New DCCTs for Personnel Protection in the SPS

BI Day 2012

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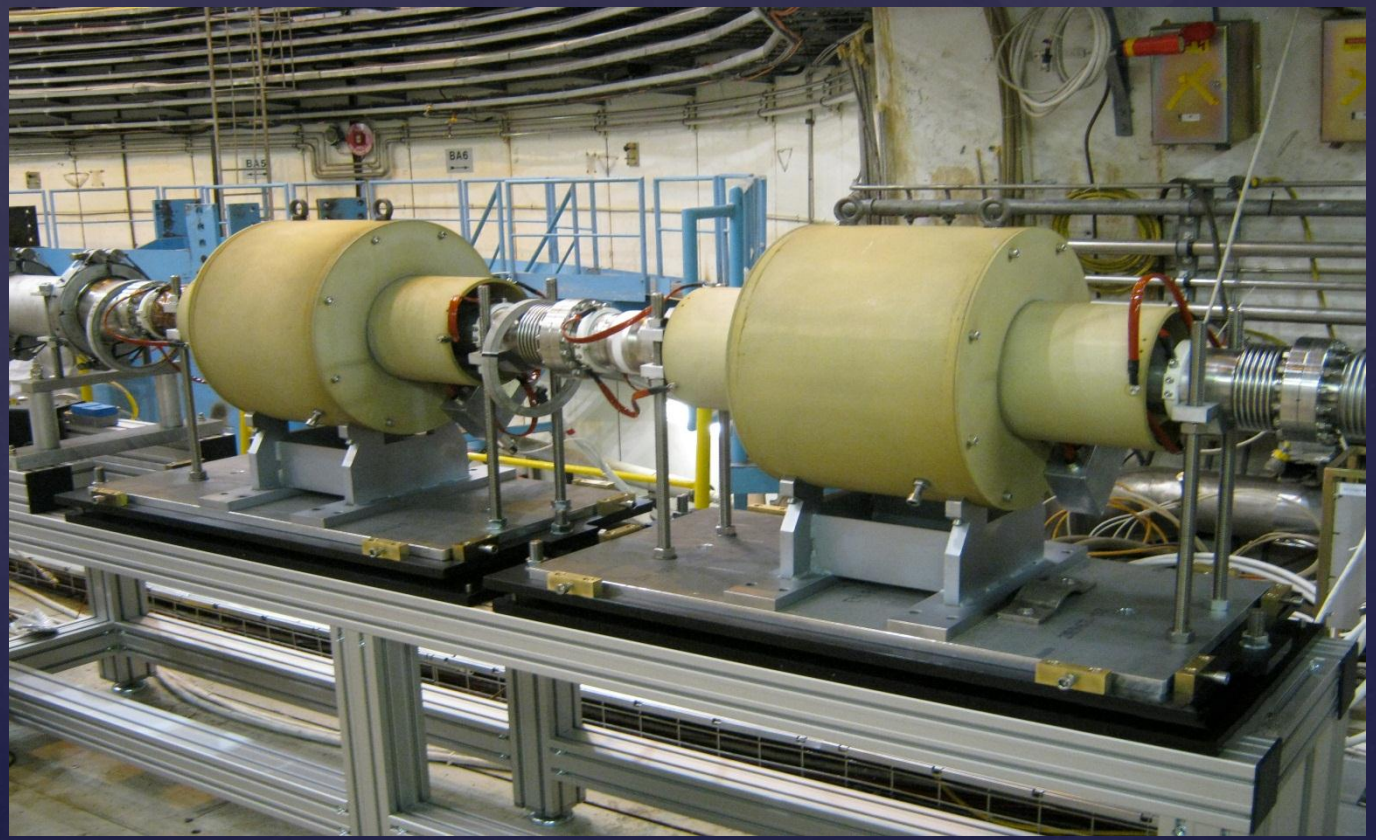


OUTLINE

- INTRODUCTION
- MECHANICAL DESIGN
- ELECTRONICS DESIGN
- TIME DIAGRAM SEQUENCE
- HARDWARE COMMISSIONING
- PLANNING
- CONCLUSION & THANKS

