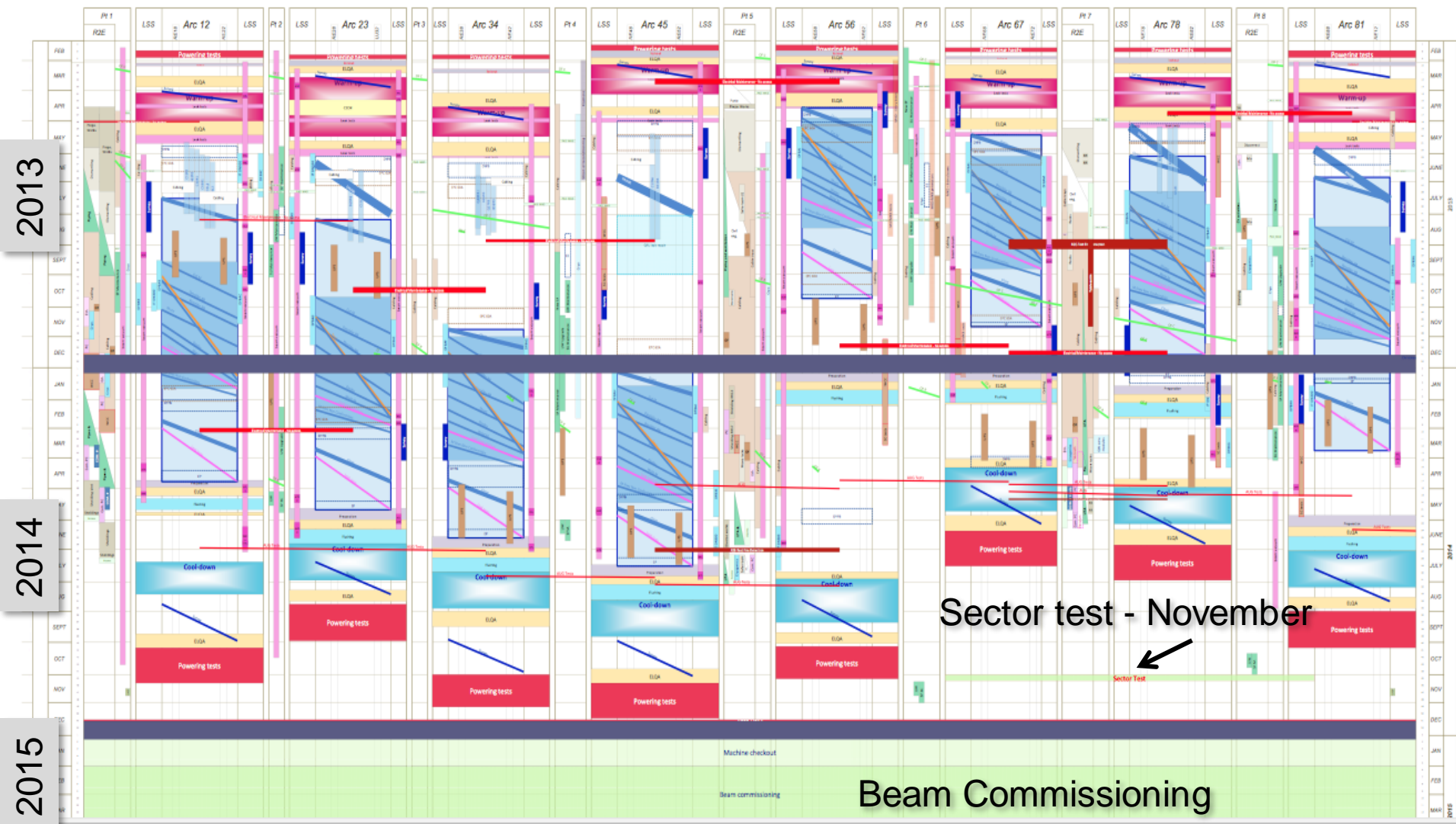


Outline of 2014/2015 plans

V. Kain, M. Lamont, J. Wenninger

Current LS1 Planning



Sector test - November



Beam Commissioning

Sequence of Preparation for Physics post LS1

1. Individual System Tests + Powering Tests
 2. Dry Runs
 3. Sector Test
 4. Machine Check-out
 5. Beam Commissioning
-

Preliminary Planning

	Month	Activity
2014	Jan	
	Feb	
	Mar	LBDS
	Apr	Dry Run
	May	Dry Run
	June	Dry Run
	July	Dry Run
	Aug	Dry Run
	Sept	Dry Run
	Oct	Dry Run
	Nov	Sector Test
	Dec	Settings
2015	Jan	Check-out
	Feb	Beam comm.
	Mar	Beam comm.

