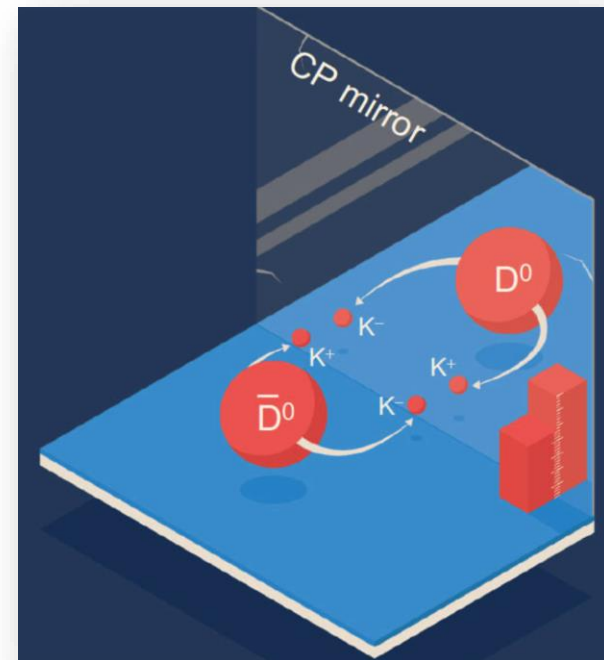
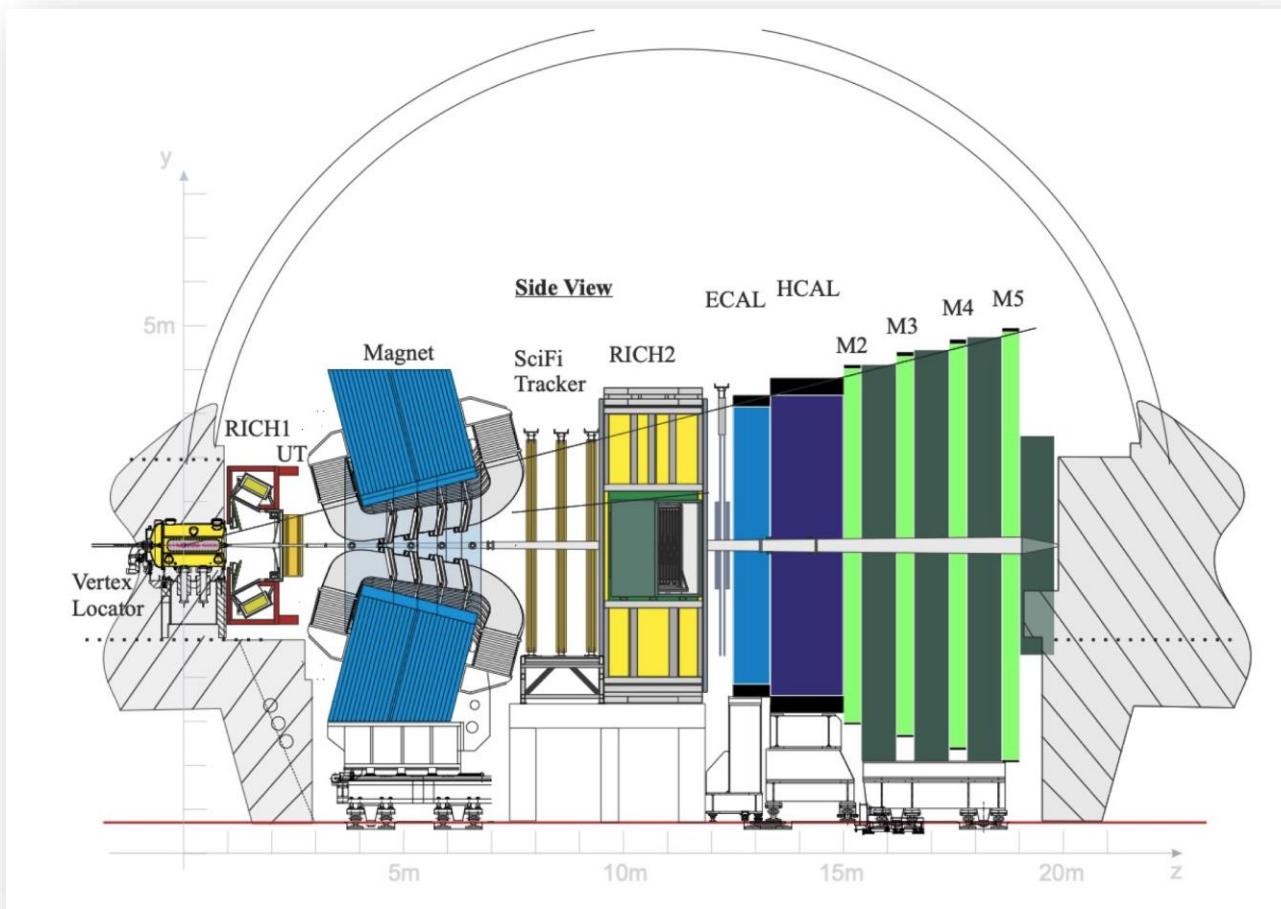