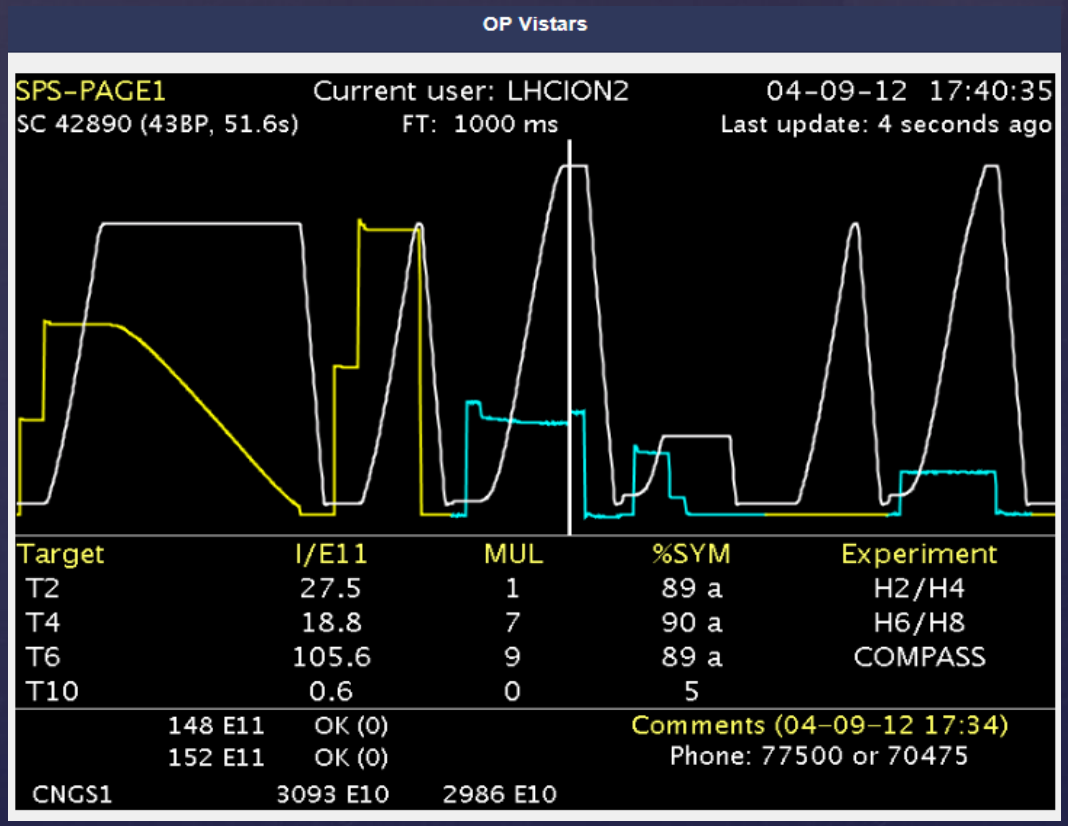
INTRODUCTION

- ***Project*** : Ion safety system in the North Hall (EDMS No. 1146023).

- For operational flexibility in the exploitation of CERN accelerators

  New scheme ***in the same SPS*** super cycle without limiting the number of charges transmitted (TAX absorbers/collimators) to the North Hall :

  ⇒ Ions for the North Area + High Intensity protons for CNGS or LHC



INTRODUCTION

- Hazards for the North Hall during this SPS super cycle ?

Human hazard to people working in the experimental areas

⇒ Filling or timing error could cause the transmission of intense proton bunch instead of ions.

To protect against this eventuality :
An instrumented safety interlock is required.

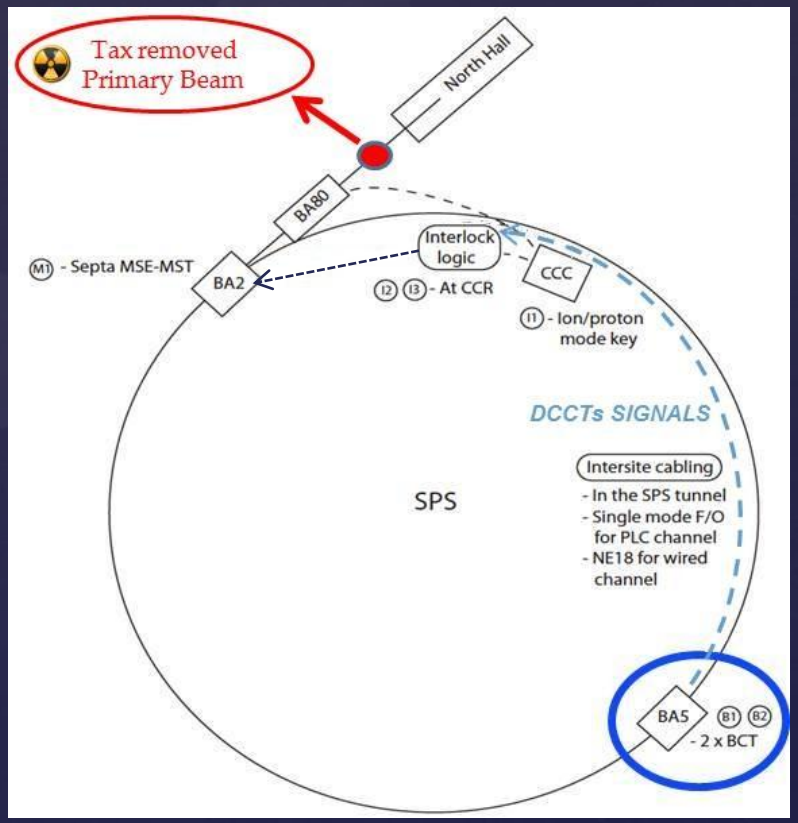
⇒ 2 ***DCCTs in BA5*** :

Why DCCTs ?

