which extracts air from critical volumes near the gas-filled detectors.

5.5 Organization

5.5.1 Participating institutes

The following four institutes will share the fabrication and commissioning of the HMPID detector:

- INFN, Sez. Bari and Dipartimento di Fisica, University of Bari, Bari, Italy
- CERN, Geneva, Switzerland
- Institute for Nuclear Research (INR), Moscow, Russia
- Instituto Superior Técnico (IST), Lisbon, Portugal

In the design, construction and testing, the following ALICE members have participated:

- INFN, Sez. Bari and Dipartimento di Fisica, University of Bari, Bari, Italy
  N. Colonna, D. Cozza, D. Dell'Olio, L. Dell'Olio, D. Di Bari, D. Elia, N. Facchini, R. Fini, A. Grimaldi, L. Liberti, E. Monno, E. Nappi, F. Posa S. Stucchi and G. Tomasicchio
- CERN, Geneva, Switzerland
  H. Beker, M. Davenport, A. Di Mauro, D. Fraissard, E. Gaummann, B. Goret, Ch. Gregory, G. Lecoeur, A. Ljubičić Jr., P. Martinengo, R. Monnin, A. Morsch, G. Paić[1], F. Piuz, J. Raynaud, J.C. Santiard and T.D. Williams
- Institute for Nuclear Reasearch (INR), Moscow, Russia
  A. Kurepin, V. Razin, A. Reshetin, K.A. Shileev
- Instituto Superior Técnico (IST), Lisbon, Portugal
  J. Barbosa, R. Carvalho and J. Seixas

In addition, the following people have provided valuable help in specific sections of this Technical Design Report: C. Lourenço, G. Rubin, K. Šafařík, D. Swoboda and P. Vande Vyvre.

[1]also Ohio State University, Columbus, USA.

5.5.2 Responsibilities

The proposed sharing of the responsibilities in the construction and operation of the HMPID detector is shown in Table 5.2.

Table 5.2: Sharing of responsibilities

Institution	Responsibilities
INFN, Sez. Bari and Dipartimento di Fisica, University of Bari	Radiator system (part) C_6F_{14} system Readout electronics and auxiliary equipment On-line software and off-line analysis
CERN	Modules (part) CsI photocathodes Gas system On-line software and off-line analysis
INR, Moscow	Radiator system (part) Modules (part) Support cradle
IST, Lisbon	Off-line analysis

The four institutes will jointly participate in the testing activities and related data analysis.

5.5.3 Cost estimate and resources

The evaluation of items foreseen to cost more than 200 kCHF was done following CERN tendering procedures. Other costs have been based, whenever possible, on industrial quotations. In Table 5.3, the cost evaluation is presented in such a way that the cost of the seven modules can be compared with the incompressible expenses on auxiliary systems.

Table 5.4 shows the cost of the major functional components of the HMPID. The manpower from participating institutes needed for construction amounts to approximately 65 man years.

Table 5.3: Cost evaluation per type

Items	Cost [CHF]
Seven modules	1392
Auxiliary systems	529
Industrial and contract-labour support	109
Spare material	121
Total	2151

Table 5.4: Cost evaluation per function

Items	Cost [CHF]
Radiator and liquid circulation systems	668
Modules, CsI photocathodes, gas system	624
Electronics and auxiliary equipments	575
Installation	54
Spare material	121
Industrial and contract-labour support	109
Total	2151