Status of ALICE: Report to the October 2006 RRB

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 about 1000 members from over 90 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 45^0 to 135^0 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 (2^0-9^0) 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. A Technical Proposal for the EMCAL has been submitted to the LHCC in April 2006.

Construction of infrastructure items, supports and the muon magnet is completed and detector construction is nearing completion for most systems. Detector installation has started in mid 2006. Planning and installation schedule have been aligned to the closure date of the LHC, end August 2007.

Silicon Pixel Detectors

Status: The production and testing of detector ladders is nearly completed. Half-stave production is on schedule. Six final sectors (out of 10) have been assembled, three are installed in the dedicated test, integration and commissioning area in the CERN DSF clean room, together with the SPD cooling plant. The readout electronic modules (Routers) have all been produced and tested. The integration of the full system is implemented using the Routers with the final DAQ, DCS, power supplies and services (patch-panels, cables and fibres). The processor module for the pixel trigger (FastOR) is in the prototyping phase.

Changes: No major changes.

Concerns: The schedule remains extremely tight.

Plans: Half-barrel mechanical integration.

Silicon Drift Detectors

Status: Detector production at CANBERRA is completed, detector characterization and the assembly of the transition HV cables is almost complete at INFN-Trieste with help from OSU. The wafer-testing of front-end chips (PASCAL and AMBRA) is completed at INFN-Roma, currently the wafers for spares are being tested. Sub-hybrids and chip-cables assembly with front-end electronics is also completed, spares are being assembled. The hybrids have been assembled to the sensors to make modules, and also this step is basically complete.

The major current activities are the assembly of the long microcables to the LV and HV endladder boards, the subsequent module test and the assembly on ladders. Over one third of the necessary modules have been assembled and tested, and the ladders of the inner of the two layers (14, with 6 modules each) have been built. The ladders are tested, and a few early ones with problems have been repaired to reach full efficiency.

The present assembly rate and yield are adequate to complete the SDD barrel in time for transport to CERN on week 48 of 2006.

Changes: A 2-month delay accumulated in May-July because of a production fault in the HV distribution boards can be absorbed with the new LHC schedule.

Concerns: Extremely tight schedule, no contingency.

Plans: Completion of the barrel by week 47 in 2006.

Silicon Strip Detectors

Status: The production of modules was finished in July, reaching 2073 modules (incl. spares). The mounting of 1886 modules on ladders (in Amsterdam and Nantes) was completed with the final 80th ladder early September. The finishing of these ladders, testing and repair will continue throughout September. The first of four sectors of the inner layer is mounted on the SSD support structure, cabled and tested. All cables and patch panels inside L3 are ready and the first half is being installed in September.

Changes: No major changes.

Concerns: Late delivery of power supplies, tight schedule.

Plans: Ready to install SSD before end of the year.

Time Projection Chamber (TPC)

Status: Pre-commissioning of the TPC in SXL2 is ongoing since April 06. The gas system is fully functional with the ternary gas mixture Ne/CO2/N2. The oxygen contamination is below the target value of 5 ppm. For pre-commissioning, two TPC readout sectors are powered, cooled and read-out at a time. The field cage is under high voltage with the nominal 100 kV at the central electrode. The front-end electronics is completely characterized and the ROC gain curve is measured using cosmic muon tracks (triggered with two ACORDE panels). The readout is done using the final DAQ chain. DCS is operational and used for the configuration of the electronics and for monitoring temperatures, currents etc. The laser system of the TPC, which provides a large number of simultaneous tracks, is also commissioned and used for testing the readout chambers.

All 36 sectors have been inspected in a first round till end Sept. The TDR specifications were reached or surpassed. The RCU cabling will be completed thereafter and all sectors will be re-tested.

Changes: No major changes.

Concerns: No major concerns.

Plans: Pre-commissioning until mid Nov 06 with cosmic and laser tracks, start installation in Nov 06.

