The physics happening at LHCb and how it is organised

Starterkit – 23 Nov 2021

Niels Tuning

Outline

- Once upon a time...

- Working Groups
  - Physics Analysis WG
  - Physics Performance WG
  - Liaisons
- Structure
- Review

- Anomalies

Why is Flavour Physics so cool?

1) Sensitive to new physics

2) At the heart of the Standard Model

History of Flavour physics

GIM mechanism in $K^0 \to \mu\mu$

Weak Interactions with Lepton-Hadron Symmetry*

S. L. Glashow, J. Iliopoulos, and L. Maiani†
Lyman Laboratory of Physics, Harvard University, Cambridge, Massachusetts 02139
(Received 5 March 1970)

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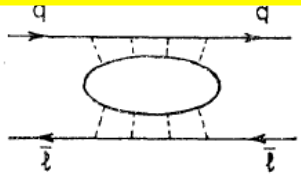

Glashow, Iliopoulos, Maiani,
Phys.Rev. D2 (1970) 1285

CP violation, $K_L^0 \to \pi\pi$

27 JULY 1964

EVIDENCE FOR THE 2π DECAY OF THE K_2^0 MESON*†

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Makoto Kobayashi and Toshihide Maskawa
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Christenson, Cronin, Fitch, Turlay,
Phys.Rev.Lett. 13 (1964) 138
Kobayashi, Maskawa,
Prog.Theor. Phys. 49 (1973) 652

$B^0 \leftrightarrow \bar{B}^0$ mixing

DESY 87-029
April 1987

OBSERVATION OF B^0-$\bar{B}^0$ MIXING

The ARGUS Collaboration

In summary, the combined evidence of the investigation of B^0 meson pairs, lepton pairs and B^0 meson-lepton events on the $\Upsilon(4S)$ leads to the conclusion that B^0-$\bar{B}^0$ mixing has been observed and is substantial.

Parameters	Comments
$r > 0.09$ 90% CL	This experiment
$x > 0.44$	This experiment
$B^{\frac{1}{2}} f_B \approx f_\pi < 160$ MeV	B meson ($\approx$ pion) decay constant
$m_b < 5\text{GeV}/c^2$	b-quark mass
$\tau_b < 1.4 \cdot 10^{-12}$ s	B meson lifetime
$\lvert V_{td}\rvert < 0.018$	Kobayashi-Maskawa matrix element
$\eta_{QCD} < 0.86$	QCD correction factor [17]
$m_t > 50\text{GeV}/c^2$	t quark mass

ARGUS Coll.
Phys.Lett.B192 (1987) 245

Flavour physics has a track record

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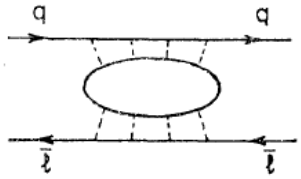

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" $m_t > 50$ GeV/c^2 t quark mass "

Rare decay implied 2nd up quark "discovery" of charm?

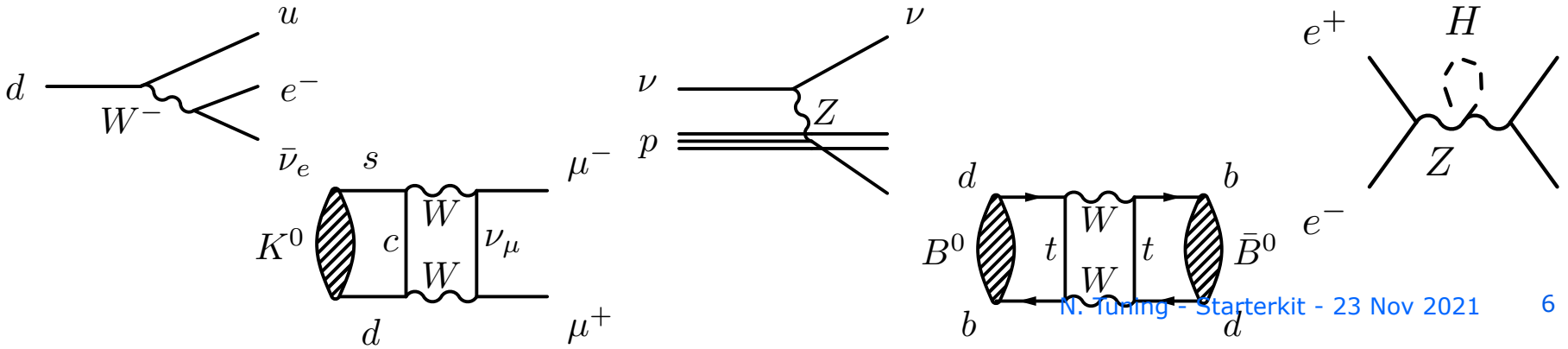
CP violation implied 3rd family: "discovery" of bottom?

Mixing implied heavy quark: "discovery" of top?

Precise flavour measurements

- Historical record of indirect discoveries:

Particle	Indirect			Direct		
ν	β decay	Fermi	1932	Reactor ν-CC	Cowan, Reines	1956
W	β decay	Fermi	1932	$W \to e\nu$	UA1, UA2	1983
c	$K^0 \to \mu\mu$	GIM	1970	J/ψ	Richter, Ting	1974
b	CPV $K^0 \to \pi\pi$	CKM, 3rd gen	1964/72	Υ	Ledermann	1977
Z	ν-NC	Gargamelle	1973	$Z \to e^+e^-$	UA1	1983
t	B mixing	ARGUS	1987	$t \to Wb$	D0, CDF	1995
H	e^+e^-	EW fit, LEP	2000	$H \to 4\mu/\gamma\gamma$	CMS, ATLAS	2012
?	**What's next ?**		?			?



Precise flavour measurements

- Direct discoveries rightfully higher valued:

Particle	Indirect			Direct		
ν	β decay	Fermi	1932	Reactor ν-CC	Cowan, Reines	1956
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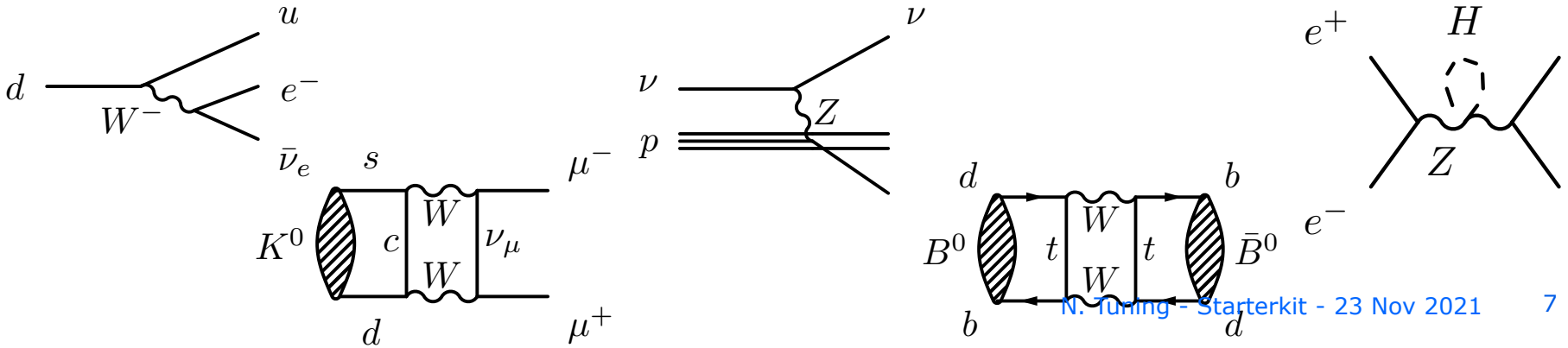
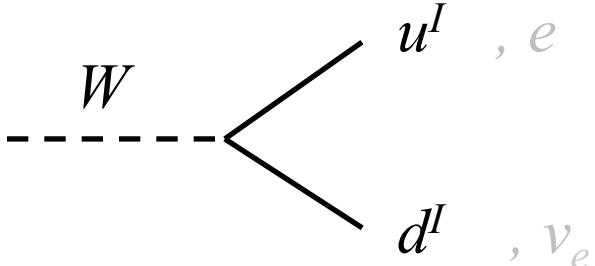


$$L_{SM} = L_{Kinetic} + L_{Higgs} + L_{Yukawa}$$

Origin of CKM

$$-L_{Yuk} = Y_{ij}^{d}\,(\overline{u_L^I}, \overline{d_L^I})_i \begin{pmatrix} \varphi^+ \\ \varphi^0 \end{pmatrix} d_{Rj}^I + \ldots$$

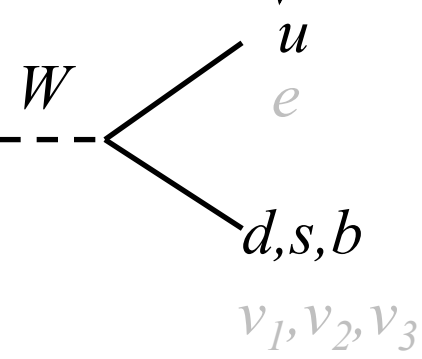
$$L_{Kinetic} = \frac{g}{\sqrt{2}}\overline{u_{Li}^I}\gamma^\mu W_\mu^- d_{Li}^I + \frac{g}{\sqrt{2}}\overline{d_{Li}^I}\gamma^\mu W_\mu^+ u_{Li}^I + \ldots$$



Diagonalize Yukawa matrix Y_{ij}

- Mass terms
- Quarks rotate
- Off diagonal terms in charged current couplings

$$\begin{pmatrix} d^I \\ s^I \\ b^I \end{pmatrix} \rightarrow V_{CKM} \begin{pmatrix} d \\ s \\ b \end{pmatrix}$$

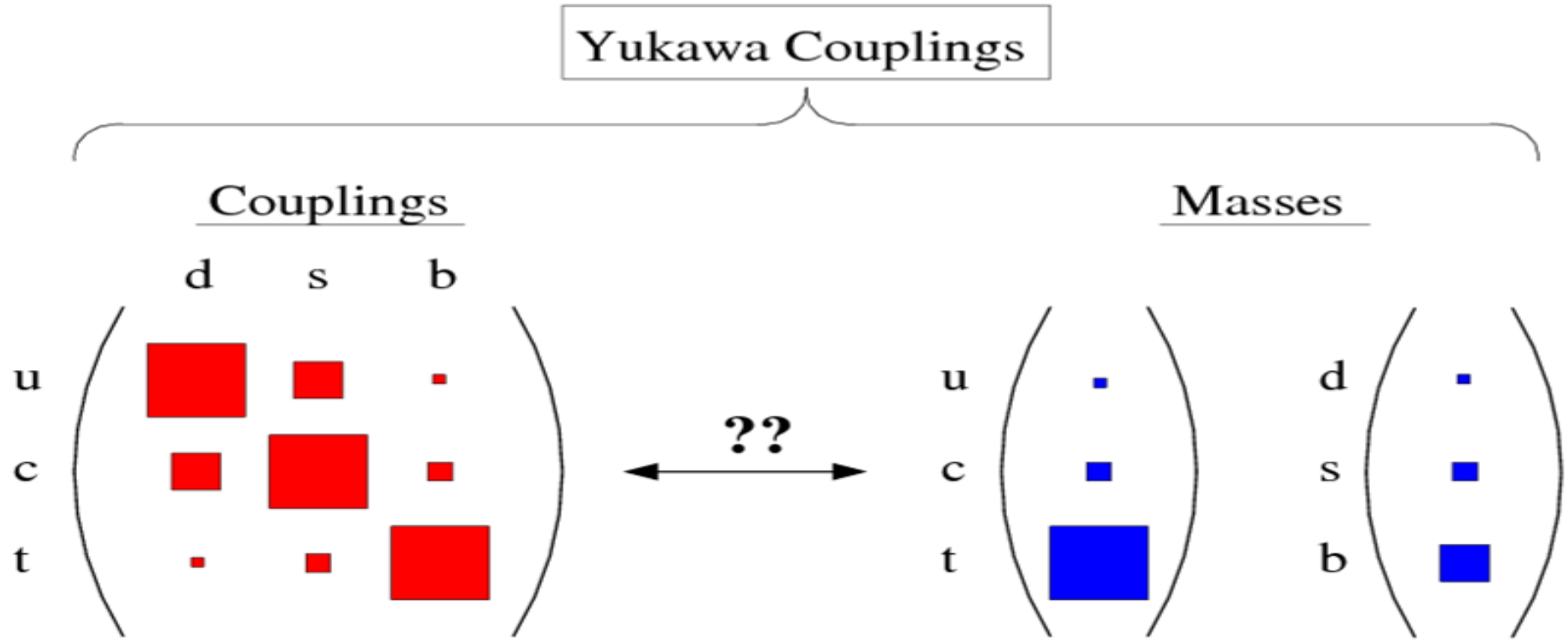


$$-L_{Mass} = \left(\overline{d},\overline{s},\overline{b}\right)_L \begin{pmatrix} m_d & & \\ & m_s & \\ & & m_b \end{pmatrix} \begin{pmatrix} d \\ s \\ b \end{pmatrix}_R + \left(\overline{u},\overline{c},\overline{t}\right)_L \begin{pmatrix} m_u & & \\ & m_c & \\ & & m_t \end{pmatrix} \begin{pmatrix} u \\ c \\ t \end{pmatrix}_R + \ldots$$

$$L_{CKM} = \frac{g}{\sqrt{2}}\overline{u_i}\gamma^\mu W_\mu^- V_{ij}\left(1-\gamma^5\right)d_j + \frac{g}{\sqrt{2}}\overline{d_j}\gamma^\mu W_\mu^+ V_{ij}^*\left(1-\gamma^5\right)u_i + \ldots$$

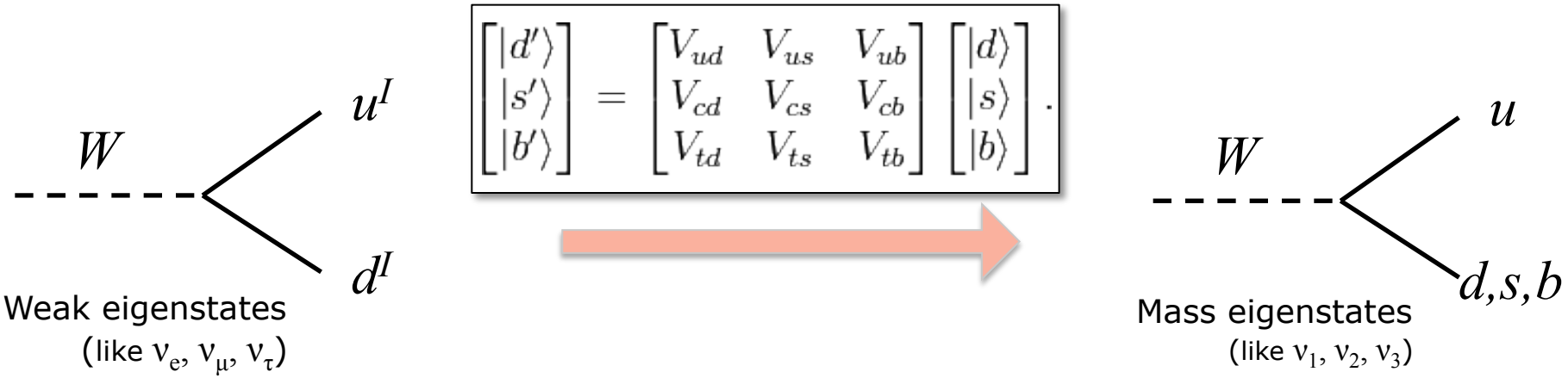
$$L_{SM} = L_{CKM} + L_{Higgs} + L_{Mass}$$

What's going on??



