



# The LHC Status / schedule

Jos Engelen

WLCG Collaboration Workshop – CERN, April 21 – 25, 2008



7 + 7 TeV p p collisions at  $10^{34} \text{ cm}^{-2}\text{s}^{-1}$

1148 + 1148 TeV Pb Pb collisions at  $\sim 10^{28} \text{ cm}^{-2}\text{s}^{-1}$

ATLAS, CMS – ‘general purpose’ detectors

LHCb – optimized for B physics/CP violation studies

ALICE – optimized for heavy ion physics

TOTEM – precision measurement of total cross section  
(and more)

LHCf – measurement of forward photon,  $\pi^0$  production

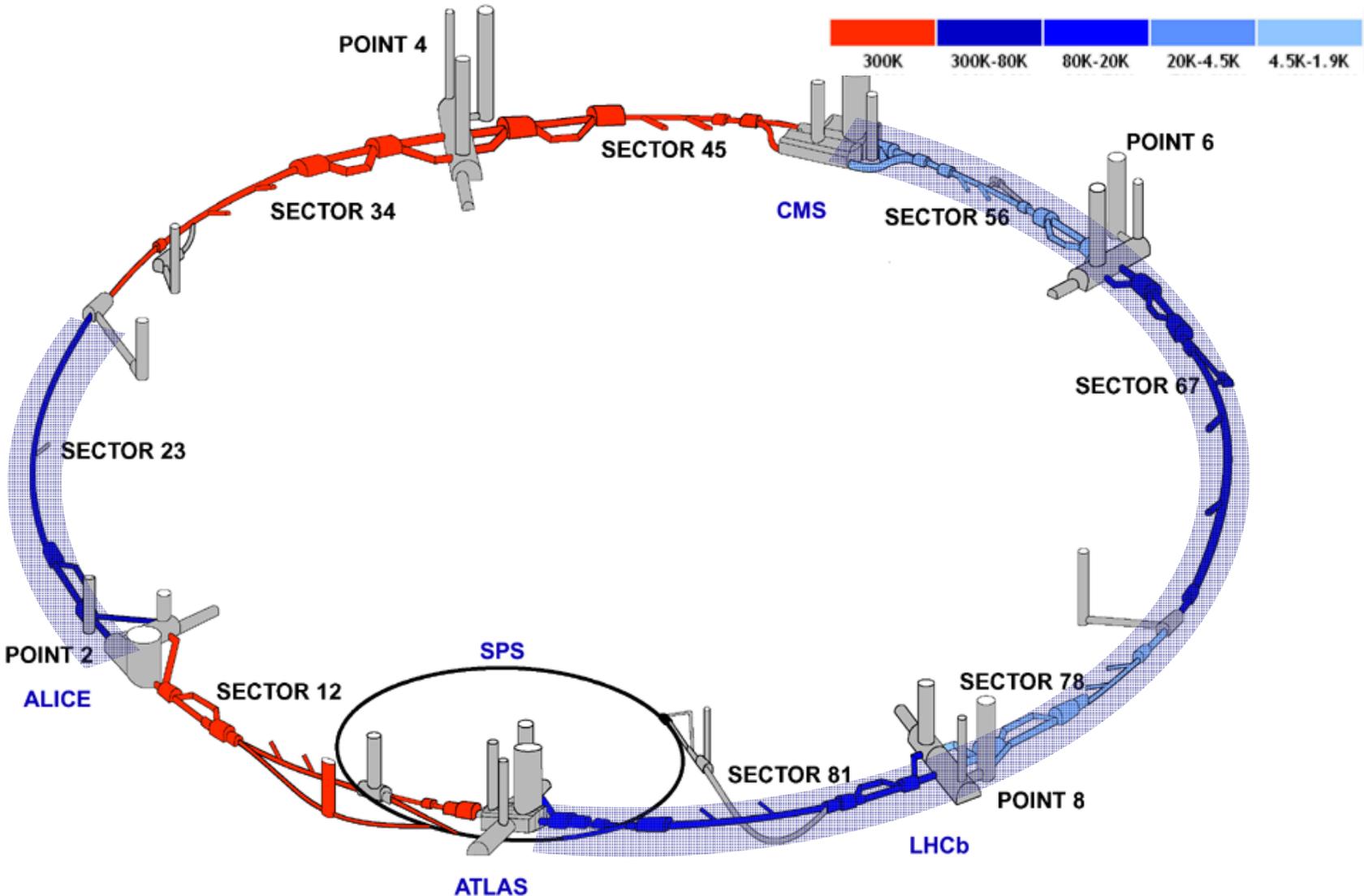


The accelerator has entered the phase of final cooldown  
-it is planned to be cold (1.9K) by the second half of June  
-hardware commissioning (powering the magnets, testing the quench protection system, etc., etc.) is ongoing  
(2 out of the 8 sectors are presently cold)