Multigap Resistive Plate Chambers (MRPC) for TOF

Status: The production of the MRPC strips is well advanced, enough strips for almost 15 (80%) SuperModules have been built by the end of August. The delivery of mechanical components of the modules and their assembly with MRPC strips is well in progress; 21% of all needed modules have been assembled with strips in Bologna. The modules needed for the first 4 SuperModules have been transported to CERN for testing in the cosmic-ray station. After the module's test, the assembly of the first SuperModule has started (mid May) and has been completed during the summer. At the end of July, the assembly of the second SuperModule started and was completed in September. The mass production and delivery of the Front-end cards (FEA and FEAC) is well advanced; enough cards for 14 SuperModules have been delivered. The delivery of the custom crates with LV DC-DC converters and of the TRM (TDC Readout Module) cards is under way, with a rate that should substantially increase in October. The cosmic-ray station at CERN and the first 2 SuperModules are already fully equipped with these components. The same holds true for the LTM (Local Trigger Module) and

CPDM (Clock and Pulser Distribution Module) cards. The first DRM (Data Readot Module) cards have been delivered and full functionality tests are under way with a crate in the final configuration (9 TRM, 1 LTM, 1 CPDM). For the test of the first 2 SuperModules a commercially available VME-master card has been used. The components of the HV system (SY1527 mainframes and A1534P/N boards) and the DCS PCs have been delivered and tested.

Changes: No major changes

Concerns: No major concerns

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

High Momentum Particle Identification Detector (HMPID)

Status: All the 7 detector modules have been equipped with photo-cathodes and electronics and mounted on the support cradle previously equipped with all patch panels, cables and pipes needed by the gas, radiator, cooling, LV, HV and DAQ sub-systems. The detector has been pre-commissioned in the surface hall together with the services on the cradle.
During this phase a leak has been detected in one (out of 21) radiator tray. The replacement of the faulty radiator would have required delaying by 2-3 months the installation of the detector. As the acceptance is reduced by only 5%, with no impact on the physics potential, and given the high risk involved in the manipulation of the detector during reparation, it has been decided to install the detector and bypassing the faulty radiator.
The detector has been successfully installed inside the ALICE magnet in September.

Changes: No major changes.

Concerns: No major concerns.

Plans: Completion of the system for the circulation of the liquid C_6F14. Installation and commissioning of cables and pipes inside the ALICE magnet. The final commissioning of the detector and related services, including DCS, will start in January 2007.

Transition Radiation Detector (TRD)

Status: More than 90% of the previously funded readout chambers have been finished at the five production sites (Bucharest, Frankfurt, Heidelberg, GSI, and JINR). including production of the new Layer 0 chambers. The first super module has been completely assembled at Heidelberg and the entire system has been tested at trigger rates of up to 190 kHz. It was shown that the noise level anticipated in the TDR is reached (sigma=1.1 ADC counts corresponding to 1100 electrons). Power consumption matches estimates in the TDR for different trigger conditions. The cooling system is able to cope with all trigger conditions. Transport to CERN is scheduled for September 28 to be followed by installation in the space frame in mid October.

HV and LV systems have been tested on the first super module and are ready for installation at CERN. The entire readout chain involving the first modules of the Global Tracking Unit (GTU) as well as components of the ALICE DAQ has been successfully exercised.

After funding for 100% of the TRD has been granted all necessary materials have been ordered and will be distributed to the various construction sites after delivery. Institutes in Bucharest, Darmstadt, Frankfurt, Heidelberg, and Moscow will proceed with chamber production. In addition, Frankfurt will take over electronics integration, and Muenster will focus on super module assembly and commissioning.

FZ Karlsruhe has finished production of 15000 MCMs and readout boards for the first super module. These tasks will now be taken over by a company (MSC) as a consequence of limited capacity and production speed. MSC has demonstrated that they are able to provide all electronics with an overall yield exceeding 90%.

Changes: Industrial supplier for assembly of MCMs and readout boards. Full TRD now funded.

Concerns: Tight schedule for the super module production.

Plans: Production of super modules for second installation period.

Photon Spectrometer (PHOS)

Status: The first PHOS module has been assembled, pre-commissioned and calibrated with electron beams at the CERN PS. Pre-commissioning of the module is now underway. 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 have been allocated in Russia, and for the APD's and preamplifiers in Japan. Funds for the production of the FEE cards for two further modules have been allocated in China. The full PHOS with five modules can be completed by the end 2009 provided that additional Russian funds are available.

Plans: Installation of the first module in October. Revision of the mechanics design and start production of the mechanics for two further modules by the end 2006.