Only precise instrument to measure number of charges independently of beam structure.

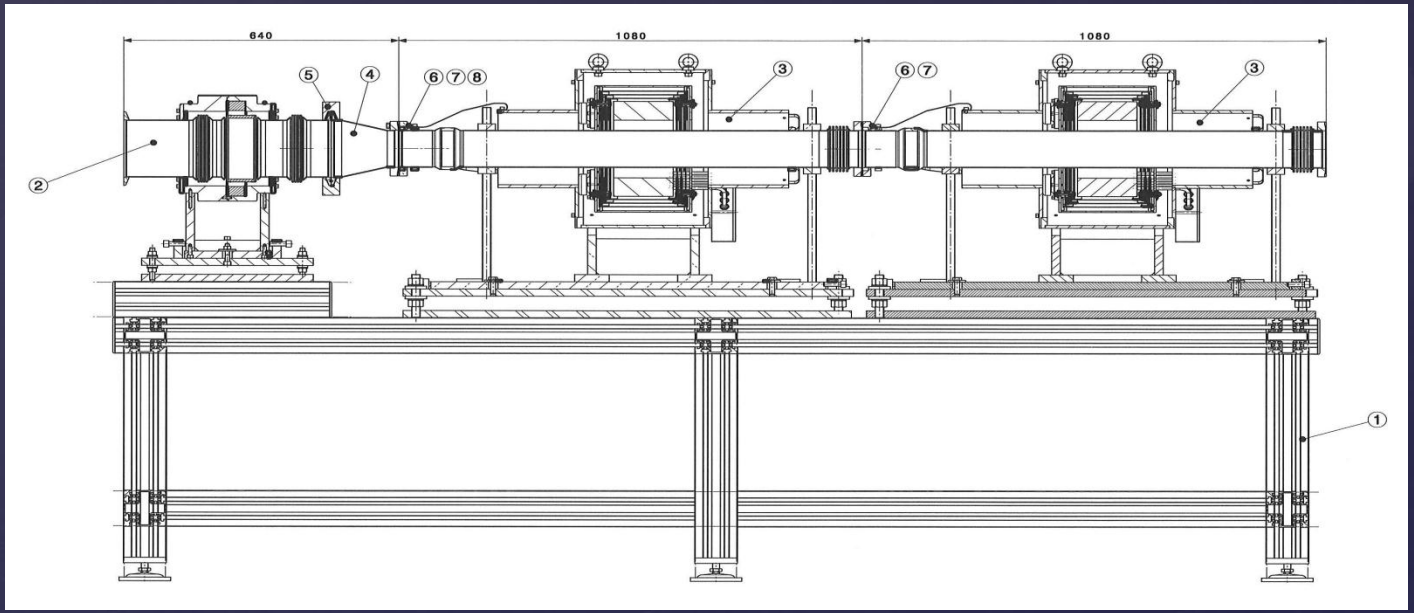
Which Role ?

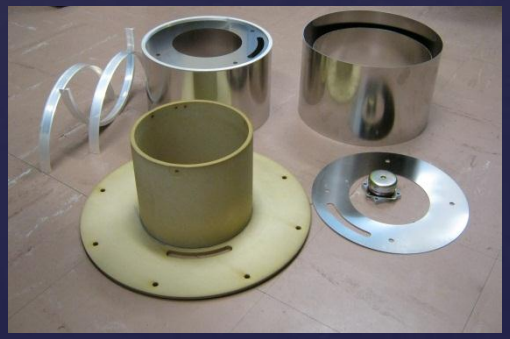
Inhibit the chain extraction septum when the beam intensity in the SPS is > 2E11 charges.



MECHANICAL DESIGN

- 2 DCCTs (made at CERN) installed in June 2012 dedicated for safety interlock with vacuum chamber , ceramic gap, …
- 1 FBCT only used for additional monitoring not in the safety chain system (Currently not installed).