ESPP considerations: LHCb



LHCb Run 3 (Upgrade 1)



General purpose detector forward geometry

SMOG, MoEDAL, CodexB

At high energies production of the b and anti-b highly correlated

Pseudorapidity range $2 < \eta < 5$

Complementary to other LHC experiments

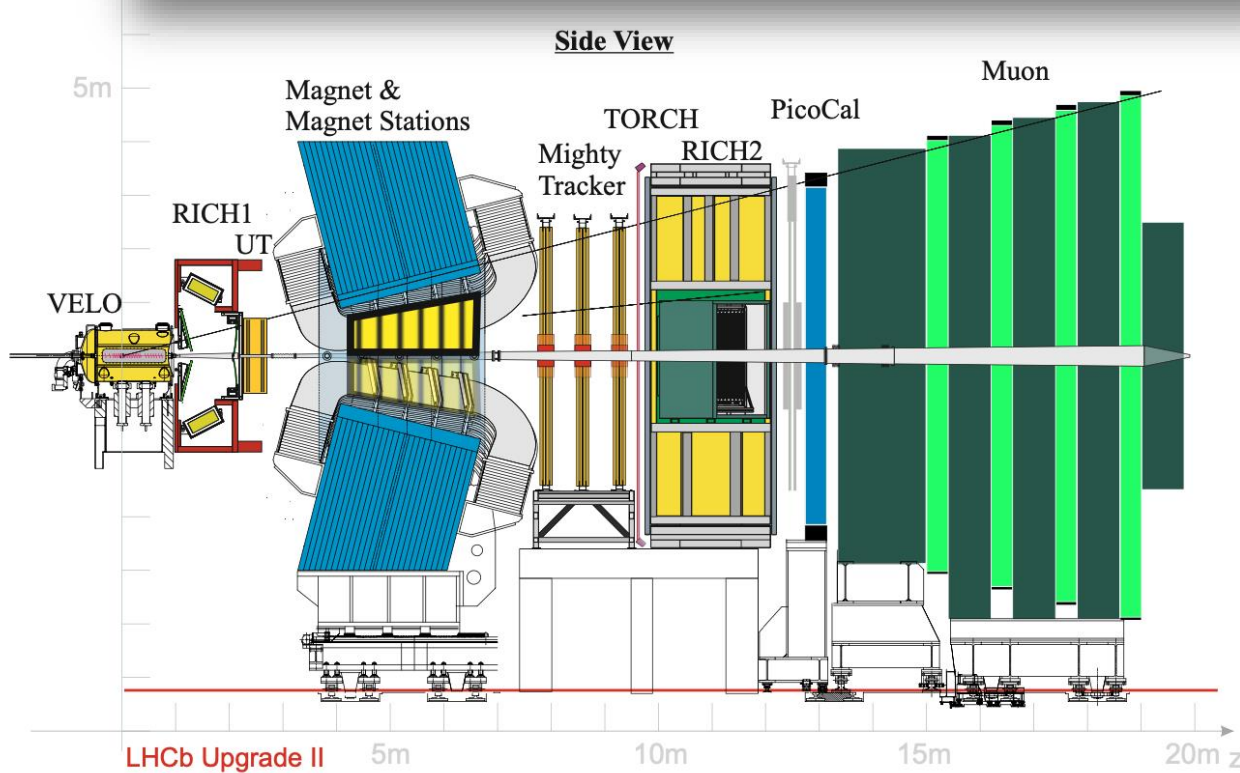
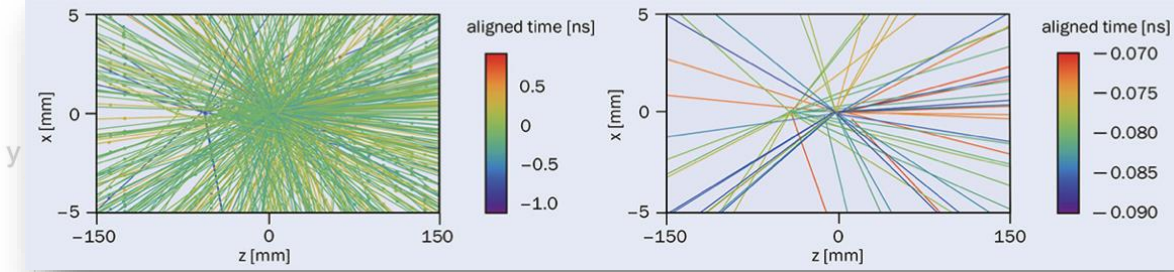
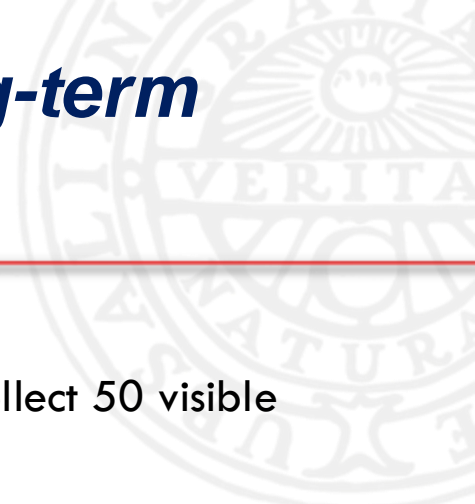
Run 1 - 3 integrated luminosity 23 fb^{-1} (9 fb^{-1} runs 1-2)