(CKM: a quick reminder…)

1) Matrix to transform weak- and mass-eigenstates:



Weak eigenstates
(like ν_e, ν_μ, ν_τ)

Mass eigenstates
(like ν_1, ν_2, ν_3)

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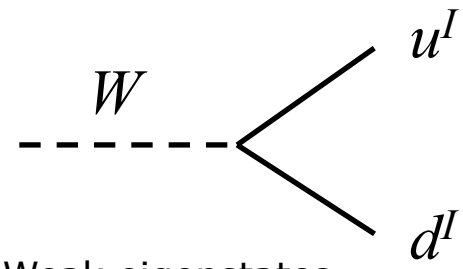
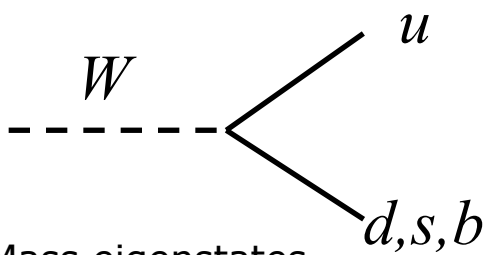


Weak eigenstates

$$\begin{bmatrix} |d'\rangle \\ |s'\rangle \\ |b'\rangle \end{bmatrix} = \begin{bmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{bmatrix} \begin{bmatrix} |d\rangle \\ |s\rangle \\ |b\rangle \end{bmatrix}.$$



Mass eigenstates

2) Matrix has imaginary numbers:

$$\begin{pmatrix} |V_{ud}| & |V_{us}| & |V_{ub}|e^{-i\gamma} \\ -|V_{cd}| & |V_{cs}| & |V_{cb}| \\ |V_{td}|e^{-i\beta} & -|V_{ts}|e^{i\beta_s} & |V_{tb}| \end{pmatrix}$$

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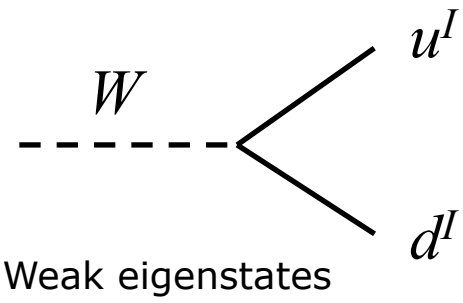

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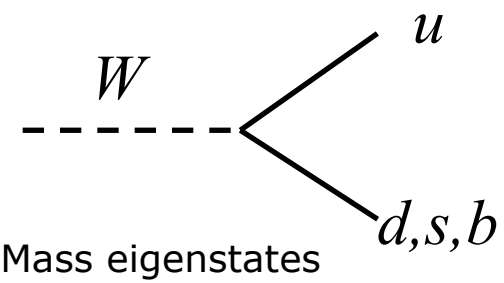

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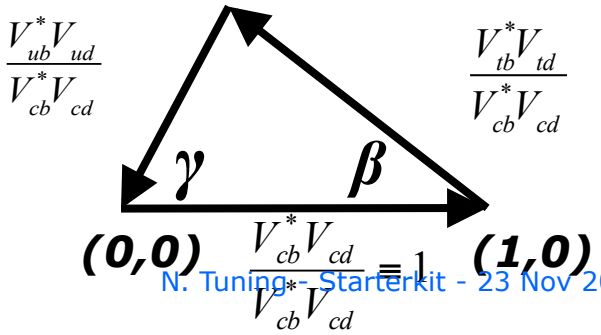
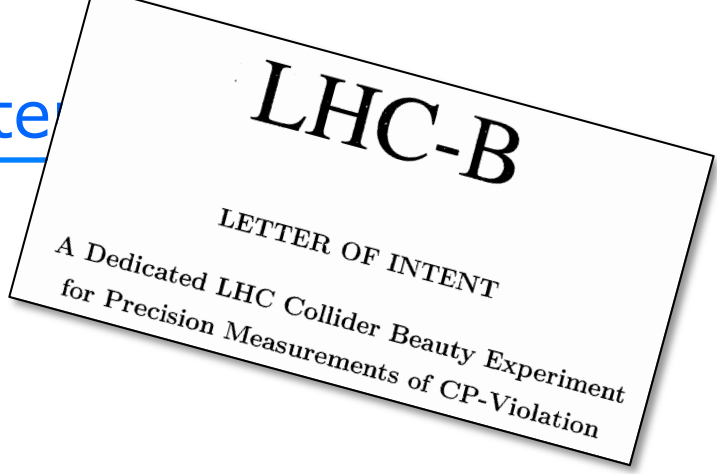
3) Matrix is unitary:

$$V^{+}V = \begin{pmatrix} V^*_{ud} & V^*_{cd} & V^*_{td} \\ V^*_{us} & V^*_{cs} & V^*_{ts} \\ V^*_{ub} & V^*_{cb} & V^*_{tb} \end{pmatrix} \begin{pmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$V^*_{ub}V_{ud} + V^*_{cb}V_{cd} + V^*_{tb}V_{td} = 0$$



CKM: (1995) LHCb Letter-of-Inte


LHC-B

LETTER OF INTENT

A Dedicated LHC Collider Beauty Experiment for Precision Measurements of CP-Violation

- LHC-B Letter-of-Intent 1995

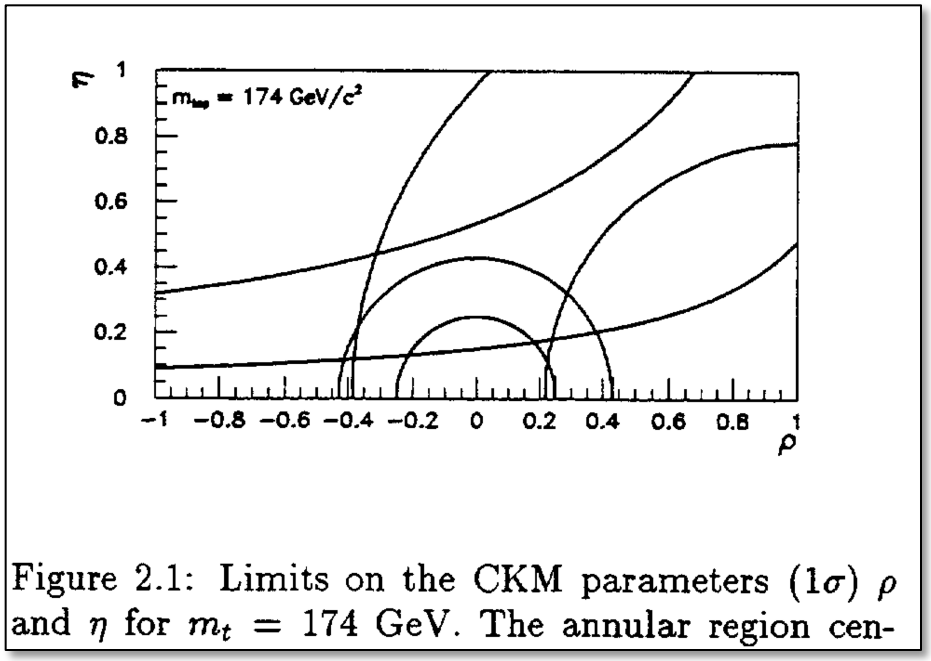


Figure 2.1: Limits on the CKM parameters (1σ) ρ and η for $m_t = 174$ GeV. The annular region cen-

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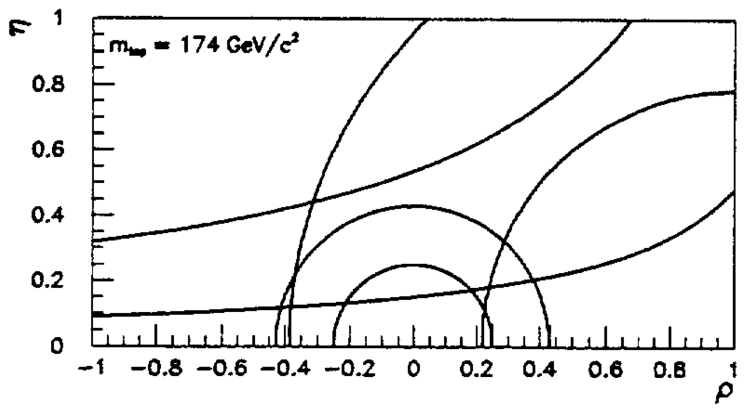

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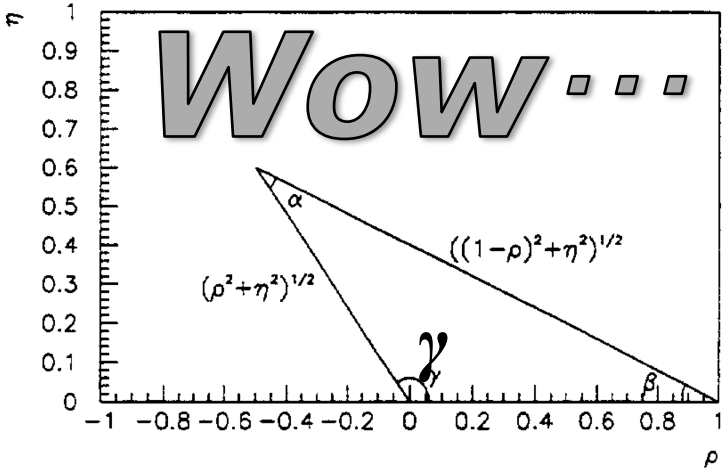
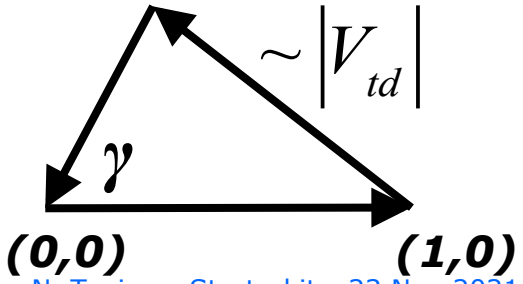


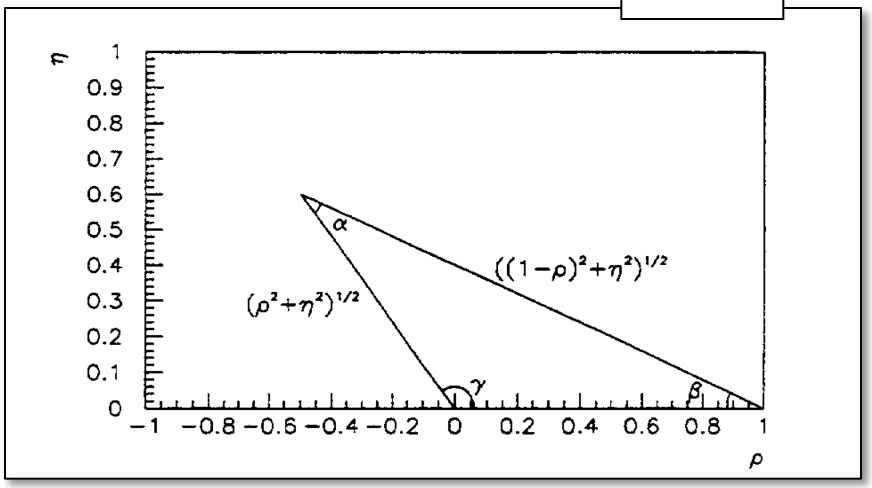
Figure 2.2: The Unitarity Triangle



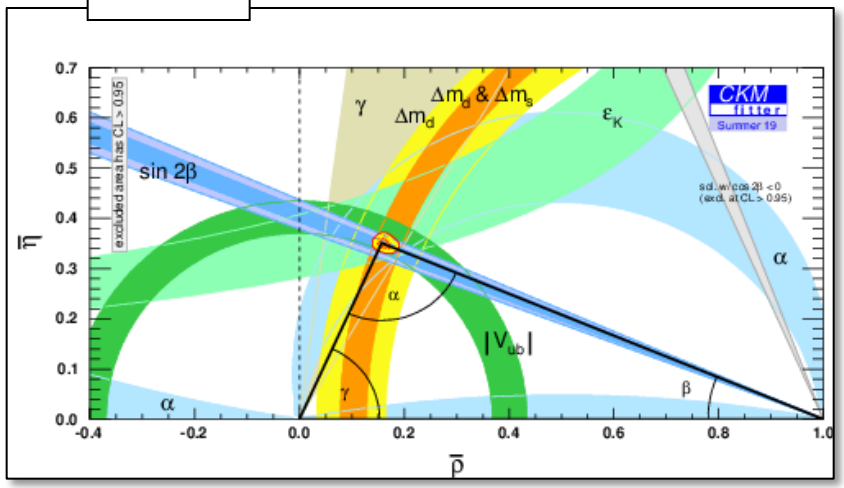
CKM

- All consistent?

1995



2019



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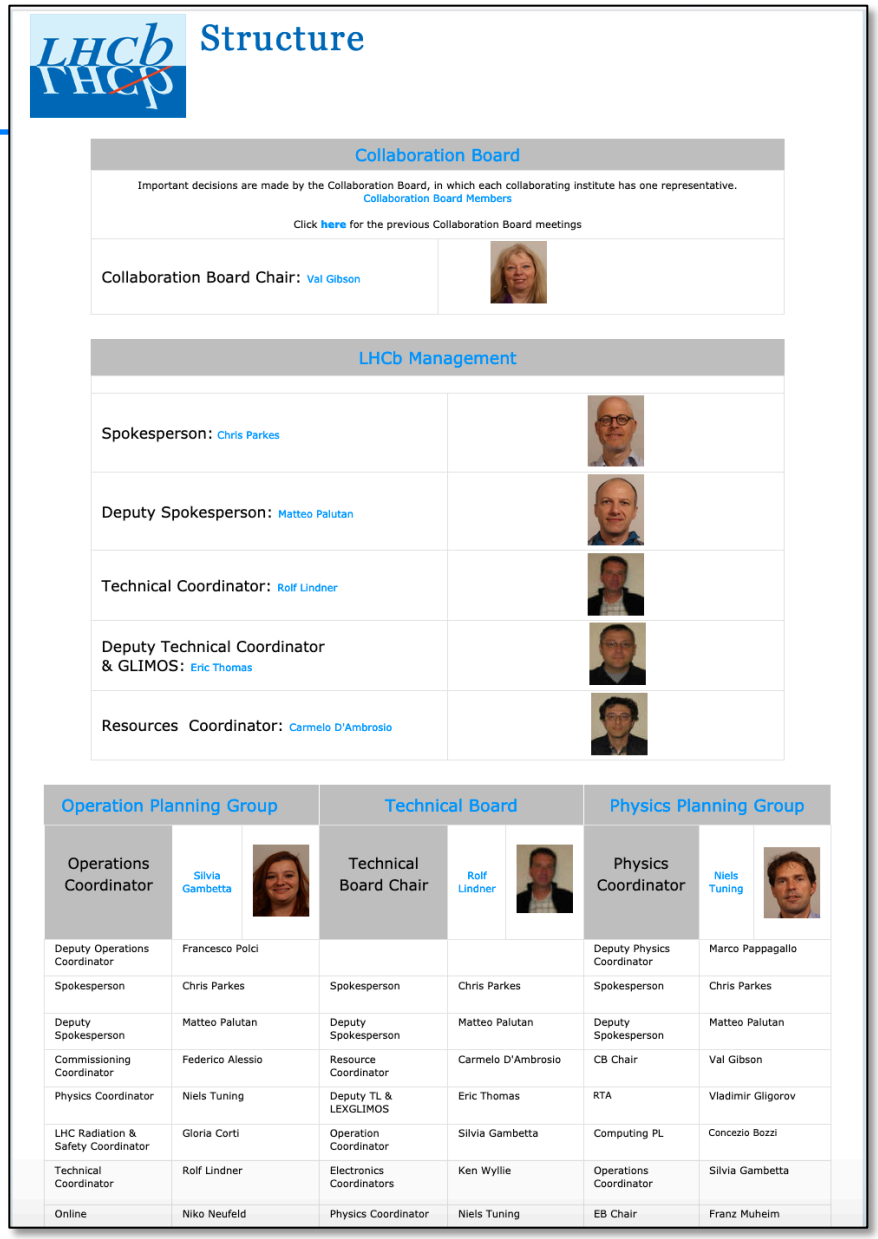
Organisation: LHCb

