

Overview

ALICE is a general-purpose heavy-ion detector designed to study the physics of strongly interacting matter and the quark-gluon plasma in nucleus-nucleus collisions at the LHC. It currently includes almost 1000 members from over 80 institutions in some 30 countries.

ALICE consists of a central part, which measures hadrons, electrons and photons, and a forward spectrometer to measure muons. The central part, which covers polar angles from 45° to 135° over the full azimuth, is embedded in the large L3 solenoidal magnet. It consists of an inner tracking system (ITS) of high-resolution silicon tracking detectors, a cylindrical TPC, three particle identification arrays of Time-of-Flight (TOF), Cerenkov (HMPID) and Transition Radiation (TRD) counters and a single-arm electromagnetic calorimeter (PHOS). The forward muon arm (2° - 9°) consists of a complex arrangement of absorbers, a large dipole magnet, and 14 stations of tracking and triggering chambers. Several smaller specialized detectors (ZDC, PMD, FMD, T0, V0) are located at small angles. A calibration trigger on cosmic rays (ACORDE) will be installed on top of the L3 magnet. A proposal by a group of US, Italian, and French institutes to construct an electromagnetic jet calorimeter (EMCAL) is under consideration by the respective funding agencies.

The detailed design of ALICE has been laid down in 14 detector Technical Design Reports. The Computing TDR has been approved in March 2006 and the Physics Performance Reports end 2004 (Vol I) and end 2005 (Vol II). A Technical Proposal for the EMCAL will be submitted to the LHCC in April.

Construction of infrastructure items, supports and the muon magnet is completed and detector construction is nearing completion for most systems.

Silicon Pixel Detectors

Status: The production and testing of detector ladders and low mass MCMs is approaching completion. The capacity of half-stave assembly has been substantially increased. The sector assembly time has also been reduced. The first two sectors have been assembled and have been moved to the dedicated test, integration and commissioning area set up in the CERN DSF clean room, including the SPD cooling plant. The integration of the full system is carried out using the final readout electronics (Routers), DAQ, DCS and services (patch-panels, cables and fibres). The assembly of the 3rd sector is completed.

Changes: No major changes.

Concerns: Temporary technical problems in wire bonding and in the ladder production facility have caused some delay, partly recovered. Further compression of the already very tight schedule.

Plans: Assembly of half-staves and sectors, system integration.

Silicon Drift Detectors

Status: Detector deliveries from CANBERRA are progressing at an increased rate of 40 detectors/month. The yield is about 55% and efforts continue to maintain and further improve this figure. The producer is on track to deliver the needed 260 SDDs by end of May 06. The detector characterization and assembly of the transition HV cables is progressing well at INFN-Trieste with help from OSU.

The wafer-testing of front-end chips (PASCAL and AMBRA) is completed at INFN-Roma, and now the wafers for spares are being tested.

Sub-hybrids and chip-cables are being delivered regularly from Kharkov. Over half of the total has been received and assembled at INFN-Torino, with a measured yield of about 90% for the chipcables and of 95% for the hybrids. About 50% of the hybrids have been assembled to the sensors to make modules with a yield close to 100%. The assembly rate is limited by microcable delivery, and is consistent with the completion of the 260 modules by end of May 2006.

Changes: No major changes.

Concerns: Delivery rate of good SDD sensors from CANBERRA and of microcables from Kharkov. In particular the delivery of the long ladder cables is on the critical path. Very tight schedule.

Plans: Completion of the barrel by June/July 06.

Silicon Strip Detectors

Status: Mass production of sub-hybrids, chip cables and ladder cables in the Ukraine is ongoing, 'just in time'. Sensor delivery has been rather smooth after contract changes and is almost finished. Module production has reached a total of 80% of the modules produced in Helsinki, at the MIPOT company and in Strasbourg. Ladder frame production is completed. Assembly of ladders is now going on at two sites (Amsterdam and Nantes). Several ladders are available for mounting on the SSD support structure, which however is delayed by some weeks. Mass production of the EndCap end-ladder modules is finishing. Cables and patchpanels are in production.

Changes: No major changes.

Concerns: very tight schedule, late external deliveries.

Plans: Integration of ladders on SSD

Time Projection Chamber (TPC)

Status: Installation of the readout chambers (ROC) has been completed in Sept 06. The surveys of chambers and end plates showed a conical deformation of 2.6 mm, somewhat larger than expected. It was decided to use two I-bars instead of the foreseen one I-bar to straighten the endplates. The ROCs were aligned on the straightened end plates with a precision of $\pm 200 \mu\text{m}$ (peak-to-peak). The completed assembly was leak tested with results exceeding specifications.

Front end cards (FEC) installation was finished in Mar 06. One sector was completely characterized resulting in a gain uniformity of 3% rms and a noise of less than one ADC bit, close to the theoretical limit. The grounding scheme was verified.