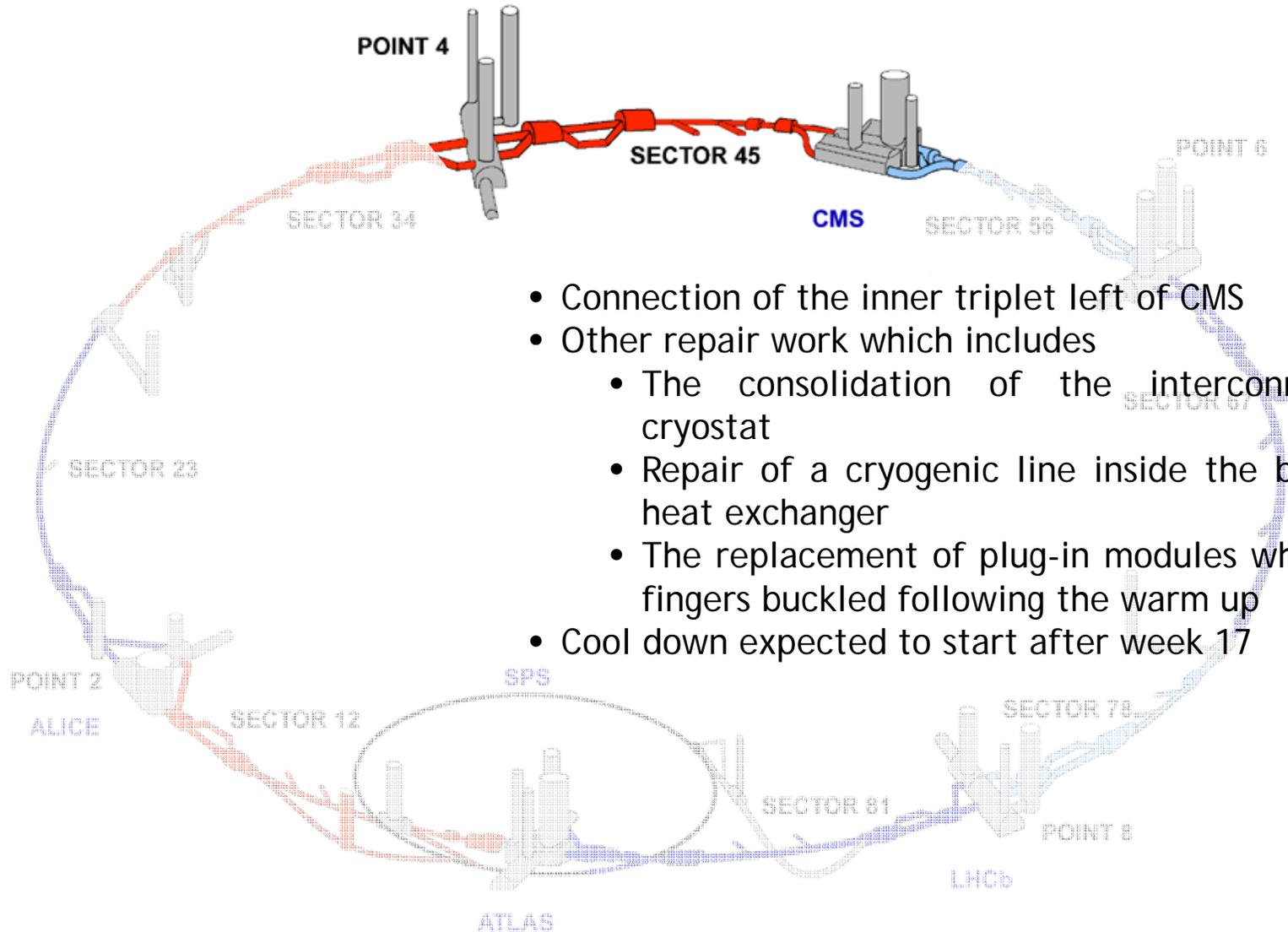
The experiments will have to be closed and ready by the end of June.