- Collaboration Board
  - Management
    - OPG, TB, PPG
      - …
        - …



LHCb Structure

Collaboration Board

Important decisions are made by the Collaboration Board, in which each collaborating institute has one representative.
Collaboration Board Members

Click here for the previous Collaboration Board meetings

Collaboration Board Chair: Val Gibson

LHCb Management

Spokesperson: Chris Parkes

Deputy Spokesperson: Matteo Palutan

Technical Coordinator: Rolf Lindner

Deputy Technical Coordinator & GLIMOS: Eric Thomas

Resources Coordinator: Carmelo D'Ambrosio

Operation Planning Group		Technical Board		Physics Planning Group	
Operations Coordinator	Silvia Gambetta	Technical Board Chair	Rolf Lindner	Physics Coordinator	Niels Tuning
Deputy Operations Coordinator	Francesco Polci			Deputy Physics Coordinator	Marco Pappagallo
Spokesperson	Chris Parkes	Spokesperson	Chris Parkes	Spokesperson	Chris Parkes
Deputy Spokesperson	Matteo Palutan	Deputy Spokesperson	Matteo Palutan	Deputy Spokesperson	Matteo Palutan
Commissioning Coordinator	Federico Alessio	Resource Coordinator	Carmelo D'Ambrosio	CB Chair	Val Gibson
Physics Coordinator	Niels Tuning	Deputy TL & LEXGLIMOS	Eric Thomas	RTA	Vladimir Gligorov
LHC Radiation & Safety Coordinator	Gloria Corti	Operation Coordinator	Silvia Gambetta	Computing PL	Concezio Bozzi
Technical Coordinator	Rolf Lindner	Electronics Coordinators	Ken Wyllie	Operations Coordinator	Silvia Gambetta
Online	Niko Neufeld	Physics Coordinator	Niels Tuning	EB Chair	Franz Muheim

https://lhcb.web.cern.ch/lhcb_page/collaboration/organization/lhcb-conv/StructureDefault.html

Organisation: Physics

- Working Groups

LHCb Physics Organisation

The LHCb Physics Coordinator for 2020 and 2021 is Niels Tuning with deputy Marco Pappagallo and should be contacted using lhcb-physi

The physics output of LHCb is discussed by the Physics Planning Group (PPG), which is chaired by the Physics Coordinator. The member
Physics Coordinator. The membership outlined in the image below was ratified by the Collaboration Board on 27 September 2011 (see a

More details of the roles of some of the positions represented in the PPG can be found on the LHCbPhysicsOrganisation Twiki page. Conta

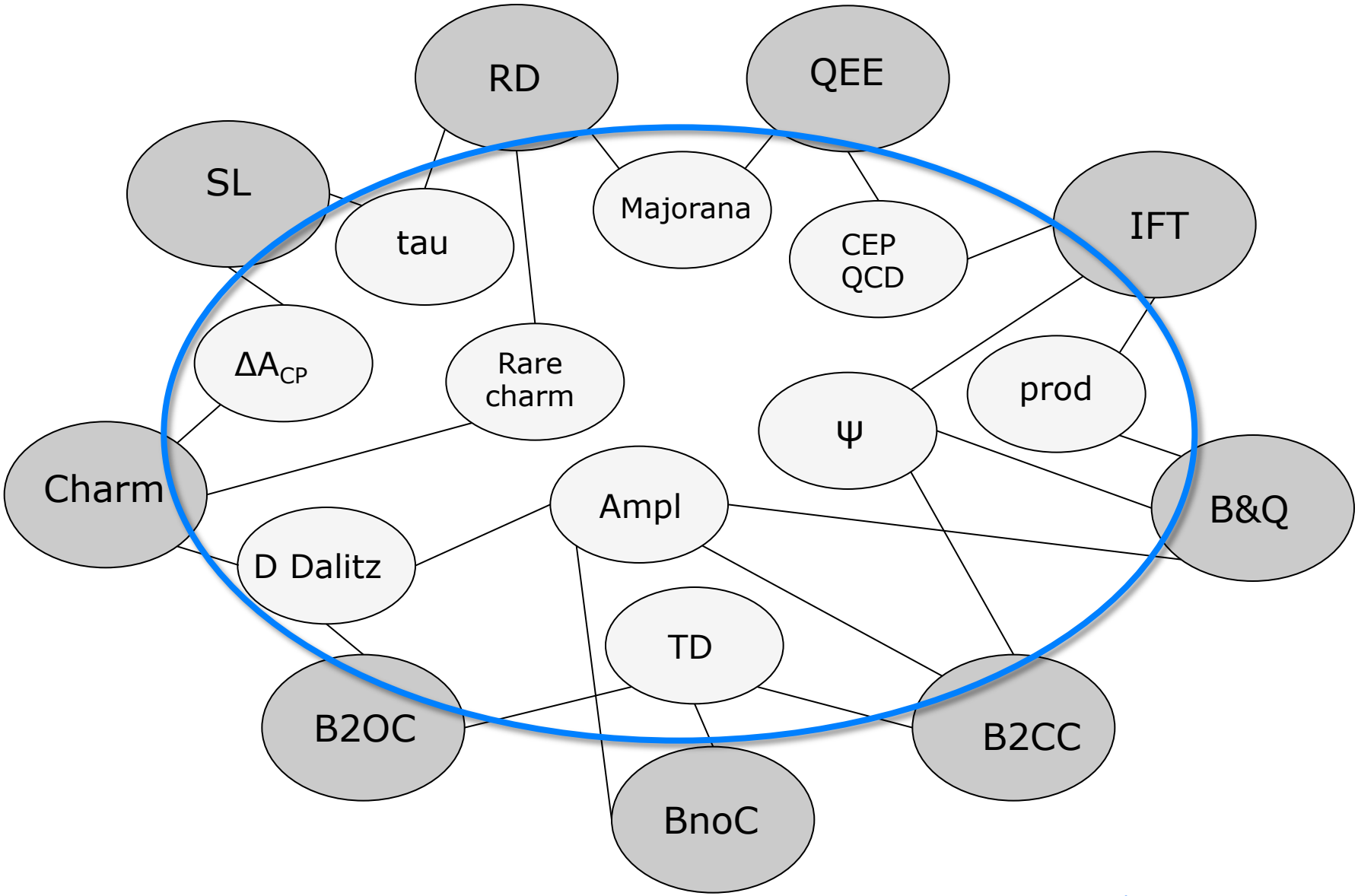
The current (*) conveners of the Working Groups are given in the table below. More details on the physics topics covered by each Working

Physics Analysis Working Groups	
QCD, Electroweak and Exotica	Olli Lupton, Carlos Vazquez Sierra
B hadrons and Quarkonia	Ivan Polyakov, Jibo He
Charm physics	Mark Williams, Michael Morello
Rare decays	Flavio Archilli, Paula Alvarez Cartelle
B decays to Charmonia	Sevda Esen, Diego Martinez Santos
B decays to Open Charm	Agnieszka Dziurda, Nathan Jurik
Charmless b-hadron decays	Jeremy Dalseno, Roberta Cardinale
Semileptonic decays	Michel De Cian, Marcello Rotondo
Ions and Fixed Target	Yanxi Zhang, Benjamin Audurier
Physics Performance Working Groups	
Run1-2 performance (covering Tracking, Particle identification and CALO Objects)	Michael Alexander, Vitalii Lisovskyi
Flavour tagging	Daniel O'Hanlon, Veronika Georgieva Chobanova
Luminosity	Pasquale Di Nezza, Vladik Balagura
Simulation Group	Michal Kreps, Dominik Mueller, Adam Davis
Other groups and fora	
Stripping	Nicole Skidmore, Alison Tully
Statistics	Hans Dembinski, Matthew Kenzie
Amplitude Analysis	Jonas Rademacker, Biplab Dey
Early Measurements Task Force (Run3)	Eva Gersabeck

(*) Last updated 31 Jan, 2020.

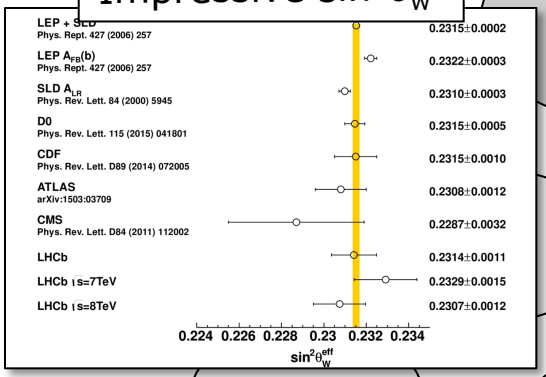
https://twiki.cern.ch/twiki/bin/viewauth/LHCbPhysics/LHCbPhysics

Physics Analysis WG Landscape: lots of overlap

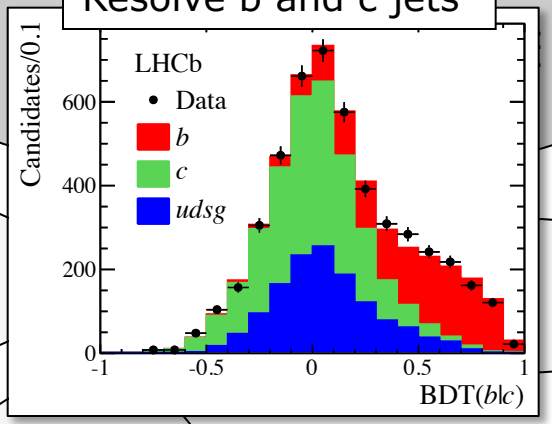


Physics Analysis WG Landscape: more than b!

