

LHCb Highlights (II)

Current team

USC (founding member of LHCb)

- Catedráticos :** Maximo Plo (Emerito desde 2021) , Bernardo Adeva
- Investigador Distinguido Manuela Barreiro:** Veronika Chobanova
- RyC :** Xabier Cid Vidal
- Postdoc Global Talent (IGFAE/MdM):** Jeremy Dalseno
- JdC :** Titus Mombacher, Claire Prouve
- Students:** ~ 10 PhD students, 3 Master/Undergraduate students

Conselleria de Economia e Industria, Xunta de Galicia

Diego Martinez Santos (Investigador Distinguido Oportunius)

In the last 7 years had postdoctoral researchers from several nationalities:



Activities

- High Level Trigger (GPU-based HLT1, HLT2)
- Flavor Tagging
- Physics WG's
 - CPV in B decays to charmonia
 - Charmless B decays
 - Semileptonic hyperon decays
 - Direct searches of BSM particles
 - Very rare decays
 - B decays to Open charm
- Other activities: precise fast simulation and event display, HFLAV, phenomenology, machine learning, CODEX-b

Activities: Technical

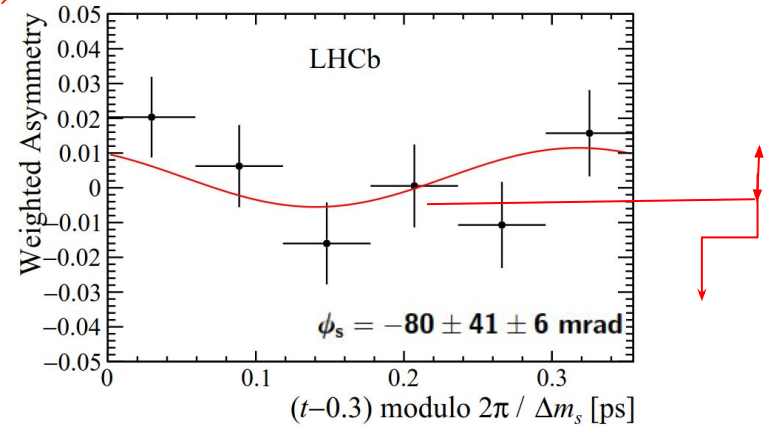
- High Level Trigger (nowadays called Real Time Analysis, RTA)
 - Soft Dimuon trigger for Run2 (lower muon pT thresholds to 80 MeV !)
 - Improved $s \rightarrow X$ trigger efficiency by $\sim 10 \times$
 - Proponents of GPU HLT for the upgrade
 - Improved $s \rightarrow X$ trigger efficiency by yet another $\sim 10 \times$
 - \rightarrow Two of the main ERC-StG-639068 deliverables on time (and performing above expectations)

- Flavor Tagging
 - Working on Inclusive Flavor Tagging ($\sim O(10\%)$ improvement on effective stats)
 - Persistency of Flavor Tagging in HLT

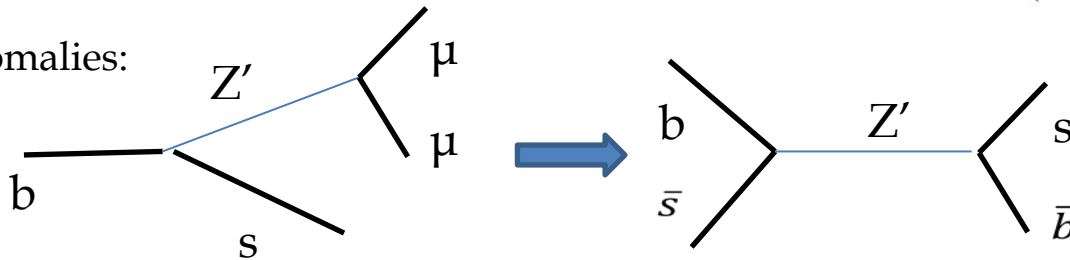
V. Chobanova convener of Flavor Tagging (2020-2022), C. Prouve convener of Flavor Tagging (2022-2024)
 J. Prisciandaro responsible of LHCb muon trigger (2016-2018)

Analyses: B to charmonia (B_s oscillation)

- B_s lifetime
- mixing parameters
 - Most interesting: (TH clean, EXP clean, BSM sensitive).
- Fundamental test to any model that predicts new physics in the B_s system



- Eg, B anomalies:



Eur. Phys. J. C 79 (2019) 706
V. Chobanova contact author

- Central also for B-mesogenesis (=dark baryons) models

Analyses: B to charmonia (B_s oscillation)

Biggest pain here: The lifetime measurement requires per mil systematics (ie. fs precision)

