LHCb Upgrade

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On behalf of LHCb TC team
LHCb Upgrade parameters

**Luminosity**
Run2 $4 \times 10^{32}$ cm$^{-2}$ s$^{-1}$ (2 x nominal)
Upgrade: $2 \times 10^{33}$ cm$^{-2}$ s$^{-1}$ Run

**Read-out**
Run 2 1 MHz
Upgrade 40 MHz

**The LHCb upgrade in short:**
1. Replace all detectors which cannot stand the rate (occupancy) and the corresponding infrastructure
2. Replace all Read-Out Electronic
3. New Data Center
Further readings
LHCb Upgrade: Surface

- New Data Center
- Pull 17000 x 300m fibres from UX to Surface
- New data centre 2MW IT power
- New technical galleries

Not constrained by LHC schedule

(container is one option)
LHCb Upgrade: Underground

**Systems to be removed**
- VELO
- TT
- IT
- OT
- M1
- SPD
- Lead
- PS
- PC farm

**New systems to be installed**
- VELO Pixel
- UT
- SciFi

**Systems to be partly modified/removed**
- MUON Electronics
- CALO Electronics
- RICH1 & RICH2 HPDs
 VELO

- New silicon pixel sensors
- New RF foil
- New Wakefield suppressor
- New motion System
- New CO2 cooling
- …
RICH1 and RICH2

• New photon detector: 64ch MaPMT
• New optic (RICH1)
• New gas enclosure (1)
• Re-use (part) existing cooling facilities
• Modifications of shielding
• …
UT

• New silicon sensors (strip)
• Less material, closer to beam pipe, read-out strip geometry adapted to particle flux
• New CO2 cooling system
• Keep only supporting rails
• …
SciFi

- Scintillating fibers (12,000 km)
- Read out by SiPM (-40°C)
- New monophase cooling system
Silicon Photomultipliers are not immune against radiation

- Shielding will be required.
- Concept, design and integration being studied!
- Structure to be built!

1MeV neutron equivalent fluence: Absolute Values
2x5cm + 10cm PE (maximum thickness)
CALORIMETERS

- Replace only few innermost modules (ECAL) (may be shifted to LS3)
- Add shielding (HCAL)
- New R/O electronics
M2-M5

- Production of New chambers
- Remove R/O electronic and cables
- Install new R/O electronic chain
- Additional shielding and modification of the beam pipe plugs (could be anticipated yet, eyets)
Vacuum Chamber

• Remove and re-install vacuum chamber
• Access structures and platforms to be installed
• In Addition wrt LS1: Section1, Wakefield suppressor, RF foil, and bake-out.
• Constraints from VELO, RICH1, and UT
• Tight planning and correlation
Large objects to dismantle

• M1
Large objects to dismantle
• PS/SPD
Large objects to dismantle

- Lead
Large objects to dismantle

• OT
Large objects to dismantle

• Services
Shielding wall

- Dismantle ~33%
- For passage of detector services
- Issue: dust, logistic and storage of blocs
• The planning is tight and not much room is left for contingencies
• There are several internal dependencies and the main sequence is unlikely to evolve much
Interfaces and support from CERN groups
EN-EL 1/2  Power distribution

• Power for DATA CENTER (→ before LS2)
  • Primary power supply, 18kV transformer
  • Power distribution for Computing (2MW)
  • Power for services (cooling, ventilation, building …)

• Power for new equipment's (e.g. cooling plants)

• Modification/consolidation of existing installation wherever required.
EN-EL 2/2 Optical Fibers

• 17k fibers through PM (access and collaboration with Cryo)
• Installation: two options (trunk cables – blowing)
• All supports in place (LS1 – thanks to EN-MEF/EL)

• Provider of cables to be defined
• EN has forwarded a much lower bid than before
• LHCb expects in-kind contribution from institute
• Both fibre types meet specification.
• Cost and administration to be defined.
EN-CV 1/5 Detector Cooling

For Velo-UT

• CO2 2 phases
• Two independent cooling plant systems
• Should be redundant (back-up each other during maintenance, tech problems)
• To be supplied by PH-DT / LHCb – requirements to be issued soon.

➢ Primary cooling: air and mixed or chilled water (may be anticipated to EYETS)
EN-CV 2/5 Detector Cooling

RICH1 and RICH2

- C6F14 monophase >11C
- Power: may exceed the current RICH1+2 (8kW) by ~30% (TBC)
- Baseline: keep existing system and transfer lines (see edms 1327542)

- Modify existing plants to cope with new specification
- Upgrade/consolidation to run until LS4 and beyond
- Consider Greenhouse friendly alternative to C6F14
Detector Cooling

SciFi - SiPM
C$_6$F$_{14}$ monophase, -50°C
- New plant & transfer lines
- Greenhouse friendly alternative should be considered

SciFi – FE Electronics
Technology Demineralized H$_2$O
- Power: probably significantly (50%) above the current OT/SPD plant
- Baseline: adapt existing OT/SPD plant, keep the transfer lines (TBC)
- Upgrade/consolidation wherever needed to run > 2030
Technology still to be decided

Quickly evolving field

- Main options identified until today:
  - Direct Liquid Cooling (DLC)
  - Natural free cooling (NFC)
  - Water Cooled Heat Exchanger Doors (WCD)
  - ...

➢ Primary cooling / air conditioning shall be supplied
EN-CV 5/5  Ventilation UX85

• Pressure differential cascade found acceptable for run2 running conditions

• Increase to Lumi $\sim 2 \times 10^{33}$ Hz cm$^{-2}$

- Pressure differentials shall comply to HSE/RP requirements (does the current ‘derogation’ still hold?)
EN-HE HANDLING

• Handling for dismantling and installation of detectors, associated services, access platforms and support structures.

• Transport from UX to storage space

• Handling for dismantling and re-installation of shielding wall

• Transport of the concrete block.

• Handling for SiPM shielding wall installation

• Crane operators, cherry picker driver
EN-MEF-SU SURVEY

- Consulting during R&D phase (ongoing)
- Survey during the assembly phase
- Sporadic survey before and during installation
- Survey of most systems after installation
EN-MEF-COL SAFETY COORDINATORS

The LS2 safety risk factors:
  • Heavy handling
  • Co-activities
  • Users, contractors,
  • Tight schedule

LHCb needs on site Safety Coordinator
  ➢ Provide VIC
  ➢ attending meetings - aware of activities
  ➢ Providing advice to users, contractors, and Staff
HSE-RP RADIOPROTECTION

- LHCb is providing personnel for low risk and low duty task (RPE and RPA).

- Additional support will be needed, mostly during the dismantling phase (high flow of outgoing material)
  - Clearance and sorting of outgoing material
  - Risk assessment for destructive work
GS STORAGE - LOGISTICS

- Detectors parts will be recuperated, stored, or become (radioactive) waste.
- Some may return to institute
- Final fine dis-assembling will not take place in the pit

- Need storage space for large detector parts, with some components being radioactive (min 200m$^2$)
- Need protected storage space for concrete blocks (100m$^2$)
GS Civil Engineering

• Civil Engineering for new data center
  • Preparation for the housing of PC farm
  • Technical galleries from SCX to PC FARM
  • Technical galleries from Transformers to PC farm
SUMMARY

• LHCb will have a major upgrade in LS2
• The planning is tight and sequences must be respected.
• Resources and support from CERN technical department are needed
• In addition to high level of technical support LHCb relies on commitment and flexibility of all stakeholders
Thank you for your attention!