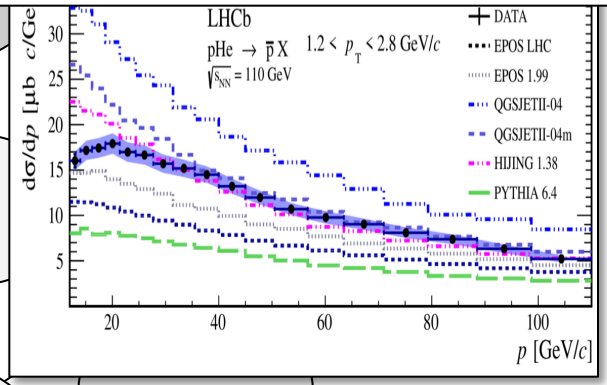
Impressive $\sin^2\theta_W$



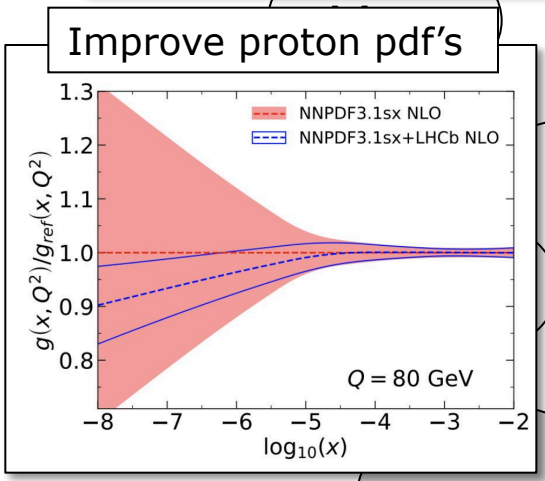
Resolve b and c jets



Anti-proton flux for cosmic rays

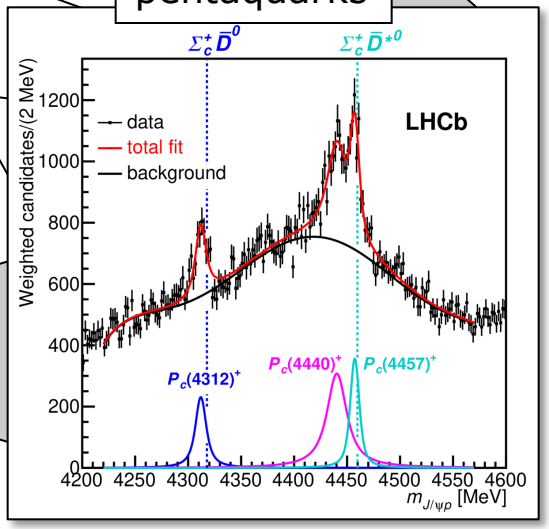


Improve proton pdf's

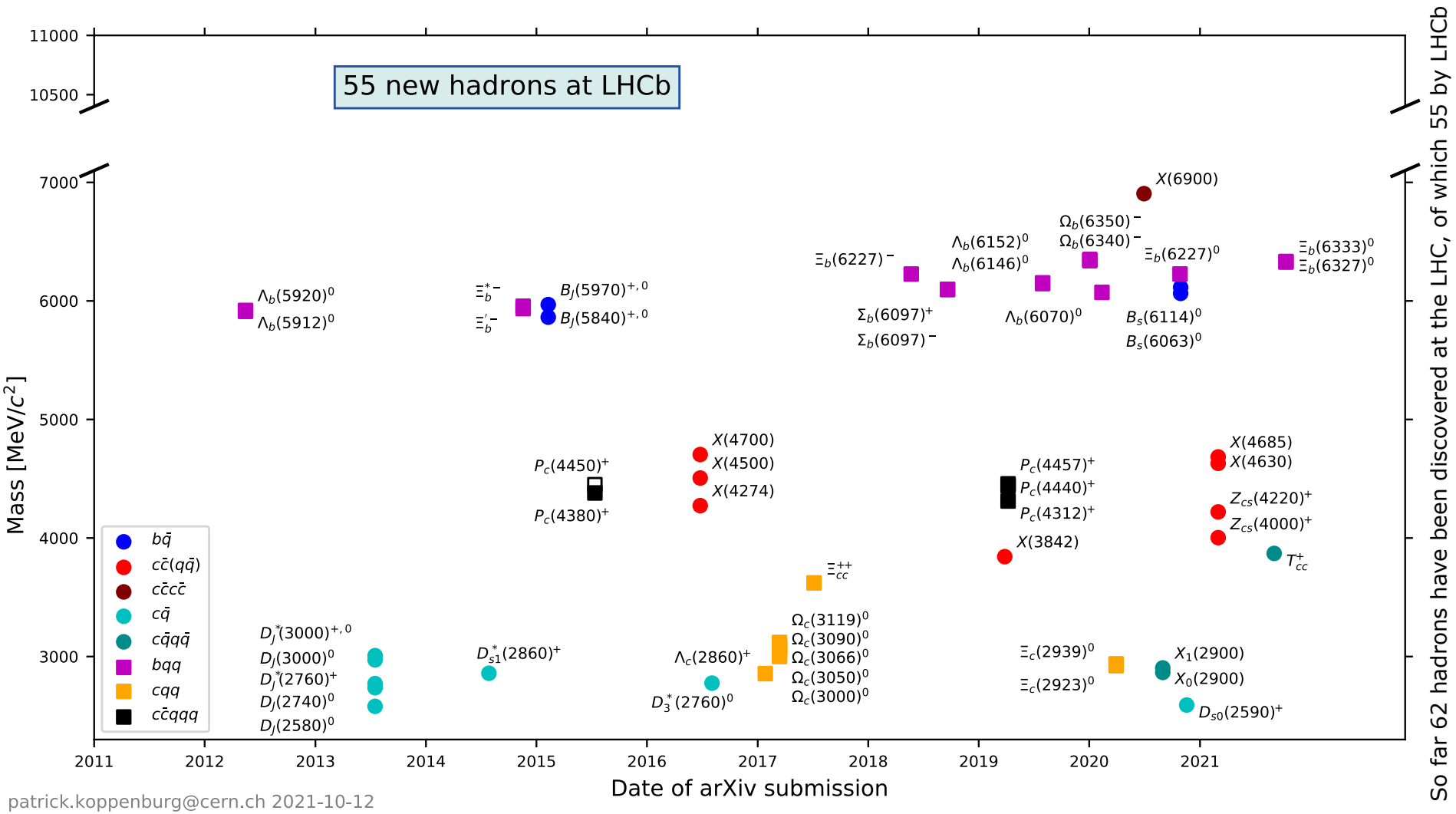


A.Garcia, R.Gauld, A.Heijboer, J.Rojo
arXiv:2004.04756

Discovery of pentaquarks



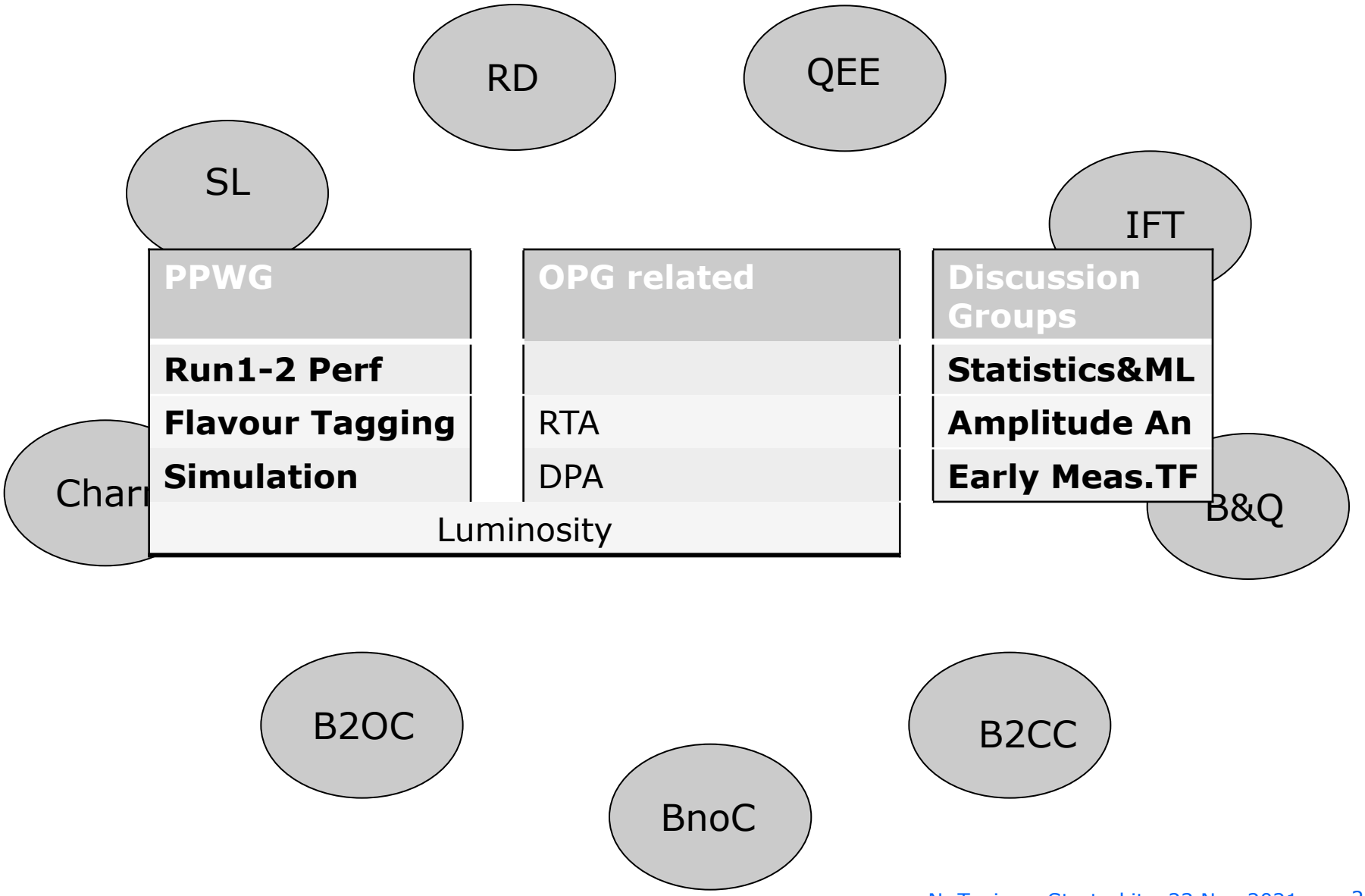
New hadrons discovered...



patrick.koppenburg@cern.ch 2021-10-12

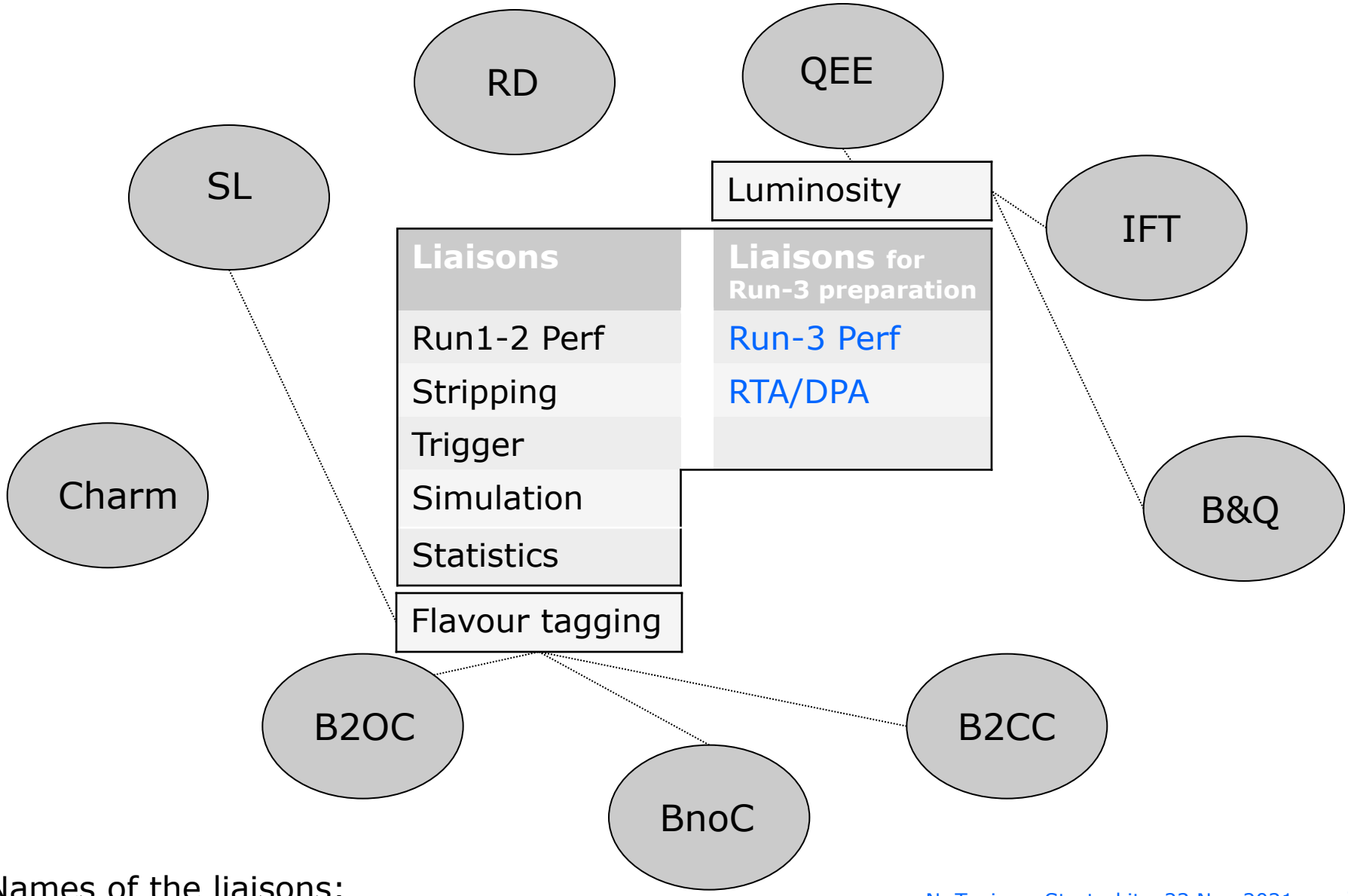
https://www.nikhef.nl/~pkoppenb/particles.html

Physics Performance WGs



https://twiki.cern.ch/twiki/bin/viewauth/LHCbPhysics/LHCbPhysics

Liaisons



Names of the liaisons:
https://twiki.cern.ch/twiki/bin/view/LHCbPhysics/LHCbWGLiaisons

Preparing for run-3: Liaisons

- Liaisons to contribute to run-3
  1) RTA/DPA (help implementations, relevant to WG)
  2) RTA/EMTF (run-3 performance, ensure variables relevant to WG are monitored)

MC
Simulation
Validation

EMTF		RTA	(Real Time Analysis)
Early		WP1	Data structures
Physics		WP2	Reconstruction
Analysis	1)	WP3	Selections
Data	2)	WP4	Align & Calib
Validation		WP5	QA
		WP6	R&D

DPA	(Data Processing & Analysis)
WP1	Sprucing
WP2	Analysis productions
WP3	Offline analysis tools
WP4	Innovative techniques
WP5	Legacy software & data

Preparing for run-3

- RTA/DPA/EMTF/Simulation structure exists
- Data validation is more important than ever

CERN-LHCC-2020-006


EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN)

CERN-LHCC-2020-006
LHCb-TDR-2020-021
June 2, 2020

LHCb Upgrade GPU High Level Trigger Technical Design Report

LHCb collaboration

Abstract

We present **Allen**, a GPU based solution for the first stage of the upgraded LHCb detector's High Level Trigger.

The Allen project is named after Frances E. Allen.

The cover image was created by Takashi Tomooka and is licensed under the Creative Commons Attribution-Share Alike 2.0 Generic license.

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LHCb-INT-2020-009


LHCb-INT-2020-009
May 21, 2020

Data Processing & Analysis (DPA) Project

Abstract

This note introduces the Data Processing & Analysis (DPA) project recommended by the Offline Analysis Task Force [1]. It presents the proposed organisation of the project in terms of work packages, prioritised deliverables, and person-power required to carry out the programme.

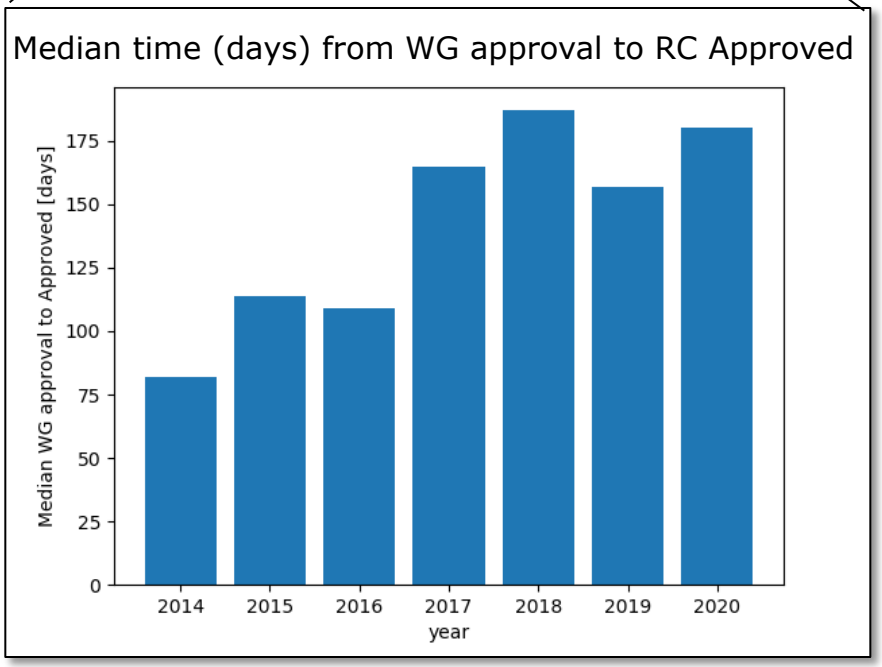
MC	EMTF	RTA	(Real Time Analysis)	DPA	(Data Processing & Analysis)
	Early Physics Analysis & Data Validation	WP1	Data structures		
		WP2	Reconstruction	WP1	Sprucing
		WP3	Selections	WP2	Analysis productions
		WP4	Align & Calib	WP3	Offline analysis tools
		WP5	QA	WP4	Innovative techniques
		WP6	R&D	WP5	Legacy software & data

Review

- Review procedure widely appreciated by the collaboration!
  - (even though it can be lengthy at times...)

Review

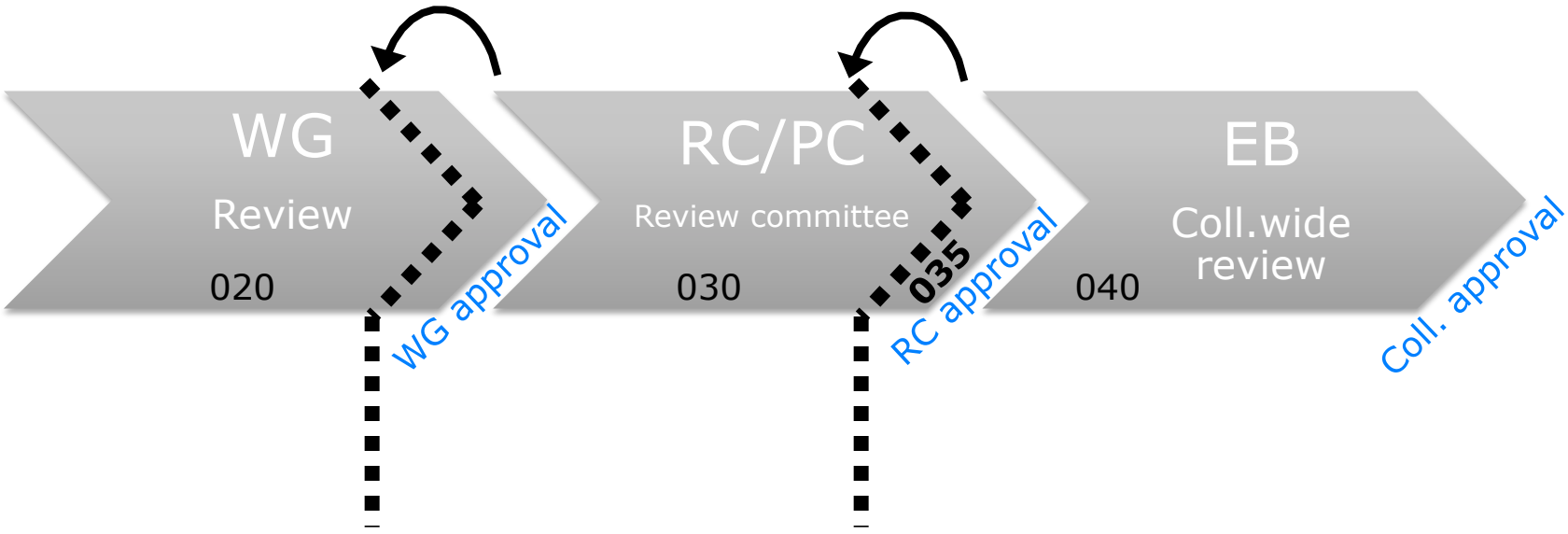
- Review by RC is thorough!



