Testing Real Time Analysis at LHCb

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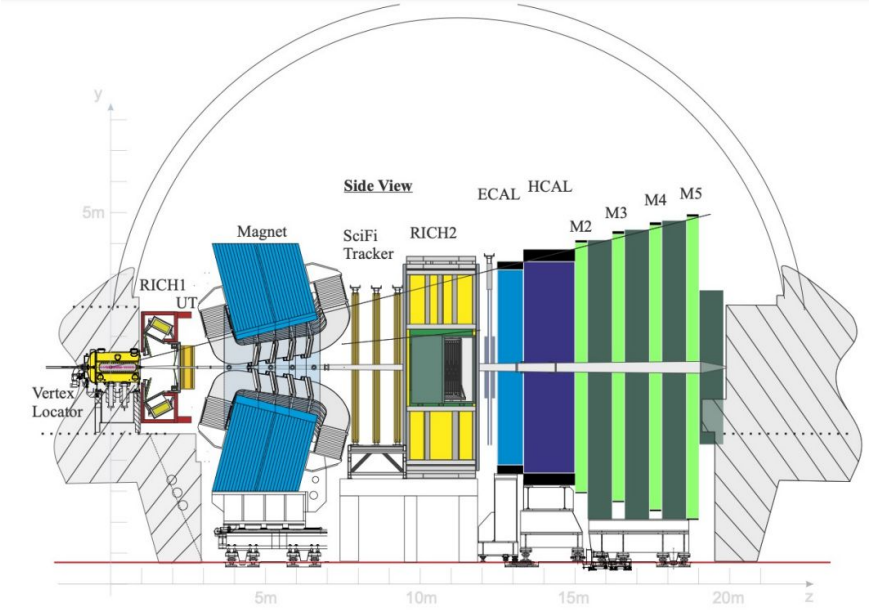
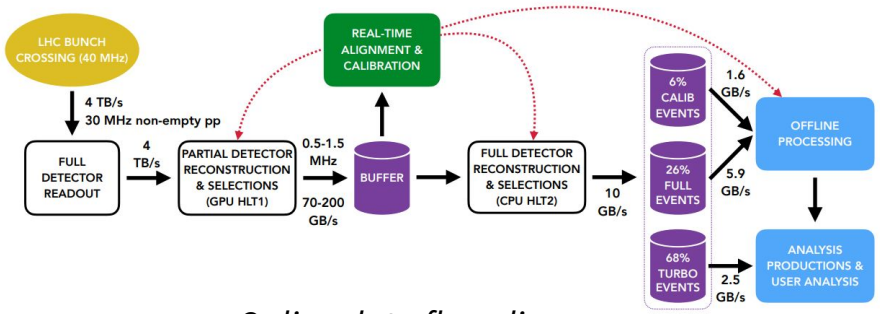
LHCb Detector



Layout of the upgraded LHCb detector

- The LHCb experiment - one of the **four** large detectors at the **Large Hadron Collider**;
- The experiment has demonstrated **excellent capabilities** in many domains;
- The **LHCb Upgrade** designed with **wider physics** programme in mind;
- The Upgrade incorporates first **fully software trigger**;

LHCb Trigger Paradigm



Online data flow diagram

recorded all event information

rate of recorded events increased by decreasing the volume of information recorded for each event

- objective = **data volume reduction** (from 4 TB/s to 10 GB/s)
- **Real-time analysis approach (RTA)**, (LHCb Run 2), requires a full offline-quality reconstruction.
- Two-stage trigger system:
  - **HLT1** (reduction of a factor of 20),
  - **HLT2** (full offline-quality reconstruction).

Available Lines

inclusive selection on more common features of decays

- the topological trigger;
- inclusive detached dilepton trigger.

exclusive selection of specific decays

- dilepton *B->Xll* trigger.

Decays: $B^+ \to K^+ J/\psi \quad , \quad B^0 \to K^{*0} J/\psi$

- expected to be easily selected in data;
- channels look very similar, but differ quite remarkably in their angular distributions.

Project Goals

Overall goal: assessing the performance of the new trigger-paradigm at LHCb.

1. BDT-based machine learning algorithm to cleanly select $B^0 \to K^{*0} J/\psi$ and $B^+ \to K^+ J/\psi$ decay candidates in 2022 data.
2. The decay properties of these channels, will then be compared and their agreement with simulated events examined.
    - If needed, the existing trigger algorithms may be altered and improved.
3. If possible, we will also have a first look at the angular distributions of the calibration channels being studied.

Timeline of work

- Familiarization with the **idea behind the project**;
- Usage of **virtual environments, bash**;
- **Python scripting** with focus on the statistical analysis libraries such as **RooFit** or **zfit**.

Timeline of work

- Development of machine learning techniques to increase the **purity of the signal events** in data;

- First **fits to the reconstructed invariants mass** of the B meson candidates;
- Familiarization with **sPlot** technique.

Timeline of work

- **Data-simulation comparisons;**
- Comparisons across candidates selected with **different trigger lines. (alter if necessary);**
- **Parametrization of the distortion** caused by selections to the angular observables of the two channels of interest;
- **First angular fits** to the 2022 data.

Thank you for your attention!