# Dimuon measurements in the low and intermediate mass region at $\sqrt{s}$ = 13.6 TeV in pp collisions with ALICE

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22nd – 27th Sep. 2024
The 12th International Conference on Hard and Electromagnetic Probes of High-Energy Nuclear Collisions

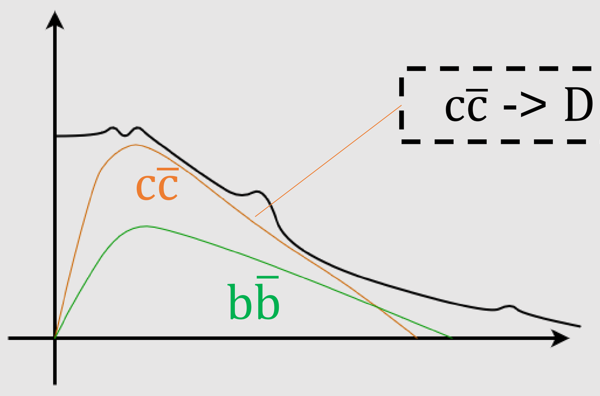
## Motivation for dimuon measurements

A clean signal with minimal background events

- Lower background compared to dielectron measurements
- High purity muon identification thanks to the system of absorber removing the hadronic background
- Signal: Light vector mesons, quarkonia, heavy quarks, and virtual photons

Focus on heavy flavor ($c\bar{c}, b\bar{b}$) contributions

- Production cross-sections of $c\bar{c}$ and $b\bar{b}$ -> important test of pQCD
- Background measurement for the other signals




$c\bar{c}$ -> D meson + $\bar{D}$ meson -> $\mu^+\mu^-$

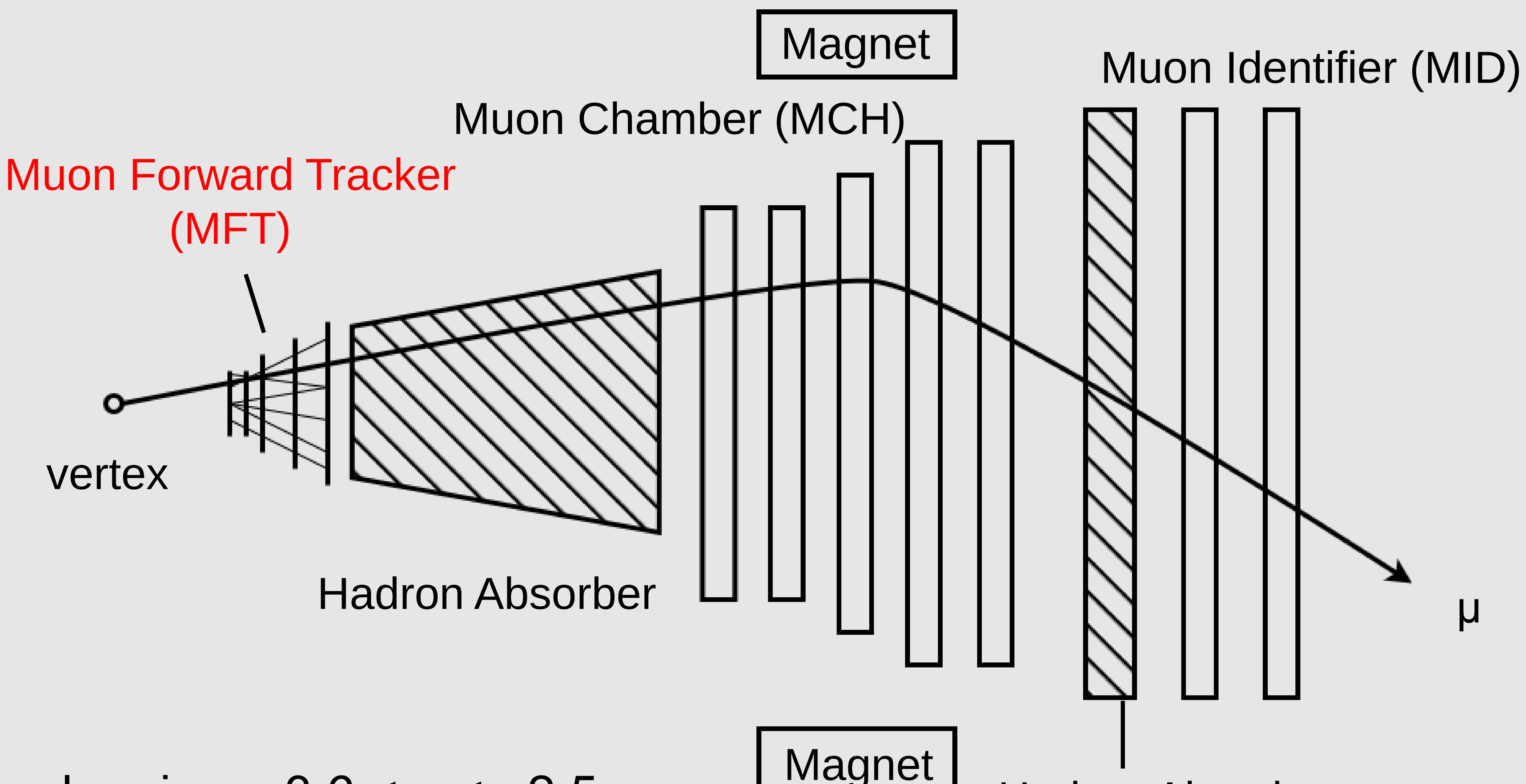
$$m_{\mu\mu} = \sqrt{(E_{\mu^+} + E_{\mu^-})^2 - (\vec{p}_{\mu^+} + \vec{p}_{\mu^-})^2}$$

