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The flash-simulation of the LHCb experiment using the Lamarr framework

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In the LHCb experiment, during Run2, more than 90% of the computing resources available to the Collaboration were used for detector simulation. The detector and trigger upgrades introduced for Run3 allow to collect larger datasets that, in turn, will require larger simulated samples. Despite the use of a variety of fast simulation options, the demands for simulations will far exceed the pledged resources.
To face upcoming and future requests for simulated samples, we propose Lamarr, a novel framework implementing a flash-simulation paradigm via parametric functions and deep generative models.
Integrated within the general LHCb Simulation software framework, Lamarr provides analysis-level variables taking as input particles from physics generators, and parameterizing the detector response and the reconstruction algorithms. Lamarr consists of a pipeline of machine-learning-based modules that allow, for selected sets of particles, to introduce reconstruction errors or infer high-level quantities via (non-)parametric functions.
Good agreement is observed by comparing key reconstructed quantities obtained with Lamarr against those from the existing detailed Geant4-based simulation. A reduction of at least two orders of magnitude in the computational cost for the detector modeling phase of the LHCb simulation is expected when adopting Lamarr.

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