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PRINCIPAL LHCC DELIBERATIONS

24TH MEETING OF THE ALICE RESOURCES REVIEW BOARD

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GENERAL

This document summarises the principal LHCC deliberations concerning ALICE at the Committee's sessions in December 2012 and March 2013.

The LHCC considers that ALICE has made excellent progress, despite some operational issues, and the Committee congratulates the ALICE Collaboration on its achievements.

CONCERNS FROM THE PREVIOUS ALICE RESOURCES REVIEW BOARD

SUB-SYSTEM	CONCERN	STATUS
ALICE Detector	Background from beam-gas interactions; varying satellite populations.	Background situation to be addressed by refurbishing of TDI beam absorber during LS1; fluctuations in the satellite population have improved significantly.

STATUS OF THE EXPERIMENT

PHYSICS

Since the October 2012 session of the ALICE RRB, ALICE has published or submitted several physics papers and during the recent Quark Matter Conference, ALICE presented 7 plenary talks, 30 parallel talks and 45 posters. The on-going analysis of the first two LHC heavy-ion runs has revealed many new results, including direct photon measurements, a study of collective effects and transport properties of the Quark Gluon Plasma (QGP), centrality determination, the centrality dependence of π , K, p production, charge correlations and fluctuations. In the heavy-flavour sector, the suppression and flow for D mesons and J/ψ has been observed. Moreover, ALICE has published their results on long-range angular correlations in proton-Pb collisions and their results from proton-proton collisions. The LHCC **congratulates** ALICE on these achievements.

ALICE OPERATIONS

The performance of the experiment was severely hampered by background from beam-gas interactions, varying satellite populations and collision conditions. As a result, about 50% of the planned proton-proton events could be collected, corresponding to 5 pb⁻¹ rare triggers and 500 M minimum bias events. The background situation will be addressed during the Long Shutdown 1 (LS1) by refurbishing the TDI beam absorber, located 80 m from the ALICE interaction point.

The LHCC **congratulates** ALICE on the completion of a very successful proton-Pb run. With the minor exception of a magnet polarity change during the Pb-proton configuration, all goals were achieved or even exceeded. Over a four-day period during which the LHC luminosity at the ALICE interaction period was levelled at 5×10^{27} cm⁻²s⁻¹, ALICE recorded 10⁸ minimum bias events with a running efficiency of 96% and a saturated detector read-out rate of ~ 1 kHz. During the high-luminosity run with peak luminosities slightly in excess of 10²⁹ cm⁻² s⁻¹, ALICE collected 31.9 nb⁻¹. Despite an extremely high load on the detectors, that at times exceeded that of the 2011 Pb-Pb run

by a factor 3.5, all detectors performed satisfactorily. To compensate for the shortening of the proton-Pb run by one day (to accommodate the $\sqrt{s} = 2.76$ TeV proton-proton reference run), two very successful ALICE-only fills were performed by optimising the pattern of colliding bunches.

ALICE conducted a careful evaluation of the various subsystems during the proton-Pb run, monitoring the frequency and causes for data-taking interruptions. Frequent problems with the Time-of-Flight (TOF) system were identified early and were solved during the run. The most frequent Single Event Upsets (SEUs) were related to the Muon System and to the Time Projection Chamber (TPC). The Muon System read-out electronics suffered from SEUs that are presently not or only partly recoverable in an automatic way. Special investigations on this are scheduled during LS1. The TPC electronics also suffered from some SEUs that were difficult to recover quickly, but interruptions due to TPC chamber trips were not negligible. The latter are hard to avoid for wire chambers in a hadron collider environment while tuning and observing TPC trip conditions will stay with ALICE in the future. All detector issues that were observed during the proton-Pb run are now followed up in detail.

The LHCC is very pleased with the achievements of ALICE during the proton-Pb run and looks forward to the completion of the on-going data analyses. The proton-Pb run is of special importance for the heavy-ion programme at the LHC since it provides crucial insight into initial state and other cold matter nuclear effects. These results will help verify that the observed signals attributed to the QGP in Pb-Pb collisions are in fact final- and not initial- state effects.