VELO and Hadron PID are excellent, neutrals possible, but challenging

VELO resolution $\sigma_{\text{IP}} (15 + 29/pT) \mu\text{m}$



LHCb Upgrade II – (3b-ii) Long-term potential

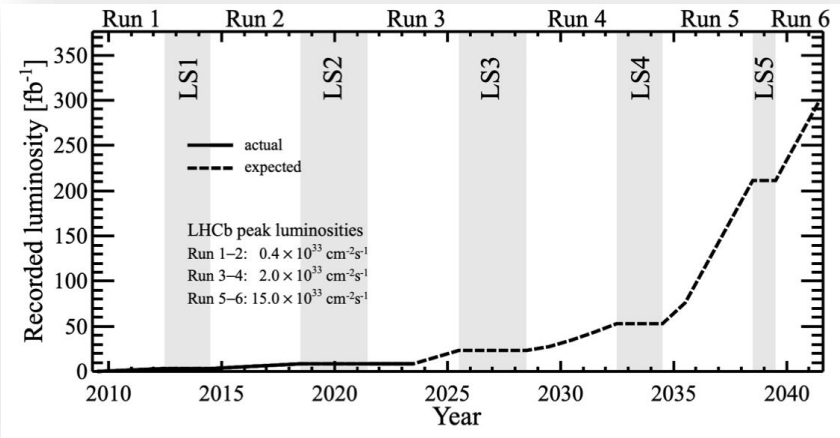


Upgrade II (2031-): aim to collect 50 visible interactions per bunch collision

End of Run 6 goal : 300 fb⁻¹

High spatial and timing precision (<50μm, <50ps) will require

New technology has often gone hand-in-hand with discoveries and unforeseen spin-offs