Schedule to be confirmed by the end of April

# Status of the LHC

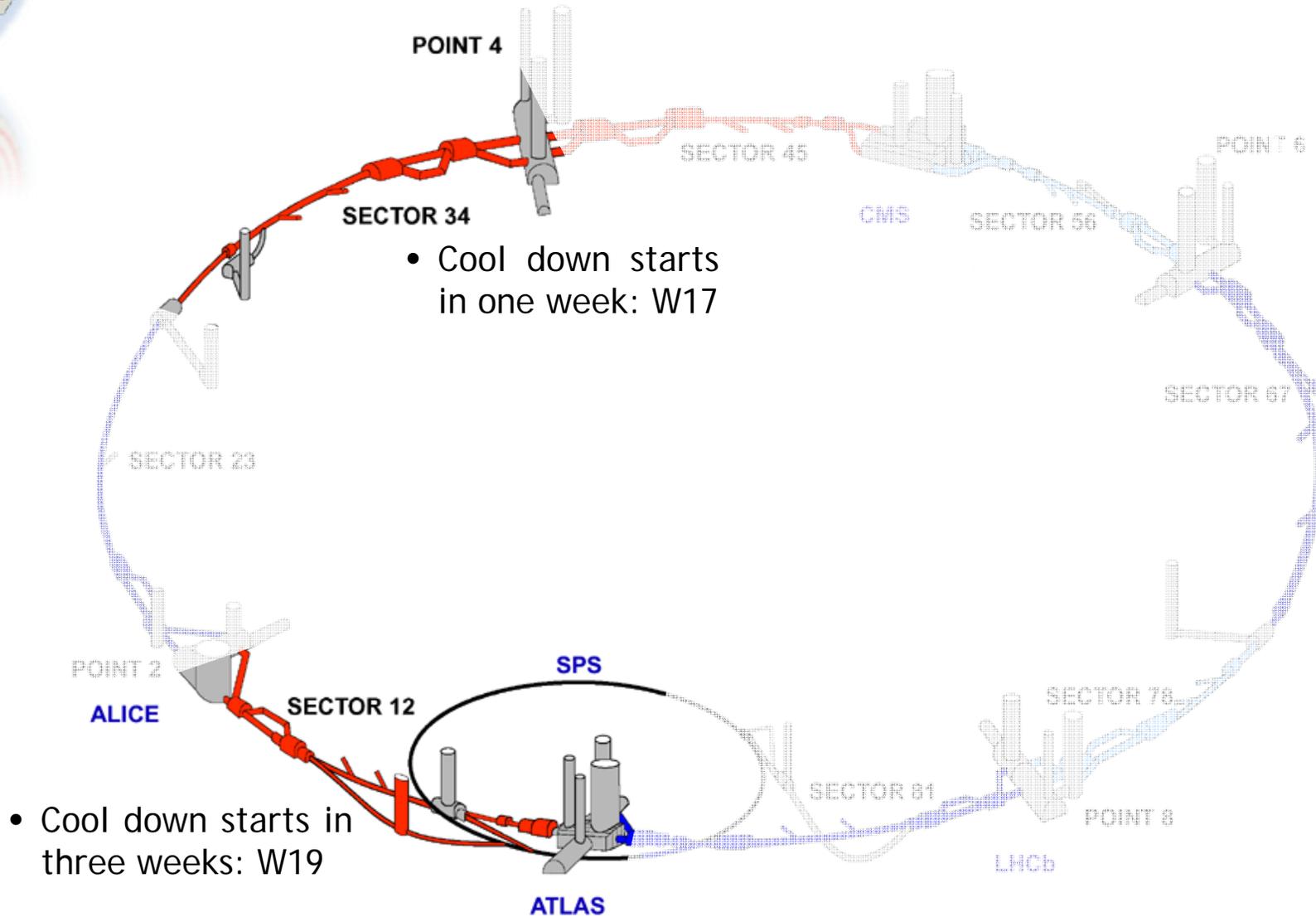


# Consolidation



- Connection of the inner triplet left of CMS
- Other repair work which includes
  - The consolidation of the interconnection cryostat
  - Repair of a cryogenic line inside the bayonet heat exchanger
  - The replacement of plug-in modules where RF fingers buckled following the warm up
- Cool down expected to start after week 17

