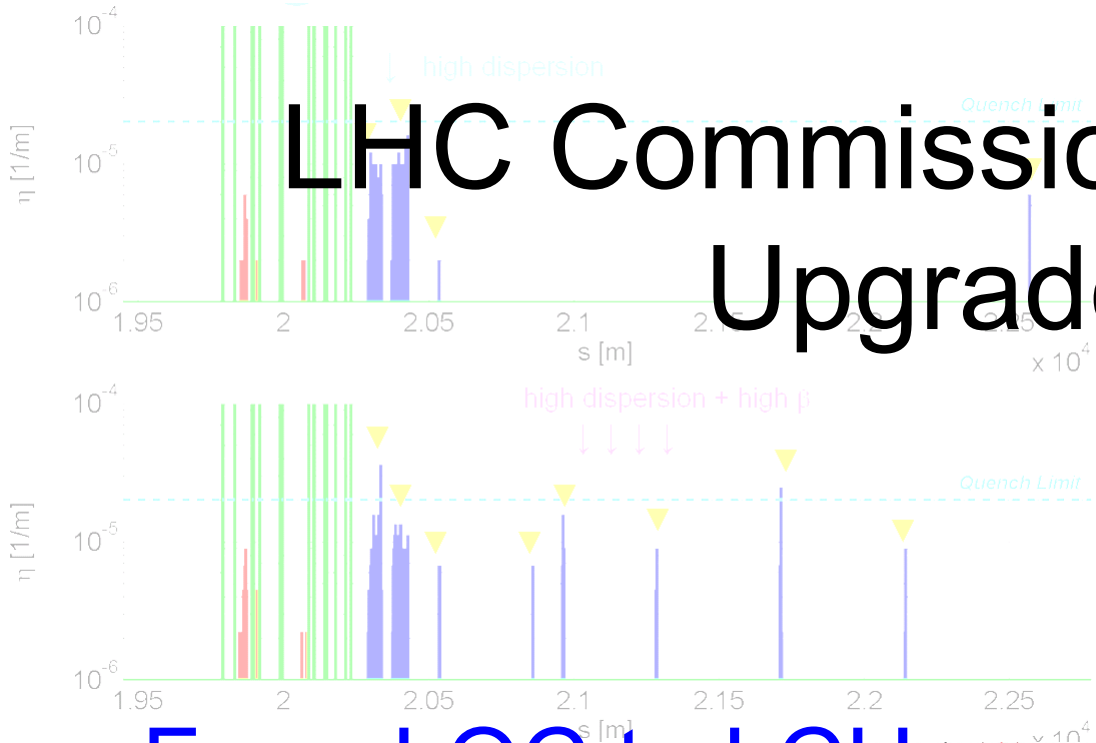
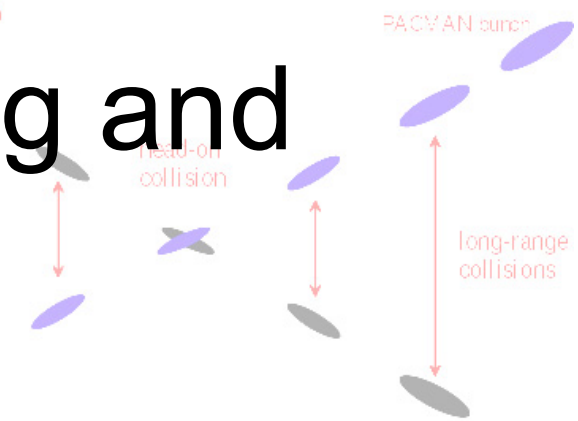
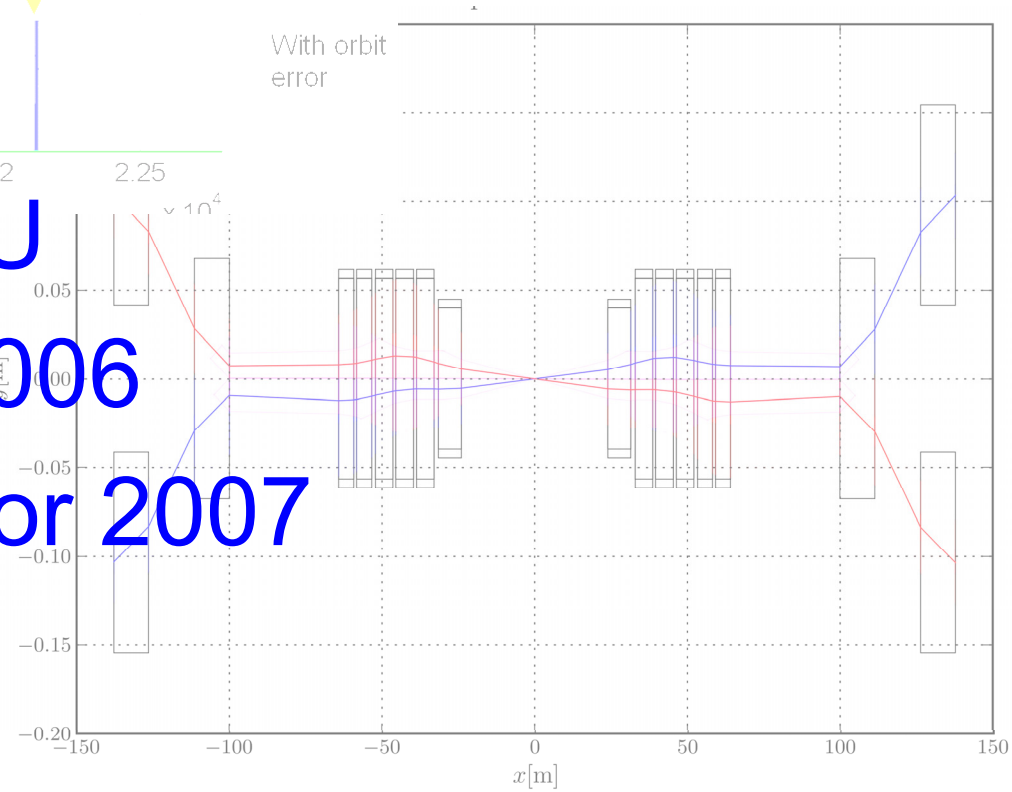
LHC Commissioning and Upgrade







