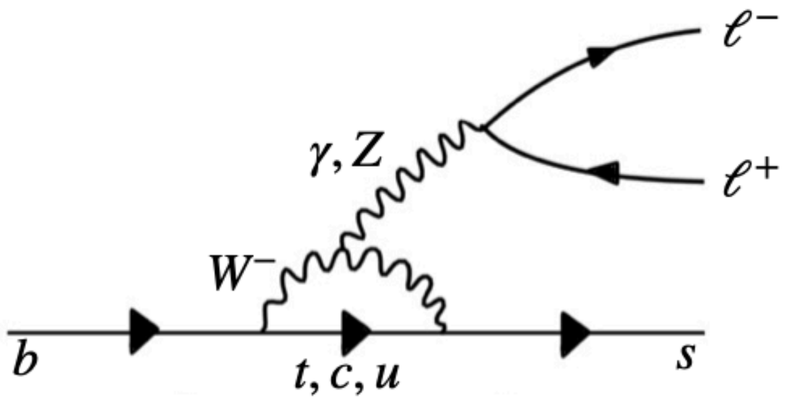
Branching fraction measurements of rare Ξ_b^- and Ω_b^- decays with LHCb experiment

First Flavour Day at IJCLab
27.10.2021

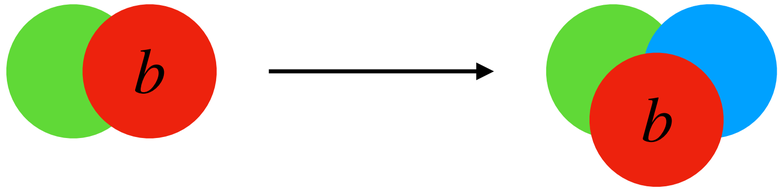
Johannes Albrecht, Vitalii Lisovskyi, Janina Nicolini
(TU Dortmund University)

European Research Council
Established by the European Commission

Baryonic $b \to s\ell^+\ell^-$ transitions



- Two spectator quarks
  → hadronic uncertainties
- Different backgrounds and challenges



- Complementary test to B anomalies
- Half-integer Spin → more observables
- Test spin-dependence of possible new physics
- Rich angular analysis

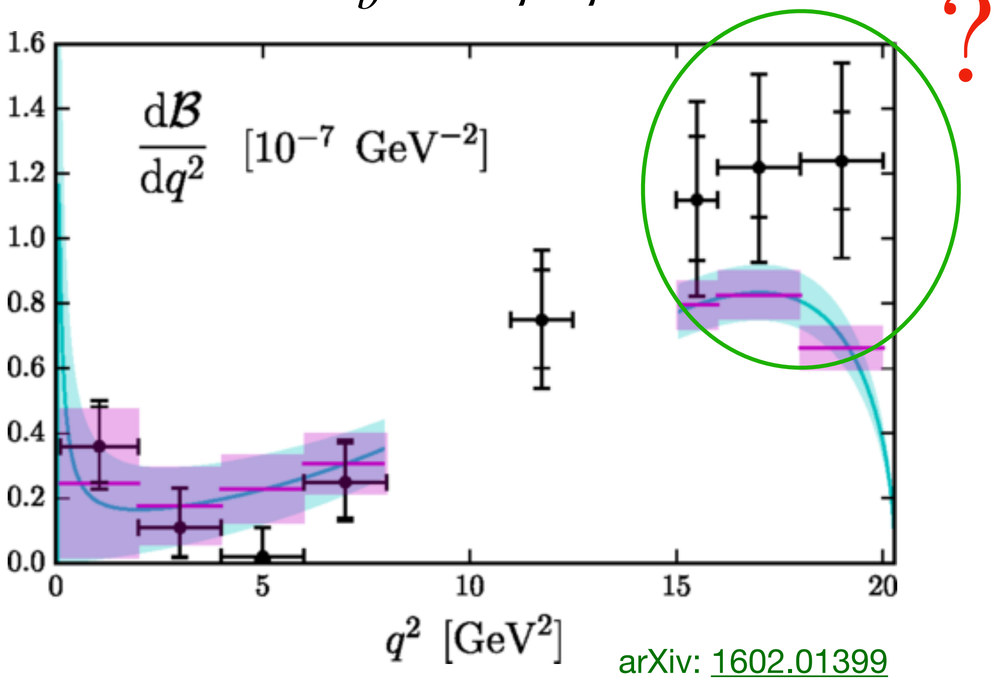
Four weakly decaying b-baryons

	$S = 1/2$	$f(b \to hadron)$
$u\,d\,b$	Λ_b	18 %
$s\,d\,b$	Ξ_b^-	1.5 % *
$s\,u\,b$	Ξ_b^0	1.6 % **
$s\,s\,b$	Ω_b^-	0.4 % **