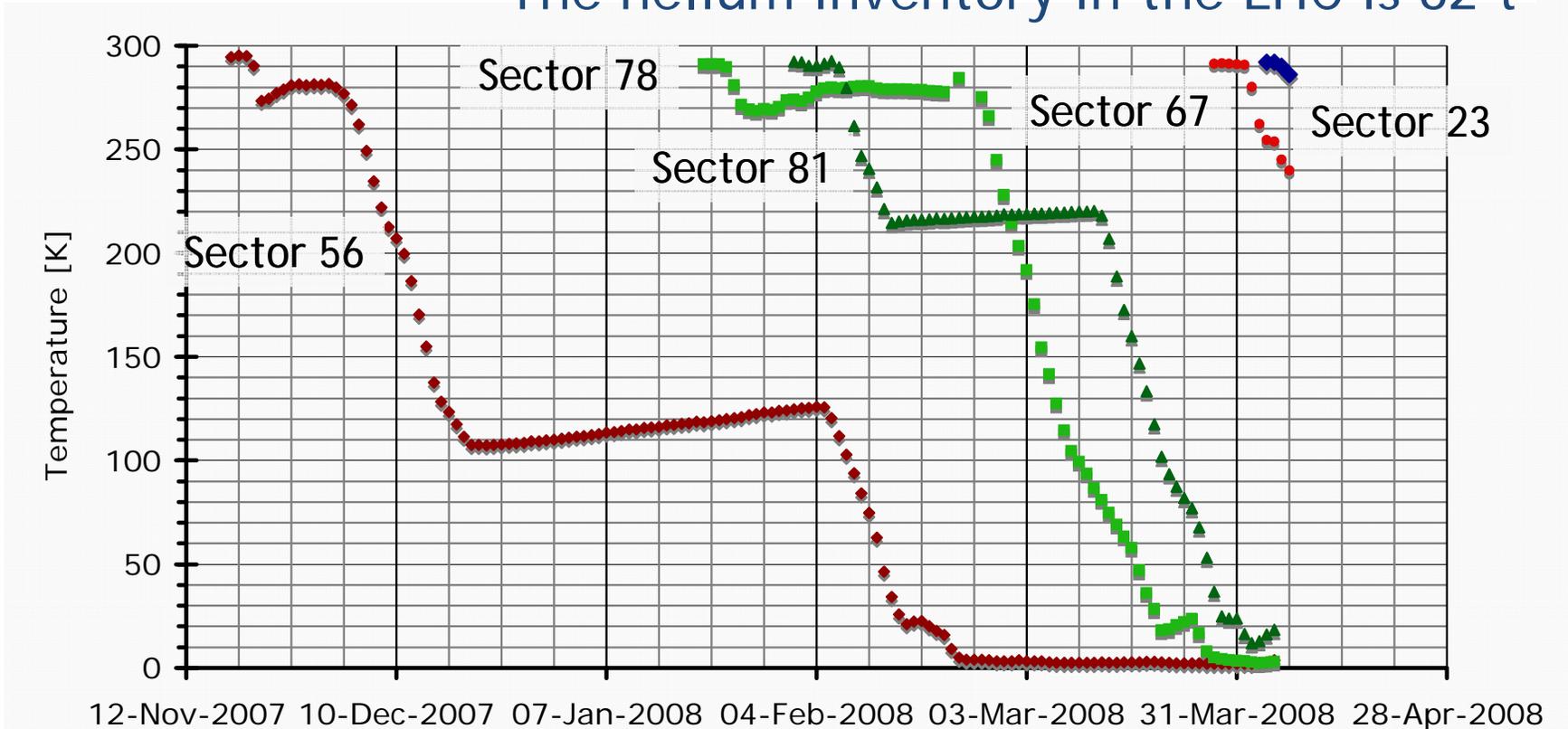
# Preparation for Cool down





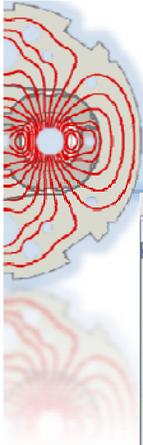
# The latest cool downs

Presently two sectors are below 2K  
The helium inventory in the LHC is 62 t

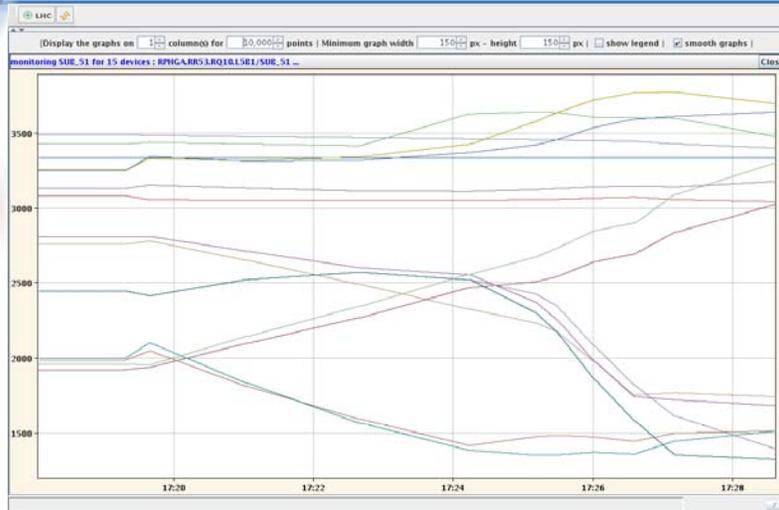


**6 weeks** to cool down from 300 to 2K +  
**3 weeks** for stabilization at 2K

Courtesy S.Claudet



# Software for operation, controls and diagnostics

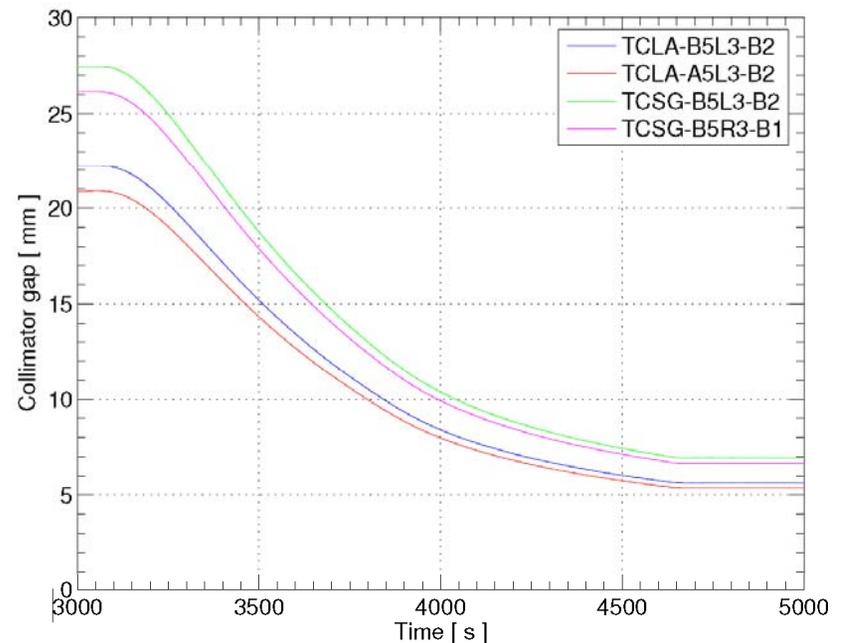


