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Swedish LHC upgrade activities

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Upgrade time line to HL-LHC

2009 — Start of LHC

Run 1: 7 and 8 TeV centre of mass energy, luminosity ramping up to few 10^{33} cm^{-2} s^{-1}, few fb^{-1} delivered

2013/14 — LHC shut-down to prepare machine for design energy and nominal luminosity

Run 2: Ramp up luminosity to nominal (10^{34} cm^{-2} s^{-1}), ~50 to 100 fb^{-1}

2018 — Injector and LHC Phase-I upgrades to go to ultimate luminosity

Run 3: Ramp up luminosity to 2.2 x nominal, reaching ~100 fb^{-1} / year accumulate few hundred fb^{-1}

~2022 — Phase-II: High-luminosity LHC. New focussing magnets and CRAB cavities for very high luminosity with levelling

Run 4: Collect data until > 3000 fb^{-1}

2030

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Long shutdown 1 - Phase 0

ATLAS

- Insertable b-layer in pixel detector (IBL)

ALICE

The central barrel spectrometer is proposed to have a new inner tracker and an upgrade of the rate capability of the TPC, both by increasing the bandwidth in the data collection and to replace the wire chambers for the TPC readout with GEM detectors which allows continuous, ungated operation of the TPC. This allows 50kHz heavy ion collision rate to be collected and after initial analysis by the high level trigger select about 1kHz for storage.

PROJECT	*% of total cost*
New muon detector sin forward direction, Muon Small Wheels (SW) to improve the L1 trigger	26,0
Replacement of trigger electronics in LAr detector	22,2
Improvements of Tile Calorimeter by equipping gap region with scintillators	1,0
New level 1.5 trigger for tracking (FTK)	10,0
Upgrade of trigger and data acquisition system	33,4
New detector in far forward region, 220 m form interaction point tio improve forward physics performance (AFP)	7,5

Table 1. The phase 1 sub-projects

Phase 1

Estimated cost 36MSFR

PROJECT	% of total cost
Replacement of entire Inner Detector with a Silicon Inner Tracker (SIT)	53,1
Replacement of readout electronics in LAr to manage higher data rates	11,0
Replacement of readout electronics in Tile Calorimeter to manage higher data rates	2,2
New forward calorimeter (FCAL)	4,8
Consolidation of LAr HEC cold electronics	2,2
Muon Barrel and LArge Wheel upgrade	4,1
Upgrade of trigger and data acquisition system	10,5
L1 Track trigger	1,3
Improvement of shielding and TAS	3,0
Upgrade of luminosity detector (LUCID)	0,4
Upgrade of infrastructure and common activities	7,5

Table 2. The phase 2 sub-projects

Phase 2

LU,UU

SU
KTH

SU
UU

LU

Estimated cost 290MSFR

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Funding

R&D

In November 2010 the LHC Consortium wrote, on request of RFI, a letter to the Swedish Research Council (VR) titled “Planering av Sveriges deltagande i och bidrag till uppgraderingen av LHC på CERN", which presents the plans for upgrades to the LHC machine and its detectors, and estimating the funding needed for the Swedish participation in the upgrades. In 2011 the Swedish ATLAS and ALICE groups submitted a joint application for R&D for LHC upgrade amounting to 22535 kKr. The application was granted with 5900 kKr and in the motivations to the decision a better long term strategic planing was requested.

In 2012 an updated R&D application (10872 kKr) was submitted to RFI

Investment

The Swedish contribution to the construction of the present ATLAS and ALICE experiments was 129 MSEK shared between VR (93 MKr) and KAW (36 MKr). With a Swedish contribution to the LHC experiments on the same level as in the past the total need for investment funding for the period 2013-2023 will be 70 MKr.

In 2012 an investment application for ALICE was submitted to RFI in 2012.