

Preparation of Muon Upgrade LOI

- Boundary conditions

$$L_{max} = 10^{33} \text{ cm}^{-2}\text{s}^{-1}$$

$$L_{integrated} = 50/\text{fb}$$

$$\text{Bunch spacing} = 25 \text{ ns}$$

- LHC time schedule (see next slides)

Startup with upgraded LHCb : ***currently planned for 2017***

'Latest' LHC schedule for the next decade

From CERN-ATS-2010075

Rolf Lindner
IT Replacement and Future Tracker Upgrade
EPFL, Lausanne
13 September 2010

2010 – 2011: “normal mode” at 3.5TeV

LHC and injectors will be operated in a “normal operation mode”.

2012 -- Shutdown ~15 months

LHC

Major consolidation to allow running safely at 7TeV/beam

- **15 months** for the ***interconnection consolidation*** and hardware commissioning to 7TeV.
- Works for the R2E project in the LHC machine.

The activities linked to the collimation project – phase 2 in IR3 will be inserted into the schedule as soon as appropriate technical solutions have been found. Two options are possible:

- Collimators ready mid 2012: schedule will need to be reviewed – additional resources may be necessary to stay within 15 months
- Collimators not ready in 2012: installation in 2016.

Activities that will be performed by the 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

For economy reasons, CERN injectors will not be operated in 2012, hence they will be in shutdown for nearly the same duration as the LHC.

2013-2014-2015 “normal mode” towards 7TeV

2016 shutdown

LHC

The length of 2016 shutdown is driven by the activities in the experiments:

- ATLAS: After accumulating 30 to 50 fb⁻¹, and before reaching “ultimate” luminosity ($\geq 2 \times 10^{34}$ cm⁻²s⁻¹), ATLAS will need to insert the new pixel layer. In parallel various systems will be upgraded and the level one trigger (LV1) will be modified.
- ALICE will upgrade its detector, with the installation of a smaller beam pipe and a new vertex detector. The outer detector will be upgraded in shorter shutdowns (Christmas breaks).
- CMS: Due to funding issues, these CMS detector activities, initially planned in 2012, are pushed in 2015. CMS requests 12 months in order to consolidate the calorimeter, forward pixel tracker, which is needed for better performance at nominal luminosity.
- LHCb will rebuilt the vertex detector and increase the readout rate to 40MHz. (*not ready before the end of 2016*)

•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.
- The preparation for installation of crab cavities in IR4.

Injectors

A shutdown of 9 months is foreseen in order to:

- Connect LINAC4 to PSB
- Upgrade the PS booster, for ≤ 2 -GeV operation

2010	2011	2012	2013	2014	2015
M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D

