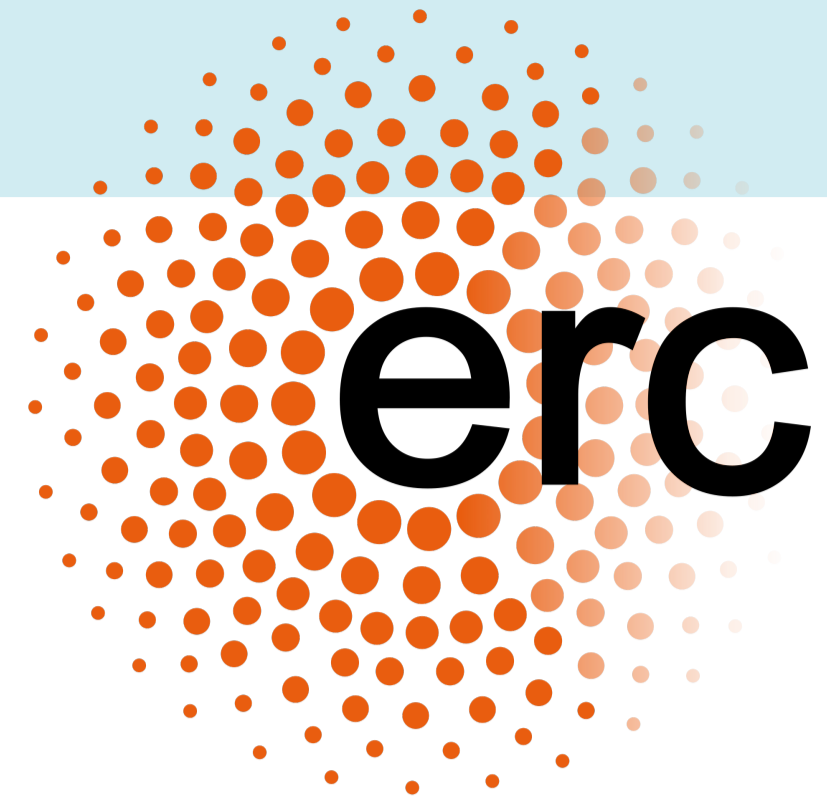# LHCb Early Measurements with electrons in the final state using first Run 3 data

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Motivation

The LHCb Experiment has undergone a major upgrade during the LHC LS2. In the first stages of Run 3 data taking an Early Measurements Task Force is being carried out:

➢ Understand the early detector performance.

➢ Provide first physics results in Run 3.

...cays with electrons in the final state play a major role in Lepton Flavour Universality (LFU) ratios ...asurement.

...We aim to provide first validation of electron reconstruction with upgraded detector.
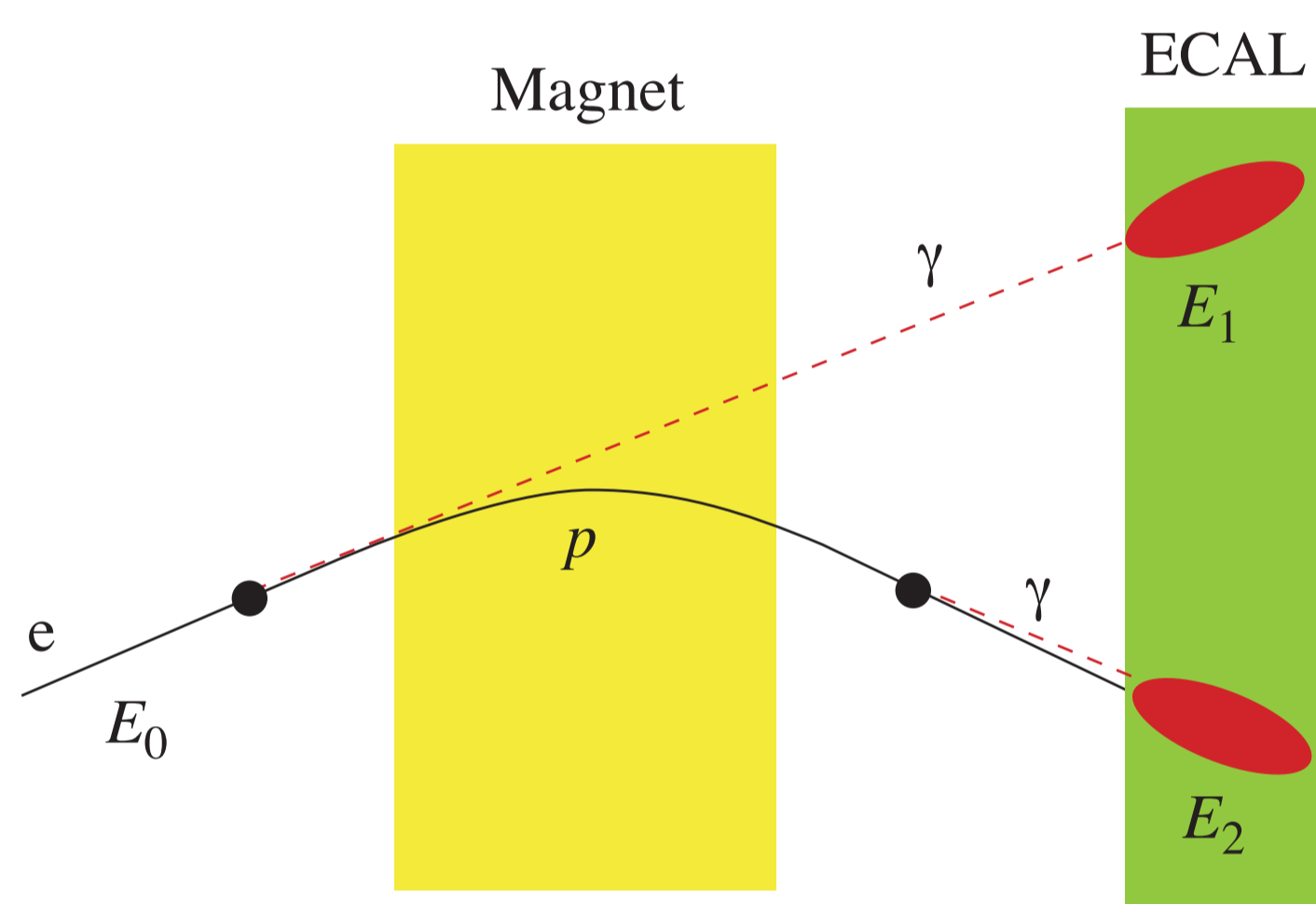
... in LHCb