Challenges: - Low momentum muon measurement
- Angular resolution near the vertex

## ALICE Muon Detector

Improved angular resolution due to the introduction of the MFT in Run3

- Possibility to measure precisely the secondary vertex




- Forward region, $-3.6 < \eta < -2.5$
- System of absorbers: high purity muon sample

Question: **What are the keys to measure the heavy flavor contribution?** → **1. Precise background subtraction** **2. Dimuon decay topology**

## Data samples

- pp collision at $\sqrt{s}$ = 13.6 TeV
- 1.85 x $10^{10}$ minimum bias events
- MFT-MCH matching $\chi^2$ < 50
  - Minimize the number of false matched tracks
- Muons associated with only one pp collision
  - Reduce incorrect associations between tracks and collisions
- Secondary vertex position from the collision point: $z_{sv}$ > -20cm
  - Exclude dimuons with same matched MFT tracks

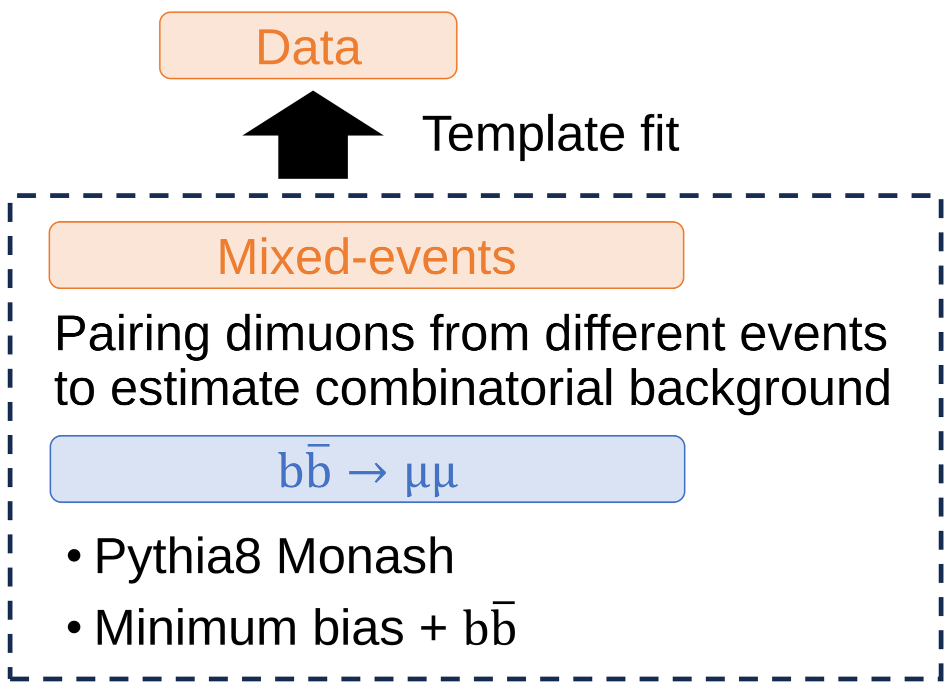
## 1. Precise background subtraction

Background estimation by event-mixing and fitting to like-sign spectrum

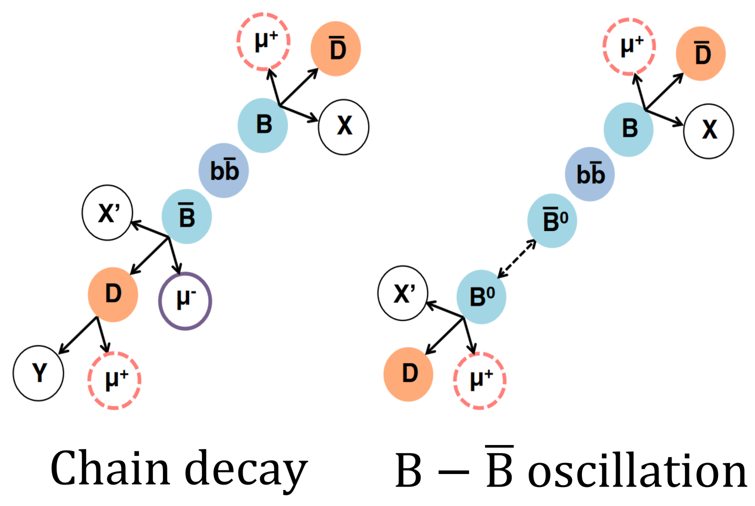
→ Goal: more accurate background understanding by considering correlated components