* large uncertainty

** educated guess

$\Lambda_b \to \Lambda\mu^+\mu^-$

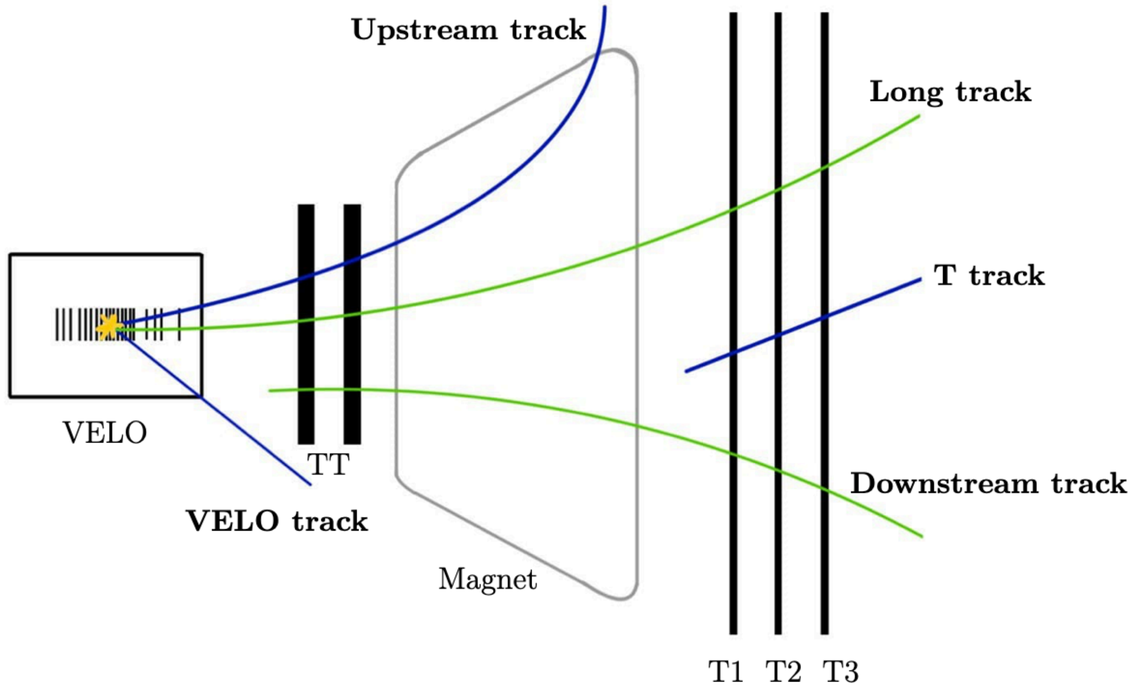


arXiv: 1602.01399

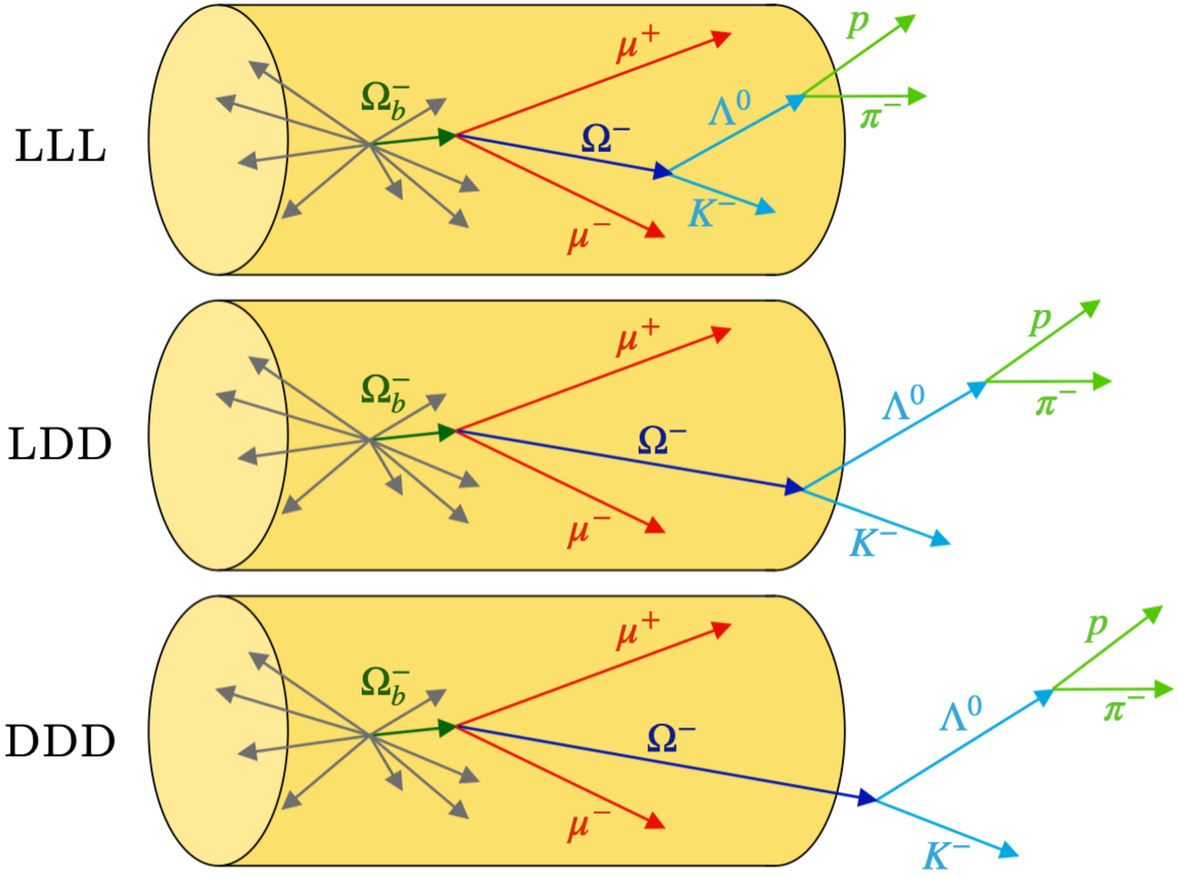
Is this a general behaviour?
