LHC Commissioning and Upgrade

- **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]
  - J.-L. Nougaret [JLN]
  - Thys Risselada [TR]
  - Frank Schmidt [FS]
  - Rogelio Tomas (part time) [RT]
  - Frank Zimmermann [FZ]
- **Fellows**
  - Ilya Agapov [IA]
  - Yipeng Sun [YS]
  - Thomas Weiler (31/08/08) [TW]
- **PhD students**
  - Chiara Bracco (31/05/08) [CB]
  - Roderik Bruce (31/10/08) [RB]
  - Yngve Inntjore Levinsen * [YIL]
  - Valentina Previtali [VP]
  - Simon White [SW]
- **Technical students**
  - Paul Anton Letnes (15/07/08) [PAL]
  - Nina Holden * [NH]
- **UPAS**
  - Rama Calaga [RC]
  - Riccardo de Maria [RdM]
  - Étienne Forest [EF]
  - Dobrin Kaltchev [DK]
  - Akio Morita [AM]
  - Tatiana Pieloni [TP]
  - Federico Roncarolo [FeRo]

*** 1 September 2008 / 31 August 2011**
*** 1 July 2008 / 31 December 2008**

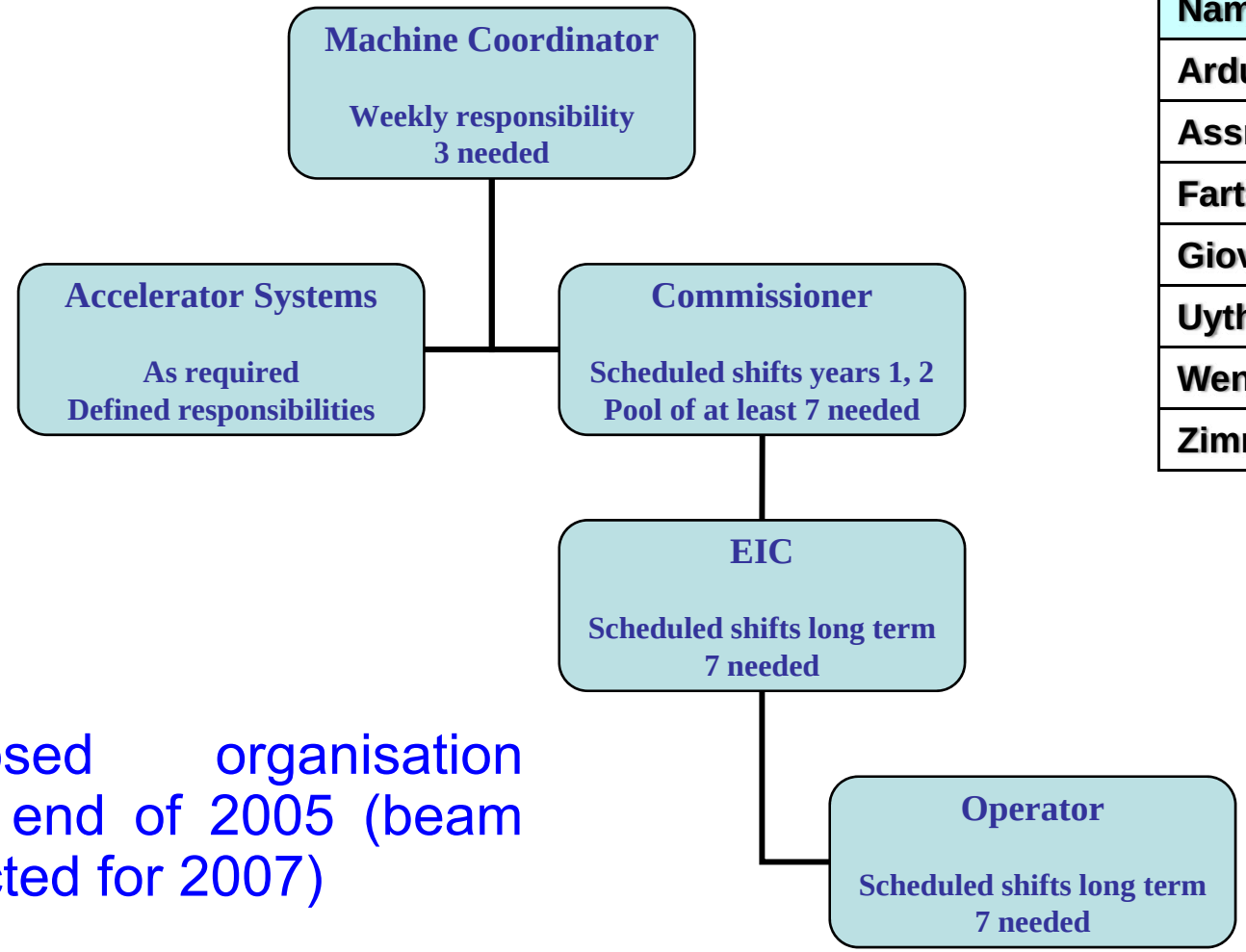
Main objectives for 2008 - I

- LHC Commissioning (M. Aiba, RA, HB, RC, SF, MG, WH, JJ, DK, PAL, AM, YP, TP, FS, RT, SW, G. Vanbavinckhove, FZ)
  - Analysis of commissioning scenarios
    - Proposal of new filling schemes for optimized luminosity in the various LHC insertions. Detailed analysis of beam dynamics consequences
    - Target beam parameters for the 2008 (5 TeV) run
    - Experimental conditions and background control
    - Follow up of hardware commissioning results/issues:
      - **Strategy of powering tests during the hardware commissioning**
