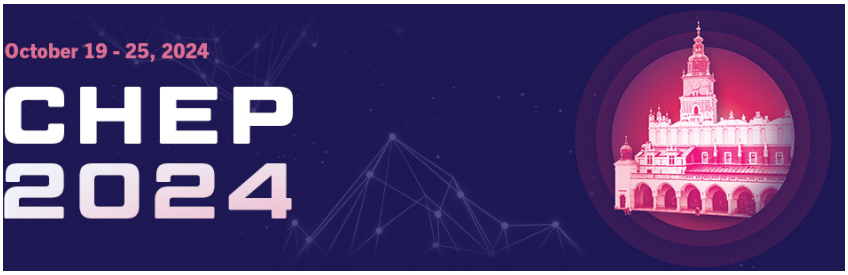

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Advancements in Offline Analysis Software for Run III at LHCb

Monday 21 October 2024 17:09 (18 minutes)

As the Large Hadron Collider progresses through Run 3, the LHCb experiment has made significant strides in upgrading its offline analysis framework and associated tools to efficiently handle the increasing volumes of data generated. Numerous specialised algorithms have been developed for offline analysis, with a central innovation being FunTuple–a newly developed component designed to effectively compute and store offline data. Built upon the robust Gaudi functional framework, FunTuple merges a user-friendly Python interface with a flexible templated design. This modern architecture supports a wide range of data types, including both reconstructed and simulated events, facilitating processing of event-level and decay-level information. Crucially, FunTuple is primed for future enhancements to integrate new event models, optimising vectorised data processing across heterogeneous resources.

A pivotal feature of FunTuple is its capability to align trigger-computed observables with those analysed offline, crucial for maintaining data integrity across LHCb analyses. This alignment is achieved through Throughput Oriented (ThOr) functors, specifically crafted to meet the high throughput demands of the trigger system. Moreover, FunTuple offers comprehensive customisation options, enabling users to define and store tailored observables within ROOT files in anticipation of future increases in data volumes. FunTuple has undergone rigorous testing, including numerous unit tests and pytest evaluations. In 2024, it is undergoing a comprehensive stress test by hundreds of analysts to validate its reliability in managing and validating the quality of data recorded by LHCb.

This presentation will delve into the design, user interface, and integration of FunTuple alongside other analysis components, showcasing their efficiency and reliability through detailed performance metrics in managing large-scale data.

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