→ focus on $b \to s\mu^+\mu^-$ first

Unique Topologies

Track Types within LHCb

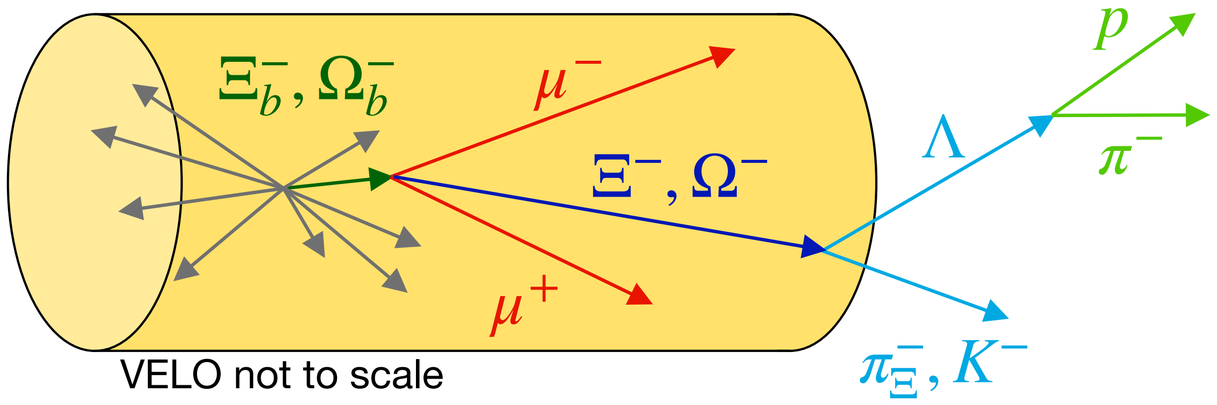


Track categories in the analyses



Why Ξ_b^- and Ω_b^- ?

