



## LHC Injectors Upgrade

# SPS: overview, LS1 shutdown work, and perspectives

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on behalf of the LIU-SPS team, who are too numerous to mention individually!



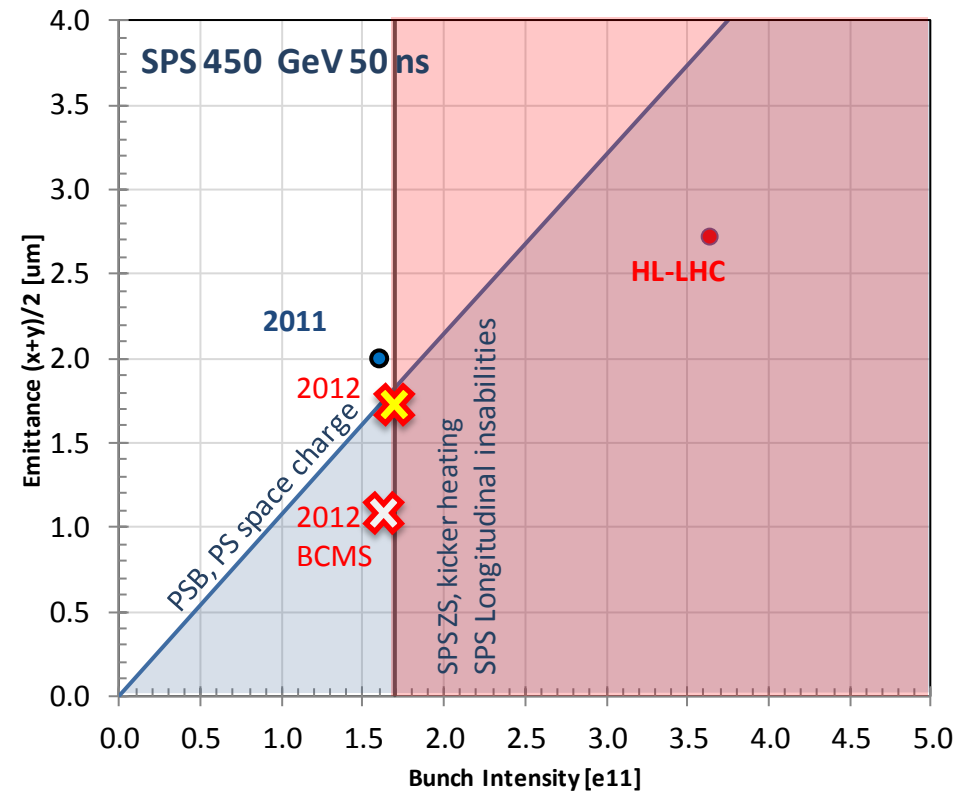
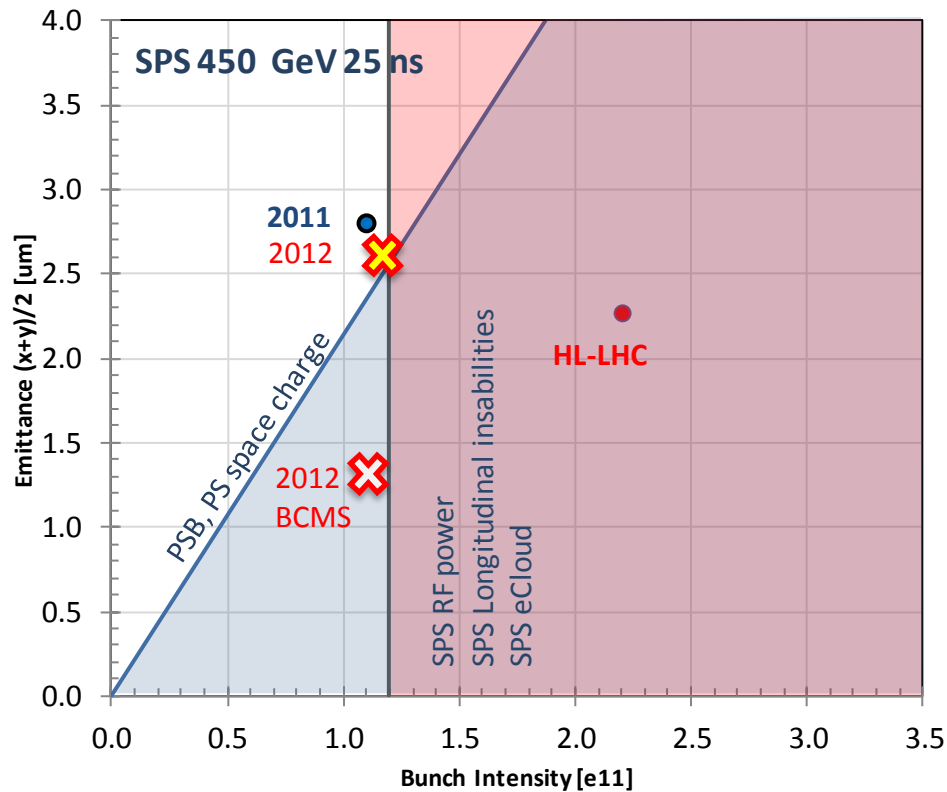
# Contents