At present, the TPC has started pre-commissioning in SXL2.

Changes: No major changes.

Concerns: No major concerns.

Plans: Pre-commissioning until Aug 06 with cosmic and laser tracks, start installation in UX2 Sept 06.

Multigap Resistive Plate Chambers (MRPC) for TOF

Status: The production of the MRPC strips is well advanced with enough strips for almost 10 SuperModules built by mid March. The delivery of mechanical components of the modules and their assembly with MRPC strips is well in progress, the five modules needed for the first SuperModule have been transported to CERN for testing in the cosmic-ray station. The cabling test of a SuperModule has been done and the installation of the rails on the Space-Frames has been completed. Delivery and test of all the HPTDC packaged chips is finished and the final yield is very good (82%). The mass production of the Front-end cards (FEA and FEAC) has started and enough cards for several SuperModules are ready. The cooling system of the first custom crate from production has been substantially improved with the use of a new type of heat dissipaters. The delivery of the TRM (TDC Readout Module) cards has started and these cards were used for the full-load test of the crate. The production prototypes of the DRM (Data Readout Module), LTM (Local Trigger Module) and CPDM (Clock and Pulser Distribution Module) cards have been received and tested; the DRM has not yet the final radiation-hard FPGAs whose firmware will be available before summer. Production of the LTM and CPDM boards has started, while for the DRM enough cards will be produced (in the non rad-hard version) for the test and commissioning of the first SuperModules.

Changes: No major changes

Concerns: No major concerns

Plans: Continue mass production of mechanical and electronic components. Start SuperModule assembly and install first SuperModules in summer.

High Momentum Particle Identification Detector (HMPID)

Status: The production of the photocathode planes has been completed. The construction of the cosmic ray facility, needed to commission the remaining two HMPID modules in view of the lack of test beams at CERN in

2005, is finished. The installation of the ancillary systems on the aluminium support structure (cradle) is finished. Rails have been mounted onto the spaceframe. The jig required to install the seven modules onto the cradle is under test. The commissioning of the cooling system is ongoing. The test of the 350 row controller cards has been successfully completed. Most of the cables and connectors have already been delivered.

Changes: No major changes.

Concerns: No major concerns.

Plans: Insertion test of the cradle onto the space-frame by April 2006 followed by the installation of the seven modules onto the cradle. Pre-commissioning of the system at the surface hall. Installation of the detector inside the L3 magnet by August 2006.

Transition Radiation Detector (TRD)

Status: About two thirds of the readout chambers have been finished at the five production sites (Bucharest, Frankfurt, Heidelberg, GSI, and JINR). Since in Feb. 05 the decision was made to introduce the new Layer 0, both procurement and production of these chambers has been very swift. All chambers are ready for the completion of the first super module. Chambers produced at the various construction sites are subjected to a common test procedure involving dark current, gain uniformity, and leak tightness measurements.

Design and production of the super module mechanics has been finished and assembly of the mechanics of the first super module has been successfully completed. All services and their respective distribution manifolds inside the super module (LV, HV, gas, water cooling, detector control system, readout and clock distribution) have been finalized and produced for the first super module. The modified rail system for installation of the super modules inside the space frame has been mounted and is currently being aligned.

Production of the digital readout chip will be done in batches following some problems with the yield. Production of the MCMs is ongoing at FZ Karlsruhe and in industry (MSC) with good yield (> 90%). Production of the readout boards has been launched and is currently running with a yield in excess of 85%. The master/slave system of the HV system has been successfully tested for the amplification section.

Changes: No major changes.

Concerns: Tight schedule for the super module production.

Plans: Assembly and installation of first super module.

Photon Spectrometer (PHOS)

Status: The front-end electronic cards for module 1 (120 cards) has been produced in Wuhan and tested at CERN. All components for one module are now ready: crystals, APD's, preamplifiers, FEE cards, mechanics, LED monitoring system, cooling system, and support cradle. Assembly of the first PHOS module is underway at CERN.

Crystals for two further modules have been produced; these could be ready for installation end 2007 if all needed funds are available. Funds for the production of the mechanics has been requested from Russia and for the APD's and preamplifiers from Japan. The full PHOS with five modules can be completed by the end 2009 provided that additional Russian and Japanese funds are available.

Plans: Complete assembly of module by June, calibration in beam by end July, installation in August.

Changes: No major changes.

Concerns: No technical concerns. Funding from Russia for 2006 is not yet known. The production of crystals in Russia has stopped due to lack of funding. Funding from Russia and Japan for the next years is under review.

Muon Dipole Magnet

Status: The magnet is complete and fully operational.