Unique topology



VELO not to scale

→ no mesonic background with similar topology

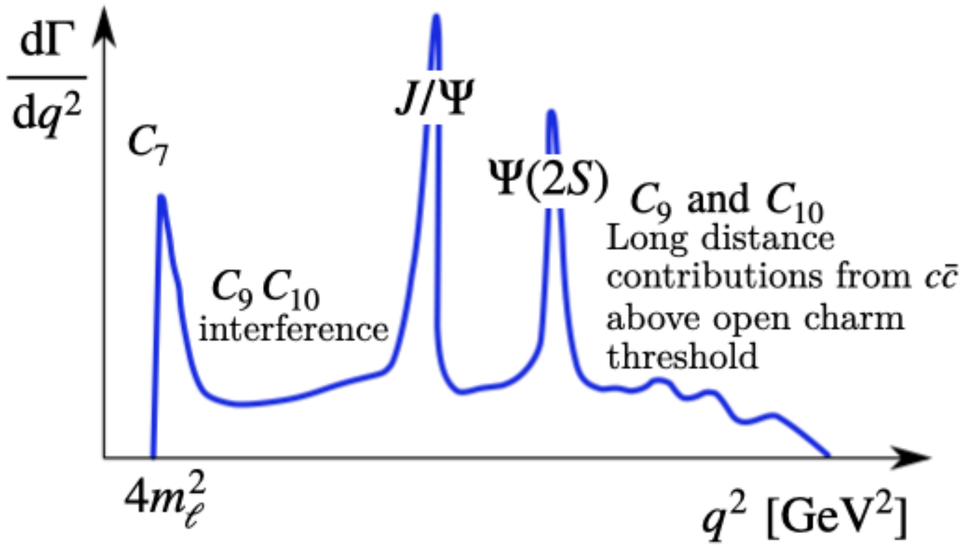
- Λ_b and Ξ_b^- linked through SU(3) symmetry
  → expect similar behaviour
- $\Omega_b^- \to \Omega^-$ spin transition $1/2 \to 3/2$
  → photon polarisation $\Omega_b^- \to \Omega^- \gamma$
- Ξ_b^0 challenging due to $\Xi^0 \to \Lambda \pi^0$
  → isospin-symmetry

Analysis Strategy

- Full LHCb dataset 9 fb^{-1}
- Blind 3σ window around mass peak
- BR measurement with normalisation

$$\frac{\mathcal{B}(\Xi_b^- \to \Xi^- \mu^+ \mu^-)}{\mathcal{B}(\Xi_b^- \to \Xi^- J/\psi)} \quad \text{and} \quad \frac{\mathcal{B}(\Omega_b^- \to \Omega^- \mu^+ \mu^-)}{\mathcal{B}(\Omega_b^- \to \Omega^- J/\psi)}$$

- Resonant decays, efficiencies not blinded
- Cut-based preselection and BDT to remove BKG



Prospects of $\psi(2S)$

- Cross check and upper limit
- First measurements of the decays

$$R_\psi = \frac{\mathcal{B}(\Xi_b^- \to \Xi^- \psi(2S)(\to \mu^+\mu^-))}{\mathcal{B}(\Xi_b^- \to \Xi^- J/\psi(\to \mu^+\mu^-))}$$