Changes: A Grant proposal for participation in the PHOS project has been approved in Japan. The funds cover APD's, preamps and some electronics for four further modules. MoU has been signed with China funding agency, which foresees significant contribution to the PHOS project. The foreseen funds cover production of the FEE cards.

Concerns: No technical concerns. The production of crystals in Russia has stopped due to lack of funding. Funding from Russia for the next years is under review.

Muon Tracking Chambers

Status: 60% of the MANAS FEE are produced and delivered; the remaining has been produced in India and is being encapsulated and tested in Singapore. 30% of the MANU cards are delivered. They have been used to equip 3 half-chambers of station 4, the 4th one being presently equipped; 5 quadrants of station 1 can also be equipped.

The installation of stations 4 and 5 rails is done. The installation of supports and cooling of station1 and 2 on one hand and station 3 on other hand are in progress. One half-chamber of station 4 is installed in the cavern, 2 others are ready to install, the 4th one will be ready by the end of September. The mounting and alignment of the Geometry Monitoring System (GMS) will be done in parallel to chamber installation.

25% of the DAQ CROCUS front cards (FRT) are produced, the remaining will be delivered in October. The concentrator card (CRT) was modified and is being tested before production. Calibration cards are produced and the production of CROCUS chassis is in progress. Irradiation tests of CROCUS did not show special problems. Additional manpower to work on the CROCUS software has been found.

Concerns: No major concern.

Plans: Station 4 and 5 will be ready to install by the end of 2006. Installation of station 1 will start in November and last until the end of the year. Start commissioning of the chambers in situ after installation of the services (cables, gas pipes…).

Muon Trigger Detectors

Status: The mechanical support of the trigger detectors (RPCs) has been installed and aligned on the superstructure. The complete set of RPCs is presently installed in its working position. The whole FE electronics (~2500 boards) is mounted on the RPC readout planes, in the ALICE cavern. Final preparation and installation of the service columns and of the translation system is in progress. The signal cables (1500 cables in total) are built and installation will start as soon as the service columns will be ready in the cavern.

The Local trigger boards (260 units in total, for trigger decision) are ready for installation and 50 additional spares are presently fabricated. The Regional trigger boards (16 units in total) and Global trigger board (1 unit) are also ready for installation. The writing/reading of run control parameters via the JTAG protocol has been validated. The prototype of the DARC readout card is built and mostly validated, including interfaces to ALICE trigger system and DAQ. The final DARC boards (2 units) are developed in parallel.

Changes: No major changes.

Concerns: No major concern

Plans: Installation of the service supports, services and trigger electronics in the cavern.

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

Status: All the hadronic ZDC calorimeters are now assembled and calibrated in beam and the construction of the two small electromagnetic calorimeters and of the support platforms is under way.

The ACORDE scintillator paddles have been installed on top of the L3 magnet. Both T0 arrays (T0-C and T0-A) have been produced. PMD and V0 production are proceeding. The V0 electronics was tested in July before fixing the final design.

All Si detectors and FEE electronics cards for the FMD detector have been delivered and glued. Bonding is 90% completed. A successful full sector test with 5 inner detectors (i.e. 5120 channels, about 10% of the total number of channels) using a 680 e- beam was completed in July. The test included the full readout system with full scale digitizer, RCU , DDL and DAQ/DATE. Signal to noise performance for all channels is between 25 and 40 depending on length (capacitance). Mounting cone for A side has been fabricated. Production order for final digitizers is about to be placed. Assembly and cooling tests are ongoing.

Changes: No major changes.

Concerns: No major concerns.

Plans: In October 2006 the T0 arrays will be commissioned with beam.

Trigger

Status: All components of the trigger hardware have been produced and successfully tested in Birmingham. Two complete CTP systems are currently set up in Birmingham whilst three more were transported to CERN in July. Software tools for CTP configuration, testing and error detection have been developed and tested. One CTP and the DAQ reference system have been successfully integrated in order to emulate two detectors in a realistic way. In this setup, DDL data generators, emulating the detectors, are triggered by the CTP system and two LTUs, and are readout by the DAQ reference system. The CTP system, itself, is also readout by the DAQ. The ECS configures and controls the whole setup and permits all possible combinations of the two detectors. Therefore, all the interfaces between the three systems, ECS, Trigger and DAQ, have now been tested and performed according to specification. The fifth CTP system is now ready to be installed in Point 2 as soon as the infrastructure is ready to receive it.