LBDS reliability
run: 3 months from
1st of March

From April:

Every 2nd week: dry run

October:

Every week: dry run +
sector test preparation

Beginning of Nov:

Sector Test

January:

Machine Check-Out

Feb + Mar:

Beam Commissioning

A propos Dry Runs

- ❑ Each dry run block will be dedicated to one or several topics
 - E.g. LHC injection, timing stress test, handshakes,...
- ❑ All interfaces required to test a certain system need to be 'operational' for the dry run; **fake input and test modes have to be foreseen → extra work**
 - E.g. beam dump:
 - Local Beam Permit Loop with frequency generators....
 - Energy simulated via BETS Sim
 - Arming sequences and sequencer operational
- ❑ A dry run hypercycle will be needed from day one:
 - Ramp with momentum and optics required (e.g. 6.5 TeV)
 - LSA functionality tested in parallel (optics upload, settings generation, knob generation) – measured optics
 - LSA needs to operational from February 2014

Dry Run Blocks

Not in chronological order:

- ❑ **Beam Dump:** local BIS loop + application, arming sequence, BETS simulator
- ❑ **Timing:** stress test
- ❑ **BI + AC D+ MKQ/A + feedbacks:** sequencer tasks, applications, logging, concentrators
- ❑ **Injection:** timing, sequencer, MKI, applications, IQC (BI), synchronization/re-phasing
- ❑ **BIS + SIS + SMP:** sequences, flag generation SPS, forcing,...
- ❑ **Collimators + TCDQ + roman pots:** applications, settings, MPS tests, sequencer tasks, logging, roman pots (simulated energy and β^*)
- ❑ **ADT+ RF+ ADT pickups:** sequencer tasks, settings, MCS checks
- ❑ **Experiments:** handshakes, beam modes, injection inhibits
- ❑ **Power converters:** test “prepare circuits” sequence tasks, sinusoidal excitation, PGCs
- ❑ **PM, XPOC**