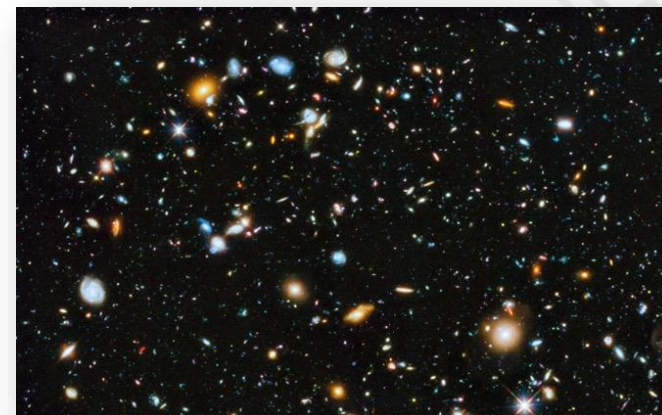


CP violation in flavour sector – (3b-iii) Physics potential

Sakharov's three criteria

*A. D. Sakharov, *J. Exp. Theor. Phys. Lett.* 5, 24

- 1) Baryon number violation
- 2) Charge, C , and combined with Parity, P , violating processes
- 3) Departure from thermal equilibrium



2001
Beauty particles: Time-dependent CP violation in B^0 meson decays
BaBar and Belle collaborations

2004
Beauty particles: Time-integrated CP violation in B^0 meson decays
BaBar and Belle collaborations

2013
Beauty-strange particles: Time-integrated CP violation in B_s^0 meson decays
LHCb collaboration

2020
Beauty-strange particles: Time-dependent CP violation in B_s^0 meson decays
LHCb collaboration

1964
Strange particles: CP violation in K meson decays
J. W. Cronin, V. L. Fitch *et al.*

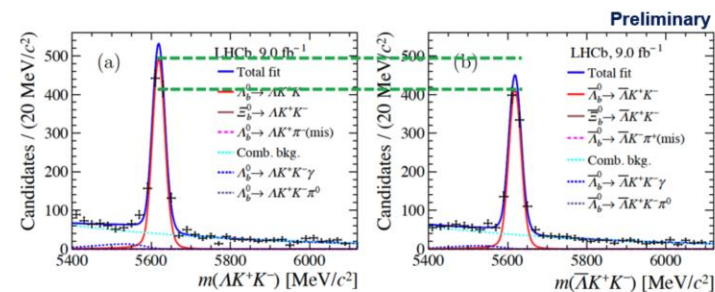
1999, 2001
Strange particles: CP violation in decay
KTeV and NA48 collaborations