Publication statistics:
https://lhcb-publications-stats.web.cern.ch/lhcb-publications-stats/plots.html

Review procedure

- We try to help the process from WG to EB:
  - Assign review committee prior to WG approval
  - Assign EB reviewer prior to RC approval



- Paraphrasing EB chair Franz Muheim:
  - *"Be aware that conferences come and go, but papers are there to stay "*
  - Or: Quality is leading, Milestones are subleading

https://lhcb.web.cern.ch/lhcb_page/collaboration/organization/editorial_board/lhcbpub.pdf

Analysis status

- Can be followed from webpages:

020-RC requested
030-Under review
040-Waiting 1st draft
050-1st collaboration review
060-Waiting 2nd draft
070-EB reading
080-Waiting 3rd draft
090-2nd collaboration review
100-Waiting for submission
110-Submitted to journal
120-Approved by journal
130-Done
140-Retired

Analyses belonging to B2OC

Status	ID	Contacts	Title	Details
020-RC requested	B2OC-Omegab2XicKpi-001	Mikhail Mikhasenko, Sara Mitchell, Marco Pappagallo	Exclusive observation of excited Ω_c^0 baryons in the Ω_b^- decays and test of spin hypotheses	more
020-RC requested	B2OC-Dms-Run2-001	Alessandro Bertolin, Agnieszka Dziurda, Kevin Heinicke, Michele Veronesi	Precision measurement of the $B_s^0 - \bar{B}_s^0$ oscillation frequency with the $B_0^s \to D_s^- \pi^+$ decays	more
020-RC requested	B2OC-Bd2DstDsst-001	Donal Hill, Malcolm John	Angular analysis of $B^0 \to D^{*-} D_s^{*+}$ decays using Run 2 data	more
030-Under review	B2OC-Bu2DstDspiAmAn-001	Anton Poluektov, Raul Rabadan	Amplitude Analysis of $B^+ \to D^{*-}(2010) D_s^+ \pi^+$	more
030-Under review	B2OC-ADSwithD2hhpi0-run2-001	Colm Murphy, Malcolm John, Donal Hill	GLW and ADS analysis of $B^\pm \to D(hh\pi^0)h^\pm$	more
050-1st collaboration review	PAPER-2020-037	Philipp Ibis, Antje Moedden, Margarete Schellenberg	Observation of the decay $B_s^0 \to D^{*\pm} D^\mp$ and measurement of its branching fraction	more
050-1st collaboration review	PAPER-2020-036	Donal Hill, Malcolm John	Measurement of CP observables in $B^\pm \to D^{(*)} K^\pm$ and $B^\pm \to D^{(*)} \pi^\pm$ decays using two-body D final states	more
050-1st collaboration review	CONF-2020-003	Matt Kenzie, Mark Whitehead	Update of the LHCb combination of the CKM angle γ	more
070-EB reading	PAPER-2020-034	Chen Chen, Liming Zhang, Tim Gershon	Observation of a new excited D_s^+ state in $B^0 \to D^+ D^- K^+ \pi^-$ decays	more
070-EB reading	PAPER-2020-030	Phillipe d'Argent, Eva Gersabeck, Matthieu Kecke	Measurement of the CKM angle γ using $B_s \to D_s^\pm K^\mp \pi^\pm \pi^\pm$ decays	more
090-2nd collaboration review	PAPER-2020-021	Jordy Butter, Sevda Esen, Niels Tuning	Measurement of the branching fraction of the $B^0 \to D_s^+ \pi^-$ decay	more
100-Waiting for submission	PAPER-2020-019	Mikkel Bjorn, Sneha Malde	Measurement of the CKM angle γ in $B^\pm \to DK^\pm$ and $B^\pm \to D\pi^\pm$ decays with $D \to K_S h^+ h^-$	more
110-Submitted to journal	PAPER-2020-025	Daniel Johnson, Tim Gershon, Mike Williams	Amplitude analysis of the $B^+ \to D^+ D^- K^+$ decay	more
110-Submitted to journal	PAPER-2020-024	Daniel Johnson, Tim Gershon, Mike Williams	A model-independent study of resonant structure in $B^+ \to D^+ D^- K^+$ decays	more
110-Submitted to journal	PAPER-2020-006	Pavol Stefko, Daniel Johnson, Fred Blanc, Tatsuya Nakada	Measurement of the branching fractions for $B^+ \to D^{*+} D^- K^+$, $B^+ \to D^{*-} D^+ K^+$, and $B^0 \to D^{*-} D^0 K^+$ decays	more

https://lhcb-publications-stats.web.cern.ch/lhcb-publications-stats/active.html

Analysis status

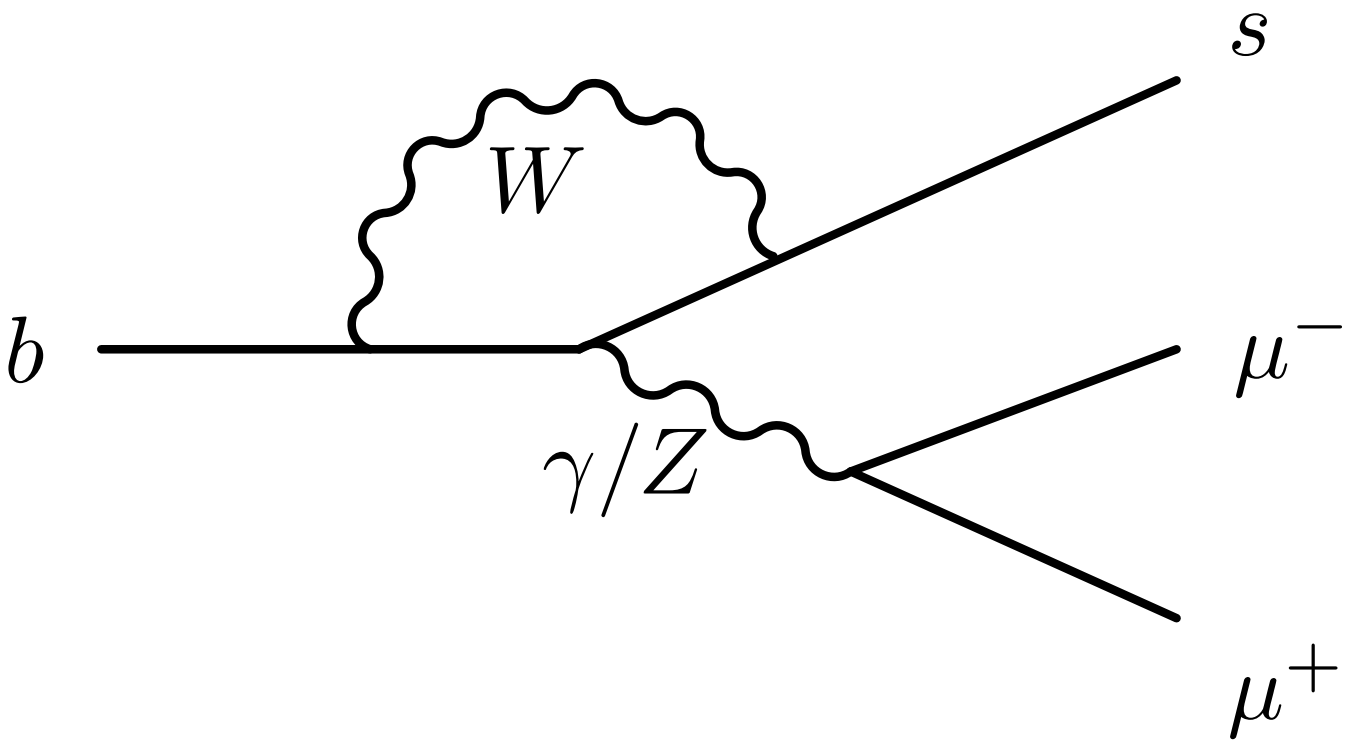
Status	050-1st collaboration review
Paper	PAPER-2020-041
Title	Angular analysis of the $B^+ \to K^{*+}\mu^+\mu^-$ decay
Can be shown in Conference?	Yes (as of 28 Oct 2020)
Working group	RD
Contacts	Martino Borsato, Michel De Cian, David Gerick
Referee chair	Mitesh Patel
Referee(s)	Mikhail Mikhasenko
EB reviewer	John Walsh
EB readers	Sergey Barsuk, Jolanta Brodzicka
Institutes	Barcelona, Spain, ITEP, Moscow, Russia, Bologna, Italy, Zurich, Switzerland, Dublin, Ireland, Ferrara, Italy,
Review e-group	lhcb-review-RD-Bu2KstarMuMuAngular (archives)
Paper e-group	lhcb-paper-2020-041-reviewers (archives)
EP number	
ANA-number	ANA-2018-022
Twiki	https://twiki.cern.ch/twiki/bin/viewauth/LHCbPhysics/Bu2KstarMuMuAngularAnalysis
Authors	LHCb
arXiv	
Journal	PRL
Dataset	2011, 2012, 2015, 2016, 2017, 2018
Analysis gitlab	https://gitlab.cern.ch/LHCb-RD/ewp-Bplus2Kstmumu-AngAna
Tuples location	/eos/lhcb/wg/RD/Bu2Kstmumu
WG approval	22-Jan-2020
EB reviewer assigned	25-Sep-2020
Perminssion to go to paper/conf	13-Oct-2020
1st collaboration-wide review	28-Oct-2020 https://cds.cern.ch/record/2741581
2nd collaboration-wide review	
Final EB reading	
Collaboration approval	
Submitted	
Accepted	
Published	

Outline

- Once upon a time...
- Working Groups
  - Physics Analysis WG
  - Physics Performance WG
  - Liaisons
- Structure
- Review
- Anomalies

What is next...

Flavour Changing Neutral Current Electroweak Penguin



What can we measure??

1) Decay rate: count number of decays

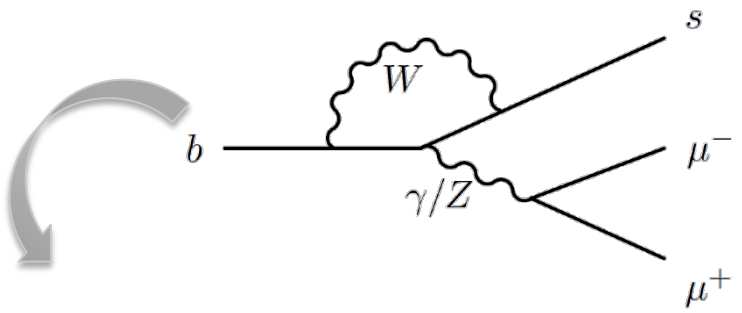
2) Angular asymmetries: compare “left” vs “right”

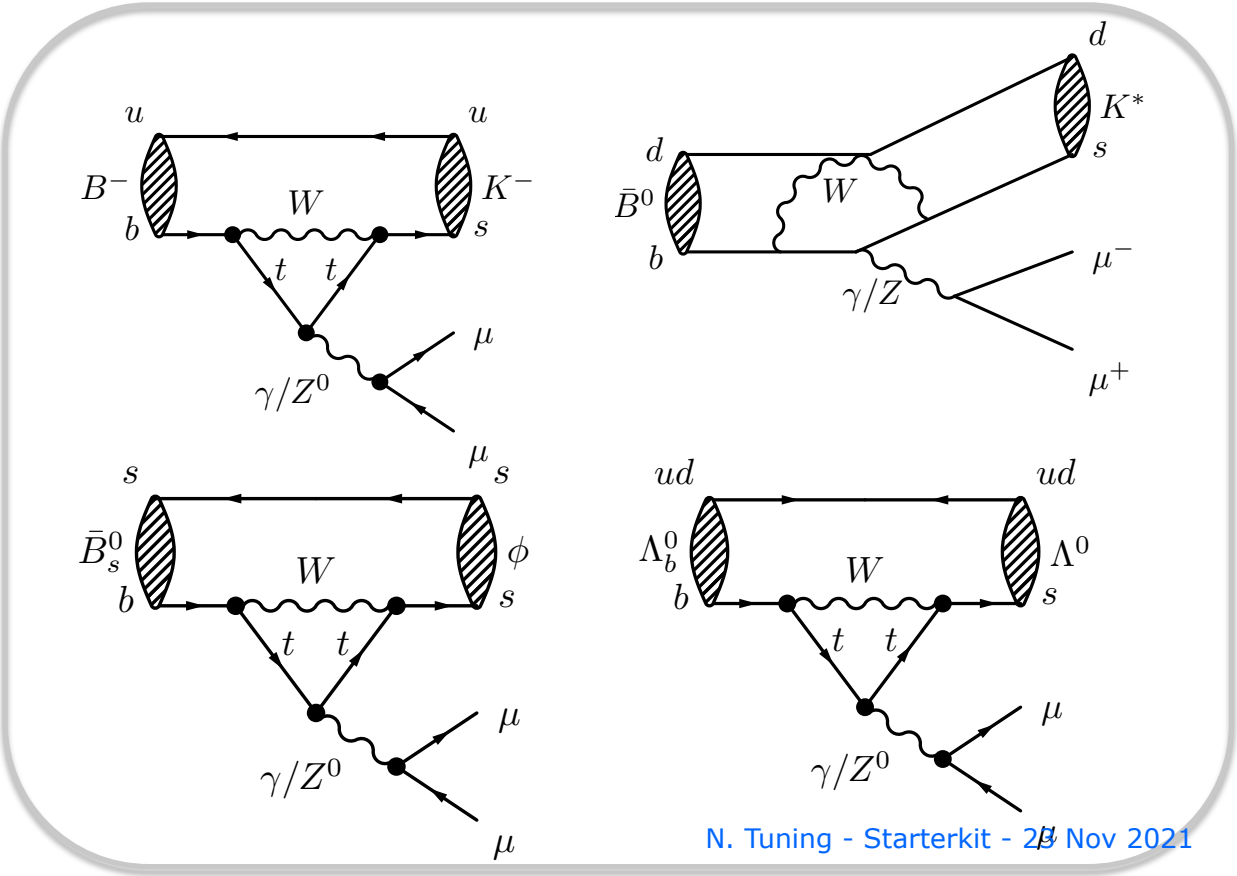
3) Ratio of decay rates: compare muons and electrons

They all show ‘funny’ results…

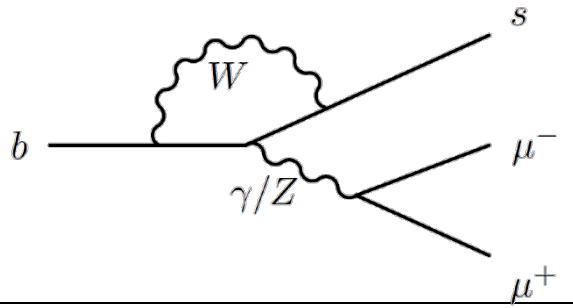
1) Decay rates: $b \to sll$

- Study same process with different hadrons:

