PSB Absorber/Scraper for LS2

LIU-PSB Working Group #201 meeting
26th September 2017

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Scope of the Presentation

- Introduction
- Operational Scenarios and Beam Parameters
- Design Overview
  - Optics and final Apertures definition
  - Thermo-mechanical simulations
  - Manufacturing Input
  - Vacuum Input
  - Impedance Input
  - Integration Input
  - Survey Input
  - Transport Input
- Project Timeline
Introduction

- LHC Injector Upgrade Project (LIU)

- The increase in beam energy and intensity will lead to potentially more harmful losses and requires mitigation measures including the study of a new collimation/scraping system

- The new PSB scraper/absorber will replace the current WBS installed in section 8L2 of the PSB

- By representing the major aperture restriction in the machine, it should localize the beam losses in Period 8 and limit therefore the activation of the remaining installed machine equipment

- Related official released documents:

  Functional Specification EDMS 1578463
  Space Reservation Request EDMS 1612378
Operational Scenarios and Beam Parameters

(provided by LIU-PSB, https://edms.cern.ch/document/PSB-TS-ES-0001/1.0/TAB3)

- **Scenario 1:**
  - Scraping high-intensity beams at injection
  - 160 MeV
  - Beam losses in scraper: 6 % of 2e13p
  - Pulse period 1.2 s, losses integrated over 20 ms
  - Yielding 4e11 p/ring/s
  - \(\varepsilon_x=9\) mm mrad and \(\varepsilon_y=6\) mm mrad (pessimistic assumption for density)

- **Scenario 2:**
  - Direct impact at top energy
  - 2 GeV
  - Isolde beam at 2e13p, full beam lost within 1 turn
  - Applied during 240 ns
  - \(\varepsilon_x=9\) mm mrad and \(\varepsilon_y=6\) mm mrad

- **Scenario 3:**
  - Beam production via shaving of bright beams
  - 181 MeV
  - Beam losses in scraper: 15 % of 2.8e12p
  - Pulse period 1.2 s, losses integrated over 20 ms
  - Yielding 3.5e11 p/ring/s
  - \(\varepsilon_x=1\) mm mrad and \(\varepsilon_y=1\) mm mrad

*Courtesy of F. Schmidt, H. Bartosik, G.P. DiGiovani and B. Mikulec*
Design Overview

QFO  Absorber/Scrapper  QDE

Big aperture mask (Fix)  Small aperture mask (Mobil)

QFO  QDE
Design Overview

- Optics and final Apertures definition

*Courtesy of F. Schmidt, H. Bartosik, G.P. DiGiovani and B. Mikulec
Design Overview

- Thermo-mechanical simulations

*Courtesy of J. Briz

*Courtesy of J. Heredia
Design Overview

- **Manufacturing Input:**
  - Several iterations during design phase with main workshop.
  - Prototype will be manufactured at the main workshop (T. Coiffet and E. Rigutto, EN-MME).
  - Challenging geometrical tolerances, but achievable.
  - No adjustment system needed.
  - Assembly Technologies such as Press Fitted Graphite
Design Overview

- **Vacuum Input:**
  - **Iterations during design phase with TE-VSC (J. Hansen):**
    - PS Booster Upgrade Working Group Meeting #183.
    - Ion pump type agreed VARIAN VACION PLUS 75.
    - Identification of trapped volumes.
    - Inclusion of hydroformed bellows.
    - Identification best flange location.
Design Overview

- Impedance Input:
  - Iterations during design phase with the Impedance Working Group:
    - CST Simulations performed by L. Teofili -> Device impedance
      - Need of closing up volumes and gaps
    - Include RF fingers
  - Simulations performed by T. Rijjof -> Assessing the influence on the total PSB impedance budget
Design Overview

- **Integration Input:**
  - Iterations during design phase with the Integration Working Group.
  - Chassis presented by N. Chritin at the ICL meeting the 14/06/2017
  - Structural simulations and modal analysis by J. Heredia (EN-STI)

![G: New Frame]

**Table: Relative effective mass**

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Figure 2: Total deformation of the frame support due to the gravity action.
Design Overview

- Survey Input:
  - Iterations during design phase with EN-ACE (T. Dobers):
    - Adjustable support
    - Alignment in surface
    - Pre-settings to be achieved with tooling
Design Overview

- **Transport Input:**
  - Iterations during design phase with EN-HE (S. Fumeys and F. Delsaux):
Project Timeline

- 11/2017 Final Functional Specification release
- 01/2018 Conceptual Design (3D)
- 04/2018 Detailed Design (3D)
- 05/2018 Detailed Design (2D drawings)
- 06/2018 Prototype Production, Qualification Test and Series Production Start
- 2019 Series Production Completion and Qualification Tests
- 02/2020 Ready for Installation
- LS2 2020 Commissioning Tests
- LS2 2020 Ready for Operation
Thank you!