LHC Beam Operation Committee

Notes from the meeting held on 24th July 2012

Participants

1. Update on UFOs (Tobias Baer)

T. Baer gave an update on UFO observations, studies and extrapolations. **In 2012, ≈8000 candidate UFOs** were observed, out of which **4 led to a beam dump.** The distribution of the UFO positions in 2011 and 2012 is very similar.

Throughout 2011, the rate of **arc UFOs** during stable beams decreased by a factor 5. **The rate in 2012 was initially about 2.5 times higher than during October 2011** and decreases since then. The increase of the rate from 2011 to 2012 is not fully explained by the increased energy; the deconditioning is expected to be e.g. due to the partially warm up of the arcs. **Additional BLMs were installed in the cell 19R3** and **complementary FLUKA simulations** were performed. The observed UFOs in this cell suggest that the **UFOs originate from various positions across the cell.**

T. Baer explained that the number of **MKI UFOs** is rather constant since 2011. He presented that a significant correlation of the MKI UFO rate and the local vacuum pressure was found.

T. Baer presented that the FLUKA simulations for arc UFOs predict that the **peak energy density increases by about a factor 4 when increasing the energy from 3.5 TeV to 7 TeV.** Based on this scaling and the reduced BLM thresholds at higher energies, it is found that out of the arc UFOs observed in 2011, **112 would have caused a beam dump for operation at 7 TeV.** The UFOs observed in 2012 so far would have caused 50 beam dumps.

Various **mitigation strategies** concerning MKI UFOs are under active investigation. For the arc UFOs, the main mitigation strategy is to increase the BLM thresholds towards the magnet quench limit. T. Baer explained that the current BLM distribution is not optimal for protection against UFOs**, a different BLM distribution could allow for a further increase of the BLM thresholds.**

T. Baer gave an overview of the studies planned for 2012/13 and emphasized the **particular importance of studies with 25ns beams and dedicated quench tests.**

Discussion:

G. Arduini mentioned that the SEY in the arcs increased from 2011 to 2012 from 1.5 to 1.6.

B. Dehning asked how the UFOs in cell 19R3 are distributed. A. Lechner replied that the largest events were observed close to the quadrupole. In total, about 50 UFOs were observed in cell 19R3 so far, most of them very small. The largest event reached 7.7% of the beam dump thresholds.

G. Arduini asked if there is a systematic difference between the two beams. T. Baer confirmed that this is the case for several cells and explained that e.g. in cell 19R3 the UFO rate is much higher for beam 1 than for beam 2.

G. Arduini noted that about 2 weeks of scrubbing are foreseen after LS1 and suggested to investigate the scrubbing time needed for UFO reduction.

2. Observation with Diamond Sensors during LHC Operation (Maria Hempel)

M. Hempel explained the acquisition hardware of the diamond BLMs and presented the observations during the last months of LHC operation. Currently 8 (CIVIDEC) diamond detectors are installed at dedicated position in the LHC. Depending on the location, **the acquisition is triggered by injection/post mortem event or by the loss pattern.** The detectors have **a time resolution of ≈2ns** and a buffer length corresponding to ≈10ms.

M. Hempel presented **MAD-X/FLUKA simulations of UFO events** which show that the elastic scattered particles are mainly lost in IR7 and are detectable by the diamond BLMs there.

M. Hempel showed examples of four loss scenarios measured with the diamond BLMs in IR7:

During **injection** the bunch-by-bunch losses due to the injection oscillations are clearly visible. Furthermore, a **significant (unbunched) loss spike about 200ns before the first injected bunch** is observed. It is believed to be either due to unbunched beam in the LHC, which is lost on the rising edge of the MKI waveform, or due to beam coming from the SPS.

During a **beam dump**, a **Gaussian shaped loss profile with a typical width of ≈50ns** is observable. It is believed to be caused by unbunched beam in the abort gap which is not intercept by the IR6 collimators during the rise time of the MKDs.

For an **UFO event**, M. Hempel showed that, consistent with the expectation, all bunches contribute to the losses.

Moreover, an example of the losses due to **beam instabilities** was shown. By comparing the losses for dedicated bunches over several turns, M. Hempel showed that major losses occur in every third turn, due to the tune of ≈0.3. Because the loss signal is not synchronized with a reference signal (turn clock) it is not possible to directly identify which bunches (bunch number) contribute to the beam losses.

M. Hempel gave an outlook, which includes **improvements to the usability and flexibility of the present operational acquisition hard- and software.** Furthermore, she pointed out that an **increased dynamic range** of the detectors in IR7 by using different signal amplifiers would be very useful.

Discussion:

G. Papotti mentioned concerning the losses during injection, that **normally there is no significant amount of unbunched beam extracted from the SPS.** T. Baer suggested that the source of the loss spike before the first bunch can be determined by **pulsing the MKI without injection of beam.** He mentioned that also with only one pilot circulating in the LHC, the amplitude of the loss spike dominates the losses of the injected bunches.

L. Jensen asked if the signal amplitude of the diamond BLMs was **cross calibrated** against the loss signal from the ionization chambers. T. Baer informed that a cross calibration based on a few loss events was done.

Upcoming meetings:

Tuesday, 31st July 2012 15:30 in 871-1-011: LBOC

Reported by Tobias Baer