

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 over 1000 members from around 100 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 two single-arm electromagnetic calorimeters (high resolution PHOS and large acceptance EMCAL). 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) is installed on top of the L3 magnet.

Experiment status

ALICE entered into shut-down mode in October 2008 for a number of modifications, improvements and maintenance operations to be carried out during the repair period of the LHC. The major activities included a re-cabling of the ITS and TPC services on the miniframe to improve the access to the TPC electronics, identifying auxiliary equipment which generated electronics noise picked up by several detectors (TPC, muons, TRD), removing and repairing two TRD and one PHOS module, and installation of addition modules for TRD, PHOS, and EMCAL. This extensive program went according to planning and was essentially finished by mid summer.

Recommissioning the detectors and online systems as well as a first cosmic run of the muon system started in June/July. Since mid August, the experiment is in stable running conditions and took cosmic data for calibration and alignment.

Silicon Pixel Detectors.

Status: The SPD is installed and operational in ALICE including the prompt (FastOR) trigger processor. In summer 2008 the SPD has participated to an intensive campaign of cosmic data-taking and it has also provided ALICE with a trigger signal. The collected data sample has allowed the alignment of the majority of the SPD modules, limited only by the geometrical acceptance for cosmics. After realignment, the $r\phi$ resolution is $\sim 14 \mu\text{m}$, close to the nominal detector resolution of $12 \mu\text{m}$. In September 2008 the SPD was ready to record the first collisions in LHC and the first beam induced collision was recorded and reconstructed in the whole ITS using the SPD trigger signal.

In October 2008, following the ALICE plan, all services carried by the miniframe were disconnected from the detector and re-routed. In June 2009, after the re-positioning of the miniframe, all services were re-commissioned and the detector operations could be resumed. The SPD was ready to take data within few days of the long shutdown and participated in the injection test at the beginning of July. During the summer the SPD has participated in the ALICE cosmic run with magnetic field, contributing to the L0 trigger definition.

Since the shutdown a program was started to improve the cooling performance which prevents to operate a fraction of the modules. This work is in progress with the aim to maximize the cooling efficiency and thus the number of modules that can be turned on.

Changes: No major changes.

Concerns: In order to cure the reduced cooling power a substantial upgrade of the cooling system may be required.

Plans: Prepare the detector for running with the LHC beams.

Silicon Drift Detectors

Status: The new software implemented in the readout boards (CARLOS-RX), which provides a new coding of the data with considerable reduction of the data volume, has been successfully installed and commissioned. The routing of services on the miniframe has been redesigned, in order to provide easier

access to the TPC chambers and electronics for maintenance. This major activity has involved all services carried by the miniframe, and has required the redesign of some of the patch panels and a detailed optimization of the routing. The new services have been installed and tested, and are now fully functional. Since Aug 17, the SDD have been taking data continuously, with stable and reliable operation.

Changes: Improved control cards (CARLOS-RX), new routing of services on the miniframe and patch panels.

Concerns: No major concerns

Plans: Steady data taking with the other ITS detectors for alignment purposes.

Silicon Strip Detectors

Status: The SSD was re-commissioned after the Miniframe modification. As expected, the signals from the A-side are now 10 % lower due to increased cable losses and 5 % lower than the C-side signals. The alignment was checked with cosmics in September and the resolution is within specifications.

The problem of high bias current in the Sintef ladders was studied extensively in the laboratory, both with bare sensors and spare ladders. The relatively high humidity inside the installed SSD was identified as a possible cause. Actions are being taken to reduce the relative humidity inside the ITS to well below 50 %. In the mean time as temporary measure, nitrogen enriched air is blown into the SSD volume. Research in the laboratory in cooperation with CAEN showed a possibility of reducing the common mode signal generated by the low-voltage power supplies. Tests are on-going in the ALICE environment until the cavern is no longer accessible. Large-scale deployment of a possible solution will not be feasible until the next long shutdown.

Changes: New ventilation with lower humidity

Concerns: Some half-ladders with SINTEF modules show high bias current.

Plans: Continue study of high ladder current problem and improvement of power supplies.

Time Projection Chamber (TPC)

Status:

In the spring of 2009 the access to the TPC electronics was significantly improved by complete rerouting of ITS cables and many significant changes on the ALICE miniframe. During this time also most of the capacitors in the IROC HV distribution boxes were replaced and a major overhaul of the cooling system was performed. The TPC was taken again into operation in July 2009 taking cosmic data at chamber gains and magnetic field settings. Since that time the detector is essentially working according to specifications. A full amplitude calibration using radioactive Kr was performed and the quality assurance and monitoring of TPC data was significantly improved.

Changes: No major changes.

Concerns: No major concerns.

