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PRINCIPAL LHCC DELIBERATIONS

12TH MEETING OF THE TOTEM RESOURCES REVIEW BOARD

16 APRIL 2013

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GENERAL

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

The LHCC congratulates TOTEM for their successful physics runs and for the experiment's physics results.

CONCERNS FROM THE PREVIOUS TOTEM RESOURCES REVIEW BOARD

No major concerns were reported to the previous TOTEM Resources Review Board.

STATUS OF THE EXPERIMENT

PHYSICS

The LHCC took note of the new data analyses currently being carried out by the TOTEM Collaboration, including the measurement of the nuclear-Coulomb interference at $t < 0.002 \text{ GeV}^2$ (with proton-proton data at 8 TeV taken during the $\beta^* = 1 \text{ km}$ run), and the soft single-diffraction t -distributions in proton-proton collisions at 7 TeV. Moreover, the Committee welcomed, in particular, the advanced stage of two measurements collected during common CMS and TOTEM data-taking in proton-proton collisions at 8 TeV: (i) inelastic $dN_{\text{ch}}/d\eta$ over the acceptance of the TOTEM forward T2 Telescope and the central CMS detector, and (ii) diffractive dijet production with protons tagged in the TOTEM Roman Pot (RP) detectors. Preliminary combined CMS and TOTEM results for both these topics are expected before summer 2013. The Committee **congratulates** both Collaborations on the excellent progress.

TOTEM collected data during the proton-Pb run at 5.02 TeV in January-February 2013 together with CMS. The T2 Telescope and the vertical RPs (aligned and operated at a distance of 4.5σ and 13σ from the beam in the proton direction, respectively) collected a few hundred million events in both proton-Pb and Pb-proton configurations. A few million events were also collected (with the T1 and T2 Telescopes and the vertical RPs at positioned at a distance of 4.5σ , 13σ and 22σ from the beam, respectively) during the short intermediate-energy proton-proton run at centre-of-mass energy of 2.76 TeV, just before the LHC Long Shutdown 1 (LS1).

OPERATIONS

As a summary of the 2012-2013 run campaigns, TOTEM stressed that the RP alignments and insertions are now carried out without beam losses or other problems, that the alignments are performed rapidly (record time of 1h30 for eight RPs), and that the insertions in standard fills were fully automated. However, the experiment regretted that the opportunity for an insertion of the horizontal RPs to study further the heating/vacuum effects observed in October/November 2012 was not fulfilled, and that physics in high-luminosity fills (8 TeV, $\beta^* = 0.6 \text{ m}$) with the RPs was not obtained. TOTEM presented simulation studies that show that the RP temperature increase due to the LHC beam and the LHC vacuum degradation in the RP147 m and RP220 m regions, could be solved by optimising the RP ferrite and RP housing, respectively.

CONSOLIDATION AND UPGRADES

TOTEM provided a detailed description of the consolidation and upgrade plans, to be carried out during LS1. The consolidation work approved by the Collaboration includes: (i) the removal of the RP147 m stations and patch panels (allowing installation of the TCL4 collimator), (ii) the relocation of the RP147 stations (with Si-strip detectors rotated by 8° to improve tracking performance) to the ± 210 m region, and (iii) the exchange of ferrites of all RPs to avoid beam-induced heating and vacuum degradation. Associated work-packages and scheduling had been defined with all relevant CERN groups.

Upgrade plans for the RP stations have also been reviewed by the LHCC. TOTEM proposes the installation, in a few months during LS1, of two new additional RP horizontal stations in the ± 220 m region, followed by the integration of new pixel detectors in the relocated RPs in the ± 210 m region, as well as of new timing detectors in the ± 220 m horizontal RPs (downstream relative to the tracking detectors to avoid the large material budget of the former). The new tracking and timing detectors can be installed inside the RPs during end-of-year technical stops after LS1 (as the installations require a vacuum break).

The physics case of the upgrade plans was only generically justified as having the goal to be capable of doing diffractive and exclusive (gluon- or gamma- induced) physics at low β^* and high luminosity. TOTEM will present the required upgrade project documentation (Letter of Intent and Technical Design Report) to the LHCC following deliberations with CMS on similar forward-physics plans (including tracking and timing detectors in the LHC tunnel). TOTEM insisted that, in any case, the present 220m stations must not be affected by any upgrade activity, until the high- β special runs after LS1 are complete and the approved baseline TOTEM physics programmed is fulfilled.

The specific request from TOTEM to the LHCC with respect to the experiment's consolidation plans includes the following points:

- Relocation of the RPs from 147m (full station) to upstream of RP220, which would allow for enhanced physics opportunities for a minimal cost through improved proton momentum tracking by a simple 8° rotation.
- Provision of services and infrastructure (patch-panels and cooling) for the installation of possible new RP stations at 220 m to host detector upgrades such as the pixel and timing detectors currently under discussion with CMS.
- Installation of the TCL6 collimator during LS1.

The LHCC concluded that the consolidation requests seem reasonable as all work-packages are ready and there is enough time available during LS1. The TOTEM upgrade plans, however, require further deliberations. In particular, the LHCC requests the submission of precise physics motivations for the upgrade, including associated simulations for all relevant measurements that also address key detector performance issues such as the expected tracking momentum and timing resolutions. The convergence with the CMS upgrade plans for the forward region needs to be finalised on a short time-scale given that preparing all required upgrade documentation (Letter of Intent, Conceptual Design Report and Technical Design Report) before the end of LS1 is a challenging goal. CMS has promised to provide its own upgrade plans for the forward region by the LHCC session in June 2013.