LONG SHUTDOWN 1

The plans for LS1 were presented in detail by ALICE at the LHCC session in December 2012. The three major work projects are (i) the completion of the Transition Radiation Detector (TRD) by adding the last 5 supermodules, (ii) the installation of the Dijet Calorimeter (DCal; 8 supermodules) including the support structure and support beams, and (iii) the installation of an additional Photon Spectrometer (PHOS) supermodule. These main projects are accompanied by numerous detector and infrastructure consolidation efforts, such as the replacement of the UPS uninterrupted power supply system, chilled water upgrade at LHC Point 2, and L3 magnet ventilation upgrades. After four weeks of access the works are progressing according to schedule: The L3 magnet doors are open since 2 March 2013, the Photon Multiplicity Detector (PMD) and PHOS have been taken out, and numerous items were removed from the mini-frame such as RB24 beam pipe and supports, the zero-degree electromagnetic calorimeter ZEM, the anticoincidence detector ADA, the Beam Loss Monitors (BLMs), and the Beam Condition Monitor (BCM). The DCal installation tooling is in place. ALICE expressed slight concern about the on-going production of the remaining 5 TRD modules as a delay in the production of electronic boards might affect the installation schedule.

ALICE UPGRADES

ALICE is following an aggressive upgrade schedule. The upgrade programme so far comprises (i) a new low-mass high-resolution Inner Tracking System (ITS), (ii) an upgrade of the TPC with the replacement of the Multi-Wire Proportional Chamber (MWPC) with Gas Electron Multiplier (GEM) detectors and new pipelined readout, (iii) read-out electronics upgrades of the TRD, TOF, PHOS, and Muon System, and (iv) upgrades of the online, high-level trigger, and offline systems. ALICE is planning to submit Technical Design Reports (TDRs) for items (i)-(iii) by September 2013 and the

TDR for the latter item by the end of 2014. The decision on additional upgrades is imminent (end of March 2013). Internal Letters of Intent (LoIs) were submitted to the ALICE Collaboration on 15 February 2013 for a Muon Forward Tracker (MFT), a Ring Imaging Cherenkov (RICH) detector for particle identification at very high momenta (VHMPID) and FOCAL, a forward electromagnetic calorimeter. Depending on the final decisions by the ALICE Management and Collaboration Board, the additional approved upgrade project(s) will be submitted to the LHCC by 28 May 2013 as addenda to the existing ALICE LoI. ALICE plans to submit the corresponding TDR(s) by the end of 2014. Eighteen institutions expressed their interest in participating in the Time Projection Chamber (TPC) upgrade. The writing and study teams for the TPC TDR are in place and editors and writers are assigned to the various chapters. The same holds for the ITS upgrade. The project organization for the ITS is largely in place and most sub-projects have a coordinator assigned. The LHCC recommends assigning coordinators to the remaining sub-projects in a timely fashion.

ALICE reported several changes to their electronic read-out upgrade plans at the March 2013 LHCC session: (i) the Muon System will not be read out upon a muon trigger but upon a minimum bias trigger, the muon trigger chambers will be used as a muon identifier only, (ii) the TPC and Muon Tracking Chambers will now use a common front-end chip, and (iii) the intention to use a Common Readout Module for at least the ITS, TPC, and Muon Tracker. ALICE plans to have a final decision on the read-out architecture by June 2013. So far no editors and writers for the TDR are assigned. Although the document will be shorter than that for the ITS and TPC upgrades, the LHCC recommends that the ALICE Collaboration puts the editorial team in place soon.

ALICE made good progress on the TPC R&D, presenting test results that indicate that the dE/dx resolution with a 3-layer GEM stack is close to that of a MWPC. Observed ion backflow levels at the desired gain of 1000-2000 are still too high ($\sim 1\%$), but ALICE is optimistic that the targeted 0.25% is achievable. Further tests with 4-layer stacks and alternative gases will be made soon. Silicon pixel R&D is making excellent progress. An engineering run was recently submitted to produce 25 wafers with many chip variants for further testing. Two test beam campaigns at DESY are planned. The LHCC **congratulates** ALICE, especially the R&D teams, for the impressive overall progress.