Changes: No major changes

Concerns: No major concerns

Plans: Installation of CTP at point 2 and start of sub-detector commissioning.

Data Acquisition (DAQ)

Status: The production of all the Detector Data Links (DDL) has been performed. The TPC is now completely equipped with DDL and the installation is in progress for the other detectors. The production of the D-RORC is in progress. 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 and the first stage of equipment has been delivered and installed in the DAQ counting room. The integration of the detector readout chain with the DAQ (DDL and DATE) has been realized for the SPD, SSD, SDD, TPC, TRD, TOF, HMPID, Muon Tracking, Muon Trigger, PHOS, FMD, V0, EMCal and ACORDE. DATE V5 has been released and documented. The DAQ reference system made of data sources, DDLs and D-RORCs, PCs, storage, network and infrastructure has been used intensively for the integration of the DAQ system with the Trigger CTP. This reference system is controlled by the Experiment Control System (ECS). The installation of the optical fibres from the detectors to the DAQ is in progress. The design of the final control room has been agreed and its installation is in progress.

Changes: No major changes.

Concerns: No major concerns.

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

High Level Trigger (HLT)

Status: The HLT production readiness review was passed successfully. HLT commissioning has started. There are 11 multi processor server nodes installed at Point-2 which are being used for TPC commissioning, including TPC on-line event display. At this point 6 DDL links are being read out with an upgrade to 12 links scheduled for beginning of October. The H-RORC production is on-going with the full delivery scheduled for the second week of October. The competitive bidding of the HLT computers for the first year, is 80 rack mount PCs, has started.

Changes: No major changes.

Concerns: No major concerns.

Plans: Verification and burn-in of the H-RORCs, installation of the HLT nodes for running in 2007.

Offline

Status: The AliRoot software is approaching the final configuration for processing real data in winter 2007. Technical changes are continuously implemented to improve the modularity of the framework and the robustness of the code. The memory consumption, which was a major concern, has been significantly lowered during data reconstruction. The calibration and alignment framework has been fully implemented and has been successfully exercised in production tests stressing the queries to the Offline Calibration Data Base. The simulation of the raw data flow has been implemented for all detectors. The commissioning of the offline framework has started together with the commissioning of detectors (PHOS and TPC).

The Physics Data Challenge is in production mode since April 2006. All the ALICE Tier1s, except NGDF, and about 30 Tier2s contribute to the exercise. The central ALICE services have reached a near production level. Seven millions of pp events have already been produced. This Physics Data Challenge is also extremely useful for the training of experts on the sites and the collection of operational experience. The storage architecture remains a concern and will require additional work in particular in view of the upcoming challenge including user driven distributed analysis. The data movement challenge, coordinated with the LCG SC4, involving transfers from the Tier1s to the CERN Tier0 and replication of data from the Tier0 to the Tier1 has not yet reached its goal of sustained 300MB/sec transfer rate. So far only a peak rate of 150MB/sec during a short period could be achieved.

The parallel analysis framework based on PROOF and to be deployed on the CAF is operational and tested by several concurrent users. The expected performance could be reached demonstrating the validity of the approach. Many analysis modules integrated in the AliRoot analysis framework are developed within the Physics Working Group and will be tested with the data produced in the PDC either within the distributed environment or n the CAF.

Monthly tutorial sessions are organize to train ALICE collaborators for using the AliRoot framework and perform analysis on the GRID.

Changes: Resource requirements adapted to new LHC schedule.

Concerns: The situation of the computing resources made available to ALICE is evolving slowly with the addition of a few new sites. The deficit of resources has also been slightly reduced in 2007 and, to lesser extend, in 2008 taking into account the revised LHC start-up scenario. However, in 2009 the situation will become again worse.

Plans: Commissioning of the offline framework together with the detector commissioning, user driven analysis challenge, understand with the sites the availability of resources.