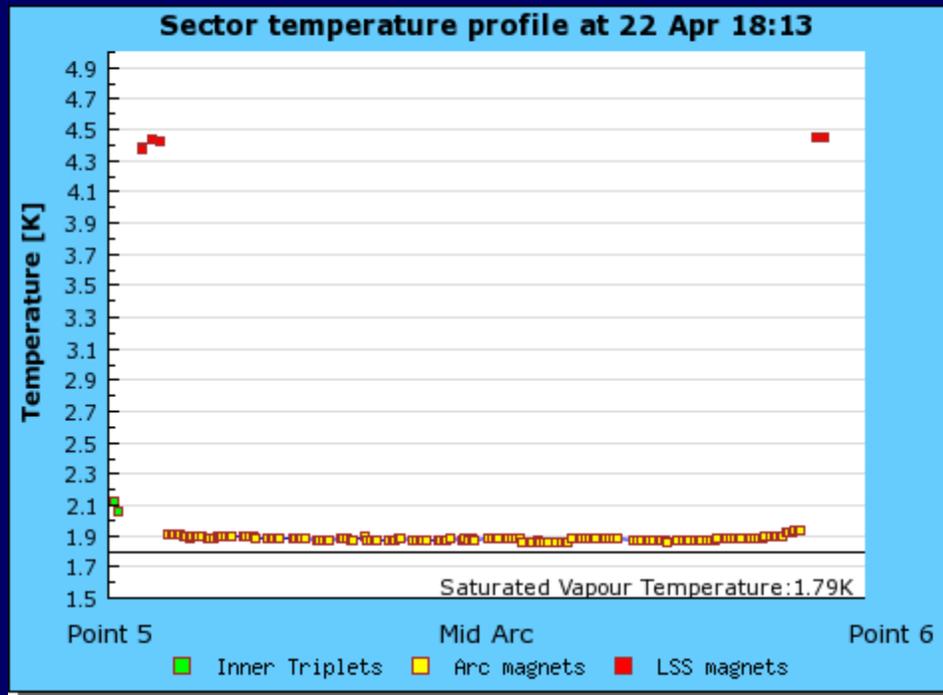
## Dry runs

- 2 Injection kickers system
- LHC Beam dumping system (kickers, energy tracking, diagnostics)
- Beam instrumentation (loss monitors, position monitors, current transformers, screens)
- Power converters in simulation mode
- Collimators
- Timing system
- Communication with experiments (handshakes, modes, fill number, beam based measurements, etc.)
- Post mortem data acquisition system
- Squeeze