Muon Tracking Chambers

Status: The construction of the detectors has progressed very well: All the slats are assembled, HV and leak tested; 85% are read-out tested. The quadrants for stations 1 and 2 are mechanically assembled and 8(7) quadrants from station 1(2) have been tested. The electronic motherboards have been tested for station 1 and tests are starting for station 2. The mechanical supports for all stations are ready. Service (LV, HV, R/O, gas...) integration studies are finished; the cables are being ordered.

The production of the DAQ front card (FRT) and of the CROCUS calibration card has started in February and the back planes are in production. The concentrator card (CRT) will have a last modification before production. Irradiation tests have been delayed and will be performed on CROCUS components in April 2006. A read-out test with CROCUS has been carried out successfully on a full quadrant of station 1; read-out tests on slats have started.

The first new production batch of the MANAS FEE electronics has arrived. The company building the MANU cards experienced problems with the soldering, now solved, and a new qualification batch has been successfully built. The first MANU for the final electronics will arrive beginning of April. An assembly space has been prepared and equipped at point 2.

Changes: The assembly of the chambers with MANU's is delayed to April 2006. Because of the electronics delays, the assembly and installation planning has been modified and compressed by parallelizing as much as possible in order to complete installation of the chambers by April 2007.

Concerns: The assembly and installation progress depends crucially on the electronics production. The CROCUS software remains a concern but additional manpower should arrive soon. CROCUS radiation tests still to be done. The planning has become tight.

Plans: Start assembly with the final electronics of station 4 in April at point 2 and station 1 at Orsay. Start installation of station 4 end of May and station 1 in September.

Muon Trigger Detectors

Status: Cosmic rays tests of all the RPCs to be mounted in ALICE have been completed and these chambers are at present ready for installation. Construction and cosmic-ray tests of spare RPCs will be completed within a few months. The mechanical support of the trigger detectors is ready and the installation will start beginning of April.

The whole FE electronics (~2500 boards) is ready for installation and the production of the signal cables (1500 cables in total) is completed. The Local trigger boards (260 units in total, for trigger decision) are ready for installation but additional spares are needed after some fabrication problems. The prototypes of the Regional trigger boards (16 units in total), Global trigger board (1 unit) and DARC readout cards (2 units) are built and mostly validated. A test bench of the whole trigger electronics, including interfaces to ALICE trigger system and DAQ, is presently under construction.

Changes: No major changes.

Concerns: Assembly/validation of the full trigger electronics.

Plans: Installation of the mechanical support, of the trigger detectors and of the electronics.

Forward and Trigger Detectors (ZDC, PMD, FMD, T0, V0, ACORDE)

Status: The last hadronic ZDC was assembled in November 2005. The construction of the two small electromagnetic calorimeters and the procurement of the mechanical parts of the support platform for the detectors are under way.

Two-thirds of the unit modules of the PMD have been fabricated. Supermodule assembly has now started after modifications in the design. Work on FEE and readout is in progress. Work on auxiliaries like cooling, support structure etc. is proceeding on schedule.

Fabrication of the ACORDE scintillator paddles is finished and construction of the other detectors (T0, V0, and FMD) is advancing very well and on schedule. T0 completed full chain electronics test in November 2005 and electronics PRR in February 2006.

Changes: Minor changes to the PMD supermodule design.

Concerns: No major concerns.

Plans: Continue construction of PMD/V0/T0/FMD detectors. Beam test of V0 and PMD in May 2006, commissioning of T0-A in October 2006. Final radiation tests of FMD electronics. Assembly of the ZDC platform.

Trigger

Status: Construction of most of the CTP boards took place in 2005. The firmware for these boards has now been completed and the boards are fully operational. The last two boards (a passive fan-in and the interface to DAQ) will be completed in April. Systematic tests of each board and full system tests have been carried out. Software development has continued, and a first full version of the control software has been completed. A more high-level version of the software, including management of trigger configurations using a database, is being prepared. The trigger system is scheduled to be sent to CERN in May 2006.

Changes: No major changes.

Concerns: No major concerns.

Plans: Development of user-level software. Integration tests with DAQ and ECS systems at CERN. Installation at Point 2.

Data Acquisition (DAQ)

Status: The production of the DDL will be performed in batches delivered between March and June. The two first batches have been delivered and will equip one full side of the TPC. The production of the D-RORC is scheduled from May to July. DDL and RORC prototype cards are used by most detectors for the test and commissioning. All the other hardware elements of the DAQ are purchased from industry. They have been selected and the purchase procedure has been started. The qualification of the event-building switch has been successfully performed during the first phase of the Computing Data Challenge VII demonstrating a sustained aggregate throughput of more than 3000 MByte/s. DATE V5 has been released and documented. The integration of the detector readout chain with the DAQ (DDL and DATE V4) has been realized for the SPD, SSD, SDD, TPC, TRD, TOF, HMPID, Muon Tracking, Muon Trigger, PHOS, FMD, V0 and EMCal. A DAQ reference system made of data sources, DDLs and D-RORCs, PCs, storage, network and infrastructure has been assembled for the commissioning of the DAQ system itself. This reference system is controlled by the Experiment Control System (ECS) and will be used for the integration of the DAQ with the Trigger CTP before its installation. The DAQ layout and the cables database have been prepared for the installation at Point 2. The installation of the first stage of the DAQ system has been done and will be used during detectors test and commissioning.

