

IWG news

IWG 53

Comment on ECRs

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SPS

EDMS NO.	REV.	VALIDITY
2647418	0.1	DRAFT

REFERENCE
SPS-BPMEA-EC-0002

Date: 2021-11-15



ENGINEERING CHANGE REQUEST

Removal of the prototype Electro-Optical BPM from LSS4 of the SPS during YETS 2021-2022

BRIEF DESCRIPTION OF THE PROPOSED CHANGE(S):

The prototype Electro-Optical BPM (BPMEA.42172) is no longer used and will be removed from the SPS for reuse in AWAKE. To improve the impedance of the region, new tapered transition chambers will be installed upstream and downstream of the Head-Tail Monitor (BPCL.42171).

✓ Accepted by VOLLINGER Christine (SY-RF)

Created on 2021-11-24, 08:39

Comment from IWG: This ECR was discussed in IWG meeting #51 and the proposed changes are fully supported by IWG.

A reduction of impedance contribution is to be expected from the removal of the beam position monitor BPMEA.42172, and in particular from the proposed (additional) layout changes in LSS4 resulting in a smooth transition. IWG thanks the equipment owners for the improvement with respect to the existing layout.

Could you add the following text to section 5.3, Impedance (final comment as foreseen):

The impedance of the area was discussed in IWG#51 (<https://indico.cern.ch/event/1083249/>) and the changes are supported by IWG. A considerable improvement with respect to impedance contribution is expected from the introduction of the smooth tapers. Also, the removal on an enamelled flange is expected to have a generally beneficial effect on impedance.

Congratulations from LMC

LMC minutes of 428th LMC meeting:

- **M. Lamont** thanked the speaker for the presentation, and the whole Impedance Working Group for the fast response time with the simulations, which helped to promptly take the decision to warm-up Sector 23 to repair the non-conformity.

→ Thanks to all of you for the help!

Several end of year workshops

- Evian for LHC (hybrid): <https://indico.cern.ch/event/1077835/>
- IEF Montreux workshop for injectors (finally remote):
<https://indico.cern.ch/event/1063281/>
- FCC-ee (hybrid): <https://indico.cern.ch/event/1085318/>

Evian

Helga

Beam dynamics studies for Run III

- Improved longitudinal impedance model
 - Crucial for all other studies!!
- Tomography and longitudinal beam parameters
 - SPS-LHC energy matching & Machine Learning tomography at injection (multi-bunch)
 - Voltage calibration studies (single bunch)
- Controlled emittance blow-up
- Beam stability (single and multi-bunch)
- Injection power limitations and losses
 - Beam loss modelling with cavity and beam control loops
 - Longitudinal damper, pre-detuning, working-point optimisation
 - Alternative beam-loading compensation schemes

Preliminary MD list for Run III

- RF power limitations and dynamics at injection
 - Minimum capture voltage w.r.t. losses
 - Optimisation of injection
 - Longitudinal damper
 - Persistent injection oscillations at high intensity - [new](#)
 - Tomography measurement of energy mismatch
- Full-detuning and LLRF studies for HL-LHC intensities
 - Adapting the full detuning algorithm for HL-LHC intensities
 - LLRF upgrades to overcome limitations
- Beam dynamics studies throughout the cycle
 - Controlled emittance blow-up during the ramp
 - Accurate threshold of loss of Landau damping
 - Coupled-bunch stability threshold - [new](#)
 - Longitudinal Schottky measurements
- LHC impedance model
 - Broad-band impedance cut-off frequency - [new](#)
 - Beam-based impedance measurements - [new](#)
- Other measurements
 - Longest bunch length at flattop for physics - [new](#)
 - Continuous emittance blow-up at flattop - [new](#)
 - Voltage calibration with beam - [new](#)
 - Longitudinal BTF - [new](#)