Plans: Continue data taking and calibration until beam.

Multigap Resistive Plate Chambers (MRPC) for TOF

Status: During spring 2009 TOF has undertaken an important effort to complete the commissioning of the full system. Several small hardware and software problems have been discovered and cured, in particular one related to incorrect power supplies in a few crates. At present about 94% of the detector is active. In June/July TOF was successfully integrated in the global ALICE DCS and DAQ system. Also the TOF trigger completed a detailed commissioning work and it was ready for the start of the cosmic-run data-taking in middle August. Since then TOF has been always included in the global ALICE data taking. The TOF cosmic trigger provided a very stable and efficient trigger for other detectors (TPC, TRD, EMCAL) and for cosmic physics studies. The first analysis of the data shows quite good data quality and a clear time-of-flight signature of traversing muons. The definition of the new calibration parameters for the full TOF is in progress. With the limited statistics available for calibration with cosmics, the TOF resolution has reached a value of about 130 psec.

Changes: No major changes.

Concerns: No major concerns.

Plans: Continue data taking and prepare for pp collisions.

High Momentum Particle Identification Detector (HMPID)

Status: After some consolidation work (repair of some HV boards, upgrade of the DCS and the repair of a leak in the C₆F₁₄ liquid system) the detector is ready again for data taking. It has been stable, running in the global partition during the cosmic run and it will take data during the LHC injection test planned at the end of week 39. In the meantime, the parameters for the operation of the circulation liquid system are optimized in view of reducing the C₆F₁₄ consumption. During the summer the photo-current from the spare photo-cathodes, produced several years ago, has been measured and found to be equal to or slightly higher than just after the CsI deposition. The online programs have been improved and QA plots included and qualified in the general ALICE framework.

Changes: No major changes

Concerns: No major concerns.

Plans: Keep the detector operational and continue the development of the offline analysis

Transition Radiation Detector (TRD)

Status: The first two installed super modules, which have been removed and disassembled to repair the micro-leaks, have been reinserted into the experiment and are being successfully operated. Three new super modules have been completed, tested, and inserted into the spaceframe. Currently, seven super modules are installed and are being calibrated using cosmics and Krypton. New algorithms for the TRD trigger in the Global Tracking Unit have been developed to produce very high purity cosmic triggers in conjunction with a pre-trigger from the time-of-flight system.

The problems in the read-out board production have been diagnosed by the manufacturer and a plan with slight modifications in the multi-chip module production has been agreed upon. After a test production, readout board production has resumed with excellent yield. However, the mass production is still limited by shortcomings in the test equipment. Normal production is expected to resume in October at a rate of one super module every 5-6 weeks using two sites working on the electronics integration.

Changes: None.

Concerns: Readout board production schedule

Plans: Production of new super modules at a rate of one every 5-6 weeks; completion of the remaining 11 super modules.

Photon Spectrometer (PHOS)

Status: The three PHOS modules were re-assembled in the new air-tight casings, tested in the lab, and installed in August. The commissioning of the PHOS modules is ongoing. In mid-September, PHOS was included in the global readout for the first time this year, though only with the module in position 2. It is expected that the two other modules (position 3 and 4) will be included soon. Two final modules (4&5) are partially funded (FEE cards by China, APD's and preamplifiers by Japan). No funds from Russia are available in 2009 for crystals and mechanics, and the situation with the Russian funds for the next years is uncertain.

Changes: No major changes.

Concerns: No major concerns.

Plans: .Commissioning with cosmics until the start of data taking.

Electromagnetic Calorimeter (EMCal)

Status: Fabrication of all subsystems continues at maximum capacity. Four super modules have been completed, tested and calibrated in the laboratory with cosmic rays and installed into ALICE. Integration of these four super modules with ALICE DAQ and trigger is progressing well and will be completed and tested before LHC startup. The 5th super module is nearing completion in the USA and construction of the 6th will commence soon at the European assembly facilities with completion expected by March 2010.

Changes: First four super modules completed, delivered, installed and commissioned.

Concerns: No major concerns

Plans: Continue mass production of detector and electronics. Finalize integration with ALICE trigger and DAQ and participate in first LHC run.

Muon Tracking Chambers

Status: All the stations are installed, cabled and commissioned. The noise on the slats is now at an acceptable level overall and good on the bending planes where the best resolution is required. All the chambers are read-out by the global Alice DAQ. They were all included in the August-September cosmic run and show a good stability with more than 90% of read-out pads fully working. The GMS system is installed except on CH6. Some work is still needed to finalize the tracking system: fix some read-out channels, finish to install and adjust the GMS and finish the survey of the chambers (CH6 and CH7, 8, 9, 10 outside). This work is in progress. The Detector Control System is fully operational. The new online monitoring (AMORE) is largely implemented including Quality Assurance. The offline reconstruction code along with the alignment with particles and electronics calibration codes are ready. A first alignment with cosmics in absence of magnetic field is in progress and the first tracks with magnetic field have been reconstructed.