LHC



Machine: Splice Consolidation

X-Mas maintenance

ATLAS - Conso. new forward beam pipes

ALICE - detector completion

CMS - Conso. & infrastr. improvements

LHCb - consolidations

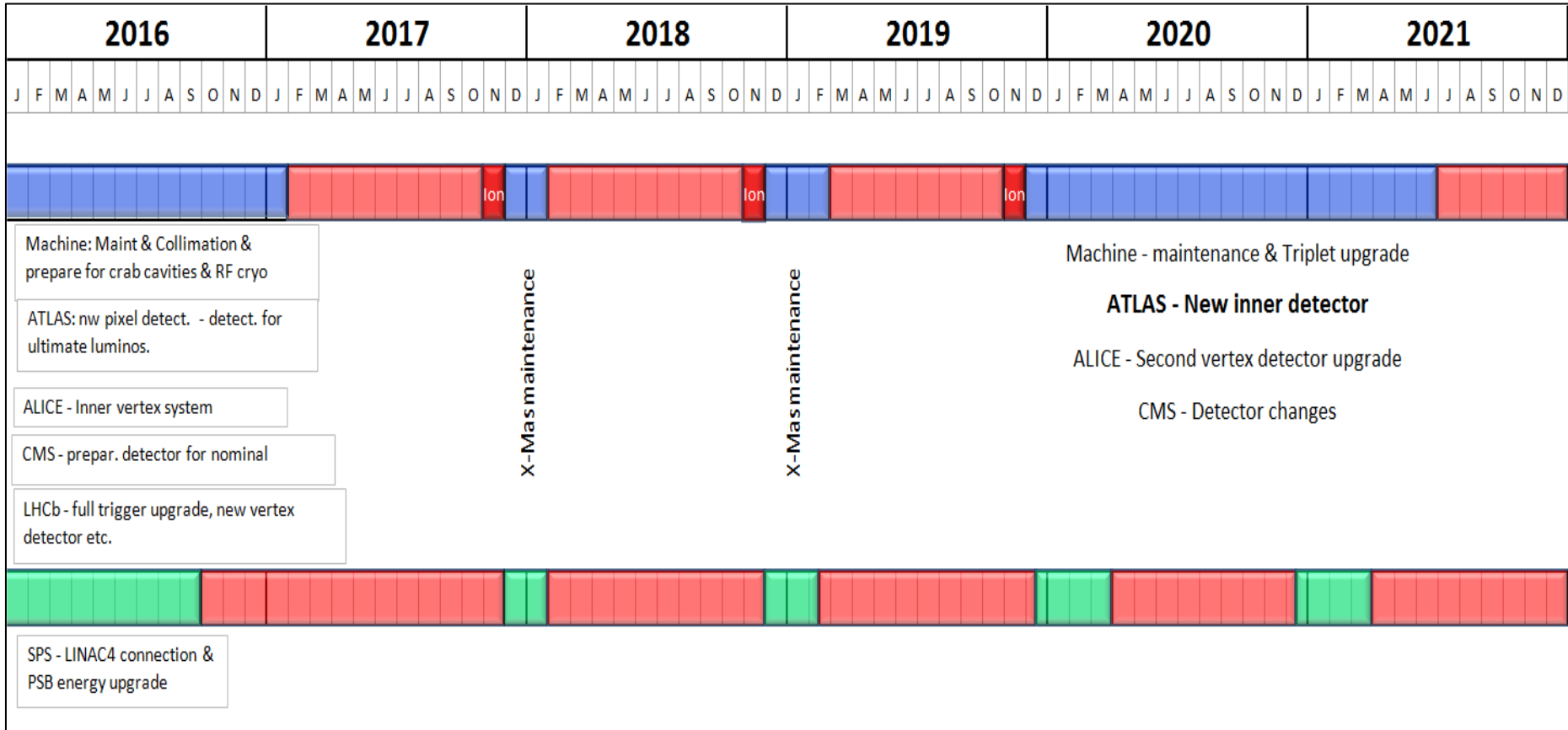
X-Mas maintenance

X-Mas maintenance

Injectors



Please note that this note has been approved by the Director General.



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Muon Upgrade LOI Layout

1. Introduction
2. Aging of MWPC detectors

Reminder of aging tests results (GIF and Casaccia)

Caveats on chamber operation (trips, etc...)

Reminder of low energy simulations extrapolated at 50/fb (Alessia et al.)

Evaluation of hit densities in real data (Giacomo)

Evaluation of currents in real data (Oleg)

3. FEE behaviour at high rate

Reminder of GIF test beam results (charge densities, rate limits, etc...)

4. Electronics upgrade (Caterina's talk)

FEE

ODE

ECS

Service systems (LV, HV and gas)

5. System maintenance

Reliability experience with the present detector

Spares chambers

Spares and future availability of electronic components

6. GEM detectors

Running experience

R&D on large area

7. Performances of Muon System at high lumi

Muon ID at average $\mu > 1$ (MC simulations and studies on data)

Effects on physics (J/Psi, data)

8. Conclusions

Plans, costs, commitments

Next steps

Collecting the missing contributions

First “final draft” **by the end of this week** (*Friday Oct 1st*)

Review, comments, final editing, etc... in the **following week** (*Friday Oct 8th*)

Deadline for submission to Sheldon in about **2 weeks from now** (at least we should show a good will...)

Refinements, updates, etc..., afterwards

My personal view on the upgrade (MWPC)

- To our knowledge the current layout should sustain 5 years at $10^{33} \text{ cm}^{-2}\text{s}^{-1}$, with a “reasonable” amount of yearly maintenance and, most probably, will need a larger amount of spare chambers
- However the recent behavior of some gaps (trips) already at a luminosity 10 times smaller than the nominal, suggests caution. It may happen that the system (or an important part of it) cannot sustain a lot of radiation. To be understood
- If the latter statement turns out to be true: new chambers ? new technology (large area GEM) ? In any case a big problem in terms of money and manpower available
- FEE seems not a problem (at least at 2nd order)

My personal view on the upgrade (Electronics)

- A lot of work well done (thanks to Caterina et al.) !
- The project now looks more like a “refreshment” of the system over a very long time scale (5 years) and the requests in term of money and manpower resources are very reasonable
- Nothing new and terribly exciting, but necessary to maintain the Muon system in the business

I think all Muon groups should commit themselves to a level of activity which will allow the system as it is now, to run it at $10^{33} \text{ cm}^{-2}\text{s}^{-1}$

I believe any other major improvement can be done only with new groups or new resources joining the Muon group