...s challenging in LHCb.

...rahlung photons when ... → energy loss.

Brem recovery: extrapolate tracks to energy deposits in ECAL from Velo and UT.

Run 3: No SPD+PS system, full software trigger reconstruction, also higher detector occupancy.

➢ **Need new electron reconstruction algorithms.**

Why $B^+ \to J/\psi(ee)\,K^+$

➢ Tree-level neutrinoless channel, highest yield and purity with electrons in final state.

➢ Constraining J/ψ mass reduces brem effect and background in the fit.
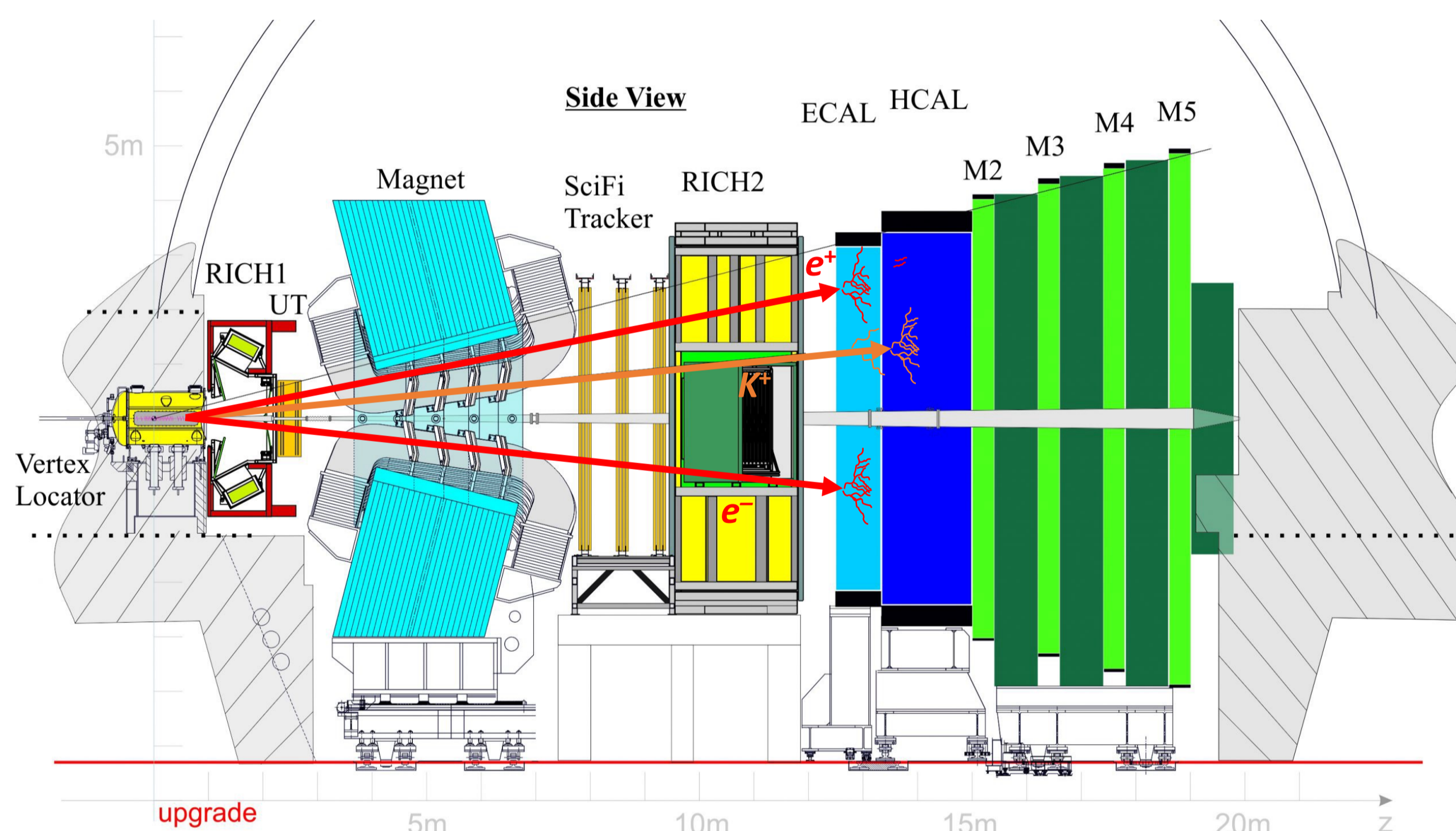
➢ Control channel in $b \to see$ analyses.