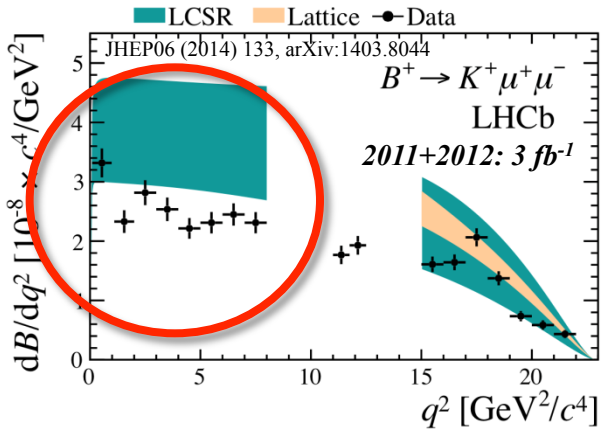


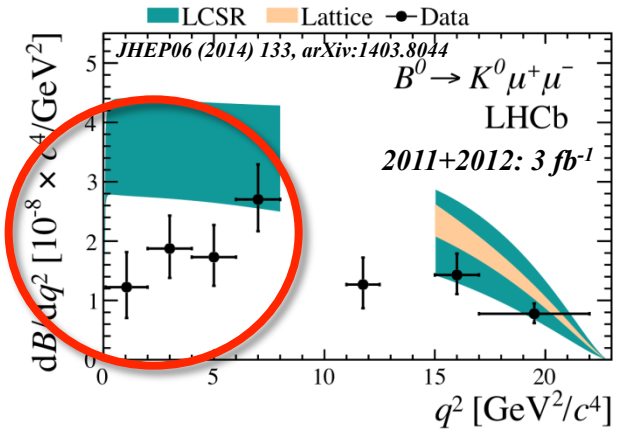


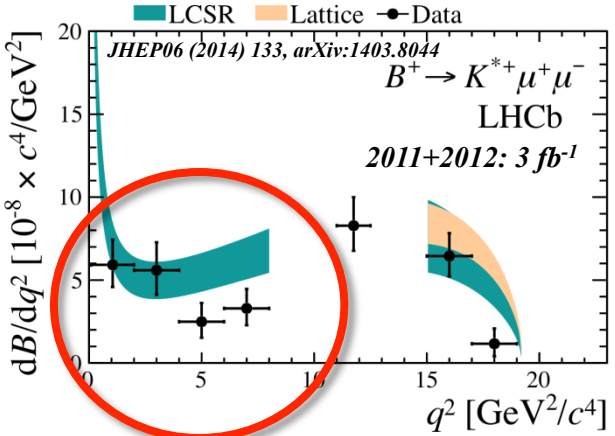
1) Decay rates: $b \to s\ell\ell$

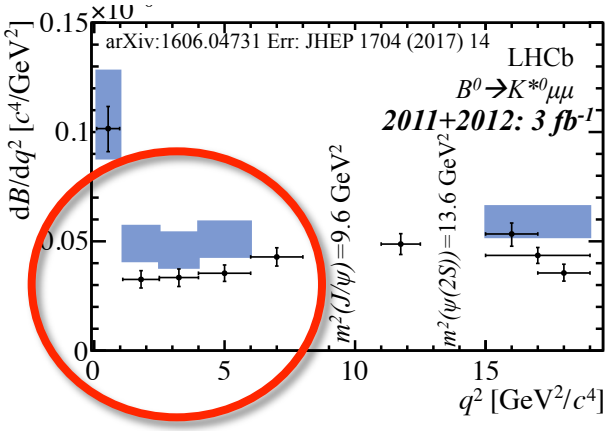


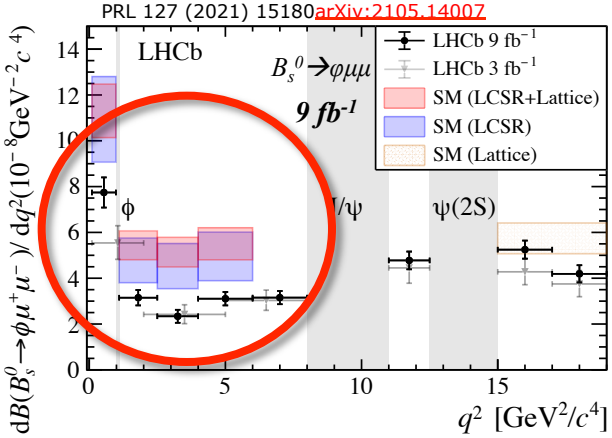
- Decay rate is consistently low:

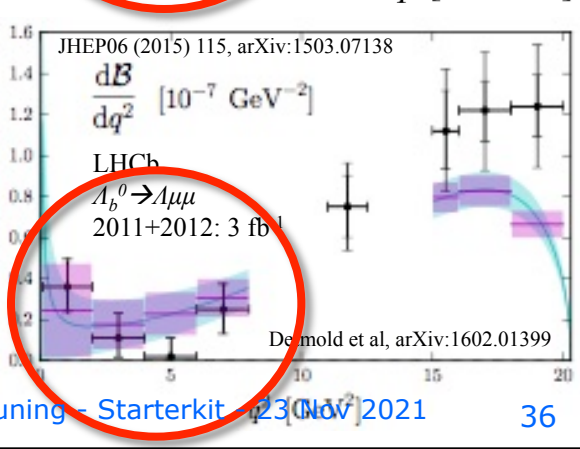




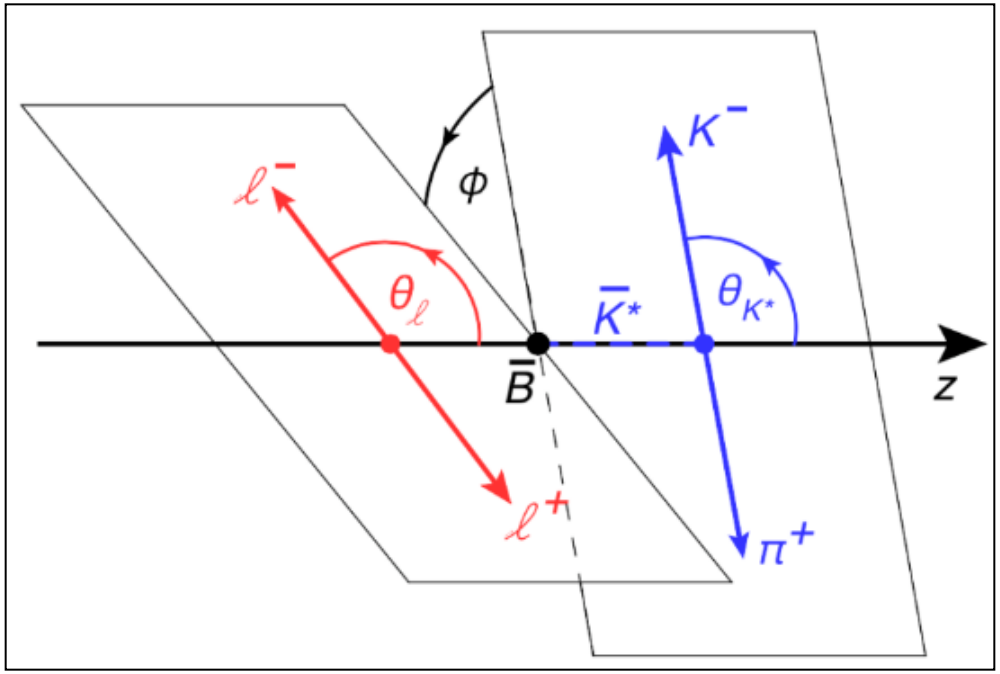




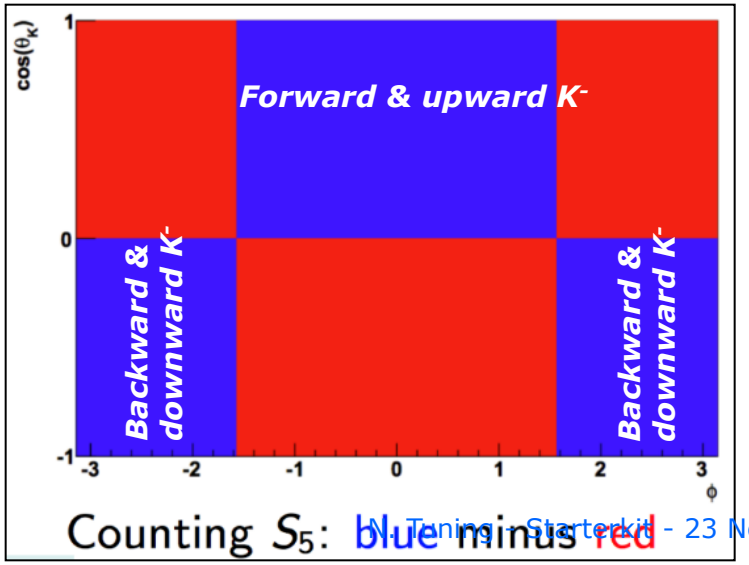




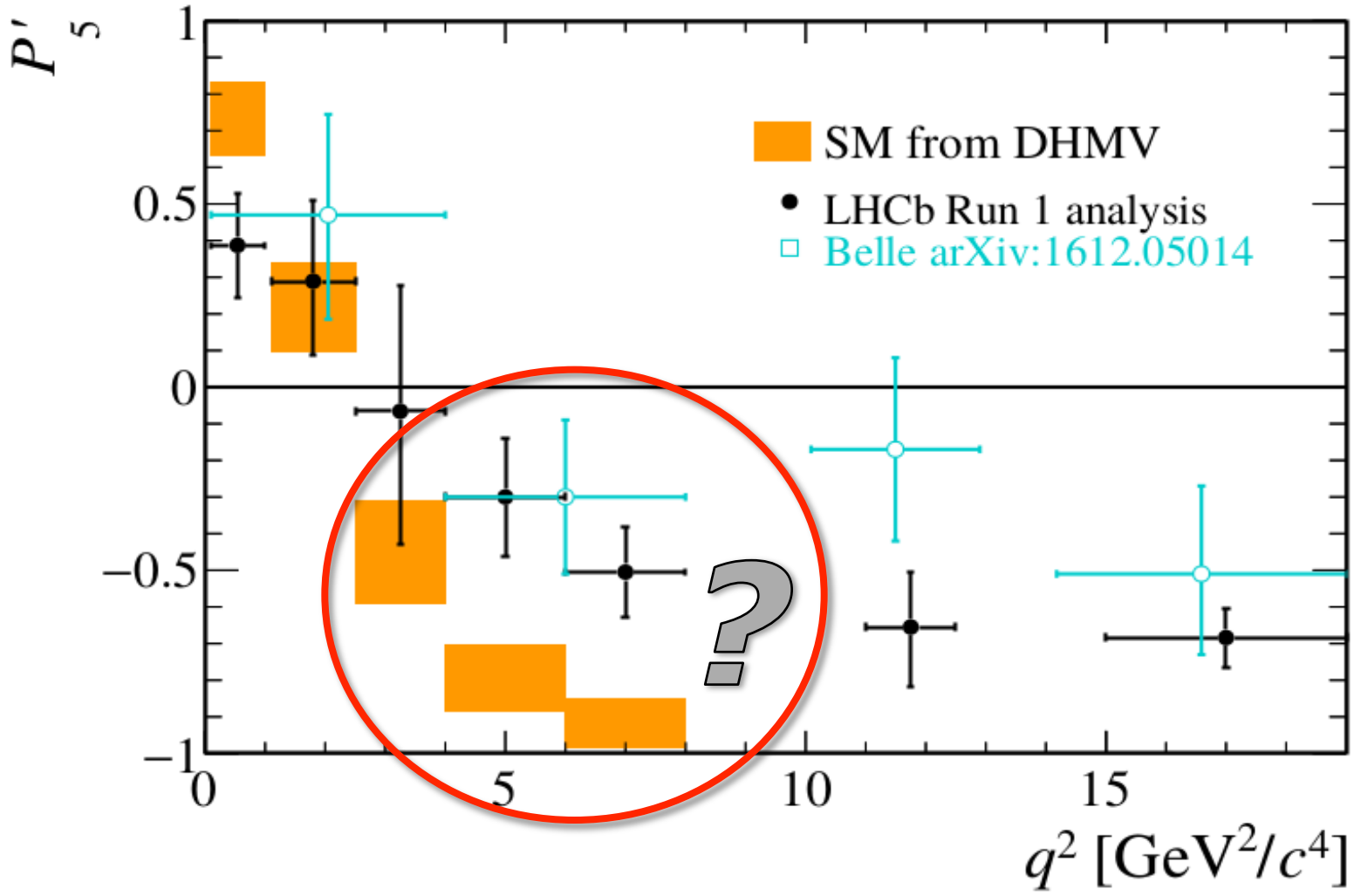
2) Angular asymmetries



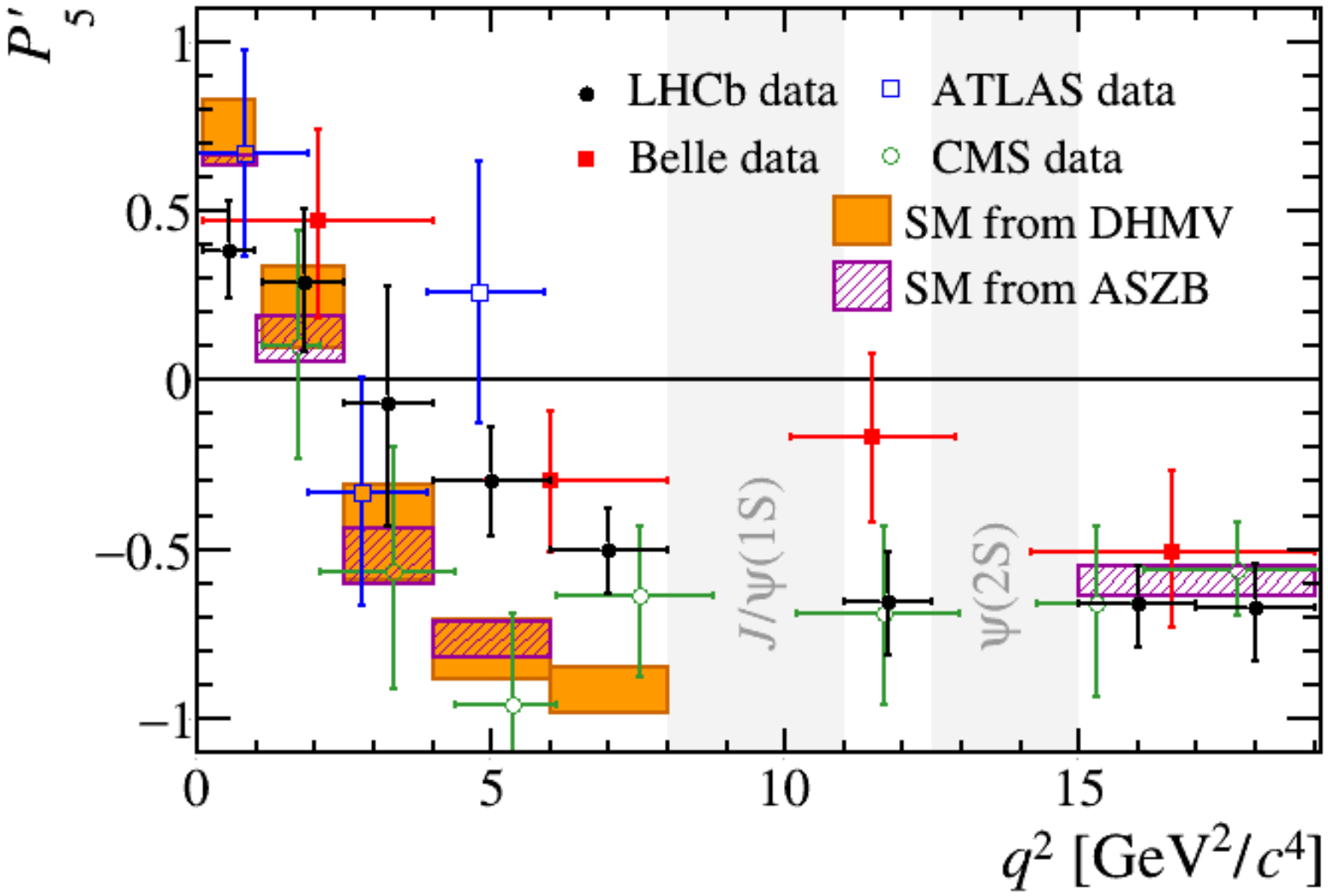
P_5':