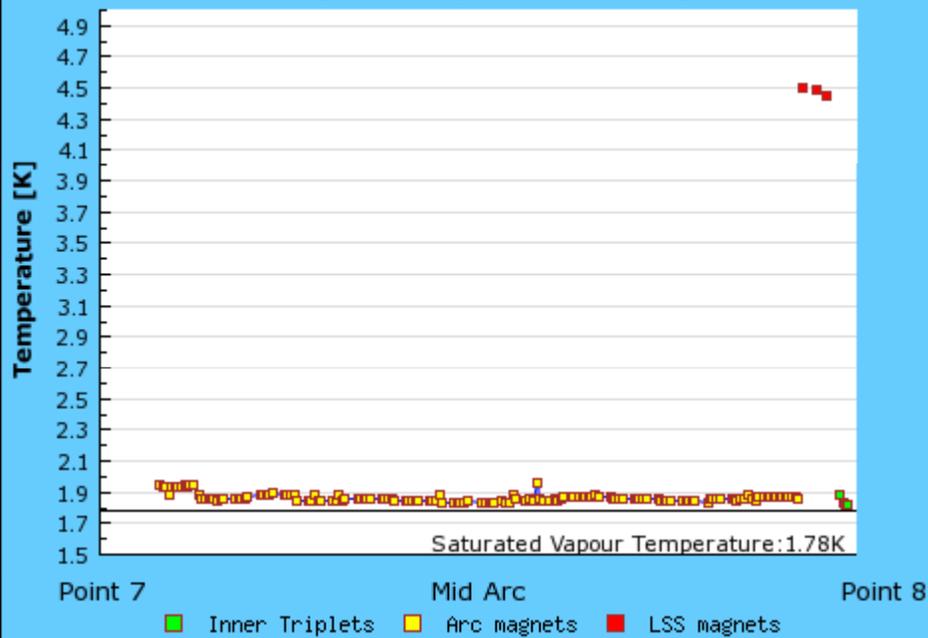
Using the final software foreseen for operation for the commissioning of the machine systems

- 1 Sequencer
- Logging system
- Post mortem system
- On-line databases
- Industrial supervision systems

