

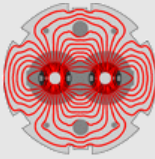
# Session 6 – Systems Operational Performance

*Tune and Orbit Feedbacks Performances: A User Perspective;*  
Laurette Ponce

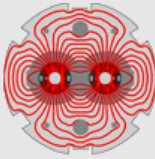
*Beam Instrumentation Performance Overview;* Mariusz Sapinski

*LHC RF 2011 and beyond...;* Philippe Baudrenghien

Reyes Alemany Fernandez, Eva Barbara Holzer



- Measure I: Keep the threshold at 2 V till 100 A
  - $\pm 2V$ ,  $t_{\text{EVAL}} = 190 \text{ ms}$ ,  $||| < 100 \text{ A}$
  - $\pm 100 \text{ mV}$ ,  $t_{\text{EVAL}} = 190 \text{ ms}$ ,  $100 \text{ A} \leq ||| \leq 200 \text{ A}$ ,  $|I_{\text{MAX}}| \leq 200 \text{ A}$
  - Should avoid problem for 2012 (But still not enough for higher energy)
- Measure II: Reduce tune FB response bandwidth (factor 5)
  - To be tested with protons (after FF?)
  - High gain was motivated by initial specification of keeping  $dQ < 0.001$   
 $\Rightarrow$  could it be relaxed?
- Possibility III: (Auto-)Switch off tune FB (when instability detected)
  - Understand/Solve problem with H orbit FB



## ➤ Mitigation Tune Measurement:

### ➤ Saturation problem:

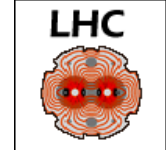
- Adapt dynamic range for higher bunch intensities  
=> should not be a problem anymore for 2012 run

### ➤ ADT vs BBQ:

- CHIRP could be used to enhance the tune peak
- Other mean for tune measurement :
  - ADT signal for Q measurement
  - Gating of ADT (tested) **and** BBQ (to be implemented)
- More set-up time to study compatible settings for ADT and BBQ

## ➤ Mitigation Orbit excursion during squeeze (matchpoints):

- 1 Squeeze with high gain and low intensity
- Apply FF based on the high gain test
- If successful, operate the OFB with lower gain for high intensity



# BPM

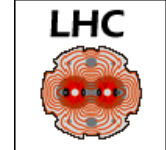
## BPM calibration

*Should be done **JUST BEFORE** injection (it takes < 10 min).*

## Interlock BPMs in IP6, possible action

Remove 4dB attenuators from stripline BPMs

- Will decrease  $3e10$  threshold to  $\sim 2e10$
- May give more spurious triggers at high bunch intensity (cable reflections)
- *What is the upper limit for single bunch intensity in 2012?*



# BI asks for:

## Beam commissioning time for:

- Calibration of **BSRT** at 450GeV & 4TeV
- Calibration of **BGI** from 450GeV to 4TeV
- Systematic study of **LSS BPM** accuracy & linearity
- Study of various scenarios for mitigating interplay of **Tune feedback & Damper**

## Designation of OP responsible for the following GUIs:

- Improved **WS** GUI including automated scan possibility
- **BSRT** bunch by bunch control & display
- More advances **BGI** GUI
- **LDM** GUI

## RF ongoing studies

**longitudinal  
blow-up** →  
essential

Investigating **more gentle technics** that would **reduce the HF part** of the beam spectrum and make it even more versatile, **allowing its use at constant energy (batch per batch blow-up at injection** for example to reduce IBS effects during filling - smaller longitudinal emittance is expected from the SPS with low  $\gamma_t$  optic)

**Decide on:** bunch length compromise between good beam lifetime in physics and heating problems. Propose a few physics fills with different lengths at beginning 2012

## RF potential issues

Current status	Potential issue with 25ns	Action
Increased capture voltage, Injection Gap Cleaning, and the shielding → filling has been much easier in 2011 ... but	<b>Injection losses will come back with 25 ns</b> operation as the SPS parameters vary more along the batch	<b>Longitudinal damper will be commissioned in 2012</b>
25 ns operation → present RF system can (likely) do with nominal intensity	<b>If intensity above nominal</b> with 25ns → <b>work on the LLRF required + careful studies of the effects of a trip on the major RF components</b>	<b>Important to start before LS1</b>

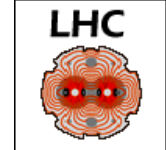
**RF commissioning/MD time is needed!**



SPARE



# Summary: perspective for 2012



- **BPM:**
  - LSS BPMs should be more reliable (needs commissioning time for checks)
  - Automatic filter selection - improved orbit position resolution (1  $\mu\text{m}$ )
  - Temperature dependence still there
- **LDM:**
  - Fully automatic & improved fixed display
- **Wire scanner**
  - Automatic gain/filter setting
- **BSRT:**
  - 20 times faster bunch-by-bunch measurement
  - better accuracy (will require further MDs in 2012 to improve this)
- **BGI**
  - independent continuous emittance measurement
- **Shottky**
  - bunch-by-bunch tune



## RF improvements in 2011

capture voltage	3.5 MV → 6 MV	+Injection Gap Cleaning (reduces capture losses) → <b>0.5 % loss from injection to 3.5 TeV</b>
voltage in physics	8 MV → 12 MV	Provides a larger longitudinal emittance (@kte $\sigma_z$ ) → <b>reduces transverse emittance growth due to IBS</b>
$\epsilon_z$ blow-up	$\sigma_z$ (1.2 ns → 1.25 ns)	<b>@3.5 TeV → <math>\epsilon_z = 1.9</math> eVs in a 4.7 eVs bucket</b>
One Turn Feedback	Commissioned for all cavities	Reduces the transient beam loading <b>to less than 0.5 degree pk-pk</b> @ 400 MHz with 2100 bunches, 1E11 p/b
(5) debunching “incidents” during physics	All understood	<b>Corrections put in place where appropriate</b>

## RF hardware upgrades for LS1

Problem	Action
<u>Cav3B2</u> → Field emission in this cavity is believed to cause the HOM problems in the adjacent 2B2 and 4B2	<b>Module 1B1 will be replaced</b>
<u>Klystron heaters</u> (equipment recuperated from LEP)	<b>Upgrade is under study</b>