Performance of the ALICE Experiment during the LHC Run 1

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ALICE (A Large Ion Collider Experiment) is a major experiment at the CERN Large Hadron Collider (LHC), built for studies of QCD matter created in high-energy collisions between lead nuclei. ALICE took data for all the collision systems and energies offered by the LHC in its Run 1 (2009-2013) (Table 1) and published ∼70 physics articles [1]. The ongoing LHC shutdown provides an opportunity to assess the performance of the experiment [2].

Table 1: Data sets recorded by ALICE in 2009–2013. The quoted statistics is that of minimum-bias and centrality-triggered events before the quality cuts.

system	$\sqrt{s_{NN}}$	recorded statistics
pp	0.9 TeV	9×10^6 events
pp	2.76 TeV	100×10^6 events
pp	7-8 TeV	1.4×10^9 events
Pb–Pb	2.76 TeV	100×10^6 events
p–Pb	5.02 TeV	140×10^6 events

The ALICE group at GSI is strongly involved in two major detectors of the central barrel, the Time Projection Chamber (TPC) and the Transition Radiation Detector (TRD). These two large-volume gas-drift detectors require care during data taking and a sophisticated calibration. The tracking performance of the TPC was as expected; the particle identification power even exceeded the expectations. Figure 1 illustrates the latter by showing the identification of anti-alpha particles, first such measurement at the LHC and contemporaneous with the analogous RHIC result.

The response of the TRD detector is shown in Fig. 2. Measurements performed in ALICE with electrons, pions,
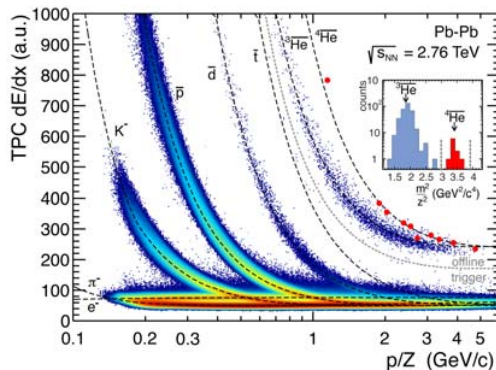

Figure 1: Particle identification in the TPC. The inset plot shows the additional separation between $^3\overline{\mathrm{He}}$ and $^4\overline{\mathrm{He}}$ for tracks with $p/Z > 2.3$ GeV/c provided by TOF.
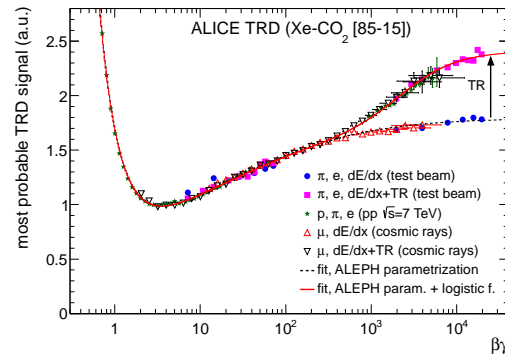

Figure 2: The TRD signal as a function of $\beta\gamma$.

and protons from pp collisions, as well as with cosmic muons, agree with the results from the chamber tests done with electron and pion beams. The lower branch represents the chamber signal without the contribution of the transition radiation, measured during the chamber tests by removing the radiator and in the ALICE setup by selecting those cosmic muons that entered the detector from outside.

Table 2 compares the observed performance with the expectations. An extensive performance report is in Ref. [2].

Table 2: The expected [3] and achieved [2] performance of the ALICE detectors for selected observables.

parameter	expected	achieved
event vertex resolution with ITS–TPC tracks		
trans. vertex resol. at $dN_{ch}/d\eta = 5$	85 μm	97 μm
trans. vertex resol. at $dN_{ch}/d\eta = 25$	35 μm	32 μm
DCA resolution of ITS–TPC tracks in central Pb–Pb coll.		
trans. DCA resol. at $p_T = 0.3$ GeV/c	200 μm	200 μm
trans. DCA resol. at $p_T = 20$ GeV/c	15 μm	15 μm
barrel p_T resolution		
$\Delta p_T/p_T$ ITS–TPC $p_T = 10$ GeV/c	1–2%	1.5%
$\Delta p_T/p_T$ ITS–TPC $p_T = 30$ GeV/c	2–3%	2.5%
barrel particle identification		
TPC dE/dx resol. in pp	5.4%	5.2%
TPC dE/dx resol. in central Pb–Pb	6.8%	6.5%
TOF resolution	80 ps	80 ps

References

[1] http://aliceinfo.cern.ch/ArtSubmission/publications

[2] ALICE Collaboration, arXiv:1402.4476 [nucl-ex]

[3] ALICE Collaboration, J. Phys. **G 32**, 1295 (2006)