- Reminder of the challenges for SPS
- Baseline and outcome of recent reviews
- LS1 activities and changes for LHC Run 2
- Key decisions to be made



# Extracted from SPS

- Requirement: taking into account LHC losses and blowup
  - $2.2 \times 10^{11}$  p+/b in  $2.3 \mu\text{m}$  at 25 ns
  - $3.6 \times 10^{11}$  p+/b in  $2.7 \mu\text{m}$  at 50 ns





# Planned baseline upgrades

- Double the power of **200 MHz RF** system (LSS3, BA/BB3);
- Power and low-level control upgrade of **800 MHz RF** system
- Electron cloud mitigation – in-situ **aC coating** of all dipole and quadrupole vacuum chambers *if needed*;
- Deployment of **low gamma-transition** “Q20” optics (done)
- Major Improvement of **beam size, orbit and loss monitoring**, plus other new or upgraded BI systems;
- Upgraded **transverse damper** electronics and new pickups;
- New **High Bandwidth transverse feedback** system;
- Upgraded **passive protection devices** in extractions and TI2/TI8;
- Improved **vacuum sectorisation** – arcs and near critical equipment;
- Complete **impedance reduction** of MKE and dump kickers;
- Upgrade of **magnet interlocking** systems;



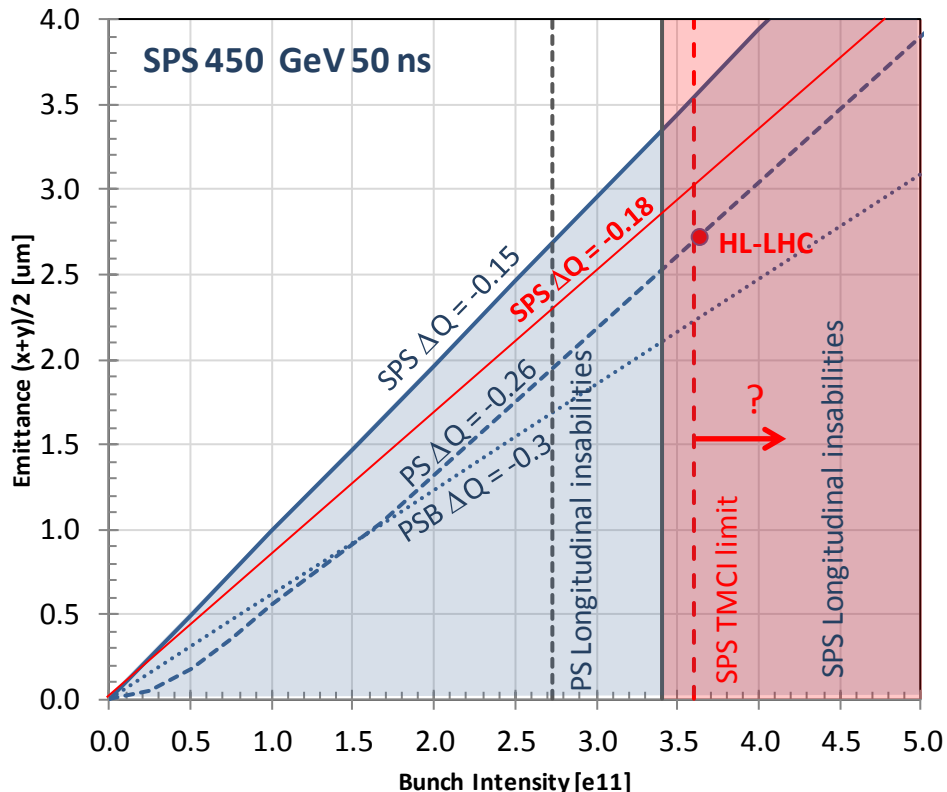
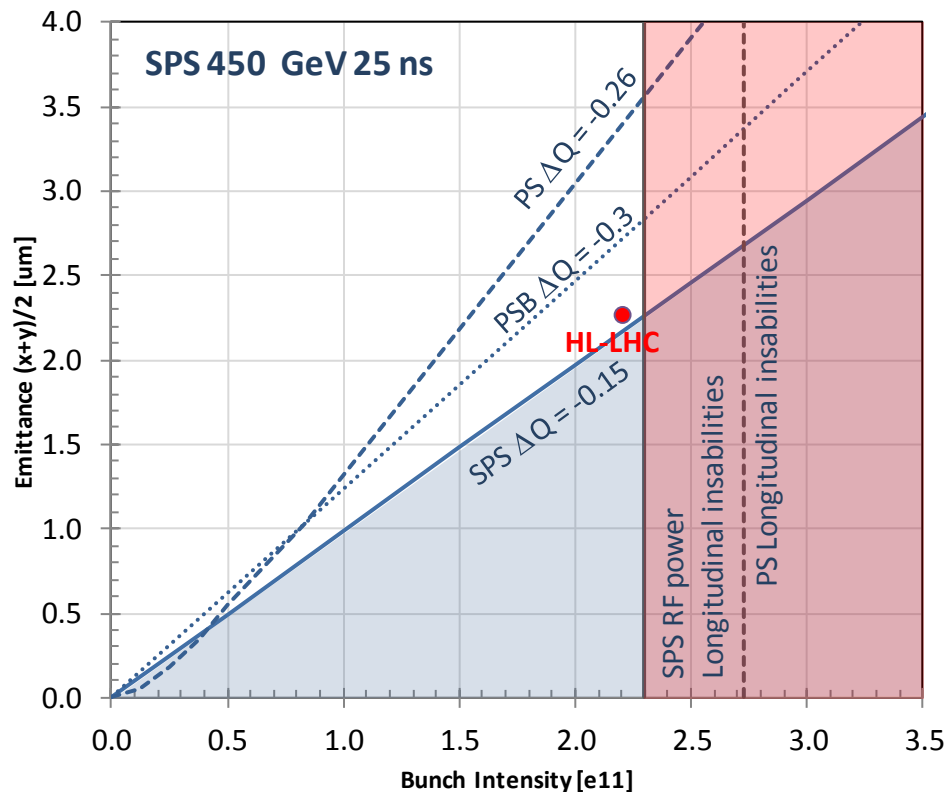
# Reviewed upgrade options