Trigger & Selection

Trigger on track signatures (HLT1).

➢ **New:** Electron HLT1 lines for Run 3.

Exclusive TURBO line to select $K^+e^+e^-$ candidates (HLT2) with PID requirements.

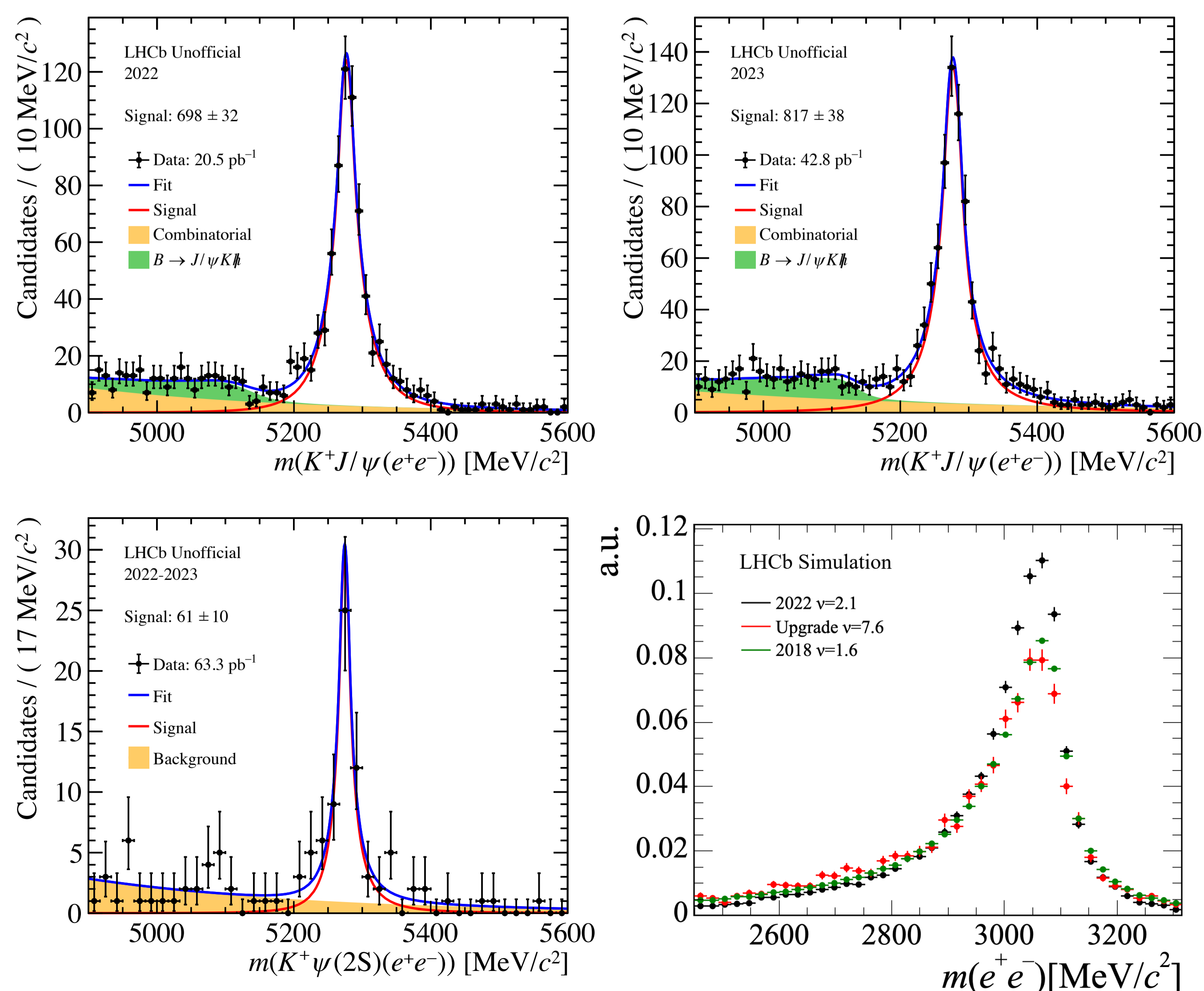Offline selection: clones removal and BDT to reject combinatorial background.

