

CERN Scientific Strategy

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Savings “Observations from the DG”

- Main changes with financial implications (following Chamonix) were associated with
 - the proposed construction of a new injector chain (LP-SPL + PS2)
 - Insertion Upgrade of the LHC

Intensity Limits

Intensity Limitations (10^{11} protons per bunch)

Reminder design = 1.15 (for 10^{34}); Ultimate = 1.7 (for 2.3×10^{34})

	Present	SPL-PS2	2GeV in PS
Linac2/LINAC4	4.0	4.0	4.0
PSB or SPL	3.6	4.0	3.6
PS or PS2	1.7	4.0	3.0
SPS	1.2	>1.7?	>1.7?
LHC	1.7-2.3?	1.7-2.3?	1.7-2.3?

Conclusion:

We continue (as planned) and terminate the study for LP-SPL/PS2 and study in parallel the PS Booster energy upgrade

Decision can be taken when we have the results of these studies and

experience with the LHC operation

Insertion Upgrade Plans

- IT Upgrade “phase 1”
 - Goal: reliable operation at $2 \times 10^{34} \text{cm}^{-2} \text{s}^{-1}$, intensity < ultimate and > nominal Very similar to “ultimate”

Same resources are needed for splice consolidation!
(up to beginning 2013)

Tough Questions:

1. Will the phase 1 upgrade produce an increase in useful integrated luminosity?
 - Installation time and recommissioning a new machine afterwards
2. Do we have the resources to complete on a time scale which is reasonable with respect to phase 2?

Task force set up immediately after Chamonix
First preliminary report given: more details at next SPC.

MTP “Observations from the DG”

- **Thus, the MTP assumes the feasibility of the energy upgrade of the PS Booster and does not include the start of the LP-SPL and PS2 construction as of 2013**
- In order to optimize the strategy towards the HL-LHC, with the goal of maximizing the integrated luminosity useful for physics, Management has set up a task force. **A preliminary recommendation from this task force is to delay the inner triplet replacement to a single HL-LHC upgrade around 2020.**

Glossary of terms

- **LHC Technical Stops**: 4 days each 6 weeks for maintenance, etc. Followed by a 5th day for re-commissioning with beam.
- **Christmas break**: mid period stop, between 2 years of operation - 9 weeks to perform minimal maintenance in order to be in conformity with legal and safety requirements, and run for another year.
- **Shut-Down**: major stop of operation with major consolidations and full maintenance of the different systems
- **“Normal mode”**

During “normal operation”, the LHC will be operated on a 2 year basis as following:

- Periodic time windows of 6 weeks: Operation during 5.2 weeks and Technical Stops of 4 days.
- At the end of each year: a heavy Ion run of 4-5 weeks total
- LHC and injectors schedules are synchronized.

Luminosity Goals (short term)

- Integrated luminosity of $\geq 1\text{fb}^{-1}$ by end of 2010
 - Need to reach a peak luminosity of $10^{32}\text{ cm}^{-2}\text{s}^{-1}$ before end of 2010
- Physics with lead ions end of 2010 and 2011

Luminosity Goals 2020-2030

- Goal from detectors 3000fb^{-1}
- High luminosity Running at peak luminosity of $\sim 5 \times 10^{34} \text{cm}^{-2}\text{s}^{-1}$ with long luminosity lifetime by luminosity levelling

Technical Goals

- New high field sc magnets (?Nb³Sn)
 - insertion quads
 - Dipoles for “cryo collimation”
 - Dipoles for energy upgrade of LHC
- Crab cavities R&D
- Intensity upgrades of injectors ($\geq 1.7 \times 10^{11}$ ppb, 2808 bunches)
 - SPS, PSB, LINAC4
 - LHC
 - Electron cloud
 - Beam screen

2012; ≥ 12 months Shutdown

LHC

- **12-15 months** foreseen for the **interconnection consolidation** and hardware commissioning for 7TeV,
- In the shadow, some R2E (Radiation to Electronics) project work –to be defined,
- Collimation project – phase 2 in IR3 ; 3 options are being envisaged:
- In the shadow, performed by experiments:
 - ATLAS: consolidation and installation of a new forward beam pipe
 - ALICE: commissioning of TID and some calorimeter modules
 - CMS: works on the infrastructure and consolidation
 - LHCb: improvements, exchange of the bigger part of the conical beam pipe
- **Injectors:**
- SPS and PS upgrade activities will be performed in 2 shut-downs of 15 weeks, at the end of 2011 and 2012.