2012
Beauty particles: CP violation in B^+ meson decays
LHCb collaboration

2019
Charm particles: CP violation in D^0 meson decays
LHCb collaboration



Baryon CPV has not yet been discovered, 3.1σ evidence

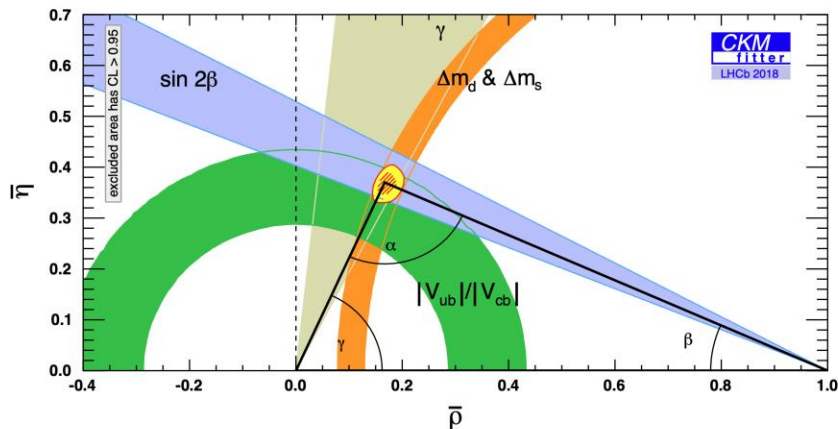


$$\Delta A_{CP} = 0.083 \pm 0.023 \pm 0.016$$

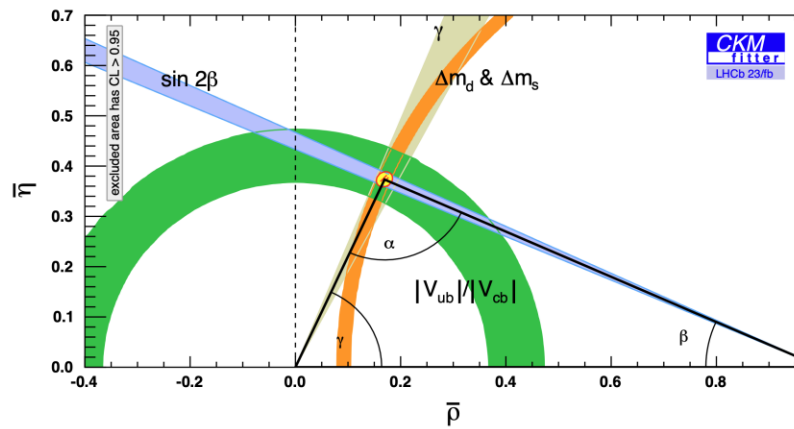
First evidence of CP violation, 3.1σ



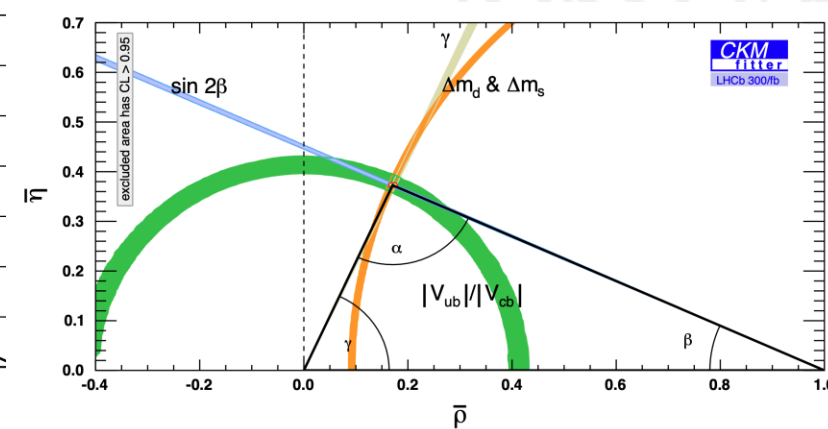
As of 2018



(end of Run 3) 23 fb⁻¹

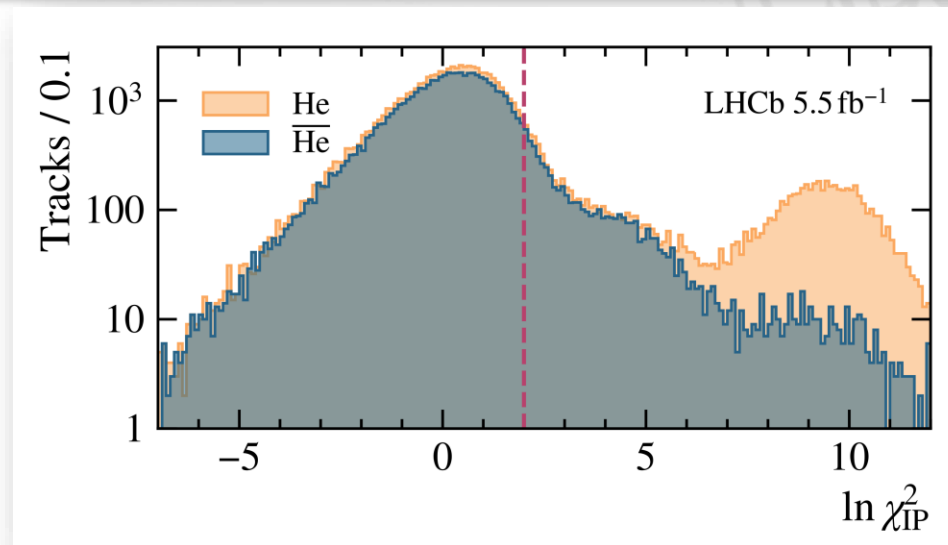
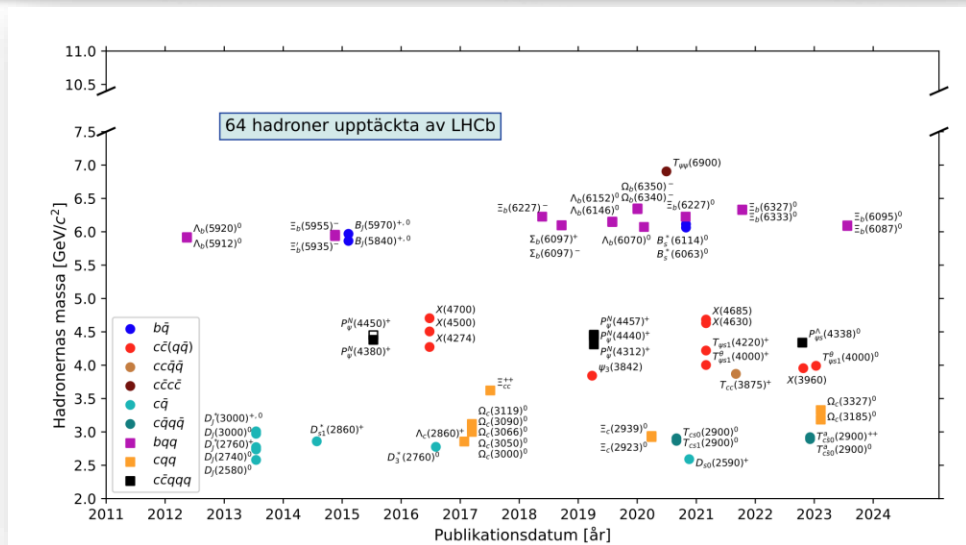