Changes: No major changes.

Concerns: No major concern.

Plans: Finalize the complete commissioning to be fully ready by the end of October.

Muon Trigger Detectors

Status: The complete muon trigger system (detector, front-end and trigger electronics) is fully installed since early 2008 and operational. The RPCs can now be operated either in streamer or avalanche mode. The commissioning of the muon trigger system has progressed during two periods of cosmic runs in spring and summer 2009, for a total data taking duration of more than six weeks. In the first run the RPCs were operated in streamer mode and data were taken without magnetic field, while in the second one the avalanche mode was tested and data were taken both with and without magnetic field. In both runs the muon trigger system showed stable behavior and was successfully delivering trigger signals for cosmic events. In addition, the Muon Trigger participated to the LHC injection tests carried out in summer 2009.

Changes: No major changes.

Concerns: No major concerns.

Plans: Minor interventions aimed at final adjustment of the detector and of the electronics are in progress and will be completed by end October.

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

Status: With the exception of the PMD, all systems were fully installed, commissioned and integrated in the read-out already in September 2008. The A side detectors (V0A, T0A, ZEM, FMD1, PMD), which had to be removed to allow the modification of the miniframe, have all been reinstalled and recommissioned. A new card has been built to speed up the read-out of the ZEM and an improved version of the T0 pretrigger amplifier (used by the TRD) was installed. The modifications to the PMD detector, including electronic protection circuits and better noise shielding, are finished and the full detector was installed in August. The air cooling was found to be insufficient for the operation of the complete PMD and has to be improved. ACORDE has participated in the 2009 cosmic run, providing a trigger signal for calibration and alignment of the barrel detectors.

Changes: No major changes.

Concerns: PMD air cooling to be improved.

Plans: Improve cooling of PMD and complete its commissioning. Participation of all detectors in cosmic running and injection tests.

Trigger

Status: The Central Trigger Processor has been operating throughout the summer cosmic ray data-taking run. It has proved very reliable, and has been used in quite complex ways to allow simultaneous commissioning of some detectors and data-taking by others. A new optical switch has been added, allowing trigger signals from any detector to be monitored using the TTCit board. The interface to offline services is being improved, allowing more information on trigger conditions to be stored with the data for offline analysis. Monitoring facilities continue to improve. Trigger input timing was achieved during the beam extraction test in July for some inputs, and will be continued with the next extraction test at the end of September.

Changes: No major changes.

Concerns: No major concerns.

Plans: Continue the cosmic data-taking run and preparations for data taking with beams.

Data Acquisition (DAQ)

Status: The DAQ has been fully deployed to 100% of its capacity. This new configuration has been fully commissioned at the occasion of a mini data-challenge in June. The system has demonstrated a performance required for the heavy ion run (1.3 GB/s) for an entire week. The DAQ has been used for detector commissioning till mid-August and for acquisition of cosmic data for 1 month till mid-September. The experiment has been taking data during 70% of this whole month.

The Data Quality Monitoring (DQM) software is under test. It includes the Quality Assurance modules of the detectors and an online reconstruction. The DQM is being interfaced to the electronic Logbook to provide an automatic archiving and a remote access. A new software package (the ALICE Configuration Tool or ACT) is being developed to automate the configuration of the different systems.

Changes: No major changes.

Concerns: No major concerns.

Plans: Put the DQM in production and deploy the first version of the ACT.

Detector Control (DCS)

Status: DCS has been continuously up and running throughout the whole shutdown in order to assure the safety of the installations and to assist the detectors in their commissioning activities. Many parts of the system have been extended and upgraded, such as the electricity distribution, the rack cooling system and the DCS network infrastructure.

New versions of the basic DCS software systems, of tools and of components have been developed, installed and commissioned in order to overcome limitations and weaknesses experienced during the runs in 2008. A new configuration schema has been developed and installed and is presently being commissioned. This allows for centralized and automatic configuration of all detectors as a function of run type and of operational needs. DCS participates successfully in the Cosmic run and injection tests and is ready for the start-up with beam.

Changes: No major changes.

Concerns: No major concerns.

Plans: Finalize the re-commissioning of DCS.

High Level Trigger (HLT)

Status: The HLT hardware infrastructure for the upcoming pp run period is installed at Point-2 and operational, including the interfaces to other ALICE on-line systems (DAQ/DCS/ECS) and Off-line. During the shutdown the installation of Front-End-Processors (FEPs) for all ALICE sub-detectors has been completed and additional Computing-Nodes (CNs) have been installed. Furthermore the InfiniBand backbone network has been installed and brought to operation.