- New transverse beam **tail scraper** system
  - 21/01/2013 Review : keep present system, finish magnetic bump scraper TDR
- Improvements or replacement of **beam dump** system
  - 07/02/2013 Review : urgent to propose TIDVG block upgrade, also study external dump on existing beamline
- New **low-impedance extraction kickers**
  - 19/03/2013 Review : present MKE kickers should be acceptable, investigate reducing number installed. Investigate MKP heating
- Improved **electrostatic septa**
  - 12/03/2013 Review : improvements in circuit to prototype
- New **high energy orbit correction** system
  - 08/02/2013 Review : new HW not needed, study using existing bumpers for high energy correction
- New **faster injection kickers** (for ions) – to organise
- New **collimation system** – to organise



# Expected situation after upgrade

- If all upgrades work as planned, **SPS machine** well matched to requirements
  - SPS should not be a limit for 25 ns beam for HL-LHC
  - Need to push  $\Delta Q_v$  above present -0.18 (2012) towards -0.2 for 50 ns beam





# LIU-SPS LS1 work - I

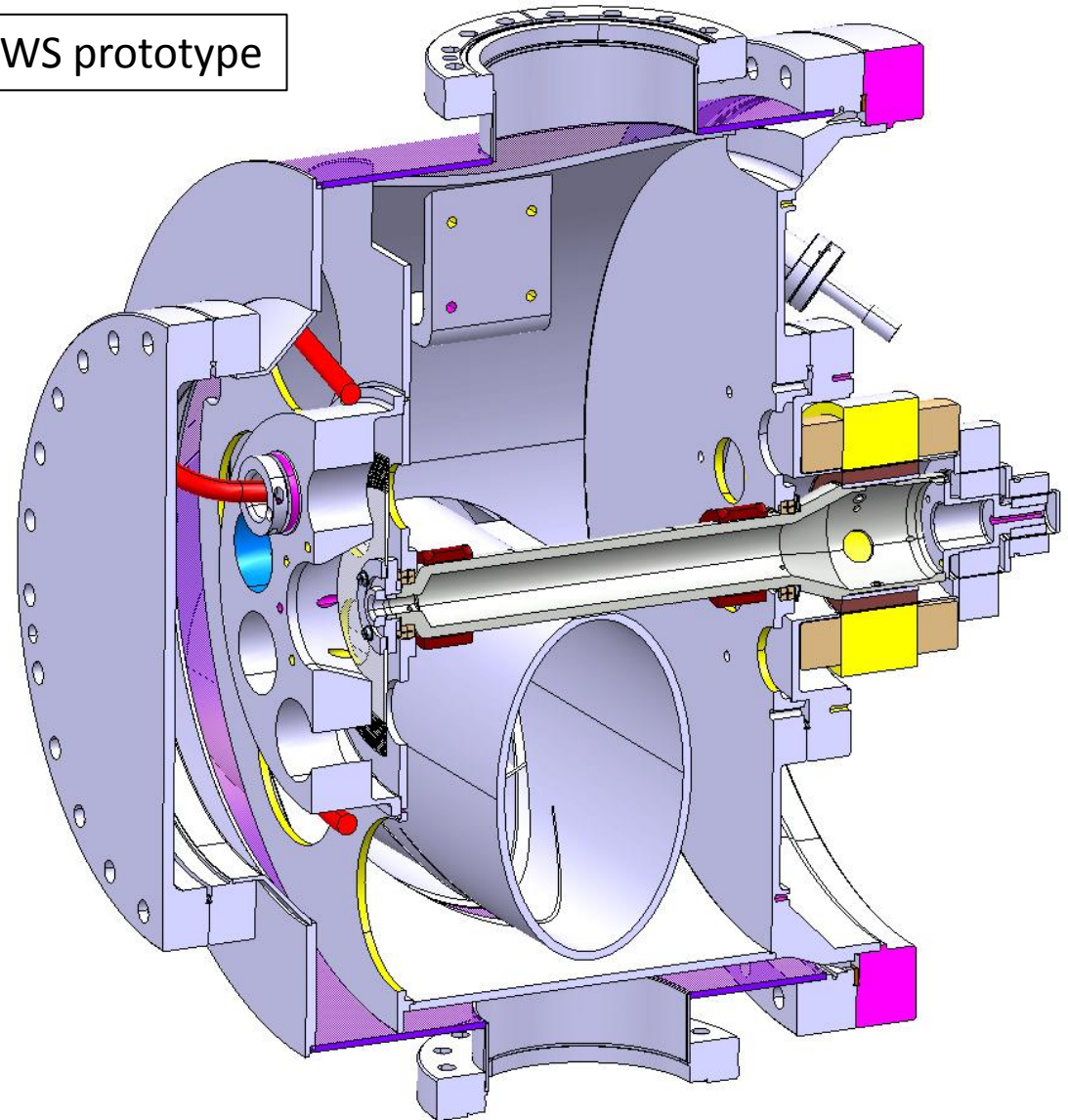
- Finish **800 MHz** power and low-level control upgrade
- Improve **Vacuum sectorisation** in LSS1, around TIDVG and MKDV/H
- Impedance shielding of **MKQH/V and MKDV**