(end of Run 6) 300 fb⁻¹



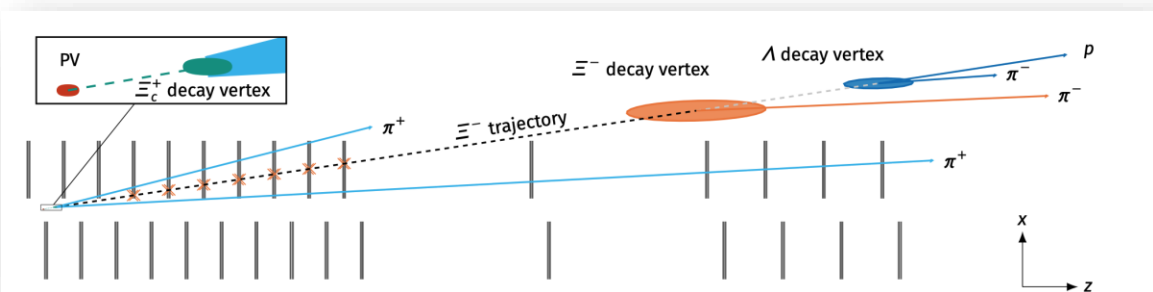
Precision with LHCb data and LQCD input alone

- Precision measurements in flavor sector has a strong track record of indirect discoveries
- **LHCb is a premier facility in the flavour regime**
- **Natural stopping point: If Standard Model explains all observed phenomena then look elsewhere**



Many hadron states discovered (hadron physics QCD)

10⁵ Helium and anti-Helium candidates in 5.5 fb⁻¹ (astrophysics)



Direct detection and tracking of charged long-lived particles EDM, BSM