Procedure:

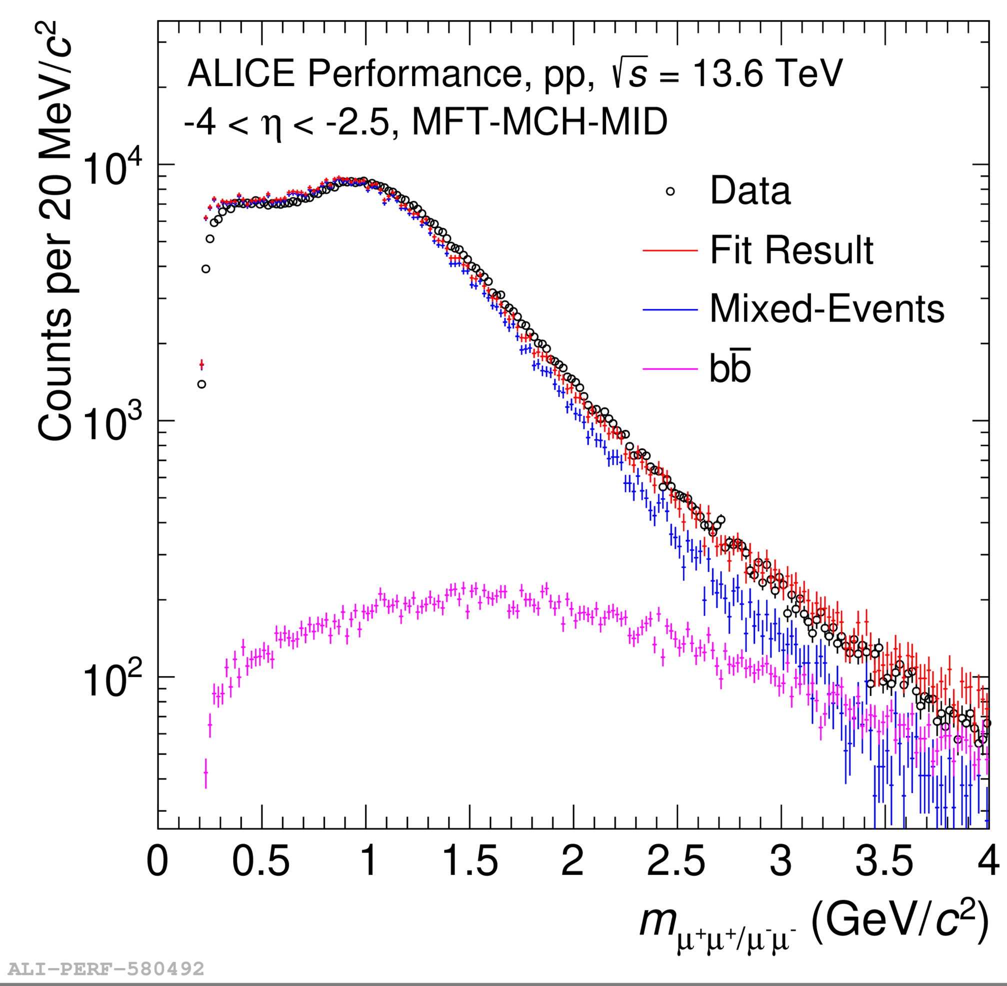
1. Estimation of combinatorial background using event mixing
2. Simulate the correlated component in like-sign spectrum
3. Normalization via fitting to the like-sign mass spectrum




Contribution of $b\bar{b}$ to like-sign $\mu\mu$
[Phys. Rev. D 99, 072003 (2019)]




Results:




**The dimuon spectrum up to 4 GeV/$c^2$ is qualitatively described by a combination of mixed events and $b\bar{b}$ background.**

