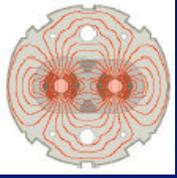
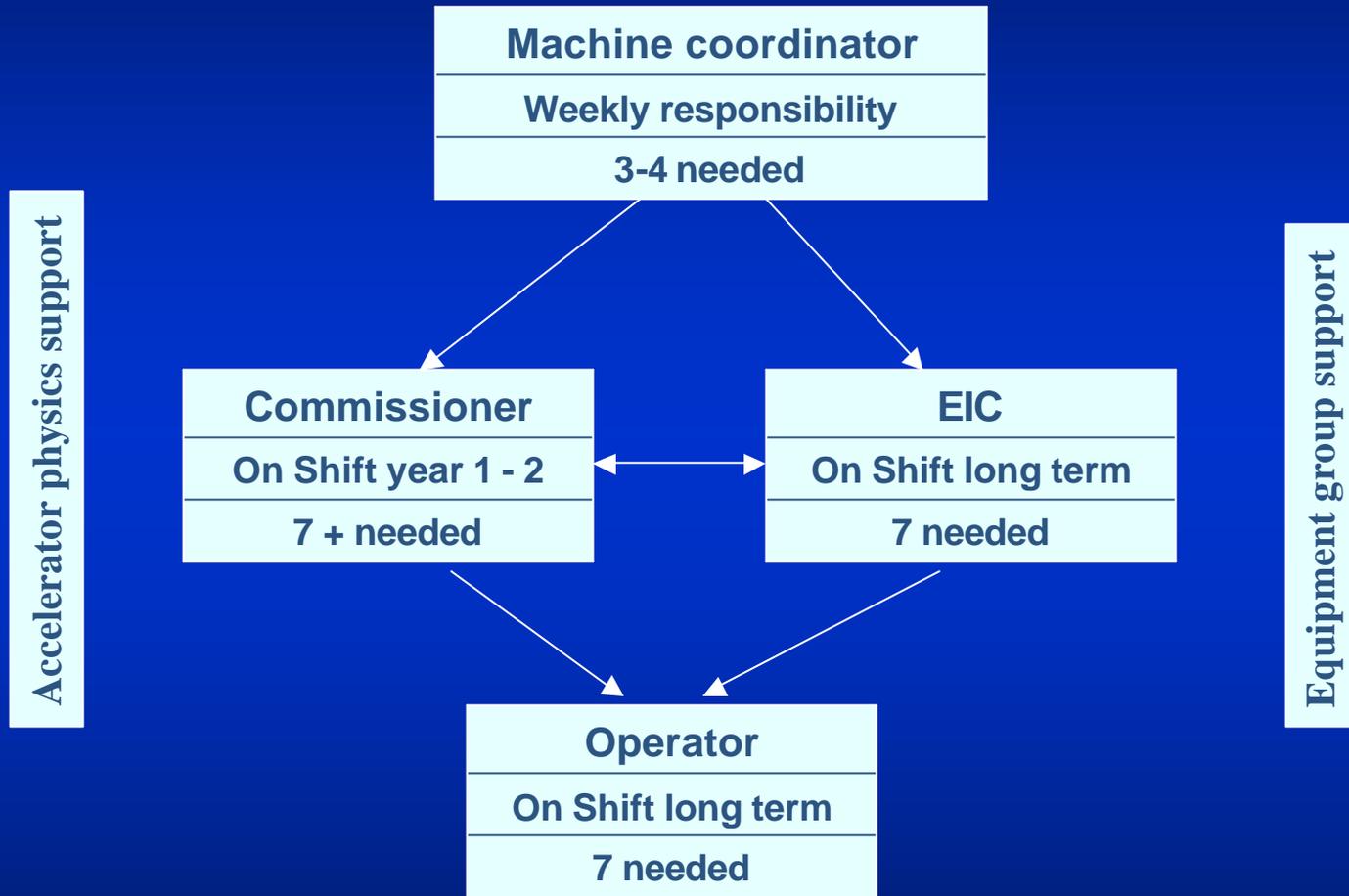


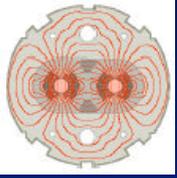
# **LHC Commissioning Organisation**

**R. Bailey**  
**AB LHC Operations**



# Commissioning organisation





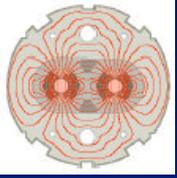
# LHC Machine Coordinator

## Role:

- **Take overall responsibility for the LHC machine**
  - Implementation of the LHC commissioning program over a week
  - supervising and directing the shift crews
  - ensuring the necessary follow up is done
  - chairing daily commissioning meetings
  - reporting progress and problems to the wider community
  - Not (necessarily) a hands-on activity

## Qualification:

- **Experienced accelerator physicist. Must have a thorough knowledge of the LHC and the commissioning plan. Must have a wide knowledge of the supporting equipment groups. Experience of doing a similar job would be a clear advantage**
- **LHCOP members + other possibilities**