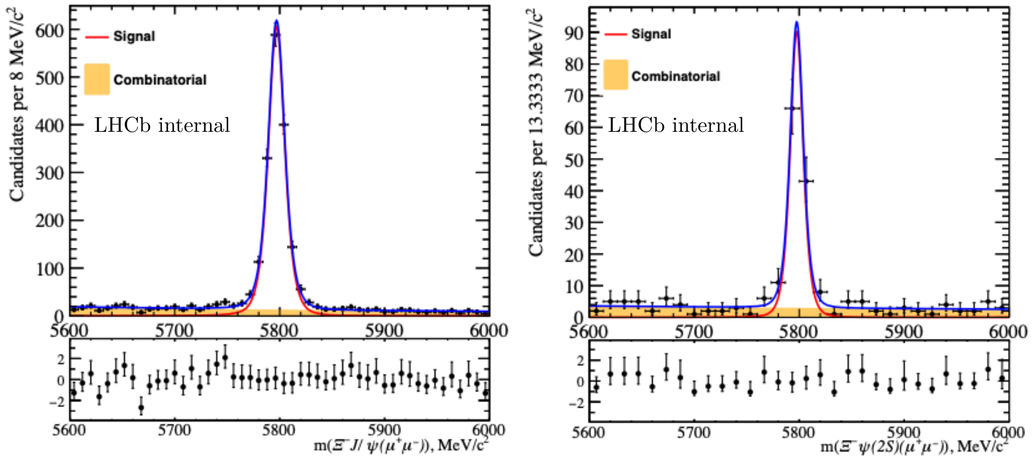
- Deviation from covariant quark model? for $\Lambda_b \to \Lambda\psi$:

$$R_\psi^{Exp} = 0.51 \pm 0.03$$

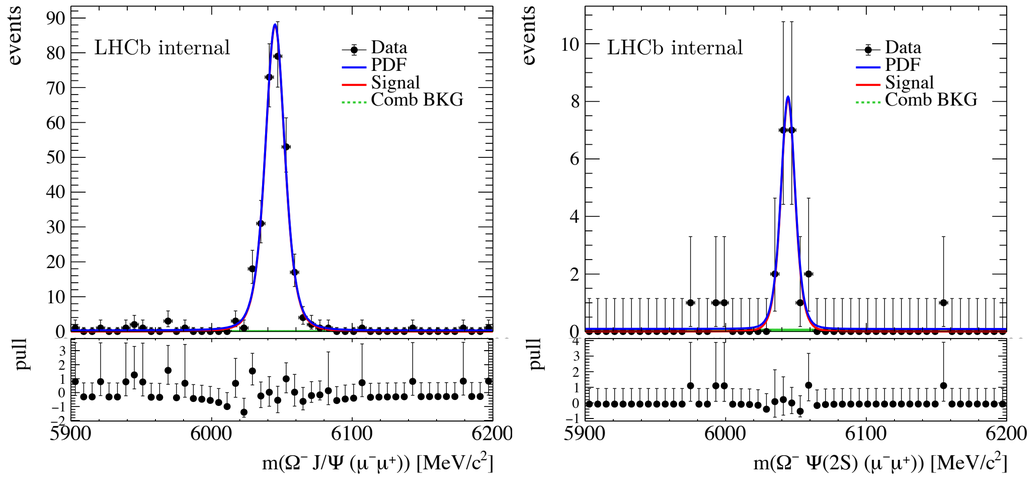
$$R_\psi^{Theo} = 0.8 \pm 0.1$$

arXiv: 1510.02266 (ATLAS)
arXiv: 1902.02092 (LHCb)