- Installation of final **serigraphed MKE** in LSS4
- Configuration of MDHD.11832 for **injection dogleg correction**
- Deploy **aC coating** on additional 12 dipoles and 4 quadrupoles in LSS5 (to give 4 complete half-cells)
- New **transverse damper** pickups, plus upgrade of low-level
- Installation of cables, kicker and pickups for **high bandwidth damper**
- Preparation in LSS3 for **200 MHz upgrade**
- **Re-alignment** of sextant 5-6
- Upgrade of **magnet interlocking** system (WIC)



# LIU-SPS LS1 work – II (BI)

- DC BCTs: **new BCT** i
- Fast Ring BCT: inves
- Fast BLMs: **new ele**
- Orbit and trajectory
  - **Separate pick-ups** f
  - BA5 equipped with
  - Radiation (electron
- BSRT: upgrade dete
- BGI: upgrade detec
- Tune: **new electron**
- BWS:
  - Remaining scanner
  - Detector **prototype**

BWS prototype







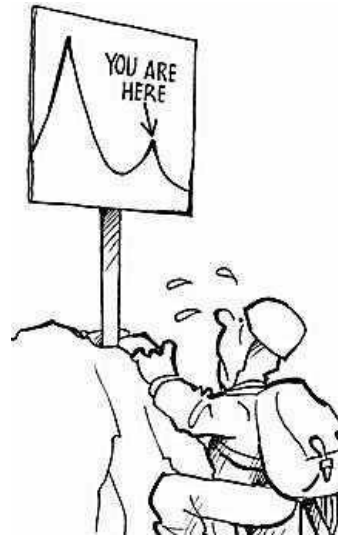
# Key decisions still to be made

- aC coating or scrubbing?
  - Needs experience in scrubbing after LS1
- 50 ns rise time ion injection kicker system?
  - Aperture, impedance, cost
- Reduce number of MKE to help long. stability?
  - Studies needed, and beam tests



# Conclusions

- Huge progress has been made in the past years
- A lot of interesting work is still ahead of us!



- Thanks to **all the teams**, for the excellent results and great collaboration