2015 shutdown

LHC

- The length driven by CMS consolidation. CMS requests 12 months to consolidate the calorimeter, forward pixel tracker, needed for better performance at nominal luminosity.
- In the shadow:
 - The full maintenance of all the equipments (machine and experiments) will be performed,
 - The completion of the collimation project – phase 2
 - The installation of a separate cryogenic system for the RF (which could be postponed in 2017)

Injectors

- A shutdown of 9 months
 - Connect LINAC4 to PSB
 - Upgrade the PS booster, for 2-GeV operation
 - *(These activities can be postponed to 2017 if necessary)*

2017 shutdown

LHC – 10 months

- Shutdown driven by the activities in the experiments and especially in ATLAS and ALICE.
- ATLAS; insert the new pixel layer. In parallel various systems will be upgraded and the LV1 will be sharpened.
- ALICE; installation of a smaller beam pipe and a new vertex detector. The outer detector will be upgraded in shorter shutdowns (Christmas breaks).
- LHCb ;rebuild the vertex detector and increase the readout rate
- In the shadow, full maintenance as well as the preparation of magnets for crab cavities in IR4.

Injectors - (2 x 3.5 months)

- consolidations and upgrades

2020 -2021 shutdown

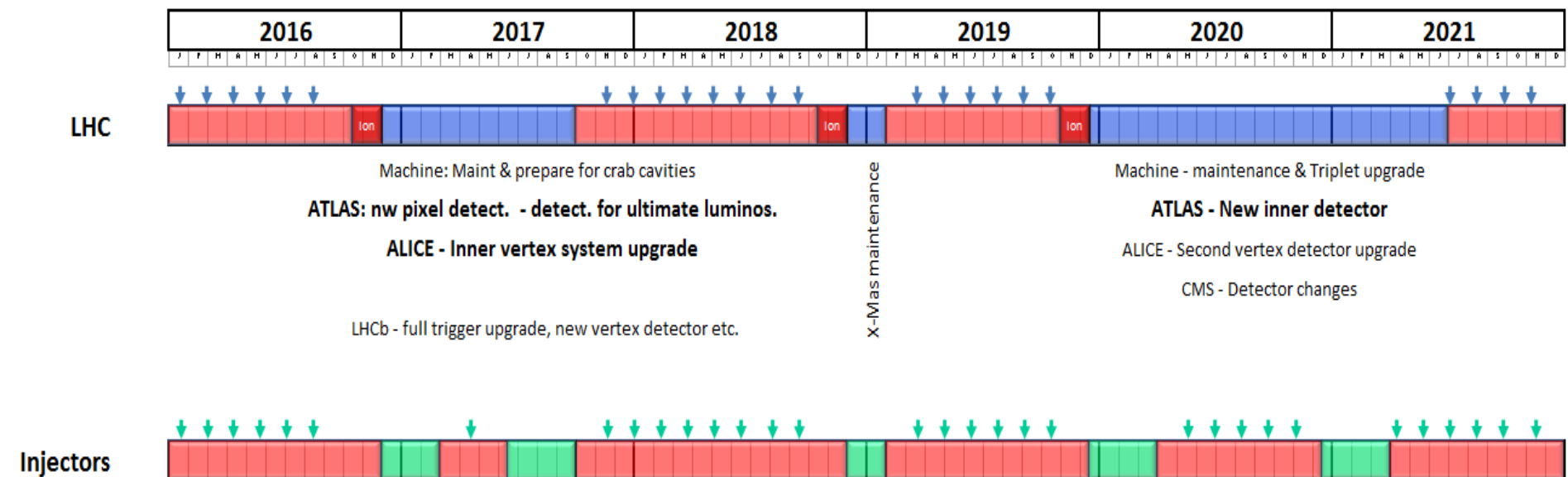
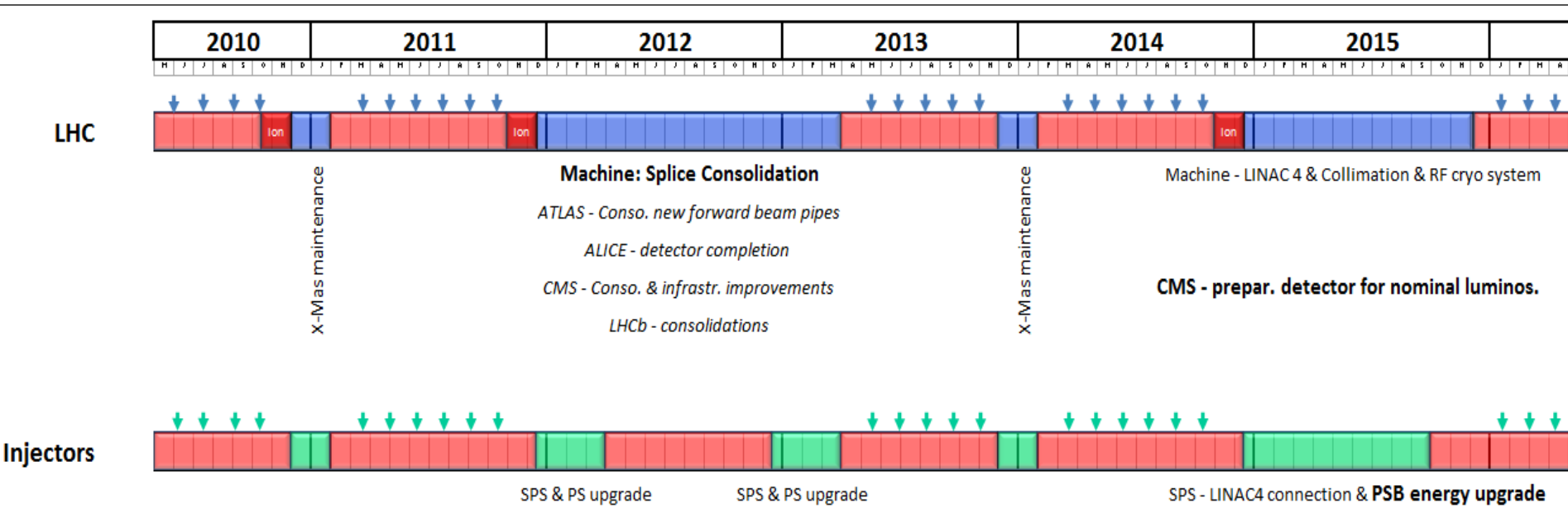
LHC