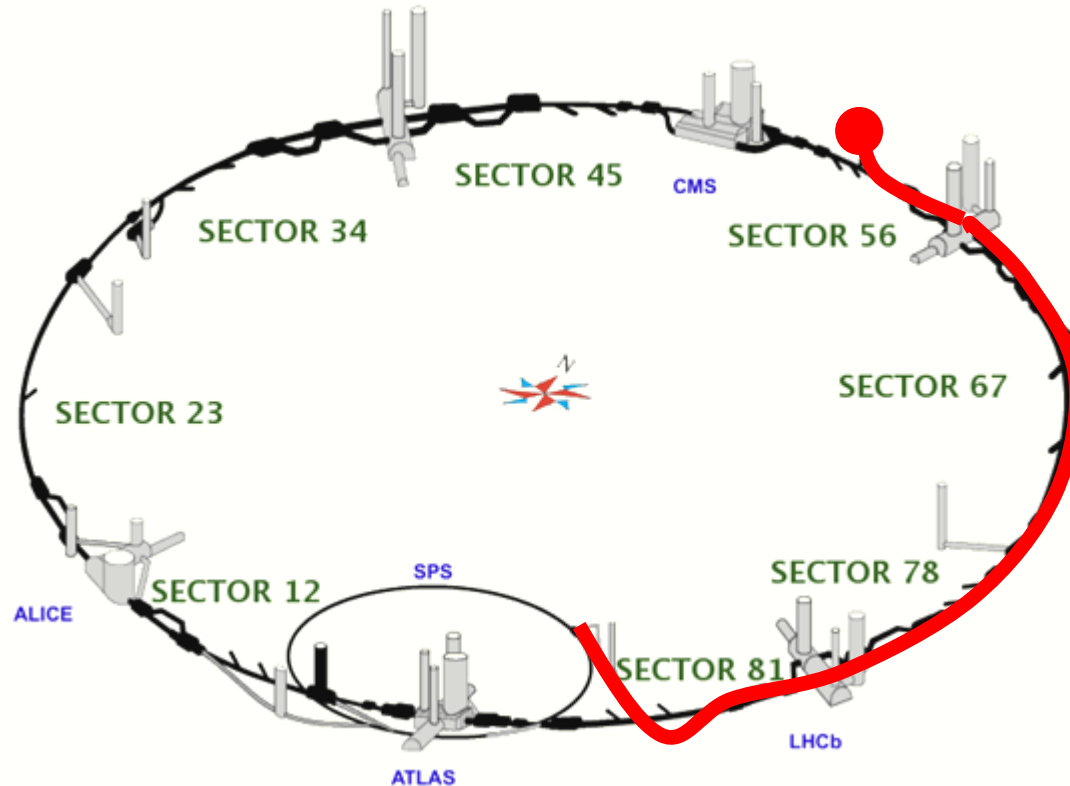
**SECTOR TEST –
NOVEMBER 2014**

Sector Test – Beginning of November 2014

- ❑ Full blown integration test
- ❑ Important first milestone and first debugging after repair and upgrade – beam is the best check

Plan:

- ❑ Beam 2: S78 + S67
- ❑ Final goal: switch on beam dump, inject & dump on first turn



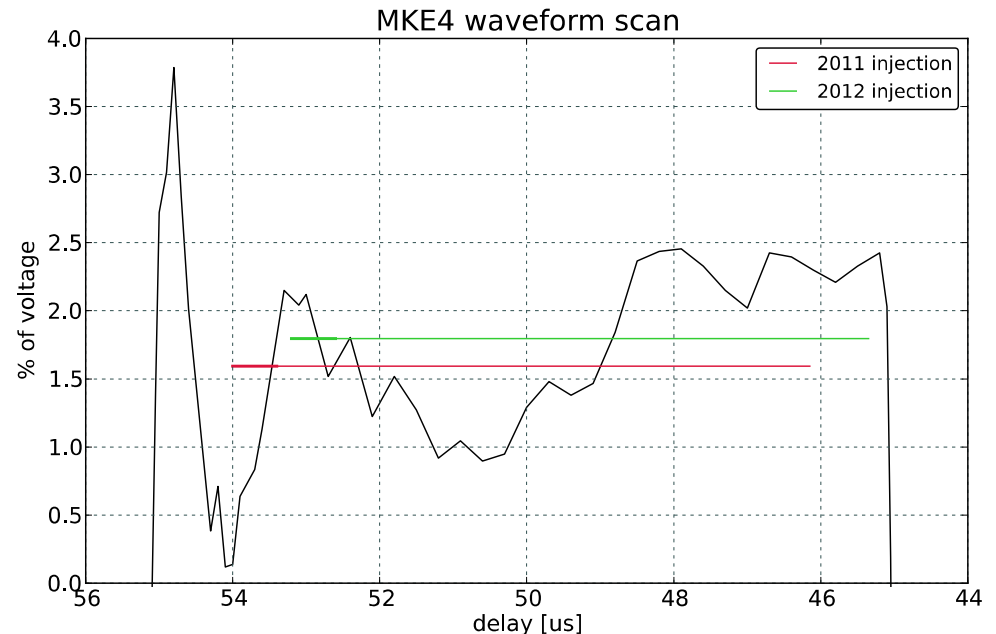
Required Readiness for Sector Test

- ❑ LHC pilot in injectors – **SPS extraction commissioned**; beam on TT40 TED
- ❑ **Optics** for transfer line + arc **uploaded**
- ❑ **Sequence** – “prepare LHC for injection” operational
- ❑ **LHC injection** fully operational (controls + equipment):
 - **MKI will be difficult to test**
- ❑ **BI** (FIFO BPMs, screens, BLMs, BCT in dump line) operational;
- ❑ **TDI, TCDs, collimators** in point 6,7 operational
- ❑ BETS Sim set to **450 GeV**
- ❑ **Beam dump connected to BIS loop** (only required inputs enabled) and tested
- ❑ **Power converters** uncondemned. Injection settings for required power converters + MSI; “flat orbit”
- ❑ TEDs and access system tested, machine closed.
- ❑ **Experiments injection handshake**

