IGFAE COMCHA activities at LHCb, Codex-b and beyond

Xabier Cid Vidal
XVI CPAN Days (Madrid)
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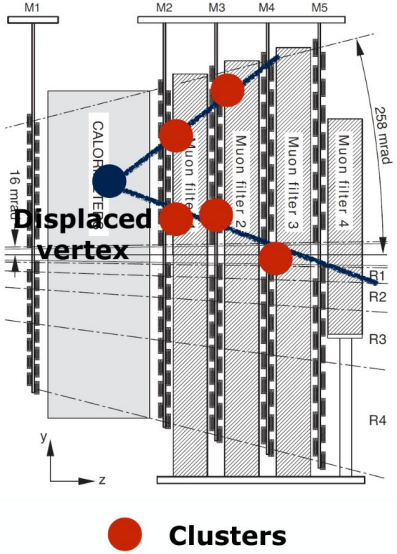
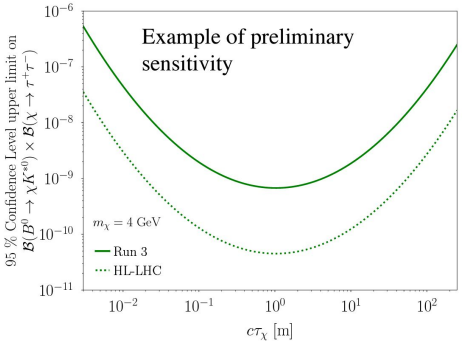
Long-lived particles in the LHCb muon system

- Challenge: Turn the muon system into a dedicated subdetector to reconstruct very long-lived LLPs
  - Use **Muon System Tracks** (MSTs), combine them into displaced vertices
  - First form clusters (produced by tracks different to muons), then combine clusters aligned in tracks
  - Best sensitivity so far: CMS with cluster counting strategy **CMS PAS EXO-21-008**
  - Signature provides more info about signal than simple cluster counting (less background), also likely to be less efficient in general

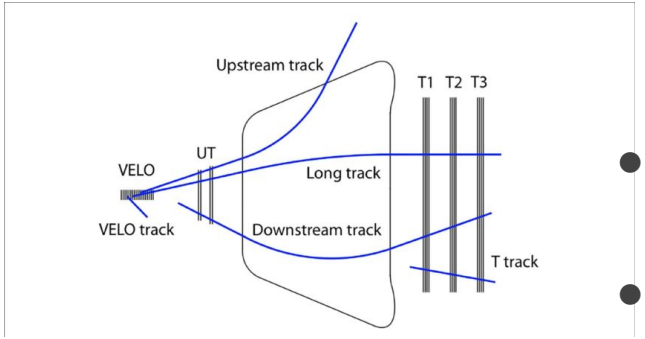




IGFAE and EPFL

M. Pereira, A. Martínez (MSc student)

GNNs for long-lived particles at LHCb



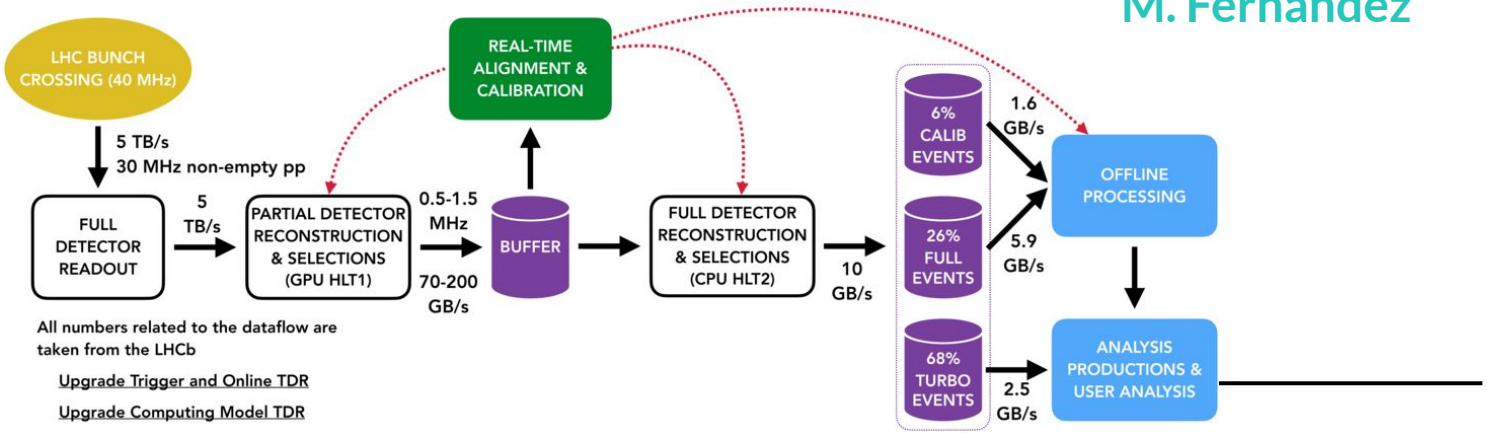
M. Fernández

- Reconstructing long-lived particles in LHCb can be challenging.
- Graph Neural Networks allow us to address the problem of high multiplicity.
- We'll need to coordinate with IFIC (leading group on the subject of displaced tracks)
- We are focused on downstream and T-tracks.
- Have already been used for tracks originating in the VELO [2407.12119]

