Beyond the SM searches with LHCb in LHC Run 2, Run 3 and HL-LHC

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Research team

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JdlC: Veronika Chobanova
Postdoc Global Talent (IGFAE/MdM): Jeremy Dalseno
Postdoc: Claire Prouvé (LHCb Early Career Award)
PhD students: Adrian Casais, Alexandre Brea, Asier Pereiro, Lorena Dieste, Marcos Romero, Pablo Baladron, Ramon Ruiz, Saúl López
Undergraduate students: Carlos Meijide, Isabel Sainz

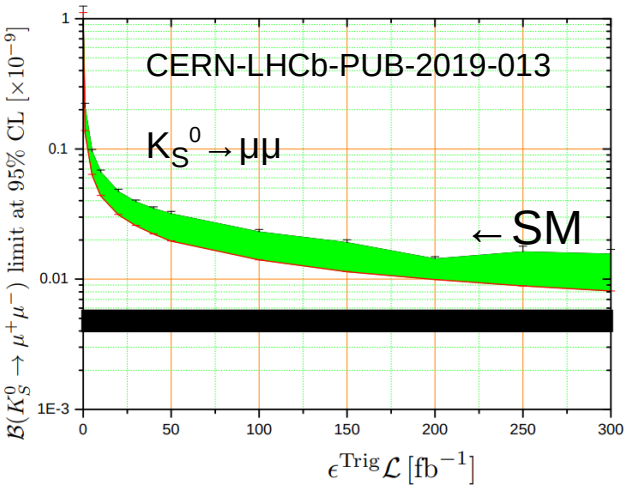
Reconstruction and trigger Real time analysis (RTA)

PERIOD	Efficiency($K_S^0 \to \mu\mu$)
2011	~1%
2012	~2.4%
Run 2	~18%
Full sw trigger	~100%

- Long-term commitment to trigger development, focus on low-pT muons (~80 MeV) – makes LHCb a leader in kaon/hyperon physics
- Official Spanish contribution to RTA with URL, IFIC
- Successfully developed cost efficient GPU-based HLT architechture (Comput Softw Big Sci 4, 7 (2020), LHCB-TDR-018)
- GPUs heavily used in analysis: framework in pyCUDA to substitute ROOT/RooFit (arXiv:1706.01420v1)

Data analysis: strange decays

- Rare kaon and hyperon decays, $K_S^0 \to \mu\mu$, $K_S^0 \to \pi^0\mu\mu$, $\Sigma \to p\mu\mu$
  arXiv:2001.10354, accepted by PRL (thesis Miguel Ramos); PRL 120, 221803 (2018);
  JHEP 05 (2019) 048 (thesis Miriam Lucio)

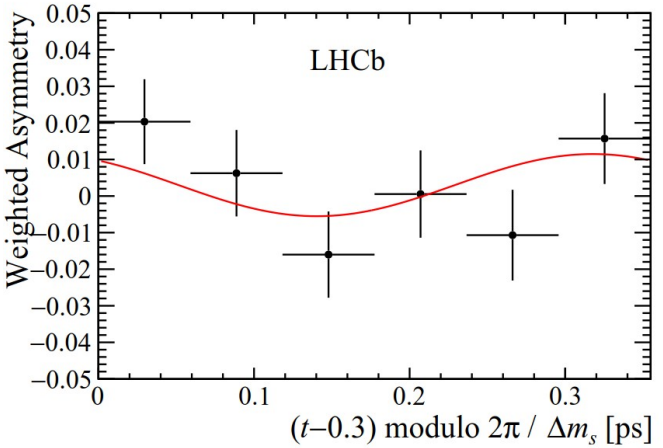


- Hyperon decays – sensitive to BSM, e.g. break lepton universality
- No updates since the ‘70s
- Measurement of $B(\Lambda^0 \to p\mu\nu)$ with Run 2 data, expecting 44k events and an error of 1% (Alexandre Brea)

Data analysis: B_s^0 oscillations

- Measurement of CP-violating phase φ_s and lifetime observables in $B_s^0 \to J/\psi KK$
- High sensitivity to BSM physics
- World's most precise measurement: φ_s = -81 +/- 32 mrad (Run 1 + 1/3 of Run 2) (EPJ C 79 (2019) 706)
- 2 PhD theses (Marcos Romero, Miriam Lucio) + 1 Master thesis (Marcos Romero)
- Measurement of φ_s penguin pollution through $B_s^0 \to J/\psi \overline{K}^*$ decays (Ramon Ruiz with Run 2; Run 1 measurement in thesis of Carlos Vázquez, 2016)

B2CC WG convener: Diego (2020-2022; 2013-2015)
Former B2CC WG convener: Veronika (2018-2020)
HFLAV Oscillations WG member: Veronika (since 2020)



Flavour tagging (FT)

- Work on Inclusive Flavour Tagging and Upgrade (Claire, Diego, Veronika)
- Run 3 stat. precision on φ_s: 14 mrad (10 mrad with inclusive FT)

