Contribution ID: **73** Type: **Long talk**

Evolution of the energy efficiency of LHCb's real-time processing

Friday, 21 May 2021 16:30 (30 minutes)

The upgraded LHCb detector, due to start datataking in 2022, will have to process an average data rate of 4˜TB/s in real time. Because LHCb's physics objectives require that the full detector information for every LHC bunch crossing is read out and made available for real-time processing, this challenge mirrors that of the ATLAS and CMS HL-LHC software triggers, but deliverable five years earlier. Over the past six years, the LHCb collaboration has undertaken a bottom-up rewrite of its software infrastructure, pattern recognition, and selection algorithms to make them better able to efficiently exploit modern highly parallel computing architectures. We review the impact of this reoptimization on the energy efficiency of the real-time processing software and hardware which will be used for the upgrade of the LHCb detector. We also review the impact of LHCb's decision to adopt a hybrid computing architecture consisting of GPUs and CPUs for the real-time part of its upgrade data processing. We discuss the implications of these results on how LHCb's real-time power requirements may evolve in the future, particularly in the context of a planned second upgrade of the detector.

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Session Classification: Fri PM Plenaries

Track Classification: Online Computing