Installation & Assembly activities

Status: All large support and infrastructure installations have been completed. The various support frames and installation tools for the central detector units are in place and the installation of the modular detectors (HMPID, TOF, TRD and PHOS) as well as the ACORDE detector has started. Following the installation of the large support structure for the Muon spectrometer chambers, the installation of the Trigger and Tracking chambers has started.

The installation and commissioning of primary cooling, detector cooling stations, gas racks and gas piping is in progress. Installation of cables has started. The refurbishing of the counting rooms is under way.

The design and integration activities concentrate on the various shielding structures and the beam line elements.

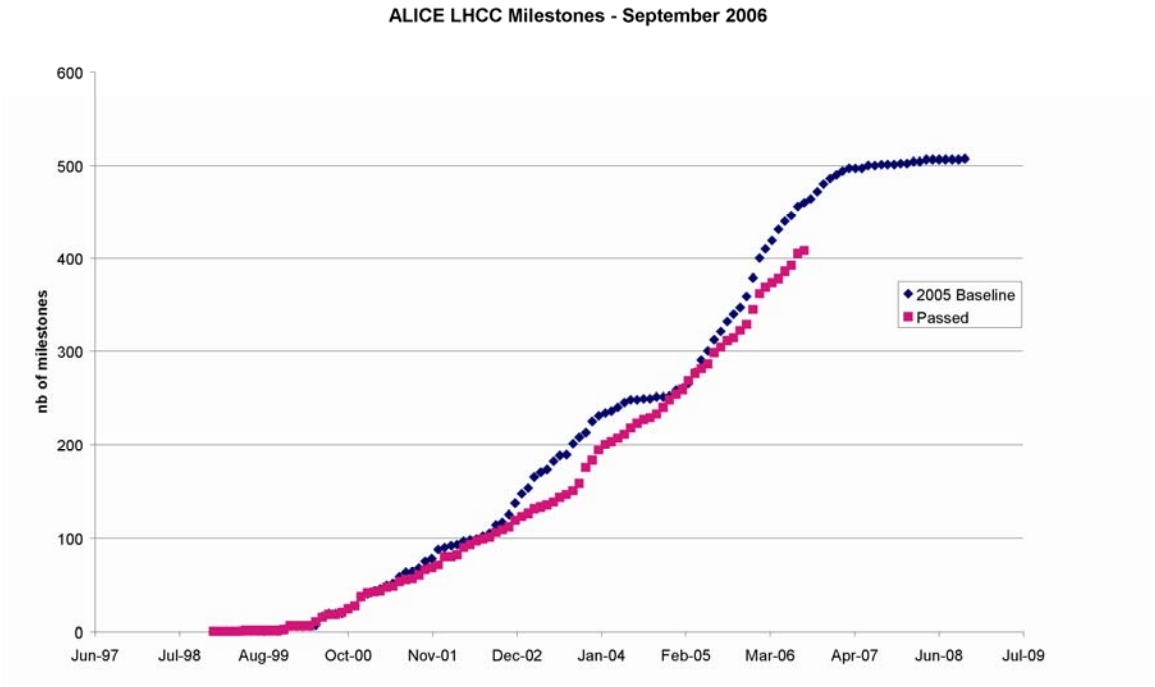
Changes: The installation schedule has been aligned with the up-dated construction schedule for detectors and the LHC machine. More time has been allocated to detector commissioning on the surface.

Concerns: The protection of the installed detector units.

Plans: Continuation of installation of detector units and services.

MILESTONES

The planning shown as 'baseline' in the plot below was established in early 2005, aiming at closing the detector in April 2007. The achieved milestones show a delay with respect to this plan of two to three months. A number of corrective actions have been implemented over the last year in order to have a working detector in place for the initial operation of the LHC in 2007. The progress achieved is compatible with the revised LHC schedule as announced in June 2006. Installation of some parts of our modular detectors (PHOS, TOF, TRD) will continue beyond that date. However, the ITS system remains on the critical path with a very tight schedule and little or no contingency.


ALICE LHCC Milestones - September 2006
nb of milestones
600
500
400
300
200
100
0
Jun-97
Jul-98
Aug-99
Oct-00
Nov-01
Dec-02
Jan-04
Feb-05
Mar-06
Apr-07
Jun-08
Jul-09
2005 Baseline
Passed