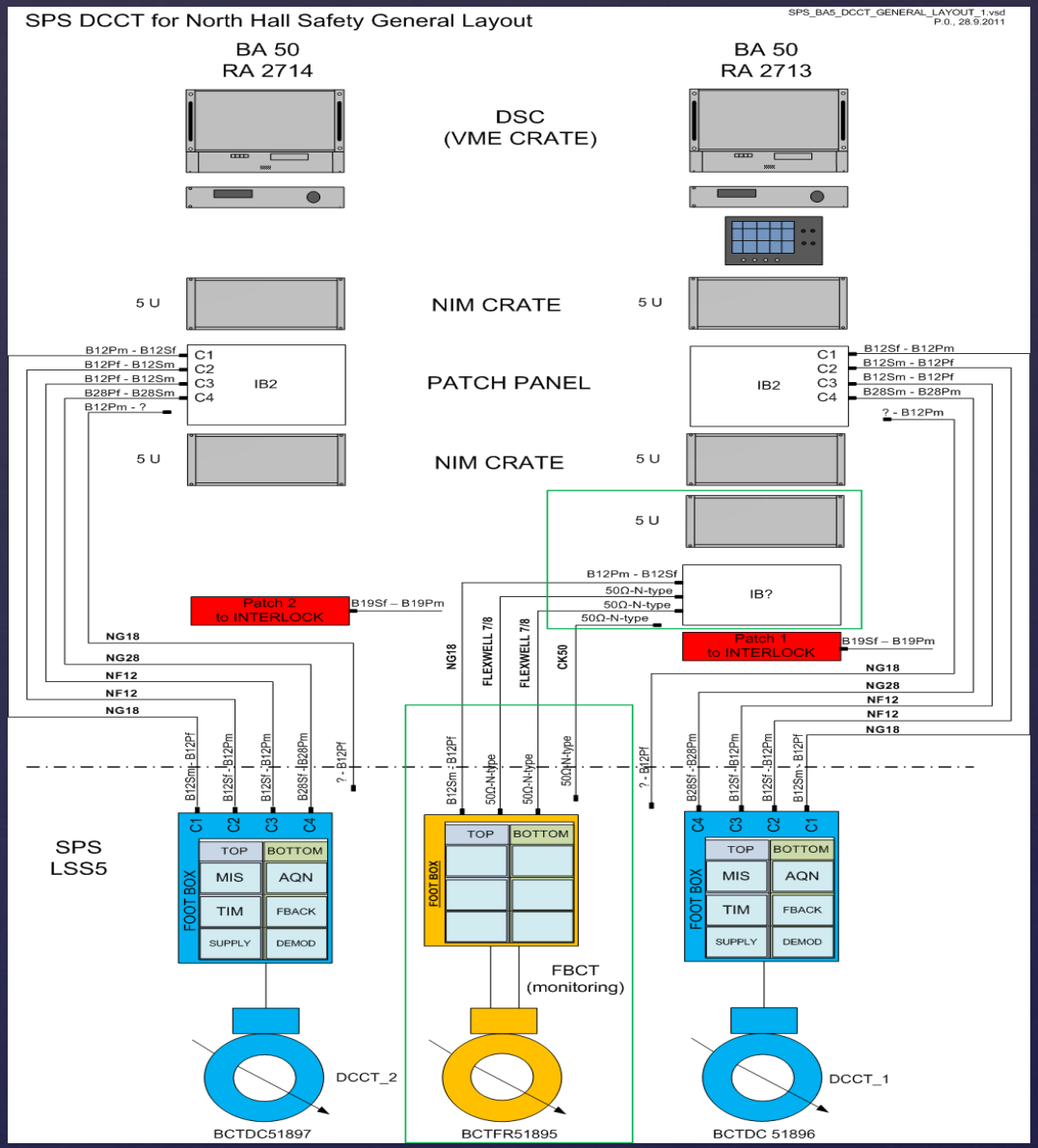




ELECTRONICS DESIGN

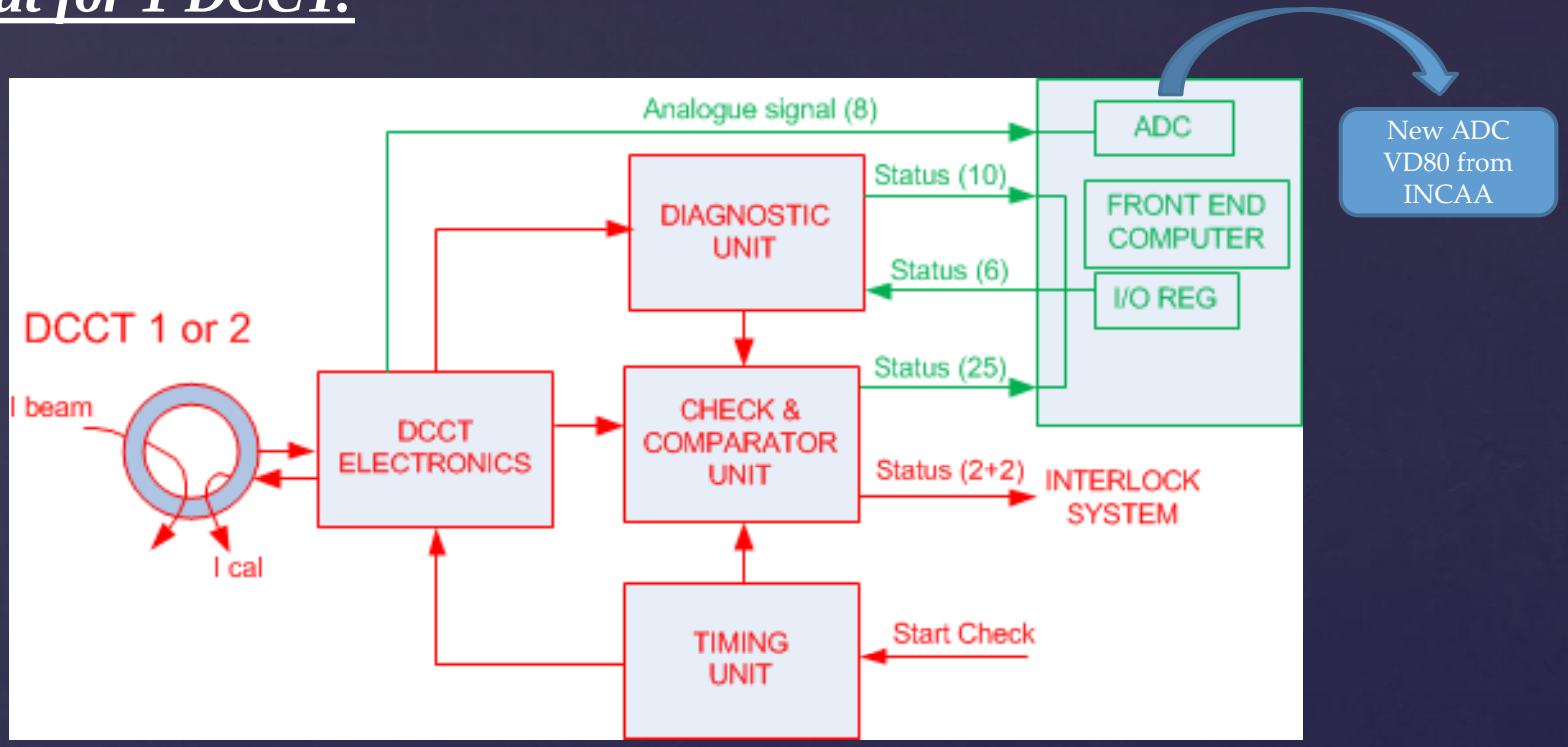
General layout :

- 2 systems (DCCTs) identical and completely independent for redundancy and safety reasons.
- Provisional location for test in BB50 with only 1 DCCT :
  ⟹ *Cable issues*



ELECTRONICS DESIGN

Layout for 1 DCCT:

