



LHC Injectors Upgrade





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Topics in 2019 and outlook to 2020

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LIU-PS Beam Dynamics Working Group

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Introduction

The LIU-PS beam dynamics working group in numbers

- 13 meetings in 2019
- > 26 presentations
- No new experimental data in 2019
- **But in-depth analysis of run 2 measurements and new simulations**

- **Many thanks to Alexandre and Salim for organizing the meetings and writing minutes!**

2019 topics of LIU-PS BD

Priorities from LIU-PS BD
08/02/2019

- **Analysis of new KFA45 field measurements**
 - ✓ Complete set of measurements before removal from PS ring
 - ✓ Excellent agreement with model
- **Prepare approach for PSB-to-PS transfer line matching after LS2 using turn-by-turn acquisitions:**
 - ✓ Detailed analysis of turn-by-turn measurements with SEM grids
 - Extend BGI to turn-by-turn capability: gas injection systems
- **Emittance blow-up studies**
 - ✓ PSB ejection kickers KFA14 are not the culprit
 - ✓ Studies on PS injection bump closure: potential optimization of bumper magnet currents
- **Analytical and simulation studies**
 - ✓ Pre-LS2 and LIU wire scanners successfully cross-calibrated (all relevant beams)



2019 topics of LIU-PS BD

- **Analysis of data probing sensitivity to WP and role of space-charge in first turns after injection**
- **Space-charge simulation studies to investigate importance at PS injection**
 - ✓ New optics repository: coherence between all users (BE-ABP, BE-OP)
 - ✓ Simulation studies of working point including space charge: benchmark of PyORBIT simulations with measurements
 - ✓ Tracking studies of injection and first turns with space charge

2019 topics of LIU-PS BD

- **Understand impedances sources exciting longitudinal instabilities**
 - ✓ Impedance of pumping manifolds or vacuum valves most likely driving microwave instability
- **Performance predictions for RF upgrades during LS2**
 - ✓ Machine learning to optimize RF manipulations
 - ✓ Predicted effect of Finemet cavity impedance on bunch-by-bunch equality
- **Longitudinal impedance model**
 - ✓ Bumper sections and kickers
 - ✓ Ralentisseur, vacuum valves and pumping ports
 - ✓ BGIs, transverse feedback kicker
 - ✓ Measurements of 80 MHz cavity for modelling

2019 topics of LIU-PS BD

- **Parameter choices for post-LS2 era**
 - ✓ Intermediate flat-top for RF manipulations at 3.08 GeV
- **PS-SPS transfer (in collaboration with SPS)**
 - Next iteration in 2020
- **Ions in PS**
 - ✓ BLongD simulations of microwave instability (~ 1.5 GHz) just after transition very similar to observations: Ions to probe for high-intensity protons
- **LIU equipment beyond beams for LHC**
 - ✓ Loss-less MTE extraction with barrier buckets: BLongD simulations
- **Review and upgrade longitudinal Tomography (not only PS)**
 - ✓ Treated in dedicated ad-hoc meetings: new Python/C++ tomography code



Milestones from LIU Days for 2019 ... and 2020

**LIU-PS BD
21/03/2019**

Aggregation of

- Priority list from first meeting of beam dynamics working group ([link](#))
- Follow-up from LHC Injectors Upgrade Workshop ([link](#))

Extraction of commitments for LIU-PS beam dynamics working group:

Due date	Topic	Responsible
Jun-19	Performance predictions for LS2 RF upgrades	BE-RF (✓)
Jun-19	Longitudinal impedance source identification	BE-RF
Sep-19	Define energy at intermediate plateau for LHC beams	BE-RF
Dec-19	2 GeV injection Space charge simulations to validate tune spread scaling	BE-ABP, ABT
Dec-19	PS microwave instability (ions)	BE-RF, BE-ABP
Dec-19	Longitudinal instability simulations / benchmarking	BE-RF
Dec-19	Investigate horizontal blow-up with large longitudinal emittance	BE-ABP, TE-ABT
Dec-19	Flat top horizontal instabilities (e-cloud)	BE-ABP, RF
Jun-20	Review longitudinal parameters at PS-SPS transfer (coordination)	BE-RF
Jun-20	Longitudinal instabilities with small longitudinal emittance (PS-SPS transfer)	BE-RF

→ Follow-up and complete ongoing studies + input from Montreux 2020

→ First beam data by next year's end-of-year presentation



Seasons Greetings

Merry
Christmas



Many thanks and see you soon in 2020!





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THANK YOU FOR YOUR ATTENTION!

