Measuring the $B^{\pm}$ meson with ALICE at low transverse momentum

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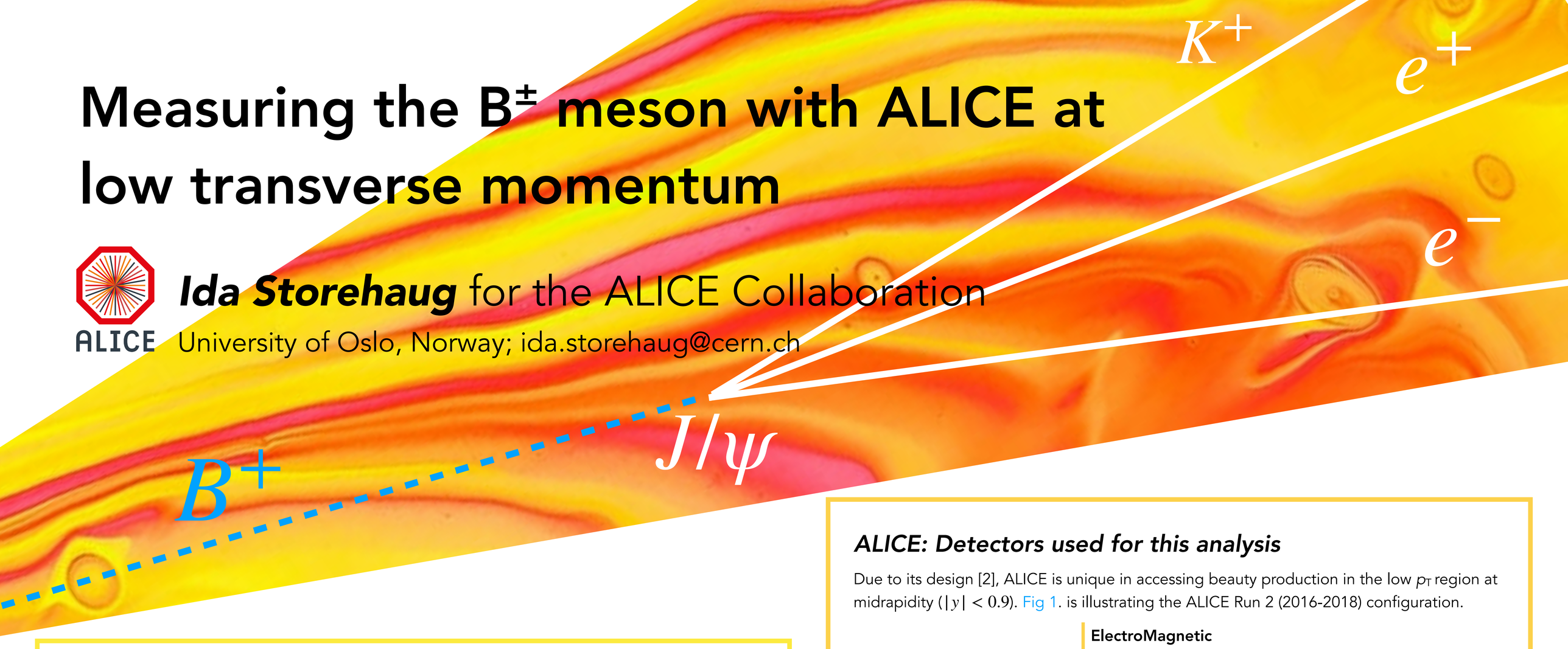


What and why?

Hard and heavy probes are gauging the properties of quark-gluon plasma. Accessing hadrons containing beauty quarks can provide constraints on the mechanism of partonic energy loss and its mass dependence.

Objective

Measure the cross section of $B^{\pm}$ in pp collisions at low p_T and midrapidity.

Why?
- Testing production models (pQCD)
- Used as reference for measurements in heavy-ion collisions

Particle	B^+ ($u\bar{b}$)
Mass [1]	5279.34 ± 0.12 MeV/c^2
Lifetime [1]	1.638 ± 0.004 ps
Decay modes Selected channels [1]	$\bar{D}^0$ X (79 ± 4) %
	D^0 X (8.6 ± 0.7) %
	J/ψ K^+ (1.020 ± 0.019)·10^{-3}
	J/ψ K^+ X ~4.0 · 10^{-3}