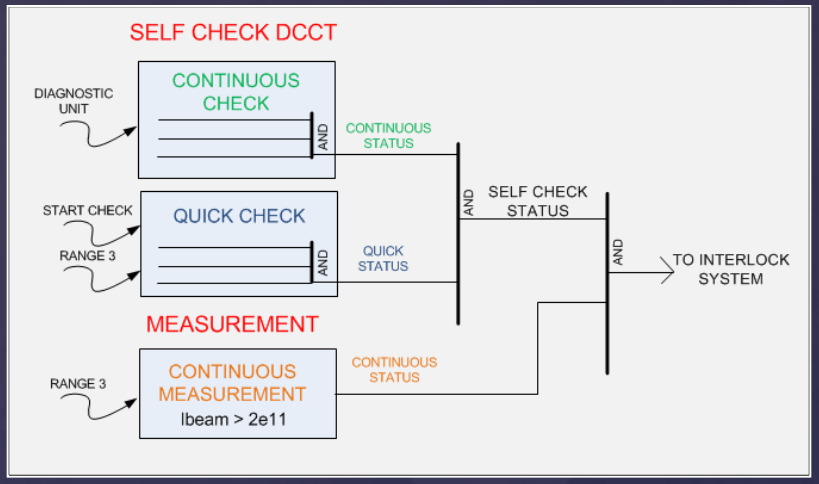


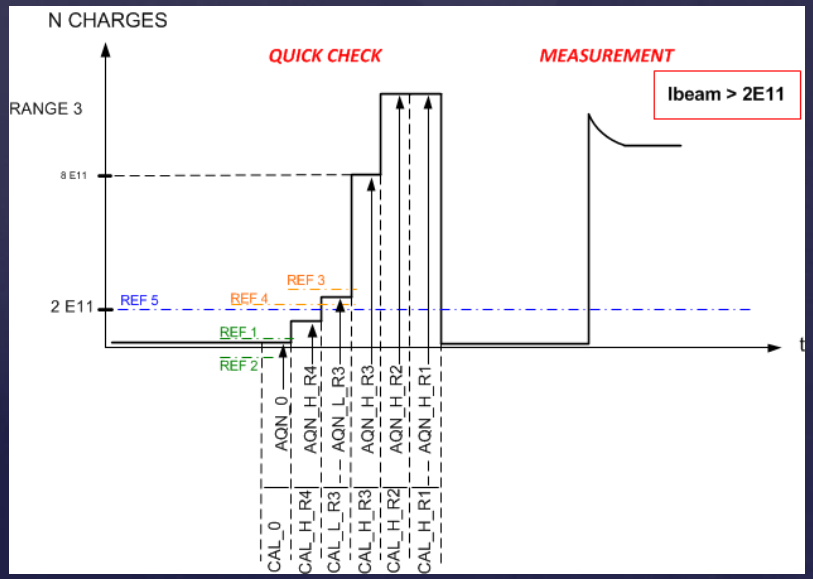
In red:
Minimum system required to fulfill the specification (pure HW solution)
In green:
Monitoring, remote diagnose tools + acquisition (could in the future, according to noise level, replace Bergoz PCTs)

DCCT ranges distribution

Ranges	Scaling Factor [nb charges/V]	Full Scale [nb charges]
1	2 E13	1 E14
2	2 E12	1 E13
3	2 E11	1 E12
4	2 E10	1 E11

Operating Principle :





- To ensure a reliable measurement system :

To be sure of the DCCT's good state :

SELF CHECK DCCT :

Continuous Check : various status as current consumption, demodulation signal amplitude, etc.

Quick Check : Offset test and good response to different calibration pulses before beam injection. Storing the result Quick Check (OK or NOT OK) until next cycle.

MEASUREMENT :

Continuous Measurement : Beam measure on Range 3 and detection when Ibeam > 2e11.

Connections between DCCT and Interlock System

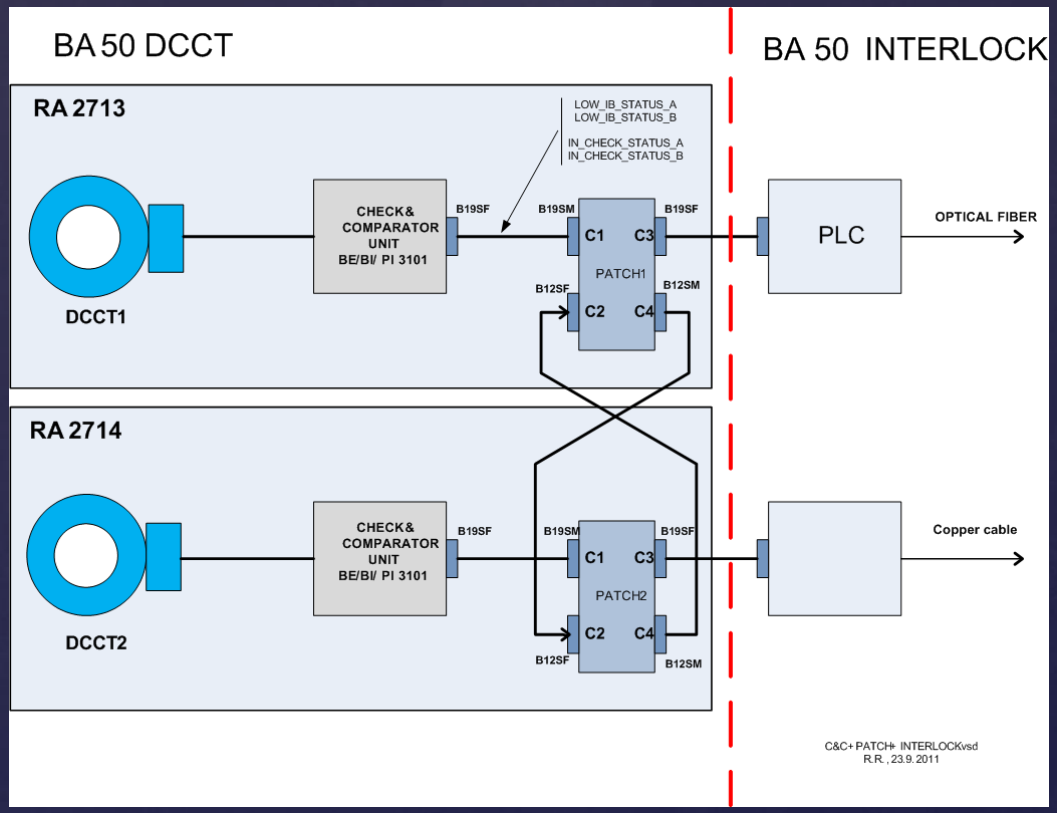
2 signals (and their complementary) are delivered, via optocouplers, by each DCCT.
2 different types of transmission.