      - **Analysis of non-conformities and their impact on beam dynamics**
  - Beta-beating correction tool
    - SPS beam tests
    - LHC beam tests
  - LHC systems support (instrumentation and other beam dynamics systems)
    - Contribution to specifications, dry runs, and readiness tests

Main objectives for 2008 - II

- MADX on-line model (IA, WH, EF, JLN, TR, FS)
  - On-line model essentially embedded in LSA. Tools already available (knob generation: LSA ↔ on-line model), new ones should be prepared
  - Completion of the PTC description of the LHC rings for future use in on-line model
  - Participation in the SPS start-up (computation of the quadrupoles misalignment to correct high energy closed orbit)
  - Participation in the LHC transfer lines re-commissioning
    - TI8: 24-25 June 2008
    - TI2: 14-15 June 2008
  - LHC beam commissioning (August)
- MADX support (FS, JLN and module keepers)
  - General support and bug fixing as needed for the LHC commissioning

New organisation of the LHC commissioning - I

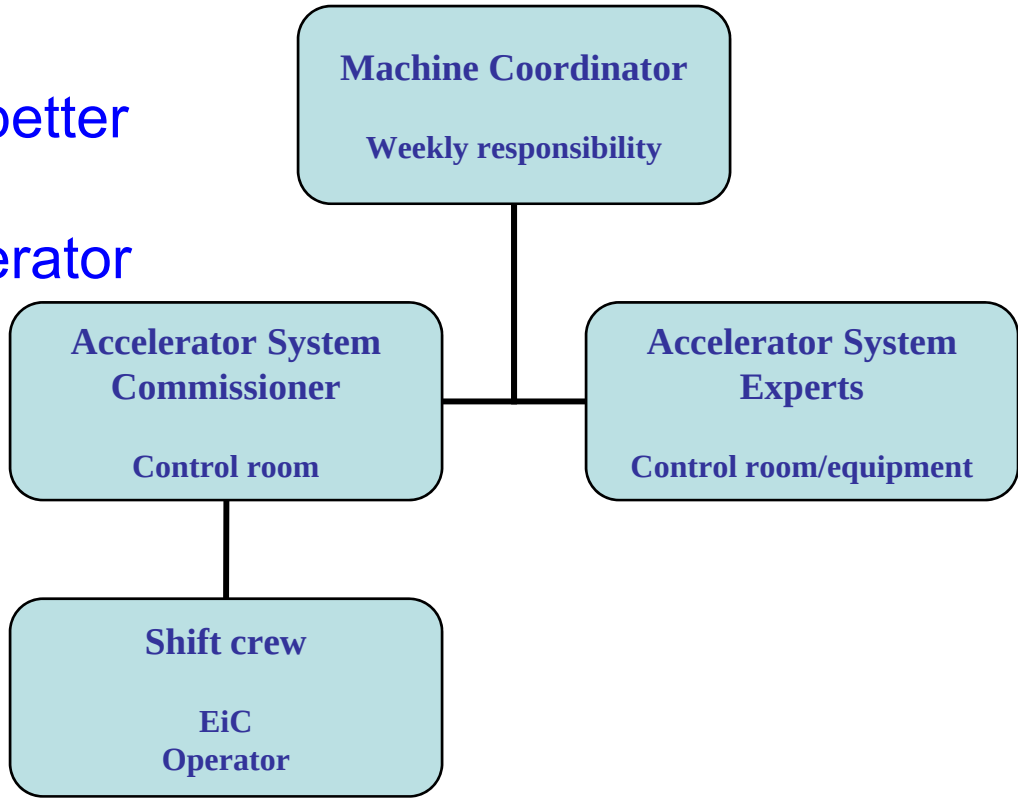


Name	Group
Arduini	ABP
Assmann	ABP
Fartoukh	ABP
Giovannozzi	ABP
Uythoven	BT
Wenninger	OP
Zimmermann	ABP

Proposed organisation since end of 2005 (beam expected for 2007)

New organisation of the LHC commissioning - II

- Slippage of the LHC schedule
- EiCs have up to 2.5 years experience
  - SPS ops
  - LHC HWC
- Role of commissioner can be better optimised to specialties
- Assign commissioner to accelerator system or activity



