

# WORKSHOP SUMMARY

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## INTRODUCTION

The subject of this joint machine-experiments workshop was to prepare for making good experimental conditions and in particular for being able to keep any machine induced background at tolerable levels. The LHC is a unique machine with its massive usage of cryogenic magnets and unprecedented stored beam energy. Taking this new machine under control, including establishing optimal conditions for physics, will require much expertise and the ability to solve problems as they emerge. The aim of this workshop was to help anticipating issues related to beam conditions and elaborate a framework to attack such problems.

The workshop was divided in three half-day sessions. The first session was a review of the experience from other laboratories, namely from the TEVATRON, RHIC and HERA machines and experiments. The second session focused on general considerations and expectations for the LHC, including simulation studies for the generation of background particles and their transport to the experimental areas, their main effects on the experiments. The foreseen infrastructure for beam interlocks and for exchanging data between the machine and the experiments was introduced. The third session was devoted to the strategy of the experiments for monitoring background, disentangling the various types and exchanging background-related information with the machine. The workshop finished with a closed summary session with participation of the organizers, speakers and representatives of the LHC machine and experiments.

The format of these workshop proceedings is as follows. The outcome of the closed session is summarized below. A summary of each session and of the discussions is presented in separate contributions. In addition, individual contributions to the workshop by the speakers have been collected.

## SUMMARY OF DECISIONS

We summarize here the main points that emerged from the discussion in the closed session and that need to be followed up.

For future work, a clear need and a request emerged for rationalisation of machine-induced background studies. It was demanded that the various contributors agree first on a set of configurations

and a systematic strategy. This implies:

1. definition of a few benchmark running scenarios, i.e. optics, bunch filling patterns, intensities, crossing schemes and ramped energy ;
2. definition of collimator settings for each running scenario;
3. IP-generated protons:
  - (a) generation and transport of scattered protons from IPs to first restriction,
  - (b) shower generation by those protons and transport of particles;
4. production of vacuum profiles for the relevant sections based on best knowledge. Here, the only missing input identified are possible pressure bumps due to elements that warm up because of e.g. beam losses. Future knowledge based on actual measurements with beams should be included at a later stage;
5. production of collimator-induced halo particles, including quartic halo;
6. production of distant beam-gas particles and transport to the experimental interface plane;
7. simulation of backgrounds within the experiments.

Special requests specific to forward detectors should be expressed by the interested experiments. Effort from the machine side will be invested in the specific interests of each experiment in proportion to their needs, while taking into account the general physics priorities.

Many LHC simulation results shown in this workshop were fostered by the Machine-Induced Background Working Group organized by TS-LEA, which offered an excellent forum for background-related issues since February 2005. A natural evolution of this working group would be to include more players from the experiments and the LHC machine, to address the questions raised in this workshop and to prepare for the first LHC collisions. This working group should be prepared to interpret background data as measured by the machine diagnostics and detectors in the experiments, perfection understanding of the data with the help of simulation tools, compare results between experiments, adjust definitions of beam conditions signals, suggest improvements, etc., as soon as first protons circulate in the LHC. The actors of the MIBWG are strongly encouraged to continue their work in this new domain.

It is also desirable that each experiment maintains (or strengthens) a small group of people to continuously address beam-induced background issues. It was also pointed out that an increased participation from the machine side would be very beneficial.

It was agreed that a few figure-of-merit signals (2 to 4) would be provided by each experiment for the operators to tune the beam conditions in an efficient way. The meaning of the signals should be clearly defined and the sensitivity to types of backgrounds (e.g. beam 1 or beam 2, if applicable) clearly stated. The experiments and machine should agree on a common scale definition for these signals, with a universal meaning. The implementation of this scale and the algorithmic of the signals involved should be discussed among the experiments to ensure that a similar interpretation is indeed implemented by each experiment. For instance, will the signals be approximately linear with the current-normalised rates ? Or is a logarithmic scale more appropriate ?

In addition to these few figure-of-merit signals, each experiment will provide a (possibly interactive) summary page about the status of their experiment that machine operators will use when discussions specific to that experiment are going on in the CCC. This should also be discussed among the experiments in order to promote a minimum coherence among the experiments. For instance, it was suggested to include a pictorial view of the experiment around which the measured signals are displayed.

It was agreed that, in order not to create unnecessary background in the experiments (especially ALICE), the tertiary collimators should be put as far out as possible, such that the triplet magnets remain in the shadow of the TCTs. This depends on the beam configuration (energy, optics  $\beta^*$ ).

It was agreed that the collimation group would provide AT-VAC with a list of elements that are expected to warm up significantly due to beam losses (which can change the local vacuum conditions due to outgassing).

## ACKNOWLEDGEMENTS

The organizing committee wishes to thank all the speakers again for their high quality presentations and written contributions. We express our gratefulness to the scientific secretaries and session conveners for their help in collecting and writing down the main points of the discussions. We are particularly grateful to Lauriane Bueno and Marie Colin, who very efficiently helped organising this workshop. We thank as well the CERN Director General, Robert Aymar, for his welcome speech, and the CERN management in general (AB and PH Depart-

ments) for supporting this workshop.

## REFERENCES

- [1] [Background working group](#) and Session V of the [LHC Chamonix Workshop 2006](#).