**More detailed checks necessary to investigate the various dimuon sources.**

## 2. Dimuon decay topology

Separation of vector-mesons and heavy flavors by decay length cuts

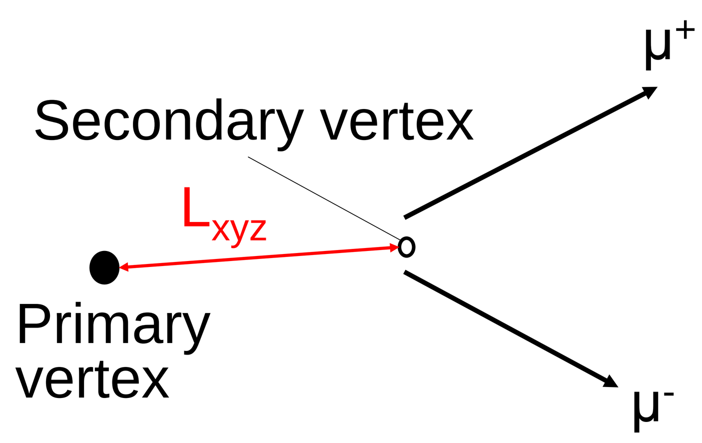
→ Thanks to the characteristic lifetime of heavy flavor meson, the decay length allows to achieve separation between heavy flavor and other sources like vector-mesons

Procedure:

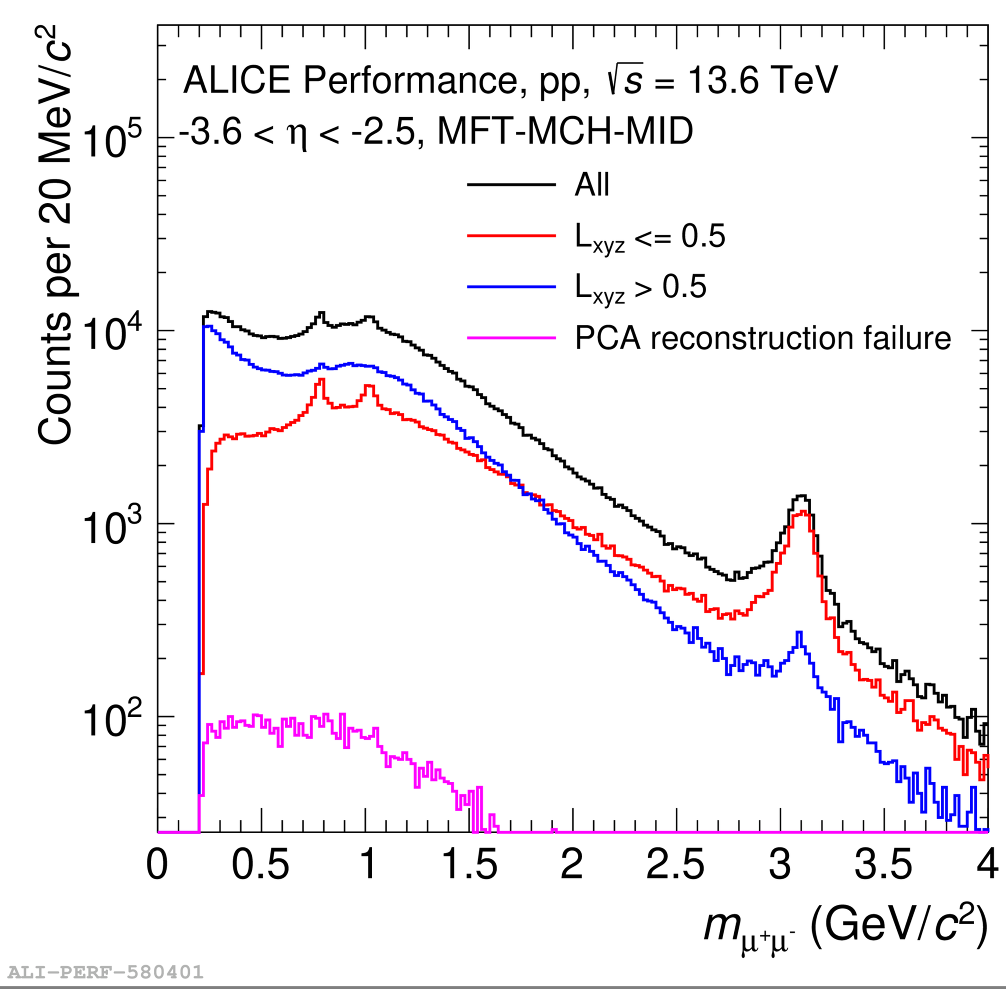
1. Reconstruction of secondary vertex from dimuon
2. Checking the difference of the mass distribution through decay length ($L_{xyz}$) cuts

Short $L_{xyz}$ :
- short-lived parent particle
- e.g., ω, φ, prompt J/ψ

Long $L_{xyz}$ :
- long-lived parent particle
- e.g., D, B, non-prompt J/ψ




Results:




**Secondary vertexing enables separation of different contributions to the dimuon spectrum. (vector mesons, heavy flavors, long-lived particles)**

## Prospects

- Cocktail creation using mass distribution and secondary vertex distribution.
- Efficiency correction considering the detector response