Triggers for strange physics at LHCb

- Efforts underway to revise all strange trigger lines ahead of 2025
- All trigger lines will be adapted for long and displaced tracks
- Cuts on final-state particles will be aligned across channels
- Good prospects for KS->mu mu and KS->mumupi0, among other channels
- In coordination with Coruña group

M. Fernández



Triggers for axion-like particles at LHCb

ALPs:

- Pseudo-Nambu-Goldstone bosons in BSM models
- Their effective scale can be arbitrarily lower than the NP physics scale
- Most promising decay at LHCb, ALP→γγ. Leading sensitivity with Run 2 data (analysis very close to publication)
- Need to update trigger for Run 3, potential to provide factor of >5-10 more data compared to current analysis

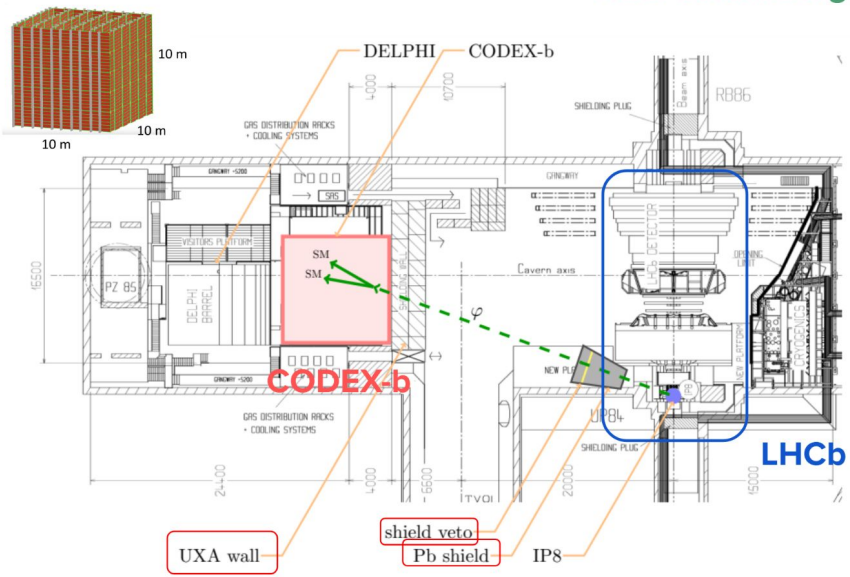
Alejandro N. (MSc student)

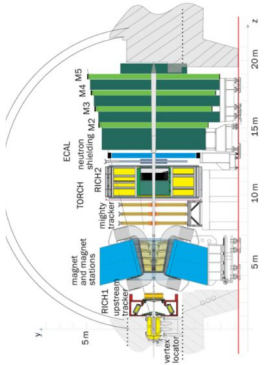
A COmpact Detector for EXotics at LHCb

Relatively **cheap** detector, **O(10) M€**

Located 25 m away from the IP8 (LHCb).

Near zero-background: wall + shield veto.



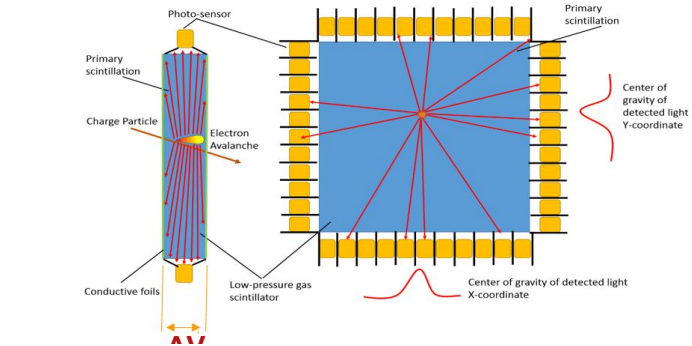


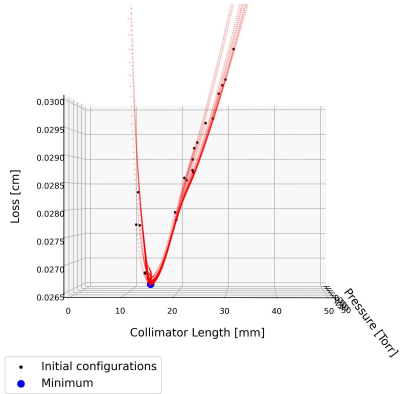
Simulation→ P. Menéndez-Valdés and E. Rodríguez. Push for the use of ML (GANs, diffusion models)

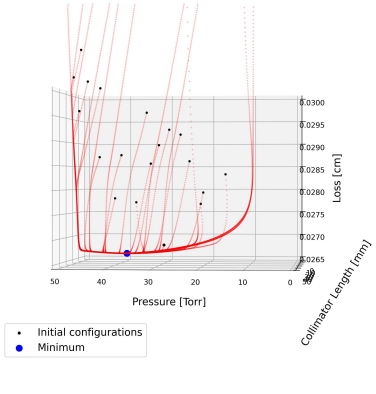
Automatic, ML based, optimization

M. Pereira

- **Optimization of detectors and experiments can be challenging:** high number of free parameters, costly simulations
- ML offers ways to optimize detectors automatically by minimising objective functions that can include both performance and detector cost
- **Our target:** the Parallel-Plate Avalanche Counter with Optical Readout
- Detector response modeled as a diff. function of parameters of interest using a surrogate NN
- Optimal parameters found by minimising an objective function containing detector response







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