Sector Test - Measurements

- ❑ Synchronization MKI, Beam dump
- ❑ Threading
- ❑ Dispersion measurement on injected beam – dispersion matching
- ❑ Kick response – BPM, corrector polarity; linear optics
- ❑ Aperture measurements – injection region – arc
- ❑ Check reproducibility after pre-cycle to 6.5 (?) TeV – if used sectors are fully commissioned

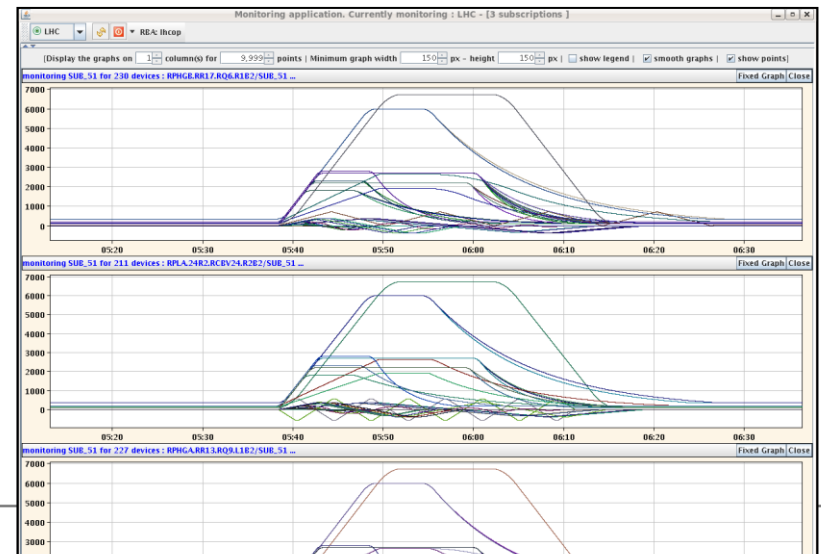
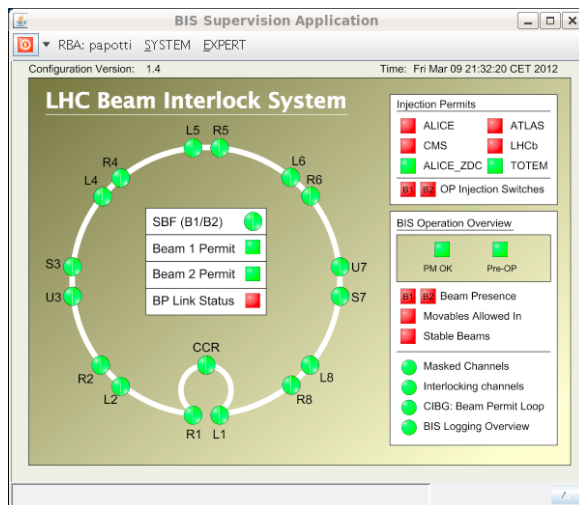
- ❑ MSI hysteresis check
- ❑ Transfer line stability
- ❑ MKE4 waveform scan
- ❑ Automatic TCDI setup



MACHINE CHECK-OUT – JANUARY 2015

Machine Check-Out: Goals

- ❑ **Heat Run**
- ❑ **All circuits ready**; test “final” functions, Energy Tracking Tests
- ❑ Final **MPS and equipment to BIS** user input tests: e.g. vacuum valves, collimators (+ roman pots), FMCs,...
- ❑ **Close beam permit loop** with all User inputs connected = no access, all circuits OK, BLMs operational, vacuum valves open
- ❑ Final tests of **beam dump with permit loop**
- ❑ Test **injection kickers**: real conditions
- ❑ **Run the LHC through full cycle** including all equipment (RF,...)