  HL-LHC (300 fb^{-1}): 4 mrad

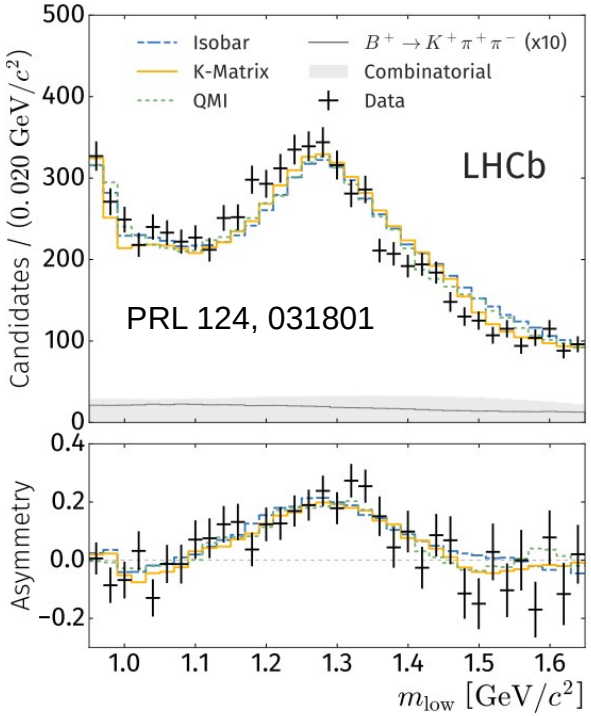
FT convener: Veronika (2020-2022)

Data analysis: charmless B decays

- Amplitude analysis of $B^+ \to \pi^+\pi^+\pi^-$

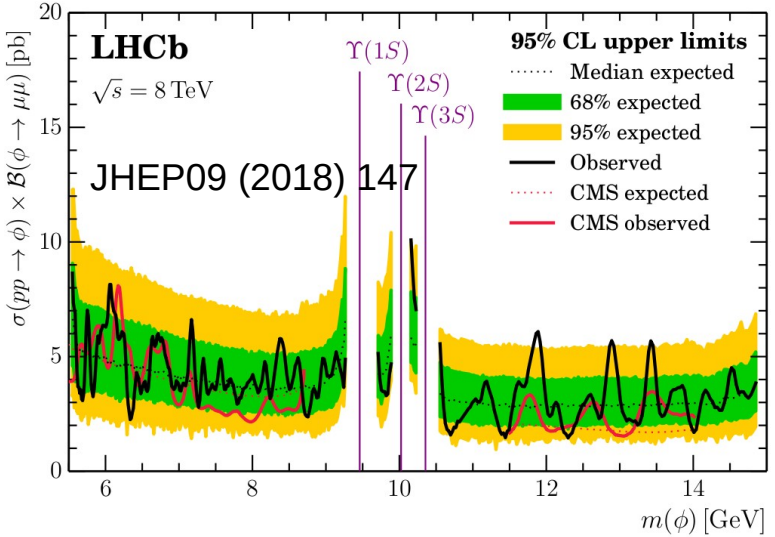
  PRD 101 (2020) 012006, PRL 124, 031801
- $B_S^0 \to K^*\overline{K}^*$ - search for BSM physics in a penguin-dominated decay, ongoing measurement with full Run 2 data (Asier Pereiro; Run 1 in thesis of Julian Garcia)
- Amplitude analysis of $B^+ \to K_S^0\pi^+\pi^+\pi^-$ with full Run 2 data (Pablo Baladron)
- Amplitude analysis of $B^+ \to K^+K^+K^-$ (Jeremy)
- Measurement of SM parameter α in $B^0 \to \rho^0\rho^0$ (Jeremy)

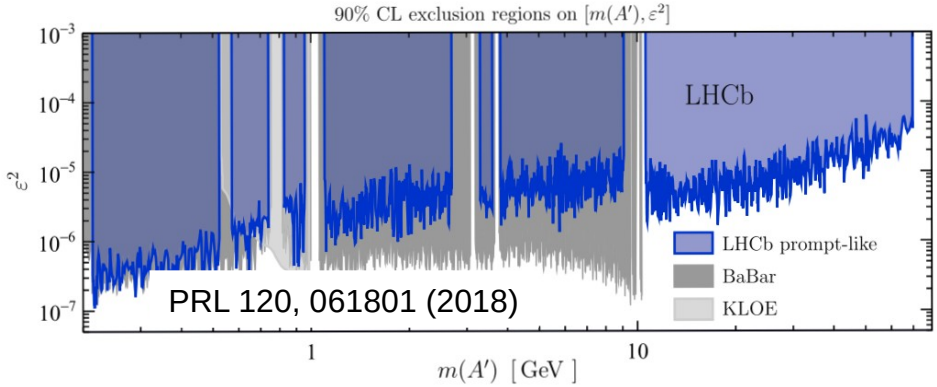
BnoC WG convener: Jeremy Dalseno (2019-2021)



Data analysis: exotica

- BSM Higgses: JHEP 09 (2018) 147, JHEP 10 (2020) 156
- QCD measurements: arXiv:2010.09437 (2020)
- Dark photons PRL 120, 061801 (2018),
  PRL 124, 041801 (2020)
- LHC papers: JHEP 01 (2020) 115, NPP 47 090501 (2020)





Xabier Cid Vidal:
Convener LPCC Dark Matter WG (since 2018)
Former LHCb QEE WG convener (2016-2018)