- From LOC to LCU
- What we did in 2006
- Main objectives for 2007

From LOC to LCU - I

- Group re-organization at the beginning of 2007
  - LHC Optics and Commissioning (LOC) section became LHC Commissioning and Upgrade (LCU)
- Mandate changed to include:
  - Collective effects for LHC (formerly in RLC).
  - LHC Upgrade studies (formerly in RLC).
  - Beam dynamics issues concerning ions in the LHC (formerly in LII).
- Composition of the section was changed accordingly

From LOC to LCU - II

- Mandate:
  - Optics design and development for LHC and its transfer lines.
  - Study the magnet field imperfections and aperture of the machine as installed.
  - Study the commissioning and machine operation scenarios, measurement procedures, including specifications of LHC beam parameters.
  - Provide support for the operation of the LHC during its initial commissioning phase.
  - Development and maintenance of software tools for accelerator design and operation.
  - Project coordination for the LHC collimation system.
  - R&D efforts related to the Phase II LHC collimation system.
  - Study the LHC beam limitations and ways to overcome them to reach and exceed LHC nominal performance.
  - Coordination of the HHH FP6 network.
  - Contribution to CARE / ESGARD related R&D activities (LHC upgrade studies).

From LOC to LCU - III

LHC Optics and Commissioning (2006)

- Staff
  - Ralph Assmann [RA]
  - Helmut Burkhardt [HB]
  - Stéphane Fartoukh [SF]
  - Massimo Giovannozzi [MG]
  - Jean-Bernard Jeanneret [JBJ]
  - John Jowett (part time) [JJ]
  - Yannis Papaphilippou [YP]
  - Thys Risselada [TR]
  - Frank Schmidt [FS]
- Fellows
  - Alex Koschik [AK]
  - Lionel Neukermans [LN]
  - Thomas Weiler [TW]
- PhD students
  - Chiara Bracco [CB]
  - Riccardo de Maria [RdM]
  - Guillaume Robert-Demolaize [GRD]
- UPAS
  - Federico Roncarolo [FeRo]

Simone Gilardoni was contributing to the magnet activity (geometry evaluation for main dipoles).

From LOC to LCU - IV

LHC Commissioning and Upgrade (2007)

- Staff
  - Ralph Assmann [RA]
  - Helmut Burkhardt [HB]
  - Stéphane Fartoukh [SF]
  - Massimo Giovannozzi [MG]
  - Werner Herr [WH]
  - John Jowett [JJ]
  - Malika Meddahi [MM]
  - Elias Metral (part time) [EM]
  - Thys Risselada [TR]
  - Frank Schmidt [FS]
  - Rogelio Tomas (part time) [RT]
  - Frank Zimmermann [FZ]
- Fellows
  - Ilya Agapov [IA]
  - Thomas Weiler [TW]
- PhD students
  - Chiara Bracco [CB]
  - Roderik Bruce [RB]
  - Ulrich Dorda [UD]
  - Riccardo de Maria [RdM]
  - Tatiana Pieloni [TP]
  - Valentina Previtali [VP]
  - Simon White (09/07) [SW]
- UPAS
  - Federico Roncarolo [FeRo]

Many thanks to Simone, Jean-Bernard, and Yannis for their crucial contributions to the LOC activities!