Draft planning for beams to LHC

Summary

- ❑ 2022 will be a very active year for the LHC
 - Hopefully we will profit a lot from the injectors readiness and high availability
- ❑ Single bunches (pilot/indiv) from Wk14
 - Floating MD blocks added during beam commissioning → high brightness bunches might be also requested, if they are available
- ❑ Scrubbing run on Wk21
 - Nominal 25ns 4x72 bunches with intensity of 1.2×10^{11} p/b beam would be needed
- ❑ Intensity ramp-up on Wk24/25
 - BCMS 25 ns beams 5x48 bunches with intensity of 1.2×10^{11} p/b with smallest as possible emittances
 - Nominal 25 ns beam with 5x48 bunches in case of issues but not favourable due to some loss of luminosity
- ❑ Single bunch intensity increase (up to 1.4×10^{11} p/b) around Wk30
 - BCMS 25 ns beams 5x48 bunches with smallest as possible emittances (ideally 1.3/1.4 μm)
 - The 8b+4e beam scheme might also needed in case of high heat load → not expected for the bunch intensities in 2022
- ❑ The 50 ns bunch spacing Pb ion beam is foreseen for the Pb-Pb run from Wk45
 - 75ns beam is still kept as a back-up solution

Montreux IEF Workshop

Talk by Foteini on LHC Proton Beam Production

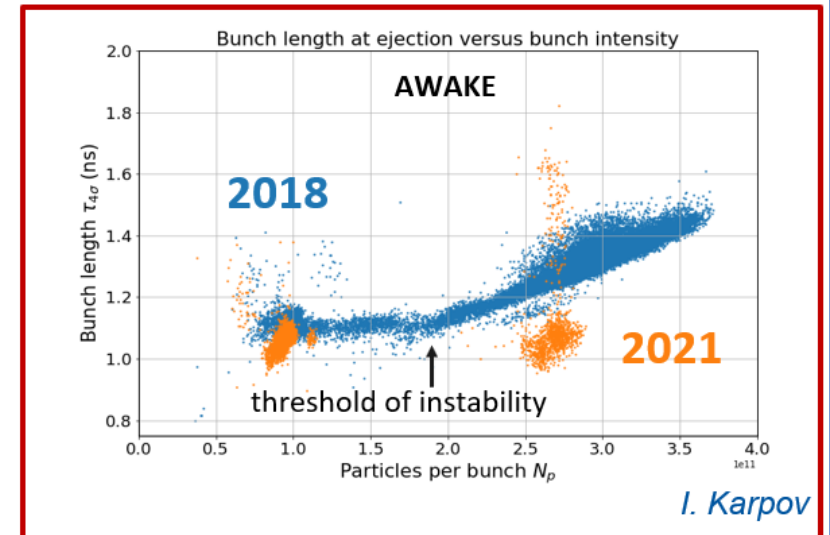


SPS : Challenges

1. Longitudinal stability:

i. Microwave instability:

- Example of AWAKE beam (*relevant for all users*):
Bunch-length increase for $N_p > 1.9 \times 10^{11}$ ppb
- ✓ **Impedance reduction** campaign during LS2 –
instability suppressed



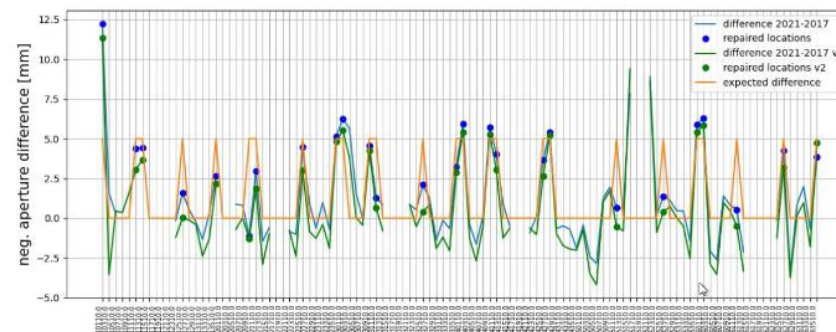
IEF Workshop, 6-9 December 2021

Montreux IEF Workshop

SPS aperture restrictions – QDs

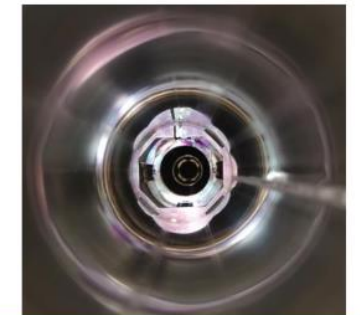
Issue

- **Layout non conformity being addressed during LS2 in 25 positions:**
 - QD : few locations are non conform still, with some (e.g. 209) with no improvement at all.