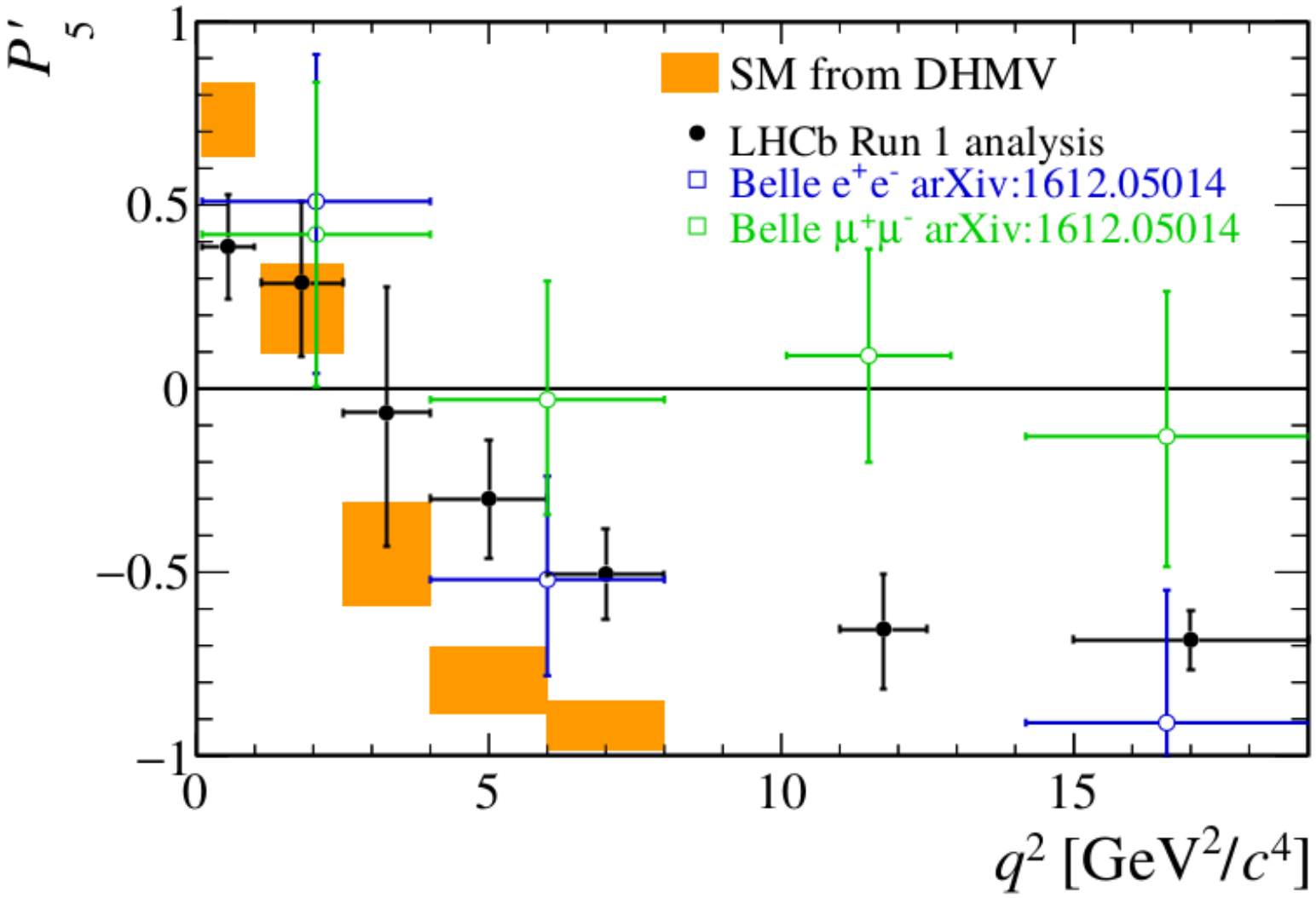
2) Angular asymmetries



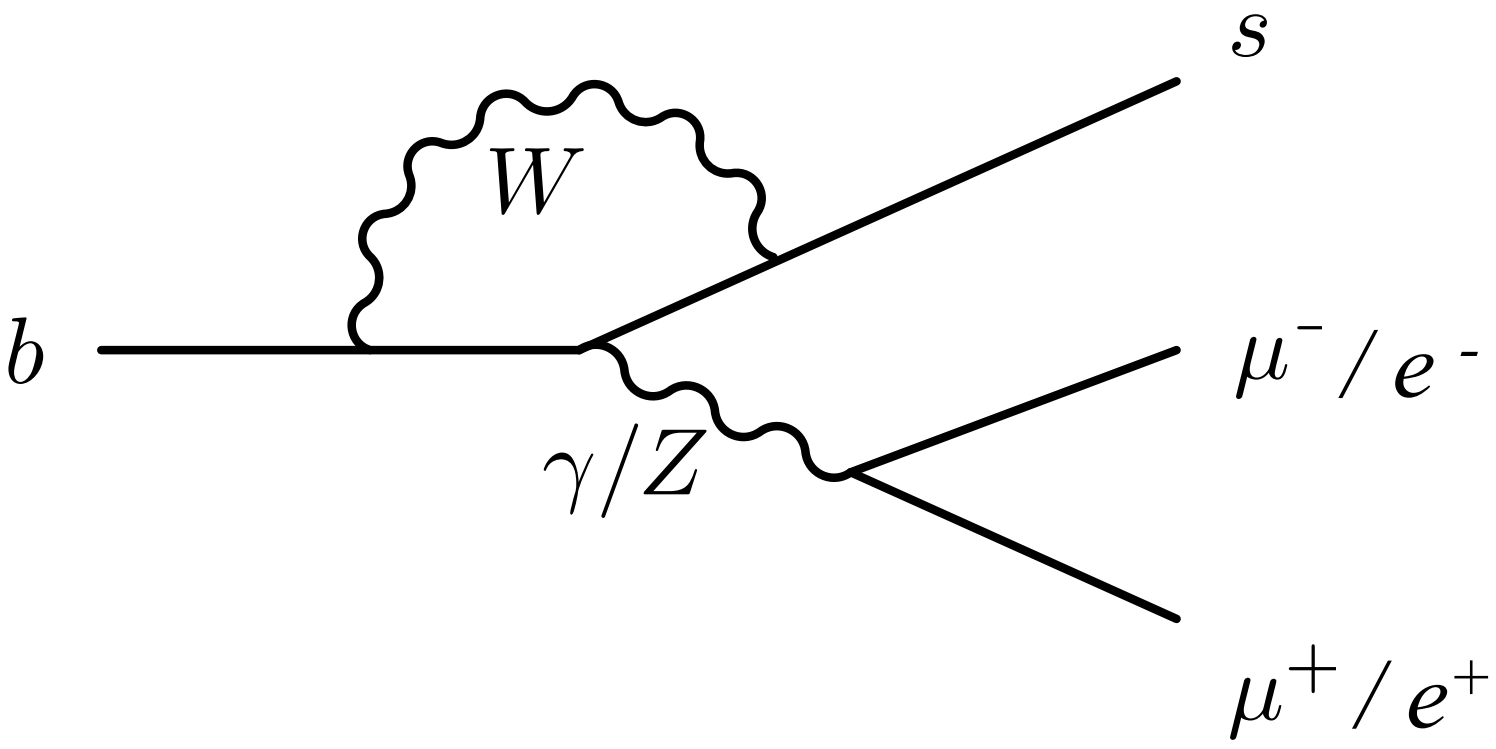
2) Angular asymmetries



2) Angular asymmetries: hint of electron muon difference?

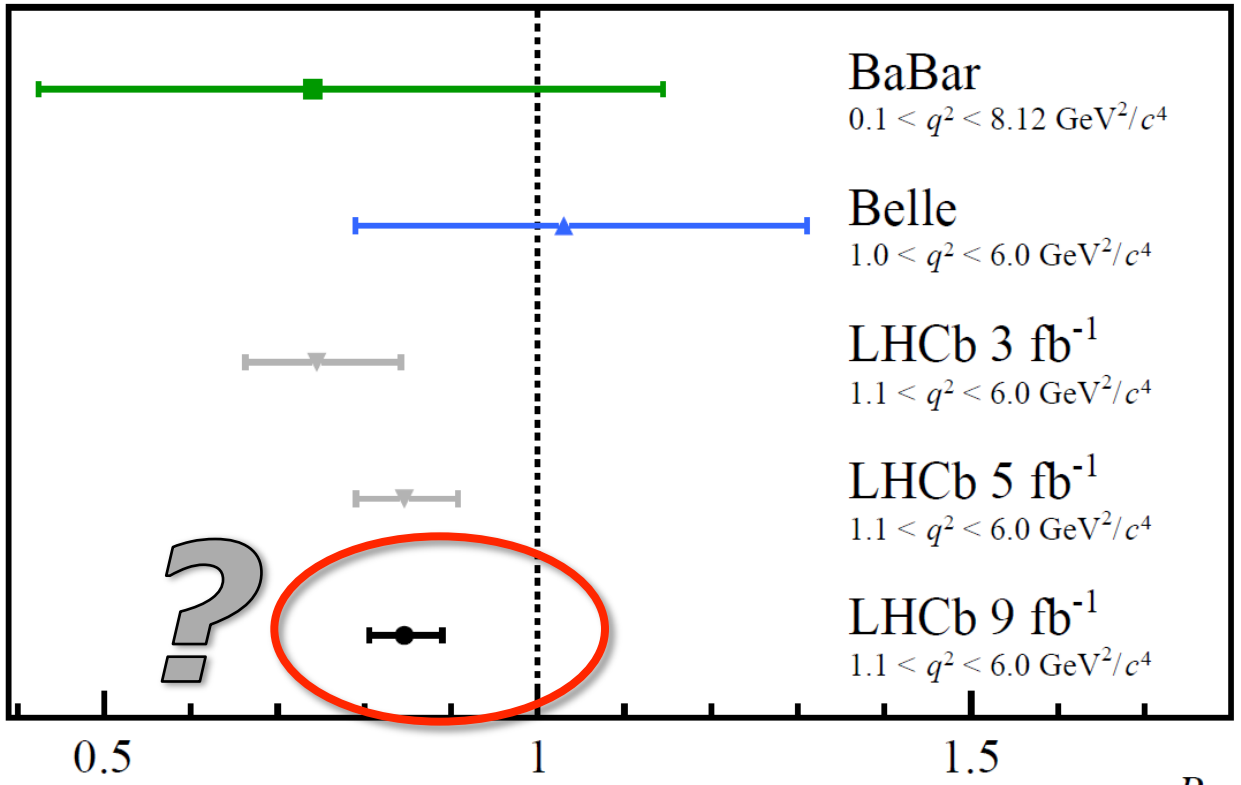


3) Ratio of decay rates



From March this year:

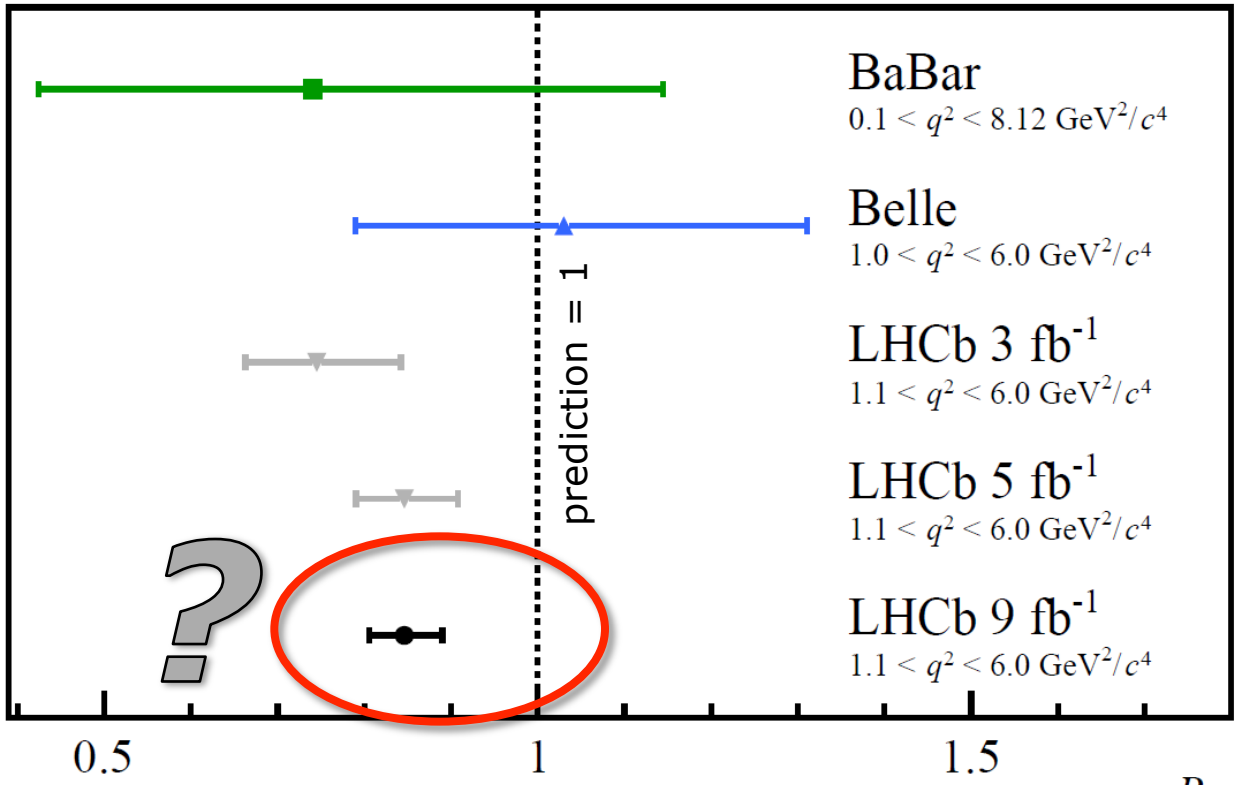
$$R_K = \frac{N(B^+ \to K^+ \mu^+ \mu^-)}{N(B^+ \to K^+ e^+ e^-)}$$



March this year: passed 3σ

$$R_K = \frac{N(B^+ \to K^+ \mu^+ \mu^-)}{N(B^+ \to K^+ e^+ e^-)}$$

Probability that it is coincidence: 1 in 1000



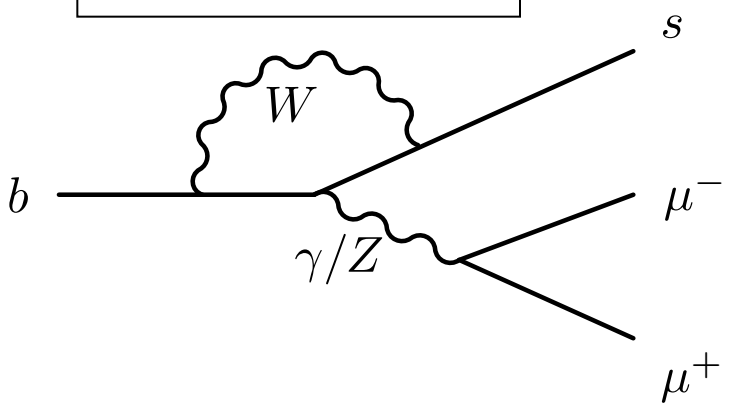
Why are people excited?