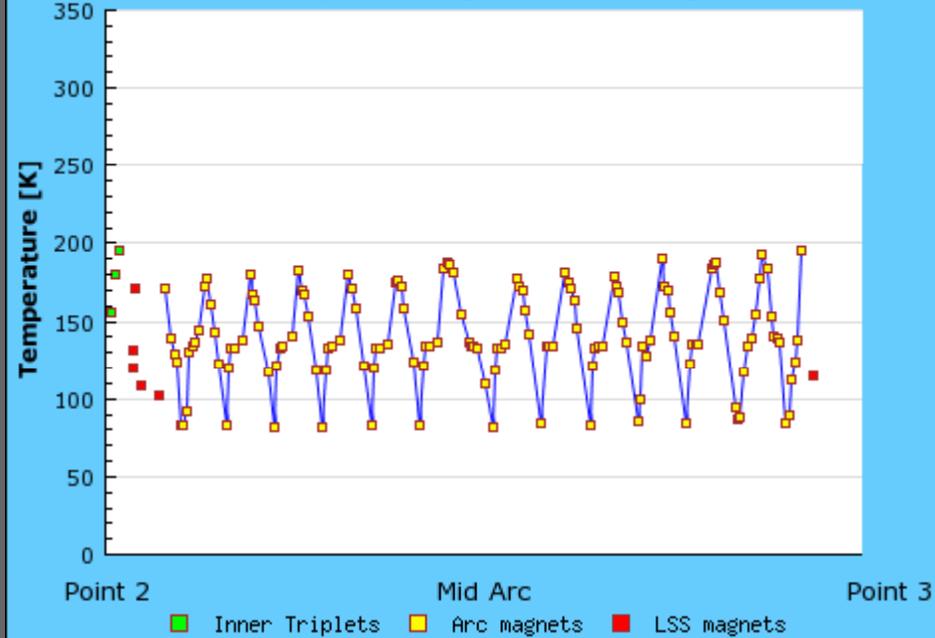




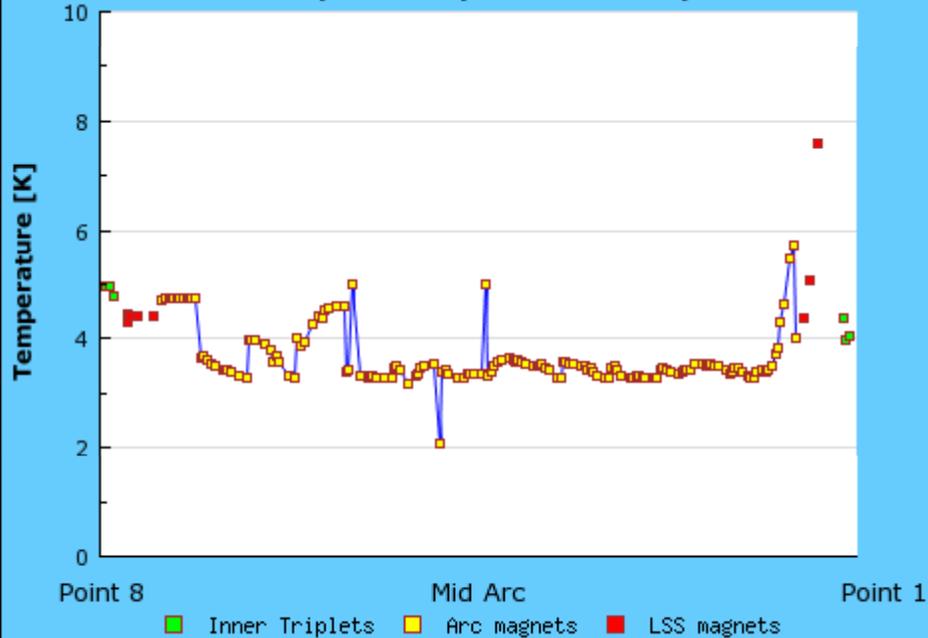
Sector temperature profile at 22 Apr 18:19



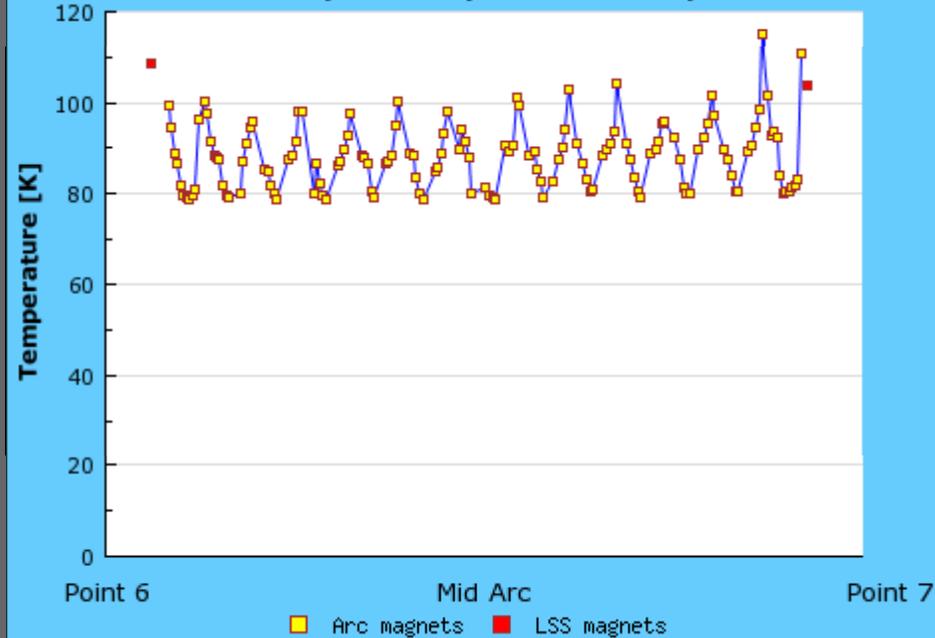
Sector temperature profile at 22 Apr 18:19