Solution & Outlook

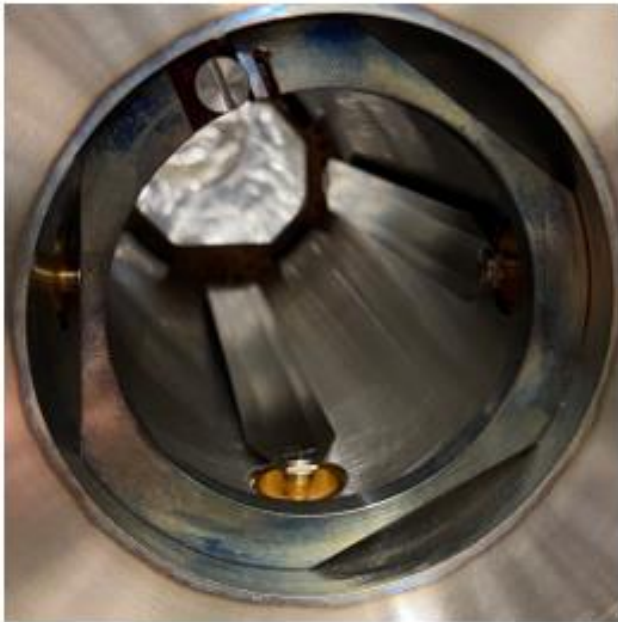
- **Alignment of the half cell confirmed during TS2;**
- **209 being checked during YETS and no non conformities found → Beam Position Coupler (BPCN) masks limiting the aperture.**



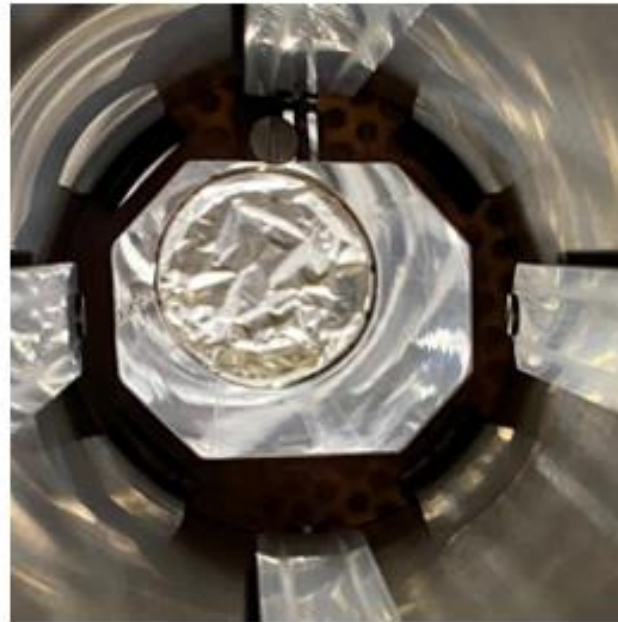
Talk by Chiara

IEFC of December 3rd

- <https://indico.cern.ch/event/1101007/>



(a) downstream mask



(b) upstream mask

Figure 3 — Views of masks from downstream of BPCN.20902.



Figure 4 — Masks removed from BPCN.20902.