Changes: No major changes.

Concerns: No major concerns.

Plans: D-RORC production, Integration DAQ and Trigger CTP, Computing Data Challenge VII Phase 2, DAQ at Point 2.

High Level Trigger (HLT)

Status: The new AliRoot interface is finalized and the TPC components are integrated. A first version of the TPC on-line monitoring and diagnostics tools are available, allowing various on-line diagnostics functions. A first, small HLT cluster is installed at CERN and ready for TPC commissioning.

The competitive bidding for the H-RORC mass production is under way, the first 10 preproduction units are expected in 3-4 weeks. The CHARM PC control devices are in production. All Ethernet cables have been mounted at the HLT counting rooms in October 2005. However about 50% of the patch panels remain to be connected, which is scheduled for late summer 2006.

Changes: No major changes.

Concerns: No major concerns.

Plans: Production of the new H-RORC. TPC commissioning and online monitoring, preparing for the HLT production readiness review in April 2006 and HLT installation later in 2006.

Offline

Status: The AliRoot code is reaching completeness with the final implementation of the raw data format, calibration procedures and alignment procedures using the ROOT geometric modeller. Detailed studies on the impact of misaligned geometries on the tracking performances in the central tracking systems and the MUON arm are well advanced. The overall calibration procedures including online calculation of calibration parameters are examined detector by detector. The framework, called SHUTTLE, for collecting online parameters to make them available in the offline Calibration Data Base has been implemented. A complete documentation of AliRoot including a primer for new users has been released.

The distributed computing environment has reached sufficient maturity to make it available to general users. It incorporates the services distributed through the LCG middleware and ALICE specific services not available elsewhere. VO boxes hosting the ALICE services have been installed in all Tier1 sites and all Tier2 sites pledging resources to ALICE. The production phase of the Physics Data Challenge 06 will start on 10 April with the simulation of pp events defined by the Physics Board. Although all the utilities exist, distributed analysis has not yet been tested in a realistic environment and at a realistic scale. This testing will be a major challenge until the end of the year. A complete documentation of the usage of ALICE distributed computing environment and distributed analysis has been released.

Distributed analysis based on the Parallel ROOT Facility (PROOF) and on the xrootd I/O subsystem will be the baseline for performing calibrations and prompt analysis on the CERN Analysis Facility during data taking and could be adopted by the Tier2 sites dedicated to mainly analysis. A prototype system will be deployed on medium-sized farms at CERN, CCIN2P3 and FZK to be exercised by general users.

Changes: No major changes.

Concerns: The computing resources pledged so far by Funding Agencies for ALICE are well below the needs documented for and validated by the Computing Resources Review. New developments in the EGEE/LCG middleware services are planned to be released as late as October 2006. The personnel situation for offline computing remains tight, stabilisation of key personnel is mandatory to ensure availability and quality of services to users.

Plans: Final offline software developments required for first data taking Calibration procedures from online to offline. Validation of the distributed analysis model.

Installation & Assembly activities

Status: Following the completion of the field mapping measurements, the installation work continued with the installation of the Muon platform and the absorber. The space frame was lowered into the experimental cavern and is ready to be inserted into the Solenoid magnet. In parallel, preparations have started on the installation of the large support structure for the Muon spectrometer chambers.

Work on primary services and infrastructure is advancing in a satisfactory manner. The installation and commissioning of primary cooling, detector cooling stations, gas racks and gas piping are in progress. Installation of cables has started. The refurbishing of the counting rooms continues.

Changes: A 2 month delay in the installation, caused by a number of uncorrelated problems during the field mapping, has been largely absorbed by rearranging the planning.

Concerns: The increasing number of installation activities, and in particular the large amount of service installations, will increase the complexity and reduce the flexibility of working at point 2.

Plans: Installation of HMPID, PHOS, TRD and TOF detectors. Continuation of installation of services.

MILESTONES

In early 2005 ALICE has re-arranged the planning (dating back to mid 2002) to take into account the actual status of detector production. A number of corrective actions have been implemented and the schedule has been adjusted in order to have a working detector in place for the initial operation of the LHC with first collisions expected in summer 2007. Installation of some parts of our modular detectors (PHOS, TOF, TRD) will continue

beyond that date. Some items on the critical path remain very tight and without contingency. Actions have been undertaken to speed up production in particular of the ITS detectors.