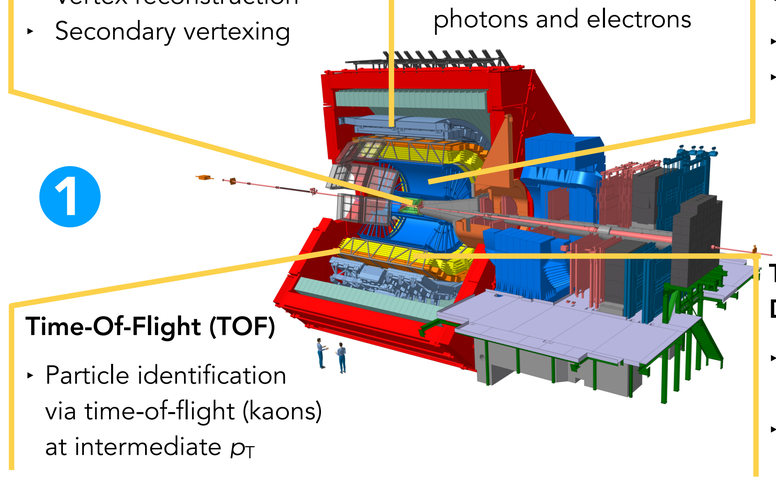
ALICE: Detectors used for this analysis

Due to its design [2], ALICE is unique in accessing beauty production in the low p_T region at midrapidity ($|y| < 0.9$). Fig 1. is illustrating the ALICE Run 2 (2016-2018) configuration.

Inner Tracking System (ITS)
- Tracking
- Vertex reconstruction
- Secondary vertexing

ElectroMagnetic Calorimeter (EMCal)
- Electron identification
- Trigger for high-energy photons and electrons

Time Projection Chamber (TPC)
- Main tracking detector
- Particle identification (electrons and kaons) at low p_T



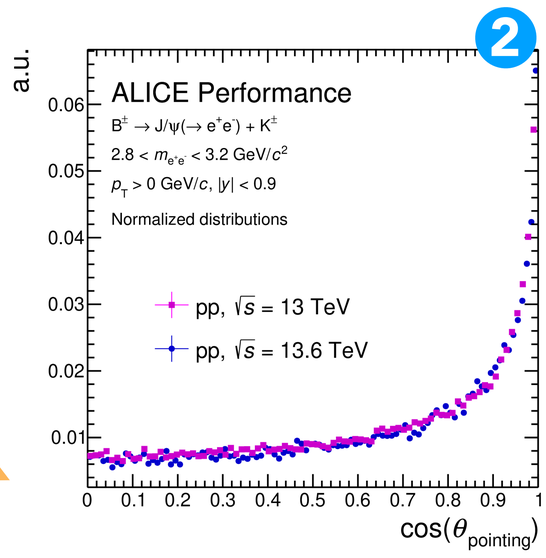
Time-Of-Flight (TOF)
- Particle identification via time-of-flight (kaons) at intermediate p_T

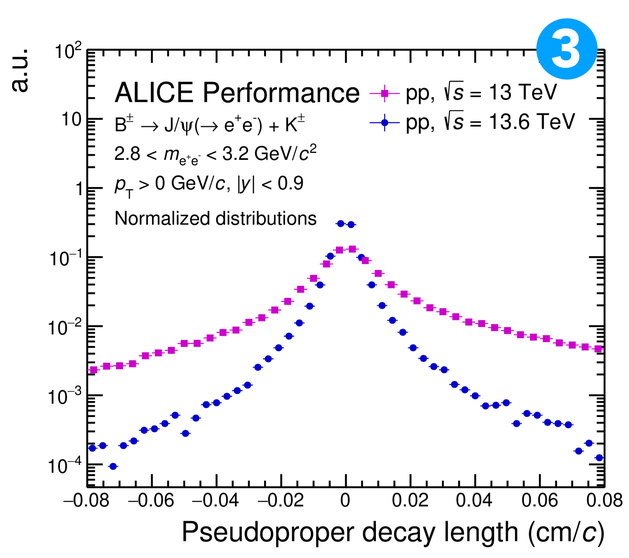
Transition Radiation Detector (TRD)
- Electron identification at intermediate p_T
- Trigger for electrons and jets

How: Analysis strategy

1) Building a J/ψ candidates sample using selections on the single electrons and electron pairs
2) A secondary vertex is reconstructed using the J/ψ candidates and the $K^{\pm}$ in the same event
3) Applying cuts on the topological variables of the $B^{\pm}$ candidate (Fig 2., 3)

Open for list of cuts!