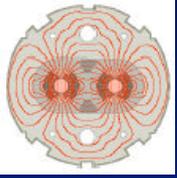
# Engineer in Charge (EIC)

## Role:

- **to run the LHC machine**
  - under the direction of a Machine Coordinator
  - take overall responsibility for the LHC during an 8 hour shift
  - drive the machine through the operational cycle
  - establish procedures for future operation
  - assist the LHC commissioner in his job

## Qualification:

- **Physicist or Engineer. Expect to draw on staff with experience as EIC on other machines, or who have worked on LHC construction projects. We should aim to hire a pool of scientists with a wide range of specialties, each of which brings their own ideas on how to improve operations. Must be prepared to perform this role for 4 or 5 years, before moving on to other things (maybe Machine Supervisor)**
- **3 serious candidates already**



# Commissioner

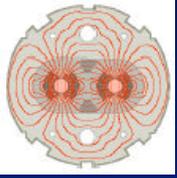
## Role:

- to execute the LHC commissioning program
  - during an 8 hour shift
  - under the direction of a Machine Coordinator
  - hands on work on the machine
  - make the necessary beam related measurements
  - obviously in close collaboration with the EIC
  - not obliged to stay around if no beam

## Qualification:

- Experienced accelerator physicist. Must have a good knowledge of the LHC machine and physics. Must be committed to doing this until the LHC operation becomes routine enough to leave to the EIC (1 or 2 years)
- 6 volunteers from AP/OP + other possibilities





# Accelerator Systems Support

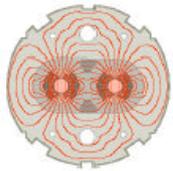
All accelerator systems have to be commissioned and will subsequently require expert support to maintain performance at the required level. For this we will obviously count on the equipment groups who are presently building the hardware systems, but we will also need a number of accelerator physicists to assume responsibility for the beam physics aspects

## Three categories of accelerator systems

- Predominately equipment systems (such as magnet circuits and power converters) requiring little accelerator physics support
- Essentially beam-based systems (such as the machine aperture) requiring a lot of accelerator physics support
- All the rest, requiring both equipment and accelerator physics expertise

## For the accelerator physicists the term responsibility here means;

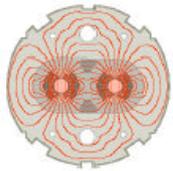
- Ensure beforehand that the system specification is clear and that all necessary tools, including software, are in place for first beam or when required
- Ensure that the system performs to specification as far as the beam is concerned. This will entail ensuring that all the necessary beam measurements are performed during commissioning and that any necessary corrective actions are implemented. All this should clearly be done in close collaboration with the central commissioning team described above
- Provide a link to the LARP personnel associated with the system



# Accelerator Systems and Responsibilities 1

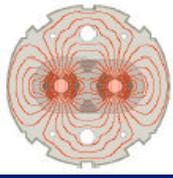
|   | System                               | Equipment Group       | Beam Physics or Operational aspects |                                  |
|---|--------------------------------------|-----------------------|-------------------------------------|----------------------------------|
| <b>Systems needed pre beam</b>                | Control system                       |                       |                                     |                                  |
|   | Applications software                |                       |                                     |                                  |
|   | Accelerator technical services       | TI operations         | <b>We know who these are</b>        | <b>No or very few names here</b> |
|   |                                      | Electrical supply     |                                     |                                  |
|   |                                      | Cooling & Ventilation |                                     |                                  |
|   | Vacuum                               |                       |                                     |                                  |
|   | Cryogenics                           |                       |                                     |                                  |
|   | Access                               |                       |                                     |                                  |
|   | Cold magnets                         |                       |                                     |                                  |
|   | Warm magnets                         |                       |                                     |                                  |
|   | Magnet circuits and power converters |                       |                                     |                                  |
|   | Power Interlock System (PIC)         |                       |                                     |                                  |
| Quench Protection and Energy Extraction (QPS) |                                      |                       |                                     |                                  |

**This is the meat of Hardware Commissioning**



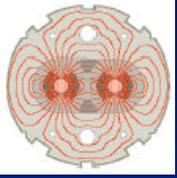
# Accelerator Systems and Responsibilities 2