In the ongoing 2009 cosmics run, the full HLT data path is in use with two HLTs running in parallel, providing on-line reconstruction of the central barrel detectors and the DiMuon arm. The trigger framework has been finalized, tested and put in operation. Apart from the cosmics trigger for the central barrel, which is already in use, the first physics triggers in the process of inclusion are a high-pt Jet Trigger, a D0 Trigger and a DiMuon Trigger and high-pt barrel tracks Trigger.

The on-line tracking algorithm based on the cellular automaton method has been successfully tested with simulated pp and PbPb data. It shows a significant speed up compared to the off-line algorithm, with about the same reconstruction efficiency and resolution. In order to reduce the ALICE data size, the HLT cosmics trigger is running on the basis of the on-line ESDs.

Changes: No major changes.

Concerns: No major concerns.

Plans: Commissioning with beam, Implementation of physics triggers

Offline

Status: Software: The version of AliRoot to be used for the first LHC run has been released. Subversions fixing urgent problems are released on a weekly basis. Analysis is run routinely as an analysis train on the Grid or as end user jobs on the CAF. The offline framework has been adapted to run prompt reconstruction and QA in the ACR synchronous with data taking.

Full Dress Rehearsal: Cosmics data are processed offline as soon as they become available at the T0 only and some runs are re-processed on demand by detector experts. No data replication is performed to save storage. A large disk buffer with a capacity equivalent to one year of data taking will hold data until the quality of the data is assessed and before data are shipped optionally to mass storage.

Physics Data Challenge: Several large scale MC productions focused on the production of data required for first physics in 0.9 and 10 TeV pp collisions.

Grid Services: The deployment of xrootd enabled SE is continuing. The deployment of SL5 on WN together with SL5 VO box has started and should be completed in all sites before the first LHC run. The deployment of the CREAM CE has started as well.

Changes: The computing resources requirements have been re-profiled so that we now rely on a just in time installation scenario.

Concerns: Insufficient computing resources remain a concern.

Plans: Continuous bug fixes and features enhancements of the AliRoot release continue test of the Computing Model in a realistic environment, MC production and large scale distributed analysis.

Installation & Assembly activities

Status: All consolidation and installation activities foreseen during the shutdown were achieved and ALICE started global COSMIC Commissioning with both Magnets ON on August 15th 2009.

The Miniframe Modification was completed successfully and the Miniframe was reinstalled in ALICE in May 2009. TPC and ITS cabling and recommissioning followed immediately.

The three PHOS modules were equipped with air tight casings and reinstalled in ALICE. The modules are continuously flushed with Nitrogen in order to ensure the low humidity level of about 5% necessary for cooling the units to -20 degrees. The Nitrogen flushing results in a slow but steady decrease of humidity.

Four EMCAL supermodules were installed in ALICE (2 more than assumed at the beginning of the shutdown). Commissioning is progressing well.

The two repaired TRD modules and three additional new ones were installed starting in April, bringing the total number of modules to 7/18.

The PMD detector was installed and connected. Short tests have shown that PMD is fully operational. Insufficient air cooling prevents however the PMD from being fully operated at this point; an upgrade of the ventilation system is under way.

The pipes for the L3 ventilation (10000m³/h) were rerouted such that they are independent of the shielding. A campaign of upgrading 140 LV Power supplies and replacement of all Rack turbines is ongoing. Mechanics to decouple the TOF detector from the Baby Spaceframe and fully attach it to the Spaceframe was installed. The Cavern was sealed from the tunnel such that a He spill in the tunnel will not cause oxygen deficiency and overpressure in the ALICE cavern. Since the cavern humidity is of the order of 65% but ITS needs a level of around 30% a new ITS ventilation system with controllable humidity is currently being installed in CR5 from where an 80m pipe brings to air to the L3 magnet.

Changes: No major changes.

Concerns: SPD cooling (see SPD), PMD cooling (see PMD)

Plans: Global Commissioning and preparation for beam. Work on PMD cooling and SPD cooling.

Global commissioning and operation

Status: ALICE entered into shut-down mode in October 2008 to allow sufficient time for modification of the ITS and TPC services on the miniframe and re-commissioning of services and detectors. Individual detector commissioning and cosmic data taking restarted early summer 2009 and the experiment is operating continuously since August, taking cosmic events for calibration and alignment purposes with the magnets at

various settings. Stability and operational efficiency of the data taking has improved considerably since last year.

Changes: No major changes

Concerns: Need to reduce the manpower needed to operate the detector.

Plans: Continue data taking with cosmics and injection tests.