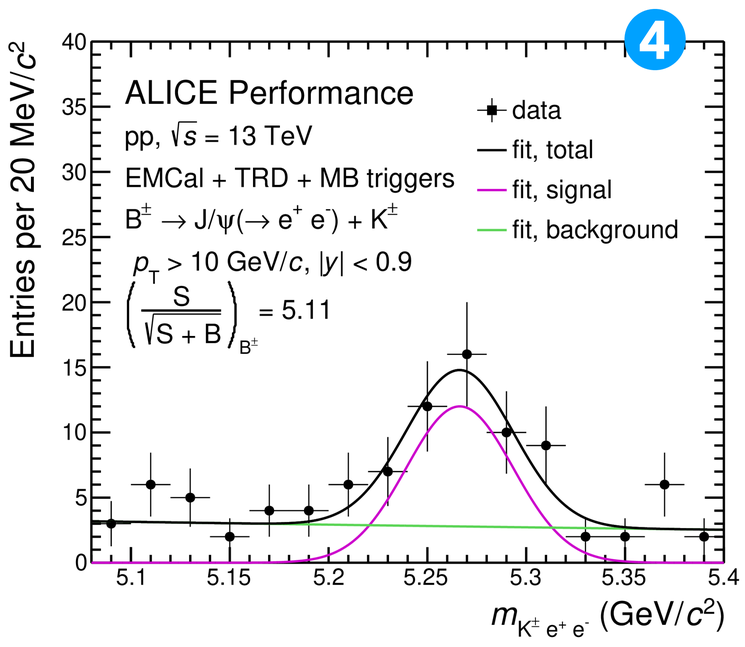
Data

Run 2:
- pp collisions at $\sqrt{s}$ = 13 TeV collected in 2017 and 2018
- Integrated luminosity:
  - TRD-triggered data: ~ 2 pb^{-1}
  - EMCal-triggered data: ~ 8.3 pb^{-1}

Run 3:
- pp collisions at $\sqrt{s}$ = 13.6 TeV collected in 2022
- Integrated luminosity: ~ 9 pb^{-1} of minimum-bias events

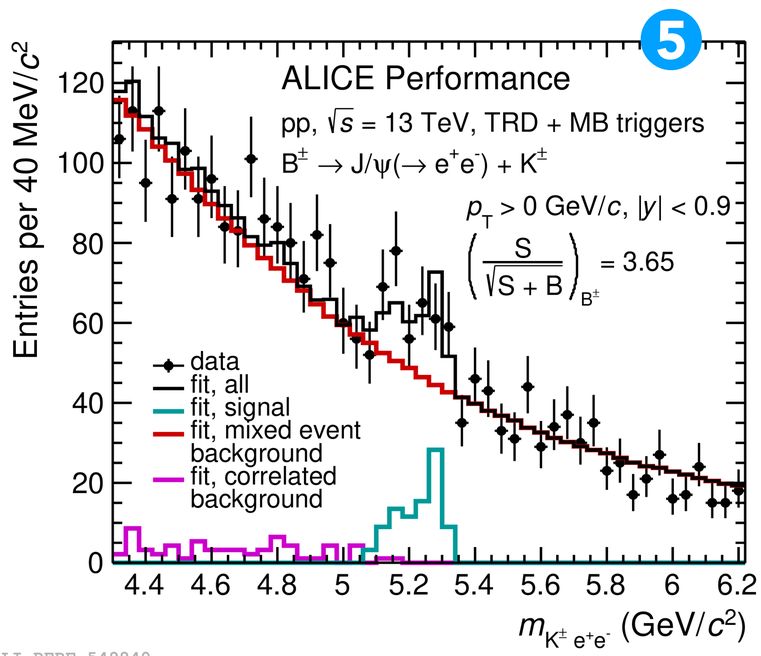
Part 1: High transverse momentum (Fig. 4)

- The signal is estimated using a gaussian function
- The background is estimated using a polynomial function



Part 2: Low transverse momentum (Fig. 5)

- Uncorrelated background is estimated using the *mixed-event* technique
- Contributions by other resonant decay channels and the signal shape are estimated using a template fit on Pythia simulations



Results and outlook

Result

The invariant mass for the $B^{\pm}$ meson has been reconstructed at low p_T and midrapidity, with ongoing efforts to enhance the significance using new Run 3 data.

Using the EMCal trigger provides sensitivity to electrons with $p_T > 10$ GeV/c. For high-p_T electrons the PID efficiency is better, leading to a **higher signal significance**.

During LS2, ALICE has undergone significant upgrades [3] that will benefit this analysis:
- The statistics will be greatly improved, as ALICE will collect data at an interaction rate 50 times larger than in Run 2
- Improved vertexing resolution due to ITS upgrades (Fig. 3)

Measuring the $B^{\pm}$ cross section in pp collisions down to low p_T and at midrapidity is an achievable goal for Run 3 at ALICE.

References
[1] R.L. Workman *et al.* (Particle Data Group), Prog. Theor. Exp. Phys. **2022**, 083C01 (2022)
[2] ALICE Collaboration, K. Aamodt *et al.*, "The ALICE experiment at the CERN LHC", *JINST* 3 S08002 (2008)
[3] ALICE Collaboration, B. Abelev *et al.*, "Upgrade of the ALICE Experiment: Letter Of Intent", *J.Phys.* G41 087001 (2014)

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Contact me!