|   | System  | Equipment Group       | Beam Physics or Operational aspects |                                    |
|---|---|-----------------------|-------------------------------------|------------------------------------|
| Systems needed for beam                   | SPS extraction, transfer, injection and first turn    |                       |                                     |                                    |
|   | Multi turn losses and BIS dependability               |                       |                                     |                                    |
|   | Protection devices other than collimators             |                       |                                     |                                    |
|   | Collimation system and Halo cleaning                  |                       |                                     |                                    |
|   | Clean Beam Extraction                                 | We know who these are | CERN AP interest known here         |                                    |
|   | Radio protection                                      |                       |                                     |                                    |
|   | Beam Instrumentation                                  |                       |                                     | Screens                            |
|   |   |                       |                                     | BCTs                               |
|   |   |                       |                                     | BPM, trajectory & orbit correction |
|   |   |                       |                                     | BLM                                |
|   |   |                       |                                     | PLL for Q, Q', coupling            |
|   |   |                       |                                     | Profile monitors                   |
|   |   | Schottky              |                                     |                                    |
|   | Luminosity monitors                                   |                       |                                     |                                    |
|   | Vacuum conditions during operation and electron cloud |                       |                                     |                                    |
| Reference magnet system                   |   |                       |                                     |                                    |
| RF systems and longitudinal beam dynamics |   |                       |                                     |                                    |
| Transverse feedback                       |   |                       |                                     |                                    |
| Experimental solenoids and compensations  |   |                       |                                     |                                    |
| Experimental equipment (Roman pots, velo) |   |                       |                                     |                                    |



# Accelerator Systems and Responsibilities 3

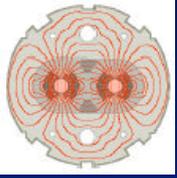
|                           | System   | Equipment Group                  | Beam Physics or Operational aspects |
|---------------------------|--|----------------------------------|-------------------------------------|
| <b>Beam based systems</b> | Beam in the injectors                          |                                  |                                     |
|                           | Ion beam in the injectors                      |                                  |                                     |
|                           | Orbit feedback system                          |                                  |                                     |
|                           | Filling efficiency and flat bottom conditions  | <b>No or very few names here</b> | <b>CERN AP interest known here</b>  |
|                           | Ramp and squeeze losses and overall quality    |                                  |                                     |
|                           | Machine protection system                      |                                  |                                     |
|                           | Optics   |                                  |                                     |
|                           | Mechanical aperture                            |                                  |                                     |
|                           | Machine Impedance and collective instabilities |                                  |                                     |
|                           | Dynamic aperture                               |                                  |                                     |
|                           | Lattice corrector settings                     |                                  |                                     |
|                           | Triplet corrector settings                     |                                  |                                     |
|                           | Lifetimes                                      |                                  |                                     |
|                           | Separation schemes                             |                                  |                                     |
|                           | Crossing angle schemes                         |                                  |                                     |
|                           | Collisions and luminosity steering             |                                  |                                     |
|                           | Experimental conditions                        |                                  |                                     |
| Ions                      |  |                                  |                                     |



# LARP involvement

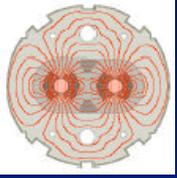
**In the present US-LARP proposal, resources are allocated for “Beam Commissioning and Accelerator Physics” activities from 2004 onwards, rising to significant numbers by 2007. In the discussions to date, we have made the point that the US-LARP commitment has to be made with long-term individual commitments of around 12 months, and that US staff should come to perform a specific role in the beam commissioning work. It has also been clearly said that CERN has to maintain sufficient expertise, particularly on shift, to ensure long-term exploitation of the machine**

**With this in mind, we feel that a very limited number of US-LARP resources could participate in the shift rota. Rather, they would be best suited to the accelerator physics and equipment group support activities**



## Next steps

- **Go back to Steve (ABMB or LTC) with this**
- **Consult with equipment groups**
- **Add non-ABP names to Beam Physics aspects**
- **Present to LARP (early April)**
- **Run through (some of) the systems at LHCOP**
  - **Ensure beforehand that the system specification is clear and that all necessary tools, including software, are in place for first beam or when required**
  - **Ensure that the system performs to specification as far as the beam is concerned**
  - **Do this with the commissioning plan in mind**
  - **Overlap with LSAT ?**



# Accelerator systems to be looked at

1. SPS extraction, transfer, injection and first turn
2. Multi turn losses and BIS dependability
3. Protection devices other than collimators
4. Collimation system and Halo cleaning
5. Clean Beam Extraction
6. Radio protection
7. Beam Instrumentation
8. Vacuum conditions during operation and electron cloud
9. Reference magnet system
10. RF systems and longitudinal beam dynamics
11. Transverse feedback
12. Experimental solenoids and compensations
13. Experimental equipment (Roman pots, velo)
14. Beam in the injectors
15. Ion beam in the injectors
16. Orbit feedback system
17. Filling efficiency and flat bottom conditions
18. Ramp and squeeze losses and overall quality
19. Machine protection system
20. Optics
21. Mechanical aperture
22. Machine Impedance and collective instabilities
23. Dynamic aperture
24. Lattice corrector settings
25. Triplet corrector settings
26. Lifetimes
27. Separation schemes
28. Crossing angle schemes
29. Collisions and luminosity steering
30. Experimental conditions
31. Ions

**Priorities needed !**

- **Points to address for each system**
  - What is the specification with beam
  - What measurements are needed
  - What tools are needed
  - What beam is needed
  - How much time is needed