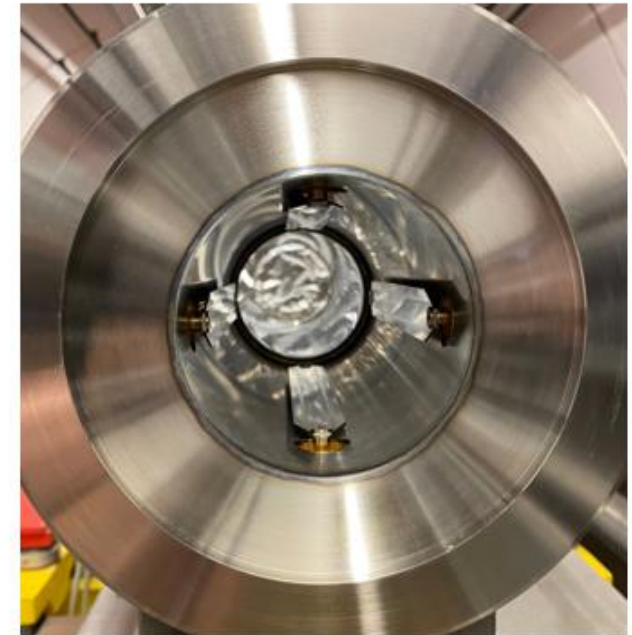


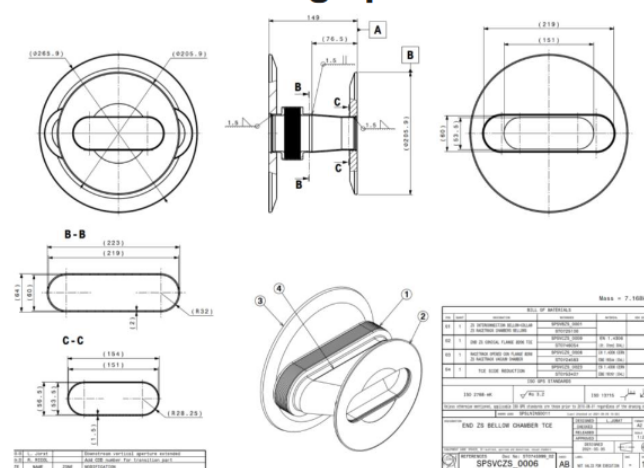
Figure 5 — BPCN.20902 after removal of the masks.

Montreux IEF Workshop

SPS aperture restrictions – 218

Issue

- Transition chamber of the ZS intertank produced with wrong aperture.



Solution & Outlook

- Vacuum chamber replaced (it entailed ZS venting + NEG activation).
- Integration of 3D beam envelopes in CATIA would help avoiding making such mistakes: this implementation would be useful for critical areas (injection, extraction, doglegs, systematic aperture restrictions).

Talk by Chiara

FCC-ee

WEDNESDAY, 8 DECEMBER

08:45 → 16:50

BE Amphitheatre: Collective effects

6/2-024 - BE Auditorium Meyrin

Join

Conveners: Lotta Methner (CERN), Mauro Migliorati (Sapienza Università e INFN, Roma I (IT)), Xavier Buffat (CERN)

08:45

Coffee break

15m

09:00

Impedance models and single-beam instabilities 1

1h

Overview

30m

Speakers: Mauro Migliorati (University of Rome "LA SAPIENZA"), Mauro Migliorati (Sapienza Università e INFN, Roma I (IT))

2021_12_08_FCC-IS_w...

Impedance model & TMCI threshold (15'+ 15')

30m

Speaker: Emanuela Carideo (Sapienza Università e INFN, Roma I (IT))

Emanuela Carideo WP...

Emanuela Carideo WP...

10:00

Coffee break

30m

10:30

Impedance models and single-beam instabilities 2

1h

Impedance of bellows and flanges (15'+ 15')

30m

Speaker: Chiara Antuono (Sapienza Università e INFN, Roma I (IT))

ImpBellows_FCCIS_wo...

ImpBellows_FCCIS_wo...

Modelling of the FCC resistive wall impedance (15'+ 15')

30m

Speaker: Dr Ali Rajabi (DESY)

ALi_Rajabi_FCCIS.pdf

ALi_Rajabi_FCCIS.pptx

Thank you very much to all for your help this year
and all the best to you and your families for the new year!