Welcome to the new members!

What we did in 2006 - I

- Magnet activities (SF, SG, MG, JBJ, YP, FS)
  - One-by-one analysis of LHC magnets to optimize allocation (sorting).
  - Development of tools for massive allocation of main dipoles.
  - Participation to the activities of the LHC Magnet Evaluation Board with the evaluation of
    - **More than 90% of LHC magnets (superconducting as well normal conducting).**
    - **Injection and dump septa.**
    - **DFBs.**
  - Beam dynamics studies to assess the impact on machine performance (mechanical and dynamic aperture) of specific features observed during the allocation process.

What we did in 2006 - II

- Optics and commissioning (RA, HB, SF, MG, WH, JJ, YP, TR, FZ)
  - Maintenance of optics and aperture database.
  - Preparation of optics versions and special configurations (collisions at 450 GeV).
  - New tools for numerical simulations: MADX error routines to assign measured magnetic errors.
  - Interface between the WISE code (Per Hagen AT/MCS) and MADX: to be used for dynamic aperture simulations and on-line model.
  - Analysis of commissioning scenarios.
- MADX on-line model (WH, TR, FS)
  - Define interface between MADX and the LHC control system.
  - General specifications of the on-line model.
  - Application to the CNGS commissioning.

What we did in 2006 - III

- Collimation project (RA, CB, GRD, TW)
  - Defined procedures for adjusting LHC collimators during LHC operation.
  - Organize the 2006 beam tests for LHC collimators at the SPS and at TT40.
  - Beam loss maps for Beam 2.
  - Evaluation of the “realistic” cleaning performance in early commissioning optics.
  - Optics and performance studies on a crystal-enhanced LHC collimation system.

Main objectives for 2007 - I

- Magnet activities (SF, SG, MG, JBJ, YP, FS)
  - Completion of the magnet allocation activities (March).
  - Documentation of the activities and evaluation of the impact of sorting on machine performance.
  - Support for the replacement of magnets (non-conformities found during hardware commissioning)
- LHC Commissioning (RA, HB, SF, MG, WH, TP, RT, FZ)
  - Analysis of sector test scenarios (end of the year).
  - Analysis of commissioning scenarios.
  - Beta-beating correction tool.
  - LHC systems support.
- MADX on-line model (IA, WH, TR, FS)
  - Implementation of tools (data extraction from multi-turn orbit data, orbit, tune, and chromaticity correction)
  - Experimental tests in the SPS.
  - Goal: be ready for the sector test.

Main objectives for 2007 - II

- Impedance and collective effects (EM)
  - General impedance police activities (special devices, experimental areas, collimators).
  - Development of the impedance database ZBASE (with the help of Huber Medina).
  - Study of the coupled-bunch instability at 7 TeV and cures. Operational procedures to be defined (end of the year).
- FP420 (FeRo)
  - Impedance, machine-induced background, and optics studies.
- Collimation project (RA, CB, VP, TW)
  - Studies of early commissioning scenarios, including system errors and performance of the collimation system with dynamic errors.
  - Accelerator physics studies for the LHC collimation upgrade, including crystal-enhanced collimation.
  - Performance study of collimation system with ions (Giulia Bellodi, Hans Braun, RB, JJ). SPS collimation tests with ions (also with SG).
  - Coordinate the phase 2 R&D work for the LHC collimation system at CERN, with supporting resources and expertise from US LARP and SLAC. Prepare an FP7 proposal for LHC collimation.

Main objectives for 2007 - III

- LHC optics (SF, JJ, MM, TR)
  - Maintenance of optics and aperture database.
  - Preparation of optics versions (also in view of LHC commissioning).
- LHC upgrade studies (RA, OB, RdM, UD, SF, WH, MM, RT, FZ)
  - Route to IR upgrade changed, recently! Staged approach:
    - **Phase 1: consolidation of present layout and more safety margin in view of achieving nominal luminosity.**
      - It should be based on available technology -> NbTi magnets (LHC main dipoles cable)
      - It should be implemented fast -> 2012
    - **Phase 2: ambitious luminosity upgrade, i.e., factor of 10 increase in luminosity, thus requiring also detectors' upgrade.**
  - Three IR layouts were recently proposed by OB and RDM (one also by AT/MCS). Detailed assessment in terms of beam dynamics properties to be prepared (September).
  - Other studies: optics for Phase 2, wire compensation, crab cavities…