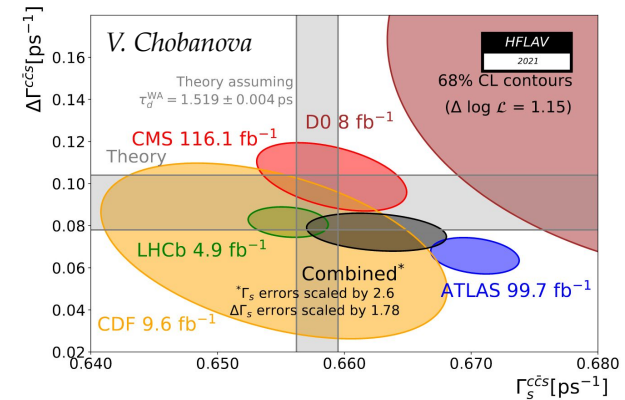
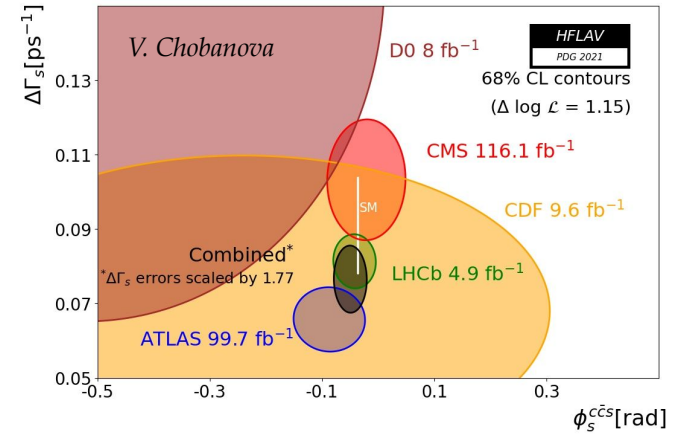
- Typically takes several years of work (very different from everything else I've done eg, $P \rightarrow \mu\mu$ or similar)

Full Run-2 analysis ongoing

B2CC conveners: D.Martinez (2013-2015), V. Chobanova (2018-2020), D. Martinez (2020-2022)

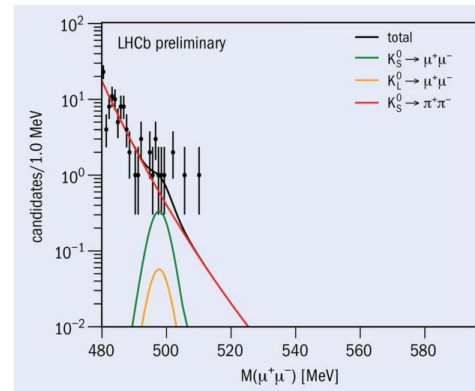
(Also current co-convenor Miriam Lucio was former student of the group)

Veronika Chobanova candidate for Physics Coordinator, short list of 3 out of 54 applicants



Analyses: Strange decays, & Rare decays

- Full Run2 $K_S \rightarrow \mu\mu$ analysis
 - Final deliverable of ERC-StG-639068, together with Upgrade strange trigger
- Currently doing SL hyperon decays, following suggestion from Camalich et al.
- Pipeline: $K_S \rightarrow \pi^0 \mu\mu$, $\Sigma \rightarrow p\mu\mu$, $K_S \rightarrow 4l\dots$
- T. Mombacher increases group activities in VRD, (eg, $B \rightarrow \mu\mu$)
- First R_{K^*} result (M. Borsato)



[CERN Courier](#)

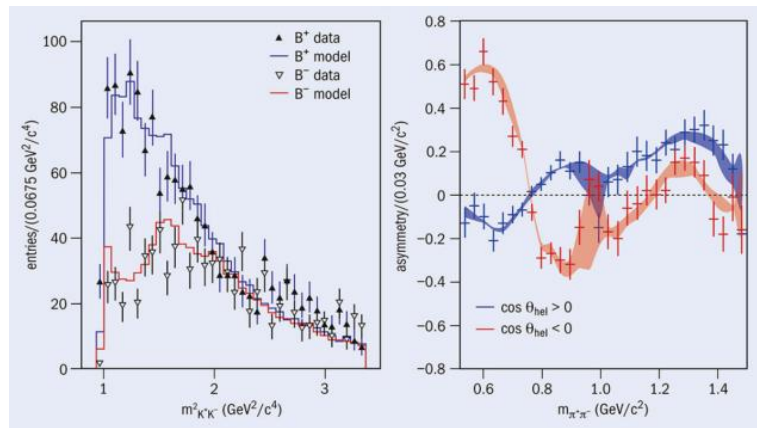
Phys. Rev. Lett. 125, 231801 (2020)
M. Ramos contact author

