# The HybridMC: a fast detailed Monte-Carlo framework for the LHCb electromagnetic calorimeter Upgrade

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The LHCb experiment will undergo a substantial renovation in order to be able to operate at a luminosity of 1.5 x $10^{34}$ $cm^{-2}s^{-1}$ and collect a dataset of 300 $fb^{-1}$. For the electromagnetic calorimeter, the solution under study is based on a combination of Shashlik and SpaCal technologies, both relying on a sampling approach and employing scintillating materials. The development of an accurate Monte Carlo simulation framework is central to the ECAL R&D effort, to guide the development of the new prototypes as well as to evaluate the performance of the proposed upgrade configurations in benchmark physics channels.

While the high light production efficiency and good transparency of the scintillators foreseen to be used in LHCb ECAL are desirable to achieve the necessary energy and timing performance, they pose a serious challenge in simulations, since the transport of optical photons is by far the most CPU-consuming part of the computation. Standard full ray-tracing approach quickly becomes unfeasible, especially when the energy and density of the particles impinging on the calorimeter increase. On the other hand, the specific use case of the LHCb ECAL does not allow to neglect the transport of optical photons, because of its impact, in particular, on radiation damage and timing resolution.

For this reason, a new simulation framework, the HybridMC, has been developed. It is based on a combination of Geant4 and ad-hoc parametrization strategies, allowing to speed up the simulation of Shashlik and SpaCal modules by a factor between 100 and 500, while keeping the level of detail necessary for the calorimeter R&D phase. This contribution will describe the HybridMC framework, detailing the solutions employed, explaining the validation strategy, and comparing the results obtained with this tool to the outcome of experimental measurements of calorimeter prototypes, performed during several test beam campaigns.