- CMS, ATLAS; Inner detector trackers to be replaced. Possibly a major upgrade of all the front-end and back-end electronics and the online computing systems.
- ALICE; upgrade its second vertex detector,
- Machine; new Inner Triplets and the crab cavities to be installed.

Injectors

- During the 2020-2021 shutdown the injectors will run in a “normal mode”, with 3.5months shutdowns at the end of 2019 and 2020.

Preliminary Plan



Thank you for your attention

Scientific Strategy

- Full exploitation of LHC physics potential
 - Reliable operation (including consolidation and LINAC 4)
 - Remove bottlenecks to reach and benefit from nominal luminosity for both machine and detectors
 - Focused R&D and prototyping for High-Luminosity LHC
 - Re-establish standards for technical and general infrastructure
- Preparation for the long-term future (>2015)
 - Energy frontier
 - CLIC/ILC collaboration and R&D (for detectors and machine)
 - Generic R&D for High-Energy LHC (i.e. high field magnets)
 - Generic R&D for high-power proton sources (High-Power SPL)
- World-class fixed-target physics programme

Full exploitation of the LHC physics potential

- LHC operation until around 2030, aim at $\int L dt \approx 3000/\text{fb}$

→ first decade **2010-2020**

up to 14 TeV, up to around design luminosity

→ reliable operation of the whole accelerator complex
(consolidation needs independent of decision on SPL/PS2)

→ shutdown around 2020 for luminosity and detector
upgrade

→ second decade **2020-2030**

up to 14 TeV, luminosity around 5×10^{34} , luminosity
leveling

Full exploitation of the LHC physics potential

- LHC operation until around 2030, aim at $\int L dt \approx 3000/\text{fb}$
 - two-year running scenario
 - run 2010/11 at 7 TeV cms energy, aim 1/fb
 - refurbish copper stabilizers in 2012
 - run 2013/14 at maximum cms energy
 - ~2015 connect LINAC4, detector improvements

CERN as laboratory at the energy frontier

- CLIC/ILC collaboration
 - CLIC CDR 2011, ILC TDR 2012
 - LC detector R&D
 - increased efforts after CDR/TDR accepted
- R&D for high-field magnets (HE-LHC)

Focused R&D for Neutrino Physics

- R&D on high power proton sources

Fixed target physics

- CERN share of HIE-Isolde infrastructure (high priority in NuPECC)
- ELENA not approved yet