BEAM

Beam Commissioning Strategy

2012: Beam commissioning with intensity ramp-up took ~ 1 month

14th of March 2012

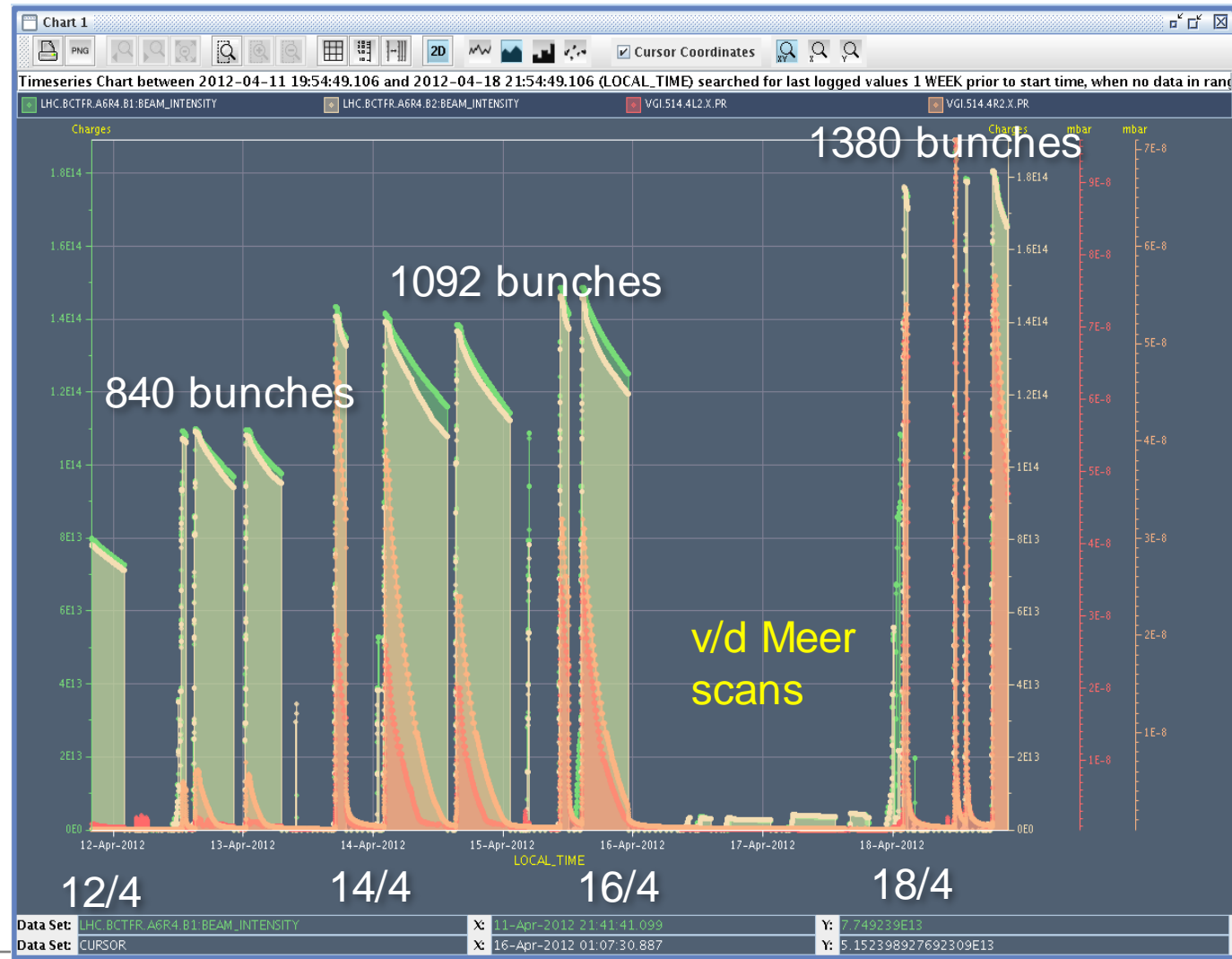
First beam

5th of April 2012

First stable beams
Start of intensity ramp-up

18th of April 2012

1380 bunches:
Intensity ramp-up
completed



Beam Commissioning Strategy

- ❑ After LS1: in depth re-commissioning of all machine aspects, especially machine protection system → allocate 2 months of beam commissioning until first stable beams
- ❑ Otherwise follow strategy of 2012

- ❑ Not discussed in the following:
 - possible additional time needed for β^* leveling or colliding squeeze tests
 - possible additional time needed for combined ramp and squeeze
 - details of machine protection qualification tests and individual system commissioning with beam