Results

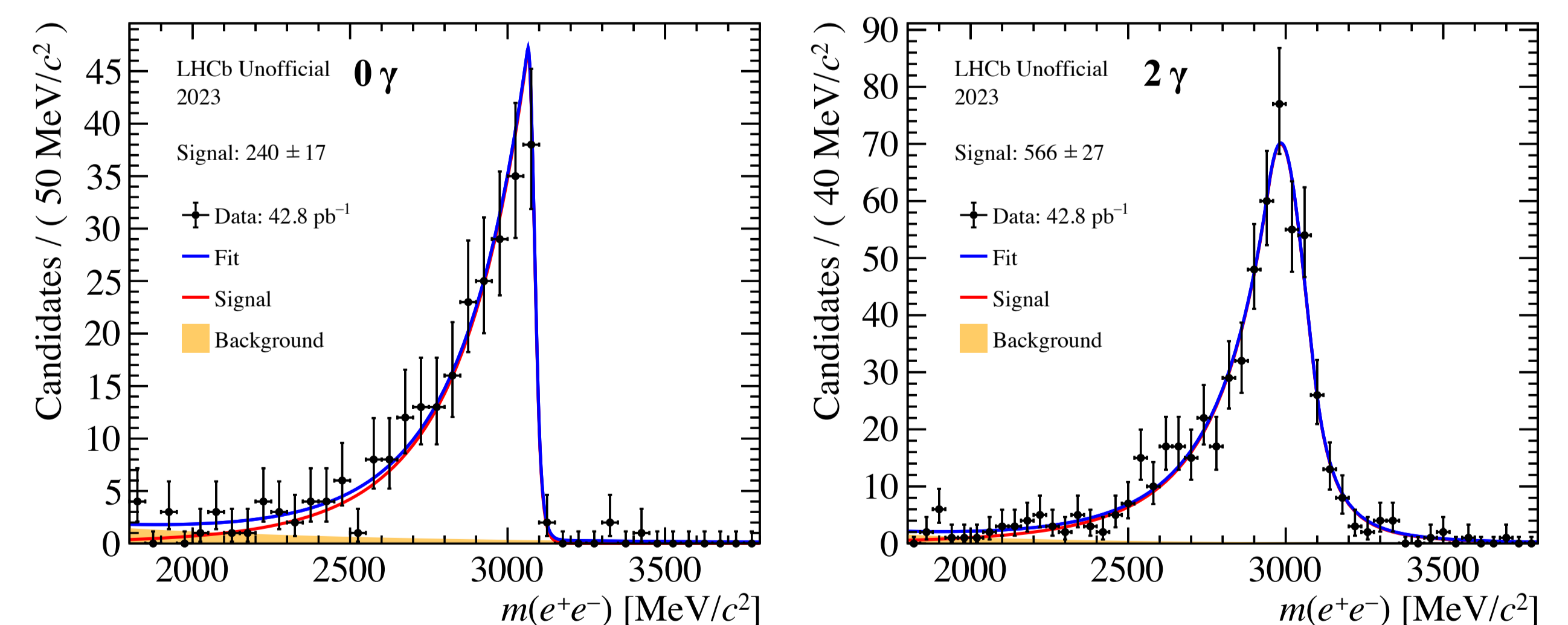$B^+ \to J/\psi(ee)\,K^+$ observed both in 2022 and 2023, found also $B^+ \to \psi(2S)(ee)\,K^+$!

Perform kinematic fit with J/ψ or $\psi(2S)$ mass constraint.

Good performance of new reconstruction algorithms with higher detector occupancy.

Bremsstrahlung categories

We define brem categories based on how many electrons have brem photons attached. Dielectron pair can have 0γ, 1γ or 2γ.

Conclusions & Prospects

➢ First decays to electrons have been observed with Run 3 data.

➢ New electron reconstruction, brem recovery are working. We've provided results to understand it and calibrate.

➢ These are first steps for LFU and other $b \to s/d\,ee$ analyses.

13th LHC students poster session