Flavour Physics at the High Luminosity LHC

LHCb Upgrade II

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Motivation
The LHCb Collaboration is planning an Upgrade II, a flavour physics experiment for the high luminosity era. It will be installed in LS4 (2030) and targets an instantaneous luminosity of 1 to 2x10^{34} cm^{-2}s^{-1}, with an integrated luminosity of at least 300fb^{-1}. Modest consolidation of the current experiment will also be introduced in LS3 (2025).

LHCb Upgrade II will allow for a broad spectrum of important flavour-physics measurements such as:
- Semileptonic b \rightarrow s l^+l^- and b \rightarrow d l^+l^- transitions, of which many not accessible in the current experiment or Upgrade I;
- CP-violating phases \gamma_s and \phi_s with a precision of 0.4º and 3 µrad;
- CP-violation studies in charm with 10^{-5} precision;
- B(B_0 \rightarrow \mu^+\mu^-)/B(B_0 \rightarrow \mu^+\mu^-) with an uncertainty of 20%;
- Lepton-universality tests in b \rightarrow c \gamma decays, exploiting the full range of b-hadrons.

Tracking System
Two general design challenges:
- Track segment matching
- Occupancy

To meet this challenge it is foreseen to:
- Increase the granularity
- Reduce the amount of material
- Exploit the use of precision timing

Vertex Locator
To achieve performant operation:
- In a high pile-up environment
- Under high-radiation conditions

We should:
- Reduce the pixel pitch size, sensor thickness
- Use detector with the timing resolution (LGAD)
- Remove the RF foil
- Use "hot-swap" mechanics

Calorimeters
New possible candidates for ECAL:
- Multi-doped GAGG:Ce crystal calorimeter with longitudinal segmentation (good radiation hardness, excellent energy resolution, very fast response);
- ShaZilk or SpaCal (tungsten-alloy converter 25 X_0 in depth, crystal component for providing a fast-timing signal)

The Hadron Calorimeter will be removed.