# LHC EXPERIMENT-ACCELERATOR DATA EXCHANGE WORKING GROUP (LEADE)

**Minutes of the 20th Meeting held on September 06, 2004**

Present: S. Baron, Ph. Baudrenghien, E. Bravin, Ph. Farthouat, Ch. Ilgner, R. Jacobsson, R. Jones, D. Macina, K. Potter, W. Smith, E. Tsesmelis, J. Wenninger

## 1. MATTERS ARISING

Approval of the minutes

The minutes of the 19th LEADE meeting were approved without modification.

Timing issues for SPS structured beam (S. Baron)

The CMS End-cap Muon group noticed that the SPS beam crossing signal (beam crossing signal) varied from its supposedly regular period of 924 bunches per orbit to either 923 or 925 during the June SPS structured beam period. The consequences for such a variation would be catastrophic to the operations of the LHC experiments.

To follow up these timing issues for the SPS structured beam, Sophie Baron presented data from the June 2004 test beam (25ns, up to 400GeV/c). The clocks run synchronously during the flat top, since they are re-phased at its start, although this re-phasing still causes problems. The machine groups will make sure that the beam crossing signal remains stable during the upcoming SPS structured beam.

Proposal for new BPTX position (E. Tsesmelis)

Integration of the collimators in the interaction regions (IRs) of the LHC is presently being studied. The positions of the collimators are being evaluated and it is becoming clear that there is a lack of space in the IRs to install collimators in their optimal locations. It has thus been proposed to move the BPTXs about 25 m. away from the interaction points (IPs) in order to free up some space in the area closer to the IPs.

Given that the signal strength will not deteriorate significantly, LEADE recommends that the BPTXs be moved by the requested 25 m.

## 2. REPORT ON THE LHC LUMINOMETERS (E. BRAVIN)

Enrico Bravin gave a report on the LHC Luminometers. The Luminometers are required to help the operators to bring the beams into collision, to optimize the machine performance, to monitor and correct beam drifts and balance the luminosity provided to the experiments. In order to assess, among others, especially collective and “Pacman” effects, the rate monitors should be installed in the (straight) trajectory of neutral particles, coming from the interaction points. In the TANs, 1-2 copper bars can be replaced by detectors in order to measure the crossing angle.

Nikolai Mokhov has made a simulation on the particle fluxes: the environment will be dominated by photons, with fewer neutrons at high energies, the latter contributing significantly to the energy deposit. Both particles can be used for luminosity measurements.

Fast ionization chambers (FICs) serve as a candidate for the monitors. They are position sensitive in four quadrants and their rate capability is being studied in order to resolve the 40 MHz LHC filling pattern. They have been proposed by Lawrence-Berkeley National Lab, where they are currently under development. The expected dose is about 1GGy/year.

An alternative solid state CdTe detector is being explored. The radiation hardness of this technology is, however, not adequate for IP1 & IP5 (CERN/LETI).

During autumn 2004, the R&D for the FICs should be completed and a review will take place toward the end of the year. After the review, and depending on the results, a decision will be taken at CERN, considering 3 scenarios:

- All IPs equipped with FICs at 40 MHz.
- IP1+5: FICs at <40 MHz; IP2+8: CdTe at 40 MHz
- All IPs FICs or other ionization chambers below 40 MHz (or even far below)

The requirements are summarized in document LHC-B-ES-007 "On the Measurement of the Relative Luminosity at the LHC". This document contains also the specifications (mainly from the machine groups, with some input from the experiments) according to which the detectors are being developed.

## 3. LUMINOSITY MONITOR INSTALLATION IN IR2 & IR8 (D. MACINA)

In her update on the Luminosity-Monitor installation in IR2 and IR8, Daniela Macina mentioned the the technologies under development: fast ionization chambers (FICs) and CdTe detectors, as already outlined in detail in the previous section.

A specific problem here is that the FICs are not compatible with the ALICE neutron zero degree calorimeter (ZN), an extremely radiation-hard quartz-fiber sampling calorimeter, since the FICs need 30cm of copper in order to develop the maximum shower. However, this conflict is specific to the heavy-ion operation. As the ZN is mounted on a movable support, it will be lowered during injection and raised during heavy-ion collisions. Movable FICs could be used during the proton runs.

The CdTe detectors need only 3 cm of copper and are thus compatible with the ZN in both operation modes (heavy ions and protons).

Preliminary simulation results show that MiniTANs are not necessary during heavy-ion operation for vertical or no crossing angle. In data-taking position, the Zero-Degree Calorimeters (ZDCs) act as MiniTANs.

In view of the integration, both luminosity-monitor technologies can be integrated in front of the ZN, once all mechanical details of the luminosity monitor are provided. If the TCTh will be located as proposed at LTC (June 02, 2004), the zone will need to be redesigned.

Moreover, the ZDC itself fulfills most of the luminosity monitor functional specifications, i.e. measure of the flux of the neutral particles produced at the IP, measure of the crossing angle and the bunch-by-bunch luminosity. It can also be used for the initial beam finding and overlap maximization.

ALICE is not against the ZN being used as machine luminosity monitor, if the operation is safe and the machine takes over responsibility for the necessary hard- and software complements.

Since the LHCf calorimeter comprises 18.8 cm of tungsten, it presumably can be used as the absorber for the luminometers (most likely with both detector options), but this requires some detailed studies.

## 4. FLAT-TOP ENERGY STABILITY AT THE LHC (J. WENNINGER)

The variation of the beam energy (or momentum) depends on the variation of the electric and magnetic fields with time, the machine state and external conditions, with the length of the beam orbit being defined by the RF frequency (at LHC: 400.87 MHz).

The flat-top momentum at the LHC is expected to vary by $4.5 \cdot 10^{-4}$ (over one year) or $1.2 \cdot 10^{-4}$ (over 24 hours). Variations due to changes in circumference of the accelerator, being driven by the earth tides, are expected to be $5 \cdot 10^{-5}$, based on experience from LEP operation.

Since the dipole fields severely influence the momentum (>99.8% of all contributions), and thus its error, a knowledge of these dipole fields is essential. The dipole magnets can be calibrated using lead ions. This method is feasible up to 1 TeV/c. An absolute proton calibration is difficult to realize.

Other smaller contributions to a variation in momentum come from higher order fields and the orbit correctors.

Since resonant depolarization could not be used at LEP, the energy calibration was done using a calibrated spectrometer magnet (calibrated to a few $10^{-5}$). With some modifications as compared to LEP, e.g. a longer lever arm, this concept could also be used for the LHC.

Complementary information on Jörg Wenninger's talk on flat-top stability at the LHC can be found in LHC Project Note 334.

## 5. A.O.B.

LHC Beam Abort Signals (C. Ilgner)

A request was put forth to start a study on registering which sensor in the experiments is responsible for sending a beam abort signal.

Ch. Ilgner

Provisional Dates for 2004 meetings:
18 October
13 December