RD conveners: None (but current convener Paula Alvarez was former student of the group)

VRD subconveners: J.Prisciandaro (2016-2017), T. Mombacher (2021-2022)

Analyses: charmless, open charm

- Charmless and open charm decays: sophisticated analyses of differential decay rates to obtain CPV information
- Strong involvement in several charmless B decays
 - $B \rightarrow 3h$ (eg, maximal CPV)
 - $B \rightarrow 4h$ (K^*K^* , $a_1\Pi$, $\rho^0\rho^0$)
 - Polarization fractions, CPV parameters
 - Measurement of α_{CKM}
- CKM angle γ in $B \rightarrow D(\rightarrow 4\pi) K$



[CERN Courier](#)

Phys. Rev. Lett. 124, 031801 (2020)
J. Dalseno contact author

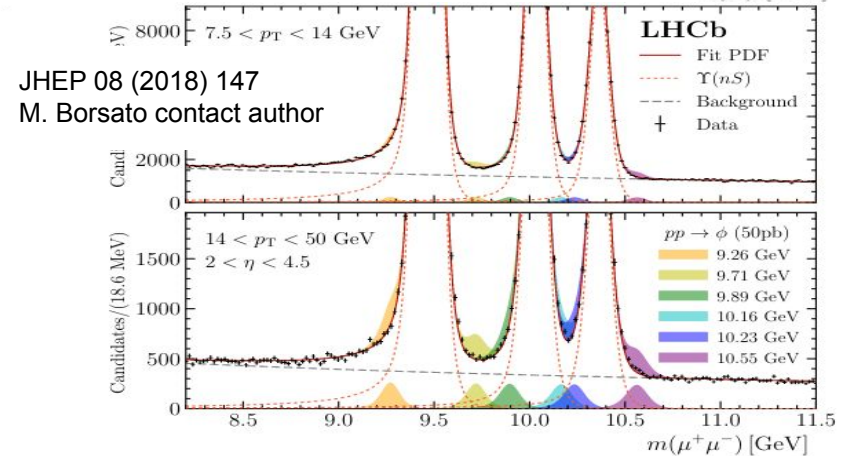
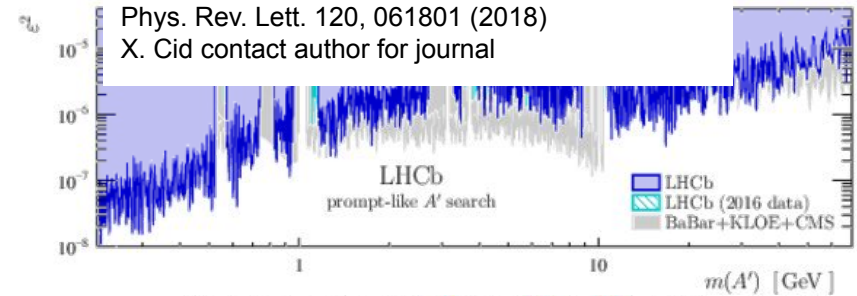
B2noC conveners: J.Dalseno (2019-2021)

Analyses: Direct Searches, Electroweak, QCD

- Searches for new dimuon searches (NMSSM higgses, dark photons)
- Searches for Axion-like particles (ALPs)
- Searches for baryonic Dark Matter
- Higgs ($\&bb, cc$) xsection at high pseudorapidity
- Measurement of pp cross section at LHC
- η leptonic decays

QEE conveners: X.Cid Vidal (2016-2018)

(Also current convener Carlos Vazquez was former student of the group)



Beyond LHCb activities

- pan-LHC (pan-experiment):
 - HFLAV (V. Chobanova) → averages for PDG
 - LHC DM WG (X. Cid Vidal)
 - SMARTHEP MSCA-ITN (D. Martinez Santos, V. Chobanova)
- Methodology
 - Machine Learning (Industry PhD)
 - New magnetic field calibration techniques
- Phenomenology:
 - MasterCode collaboration (SUSY global fits)
 - Global fits for $b \rightarrow s \ell \ell$ anomalies (first group to calculate the global significance -i.e., no LEE)
 - Devising CKM angle alpha programme for LHCb
 - Direct searches prospects
 - Convener roles at Yellow reports...
- Conference series organization: D.Martinez IAC of FPCP , & KAON
- CODEX-b (X. Cid Vidal Physics coordinator of CODEX-b)



Summary

- Big and intercontinental group with a broad set of scientific activities which often use very different methodologies
 - Complex differential decay rates to access CPV
 - Address tiny experimental effects in high precision , high statistics measurements
 - Searches for small signals (rare decays, new particles)
 - Technical work: High Level Trigger, GPU programming, Flavour Tagging
 - Theory interpretations, prospects.

Backup