Run 2 Ξ_b^- decays



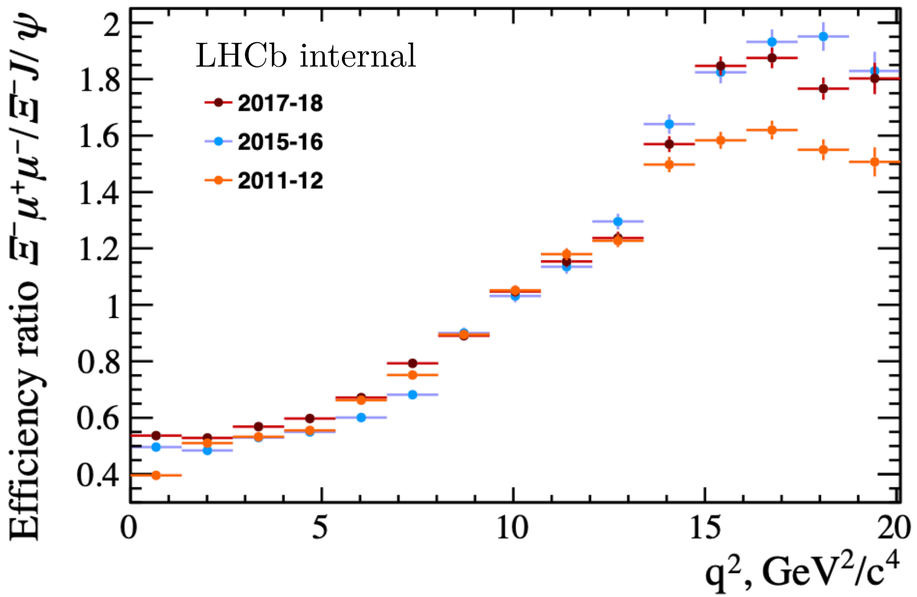
Run 2 Ω_b^- decays

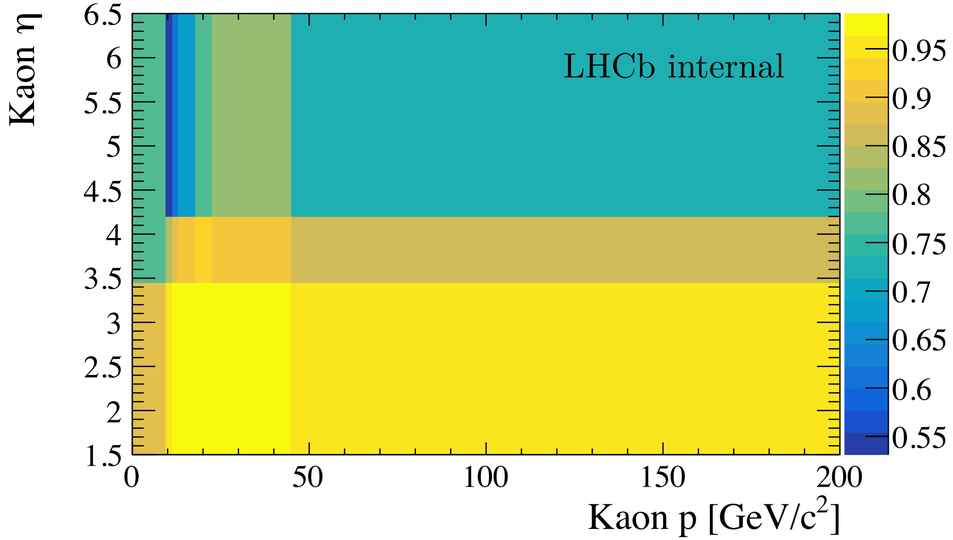


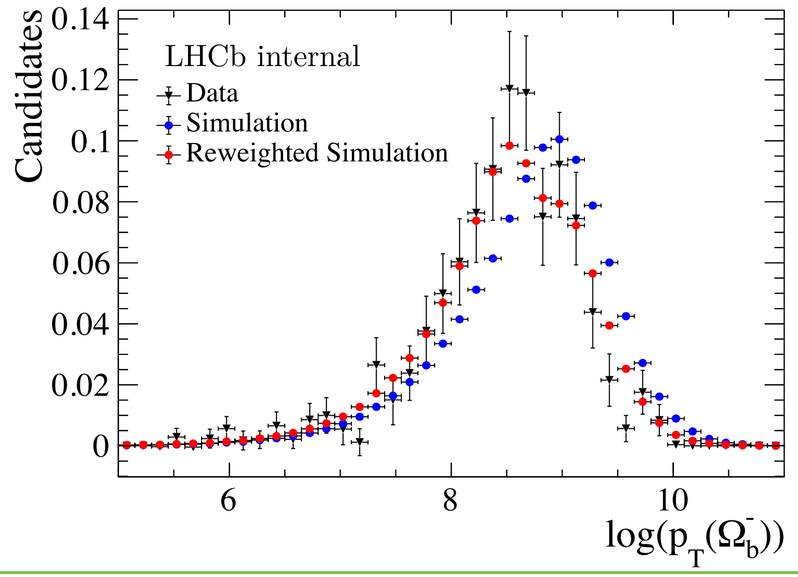
Challenges

- Low statistics → fit strategy
- Mismodeling of simulation and downstream tracks
- q^2- dependence of efficiencies

$$\epsilon_{tot} = \epsilon_{gen} \times \epsilon_{filt} \times \epsilon_{sel}$$







Thank you for your attention.
Are there any questions?