Sector temperature profile at 22 Apr 18:16



Sector temperature profile at 22 Apr 18:19



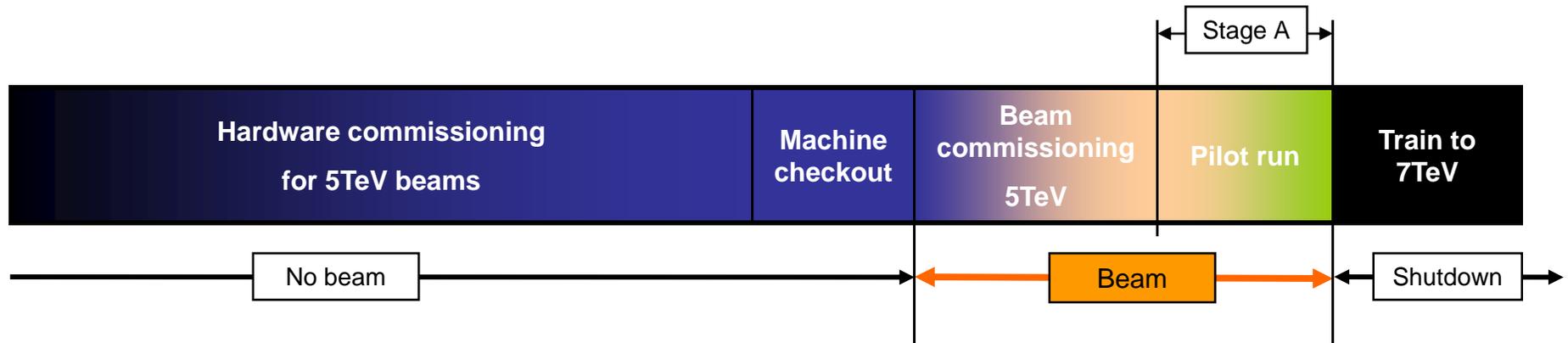


## ... in summary

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- Several teams are busy commissioning the technical systems (the superconducting magnets, the warm magnets, the RF, the injection system, the collimators, the beam dumping system, the access safety and control, the infrastructure systems, the software, etc.) of the LHC in parallel but in a coordinated manner.
  - A strategy, where the initial beam energy is at least 5 TeV, is proposed to gain time with the training of magnets and meet the summer deadline.
  - Recent results, obtained while commissioning Sector 45, indicate that this is feasible.
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# Strategy for 2008 – from LPC, Massi Ferro-Luzzi



- ❑ Strategic decision: all sectors commissioned for 5TeV beams
  - postpone time-costly training quenches that are expected beyond about 5.5 TeV
  - allows keeping the schedule with a pilot run this year
- ❑ One month to make machine ready to receive beam (Machine checkout)
- ❑ Two months for commissioning LHC to first 10TeV collisions
- ❑ Beams squeezed to  $\beta^*$  of  $\sim 3\text{m}$  in IP1/5 and  $\sim 6\text{m}$  in IP2/8
- ❑ Increase intensity:
 

<ul style="list-style-type: none"> <li>– Number of bunches: <math>2 \times 2 \rightarrow 43 \times 43 \rightarrow 156 \times 156</math></li> <li>– Bunch charge: <math>4 \times 10^{10} \rightarrow 10 \times 10^{10}</math></li> </ul>	}	12 MJ per beam!	Tevatron: 1.5 MJ HERA: 2 MJ
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- ❑ Pilot run of a few weeks
- ❑ Winter shutdown: train all magnets to 7TeV, install missing collimators, consolidate LHC electronics protection from radiation

# 2008 Pilot Run – from LPC, Massi Ferro-Luzzi

- Start "Physics" with first 10TeV collisions
  - 2x2, i.e. 2 bunches on 2 bunches, each experiment sees 1 colliding pair
- Optics squeezed as much as efficiently possible
  - about 3m in IP1 and IP5
  - about 6m in IP2 and IP8 (due to missing TCTVB collimators)
- Interleave "Physics" with machine developments to increase luminosity
  - push bunch charges:  $4 \times 10^{10} \rightarrow 10^{11}$  protons/bunch
  - push number of bunches: 43x43, then 156x156
- Target luminosities (for  $10^{11}$  protons per bunch):

zero external  
crossing angle

<u>Scheme</u>	<u>Lumi at IP1 and IP5</u>
2x2	$4.2 \times 10^{29} \text{ cm}^{-2} \text{ s}^{-1}$
43x43	$1.8 \times 10^{31}$
156x156	$6.6 \times 10^{31}$

- If time allows, interleave "Physics" periods with machine "explorations" for 2009
  - crossing angle, 25 to 75 ns bunch spacing



## Physics in first year(s)

Expected event rates at production in ATLAS or CMS at  $L = 10^{33} \text{ cm}^{-2} \text{ s}^{-1}$

Process	Events/s	Events for $10 \text{ fb}^{-1}$	<u>Total statistics collected</u> at previous machines by 2007
$W \rightarrow e\nu$	15	$10^8$	$10^4$ LEP / $10^7$ Tevatron
$Z \rightarrow ee$	1.5	$10^7$	$10^7$ LEP
$t \bar{t}$	1	$10^7$	$10^4$ Tevatron
$b \bar{b}$	$10^6$	$10^{12} - 10^{13}$	$10^9$ Belle/BaBar
$H \ m=130 \text{ GeV}$	0.02	$10^5$	?
gluino gluino $m=1 \text{ TeV}$	0.001	$10^4$	---
Black holes $m > 3 \text{ TeV}$ ( $M_D=3 \text{ TeV}, n=4$ )	0.0001	$10^3$	---

Already in first year, large statistics expected from:

- known SM processes  $\rightarrow$  understand detector and physics at  $\sqrt{s} = 14 \text{ TeV}$
- several New Physics scenarios

# SLHC Accelerator and Injector Upgrades

Lyn Evans



SLHC-PP kick-off meeting, CERN 9 April 2008