Beginning of February 2015

Initial Beam commissioning
~2 months

First stable beams at 6.5 TeV
low number of INDIVs

Scrubbing for 50 ns
(50 & 25 ns)
~7 days

Scrubbing for 25 ns

Phased intensity increase to
pile-up limit
~1 to 2 months

25ns physics
(intensity ramp up and
further scrubbing)

50 ns operation

The way of the devil
(levelled 50 ns)

Scrubbing for 25 ns

M. Lamont

INITIAL BEAM COMMISSIONING – FIRST 2 MONTHS

Commissioning at 450 GeV

First
injections
to circulating
beam

- **Threading** on collimators → close turn
Rough tune and chromaticity adjustment
- **RF capture**
- **Initial BI setup**
Phasing in BPMs, lifetime measurement; correct tunes, chromaticity

Collimators at rough settings to close phase space

- **β - and dispersion** measurement + correction
- **BPM and corrector polarity checks; scaling**
- Flat orbit reference – pilot

Nominal
bunch - orbit

- **Flat orbit reference - nominal bunch**
- **RF, BI and damper setting up** with nominal bunch
- **Collimators** in 3 and 7, **TCDQ setting up** at 450 GeV

Measurements
at 450 GeV

- Pilot: **aperture measurement** @ 450 GeV
- Pilot: **beam dump** checks
Orbit (interlocked BPMs), aperture, sweep form
- Pre-cycle and **decay measurements** at injection; switch on FiDel
- **K-modulation** at strategic locations

Commission Ramp & Squeeze, crossing/separation bumps

First ramp & squeeze

- Pilot: **commission feedback**: tune, orbit and radial
- Pilot: **commission ramp** with feedback
Continuous chromaticity measurement
- Pilot: **optics measurement** and correction during ramp/flattop
Turn-by-turn, k-modulation
- Pilot: **squeeze in steps**, correct optics, flat orbit
Coupling, chromaticity, incorporation
- Nominal (8×10^{10}): RF commission **longitudinal blow-up**
TCPs closing during ramp

Orbit with crossing and separation bumps

- Nominal: **reference orbit @ 450 GeV with crossing angles, separation bumps**
Experimental magnets on
- Nominal: collimation setup @ 450 GeV – **TCTs**

Ramp and squeeze with bumps aperture

- Nominal: **ramp for OFB** with dynamic reference change
- Pilot: **squeeze in steps; orbit feedback with bumps**, optics checks
Orbit feed forward, eventually squeeze in one go
- Pilot: **aperture check @ 6.5 TeV and @ minimum β^***
- Pilot: **measure β^* and β** at other locations with **k-modulation**

Towards nominal conditions; collisions

Collimator/
protection
device setup

Nominal: **collimation setup at flattop**
Nominal: ramp with final **collimator ramp function**
Pilot/nominal: **injection protection setup**
Transfer lines, injection region
Nominal: **collimation setup after squeeze** (TCTs+TCLs)

Loss maps

Nominal: **loss maps, asynchronous dump tests** at:
450 GeV
450 GeV + injection protection
at flattop (during ramp)
after squeeze

Collisions

Nominal: **collide** 2-3 nominal bunches, **set up TCTs**
Coarse TCT settings to start with, RF cogging adjusted with BPTX
Nominal: **loss maps, asynchronous dump** tests in collision

Trains and Intensity Ramp-up

Stable
beams

Last qualification tests for **stable beams**
Polishing sequences, settings

----- End of March 2015

Trains
Intensity ↑

- 25/50 ns trains: **BI, RF, ADT, injection setup**
- 25/50 ns trains: **scrubbing**
- 25/50 ns trains: **intensity ramp-up**

Summary

- ❑ LHC Dry Runs will start in March 2014
- ❑ A Sector Test is planned for beginning of November 2014

- ❑ The current planning foresees one month of machine check-out (January 2015)

- ❑ 2 months are allocated for the initial beam commissioning to first stable beams
- ❑ The commissioning strategy will follow the mature commissioning approach of the startup in 2012
 - Additional tests and time will be allocated for in depth re-commissioning of individual system and machine protection re-commissioning
- ❑ Details to cover combined ramp and squeeze and/or β^* leveling have to be worked out
 -if these scenarios become base line