- IN_CHECK_STATUS

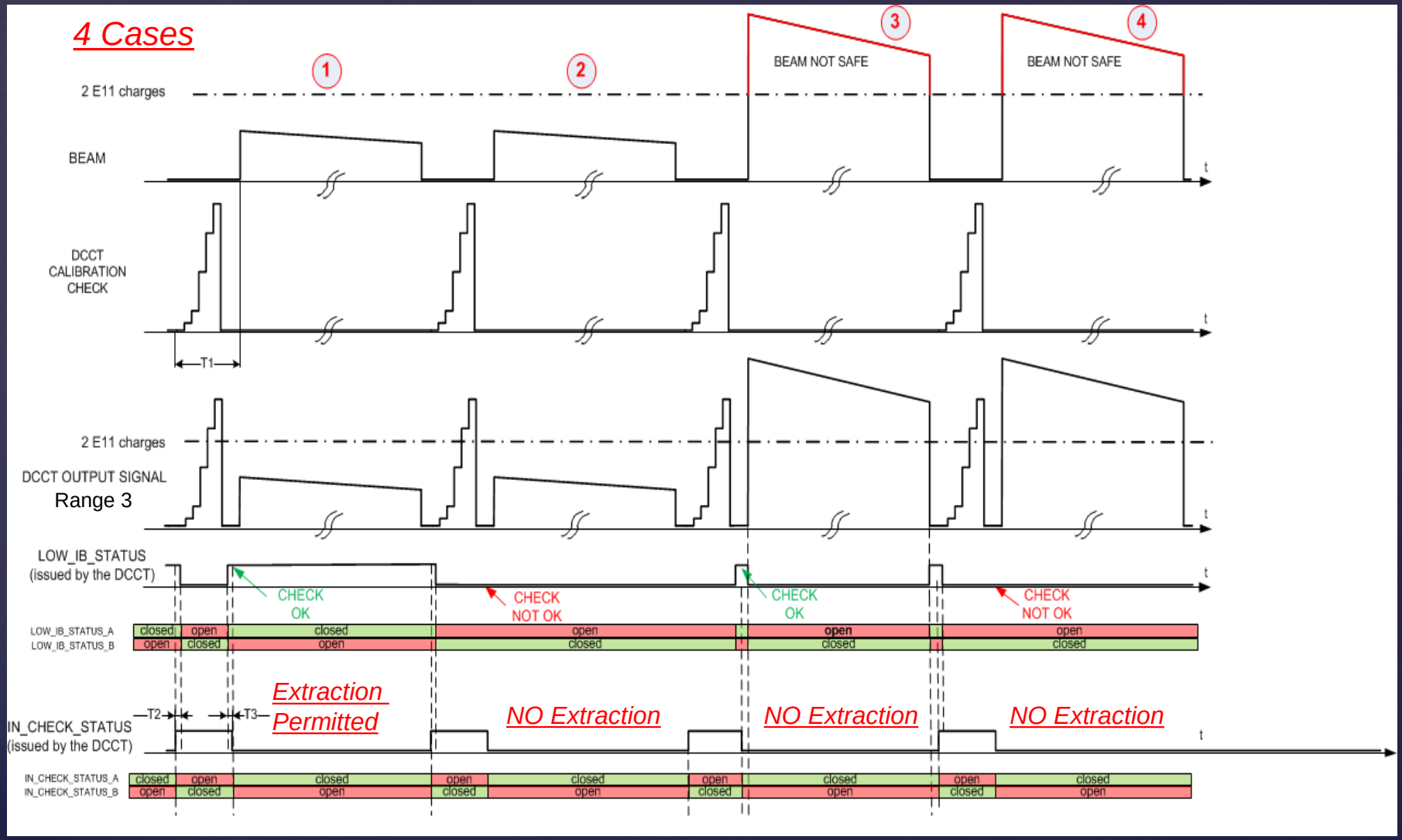
TRUE when the DCCT and the comparator are in check process (before each cycle)