New organisation of the LHC commissioning - III

- Before beam
  - Responsible for readiness of commissioning plan (procedures and dry runs)
- With beam
  - Co-ordinate activities from the CCC (System experts, EiCs, Machine coordinators) and follow ups
  - Make the necessary beam measurements and implement corrections
  - Pass on information to EICs for incorporation into routine operations

Accelerator System or activity	Commissioner
Machine checkout	**G.Arduini**
Transfer lines **LHC injection and protection**	**J.Uythoven**
Threading **First turn** **Closed orbit**	**J.Wenninger**
RF **Capture** **Energy matching**	**G.Arduini**
LBDS and protection	**B.Goddard**
BI systems	**R.Jones**
450GeV machine **Q, Q', coupling** **Beating and dispersion** **Aperture**	**M.Giovannozzi**
Collimation	**R.Assmann**
Machine protection	**R.Schmidt**
Ramp	**M.Lamont**
Top energy machine **Q, Q', coupling** **Beating and dispersion** **Aperture**	**F.Zimmermann**
Collisions **Experimental conditions**	**H.Burkhardt**
Squeeze **Q, Q', coupling** **Beating and dispersion** **Aperture**	**S.Fartoukh**

Main objectives for 2008 - III

- Impedance and collective effects (EM with contributions from F. Caspers, A. Grudiev – AB/RF, FeRo, B. Salvant)
  - General impedance police activities (special devices, experimental areas, collimators).
  - Pursue the development of the impedance database ZBASE (with the help of a Fellow, and DESY collaborator).
  - Intense experimental activities particularly focused to the assessment of the collimators (Phase 1 and 2). Results maintained at the following site:

    http://rf-impedance-measurement.web.cern.ch/rf-impedance-measurement/

  - Study of the coupled-bunch instability at 7 TeV and cures. Development of simulation tools (with the help of a Fellow).
- FP420 (FeRo)
  - Impedance (also for ATLAS roman pots!), machine-induced background, and optics studies.

Main objectives for 2008 - IV

- Collimation project (RA, CB, VP, TW)
  - Pursue study of early commissioning scenarios, including system errors and performance of collimation system with dynamic errors.
  - Collimation production completed. Hardware commissioning in progress. Waiting for beam commissioning!
  - Analysis of collimation system performance for combined betatron/momentum collimation in IR3. This in view of mitigating the potential radiation issues for electronics in IR7
  - Accelerator physics studies for the LHC collimation upgrade, including crystal-enhanced collimation.
  - Coordinate the Phase 2 R&D work for the LHC collimation system at CERN, with supporting resources and expertise from US LARP and SLAC. White Paper Phase 2 activities approved.
  - Ions studies: performance of collimation system (G. Bellodi, RB, S. Gilardoni, NH, JJ)
  - Analysis of fragmentation cross-sections
  - Simulations at various energies (injection, ramp, and top energy)
  - Evaluation of special improvements (optics change in IR7, magnetised collimators, spoilers).
  - Improvements to the collimation system for ions will be included in Phase 2 specifications.

Main objectives for 2008 - V

- Ions studies: beam dynamics issues (RB, S. Gilardoni, JJ)
  - Models to describe intensity evolution and de-bunching
  - Alleviation of Bound-Free Pair Production
  - Analysis of experiments on SPS (loss maps) and simulations

- LHC optics (M. Aiba, HB, SF, MG, JJ, MM, TR, SW)
  - Maintenance of optics and aperture database
  - Specifications for “as-built” aperture database
  - Verification of the “as-built” aperture
  - Preparation of optics versions (also in view of LHC commissioning).
  - Finalisation of squeeze (beta-beating during squeeze, smoothness of transition, power convert tests during HWC).
  - Finalisation of high-beta optics for TOTEM and ATLAS.

Main objectives for 2008 - VI

- LHC upgrade (M. Aiba, RA, RC, SF, MG, WH, MM, YP, TR, RT, FZ)
  - Phase 1 upgrade organised as a project (within White Paper scope) during 2007 (R. Ostojic – PL). Responsible persons for the various areas proposed (SF for ABP).
  - A working group (http://liuwg.web.cern.ch/liuwg/) was set-up (SF scientific secretary)
  - Results and objectives:
    - Four layouts (LHC PR 1000 and 1008) were analysed. Choice narrowed down to two (yet with aperture restrictions in the long straight section).
    - Realistic layout under conception and study (SF)
    - One crucial issue is the correction of the off-momentum beta-beating. Strategy defined (SF), which requires optics changes in arcs and other insertion regions (M. Aiba, MG, TR, RT)
    - Once optics ready, make usual assessment (aperture, non-linear effects, specification of field quality, beam-beam effects, collimation) (M. Aiba, RA, SF, MG, WH, MM, TR, RT)
  - Other studies (HHH and US LARP): mainly focusing on crab cavities (implementation, optics, impact on collimation performance). (RA, RC, YP, RT, FZ)
  - FP7-related activities…