- LOW_IB_STATUS

TRUE IF Ib < 2 E11 charges
AND check result OK
AND IN_CHECK_STATUS FALSE



TIME DIAGRAM SEQUENCE



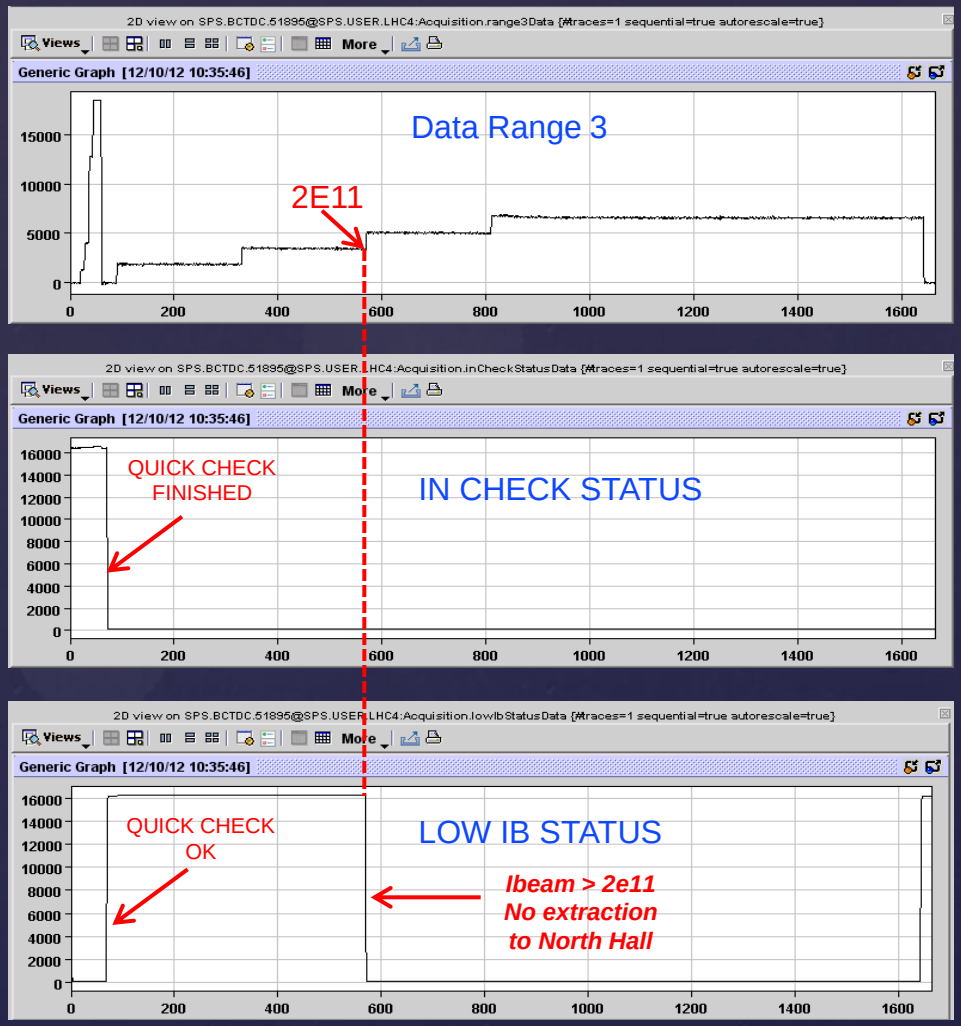
HARDWARE COMISSIONING

Location : BB5 with 1 DCCT

- Make a precise calibration of DCCT.
- Following system test :
  - Quick Check with timing.
  - Continuous measurement :

    - With a known current (calibration Generator) or with the Beam.

    - Check 2 signals state to Interlock :
      - IN CHECK STATUS
      - LOW IB STATUS



Signals view on Fesa Navigator

HARDWARE COMISSIONING

- Always ensure the reliability of the system against various events.

→ Creation of list with possible anomalies that could occur and observation of the response on the self check system :

- Offset drift and noise outside given tolerance.

- Disconnected cables :
  - Range 3 DCCT
  - Calibration Pulses
  - Timing
  - Signals to Interlock
  - BCT Status (current consumption,…)
  - Etc…

- Power Supply on OFF :
  How long to recover an operational system ?

PLANNING

- ***March 2009*** : Specification Draft
- ***April 2010*** : ECR 1075945 v1
- ***Jan 2011*** : Cable pulling for provisional location (BB5)
- ***June 2011*** : ECR 1075945 v2
- ***Sept 2011-May 2012*** : Mechanical
- ***March - June 2012*** : Electronic prototypes
- ***June 2012*** : Installation
- ***Since August 2012*** : Test of DCCT & Soft RT programme
- ***Oct 2012*** : Working document specification
- ***Jan-Feb 2013*** : Test with Interlock system

- ***LS1*** : - Cable pulling for final location (BA5)
  - Specification circulation for final approbation
  - Make final electronics
  - Installation of Fast BCT
  - Global System Commissioning (DCCT, interlock, power supply)

- ***After LS1*** : - Global System Commissioning with Beam
  - Experiment with Ions Beam in North Hall

CONCLUSION & THANKS

DCCT's and electronics used were made at CERN.

These are the same as used normally but for this project the new challenge is safety and personnel protection.

⟹ Simple & Reliable electronics

Now we are testing DCCT's and electronics prototypes to validate the principle.

⟹ Make final electronics

Finally Global System Commissioning with Ions Beam.

➢ ***Thanks to :***

- Specifications : Django Manglunki
- Mechanical : Thomas Sahner, Christophe Vuitton, Frédéric Camba, CERN Workshops
- Electronic : Patrick Odier, Jacques Longo, Romain Ruffieux
- Software : Lars Jensen
- Cables : Guillaume Gros