- all measurements seem to point in same direction...

Why are people excited?

- all measurements seem to point in same direction...
- *something* affects the muons...

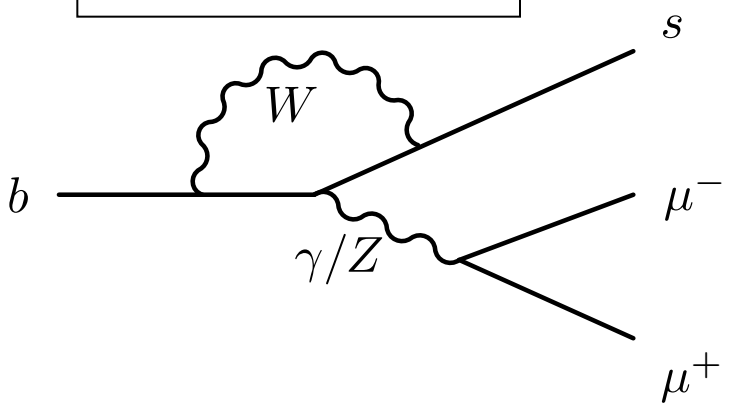
Standard Model:



Why are people excited?

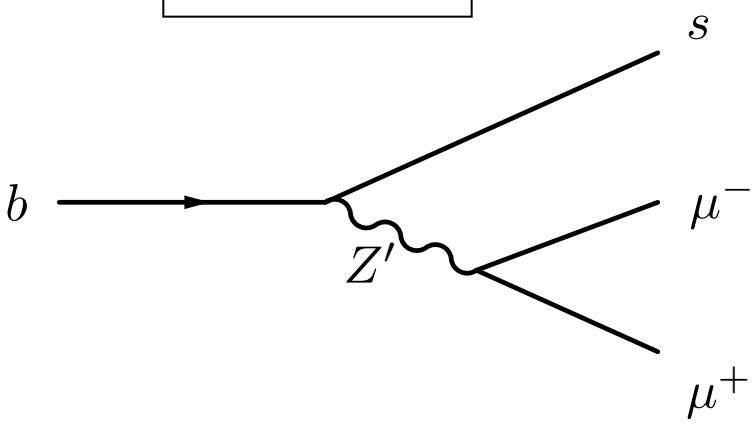
- all measurements seem to point in same direction...
- *something* affects the muons...

Standard Model:

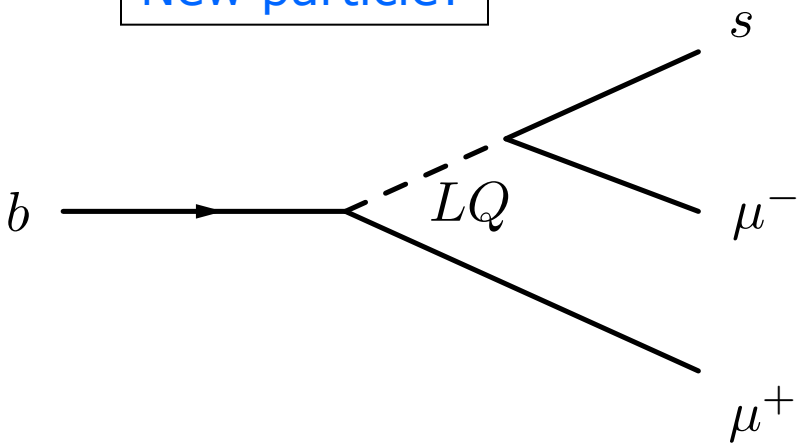


- But what??

New force?

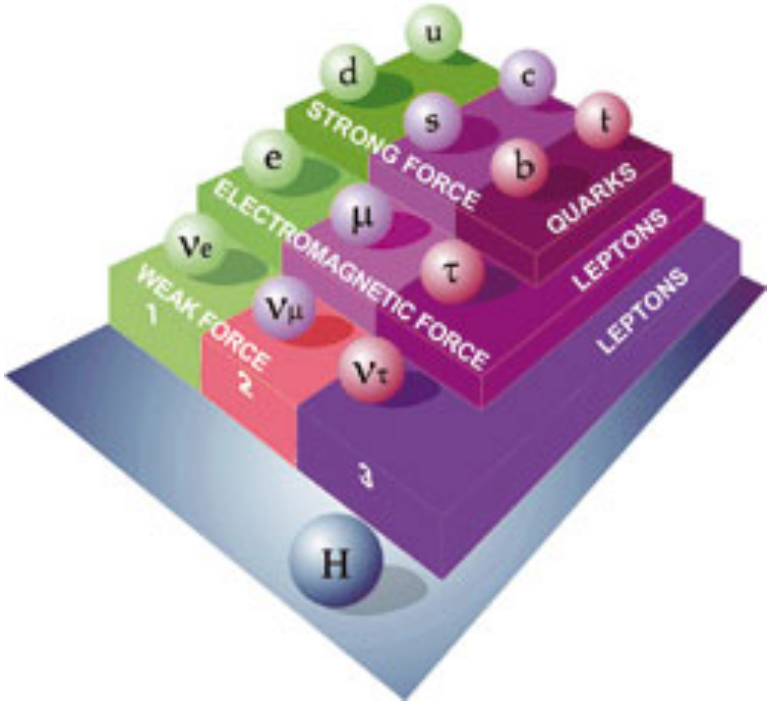


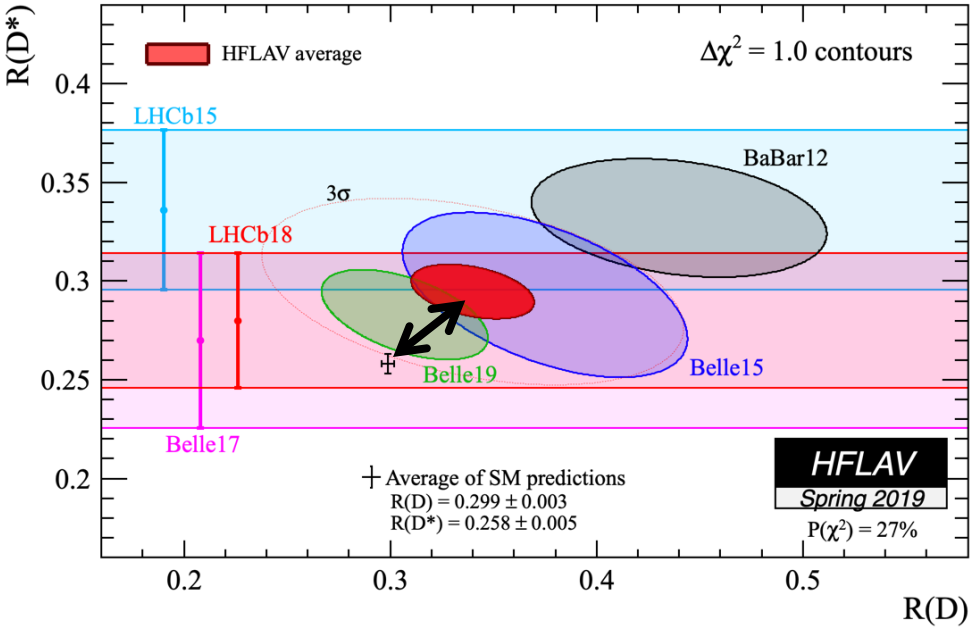
New particle?



There is more...

- What about tau?

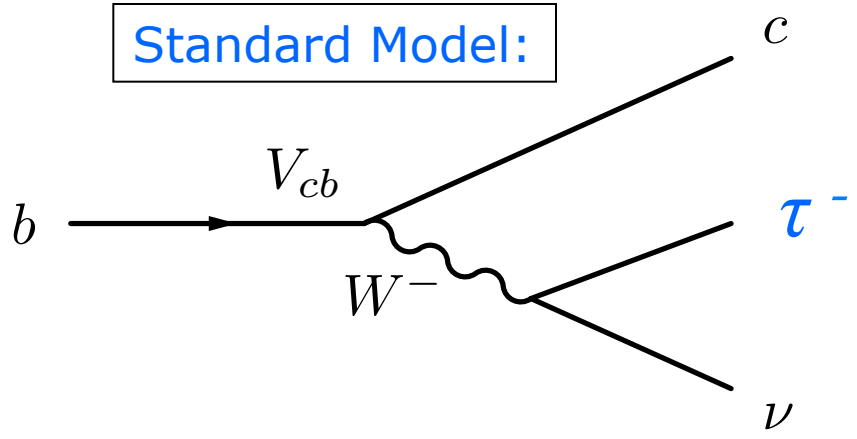




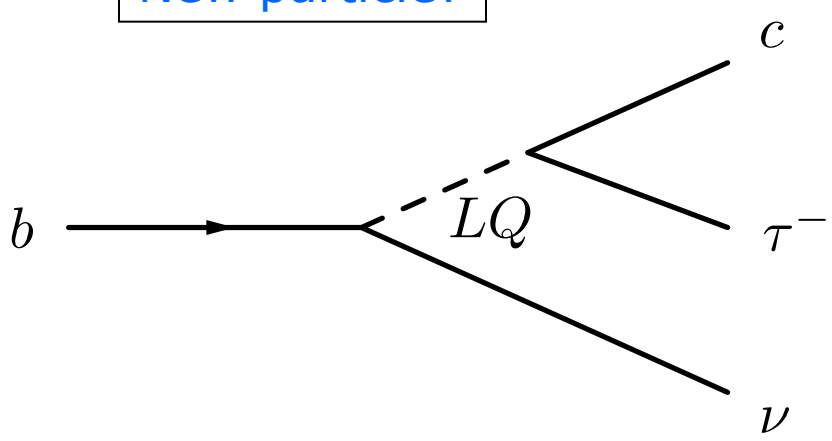
There is more...

- What about tau?

Standard Model:



New particle?



So, now what?

- Not sure if we discovered something...

- Maybe we will know coming year with more analyses
- Maybe we have to wait for run-3

- My feeling:
  - Half of LHCb believes we will make biggest physics discovery since 50 years
  - Half of LHCb is neutral or skeptic or scared or just hopeful

Towards discovery?

When do we believe??

1) Conservative: “clean” observables only (all, not ‘cherry picking)

2) Experimental checks

3) Theory consensus

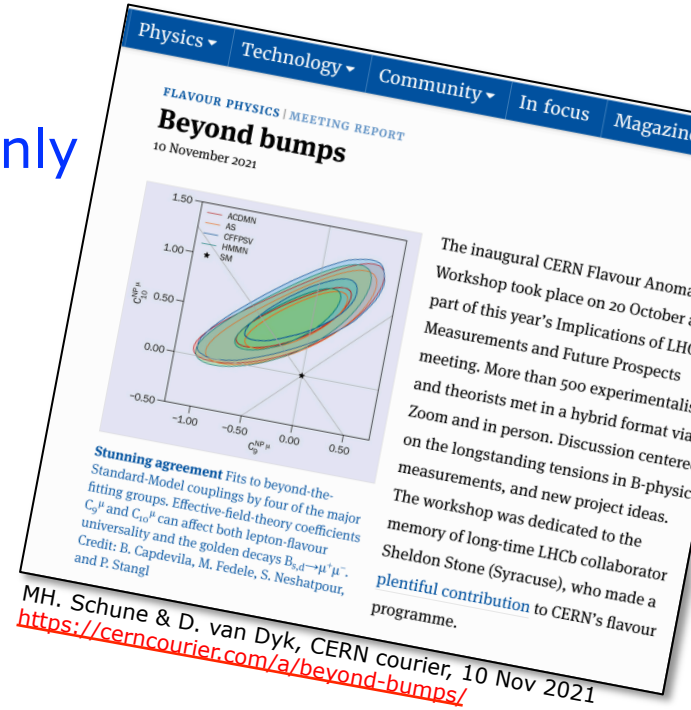
Towards discovery?

When do we believe?

1) Conservative: "clean" observables only
   - R_{pK}, R_K, R_{KS}, $R_{K^{*+}}$, $R_{K^{*0}}$, $B^0_s \to \mu^+\mu^-$

2) Experimental checks
   - Low q^2 R_{K^*} ?
   - $R(\phi\pi)$: $D_s^+ \to \phi(ee)\pi^+$ / $D_s^+ \to \phi(\mu\mu)\pi^+$

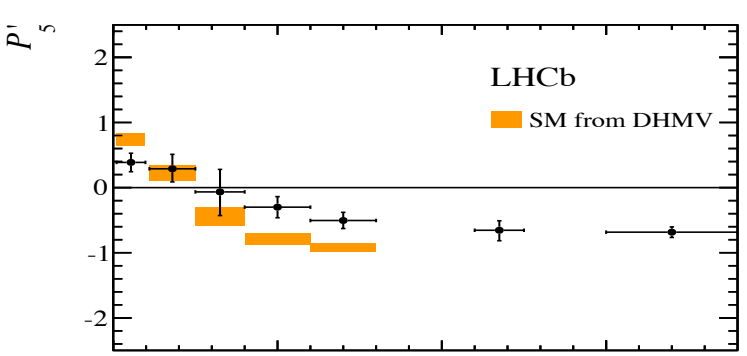
3) Theory consensus
   - Equivalent: Clean observables & all observables but C_9^{univ} as nuissance

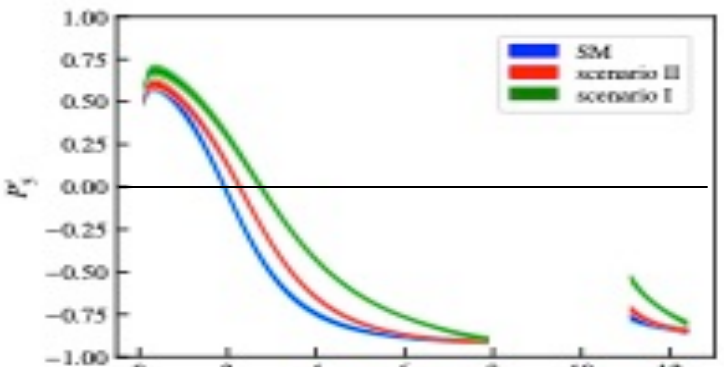


MH. Schune & D. van Dyk, CERN courier, 10 Nov 2021
https://cerncourier.com/a/beyond-bumps/

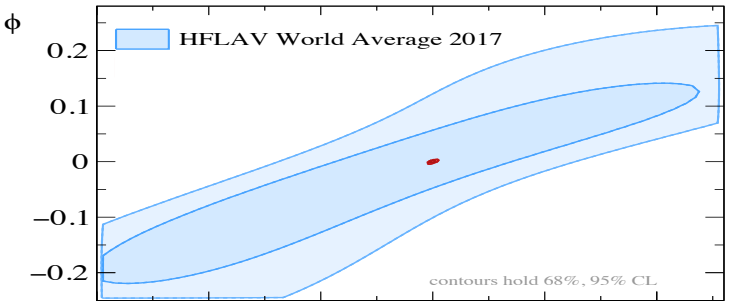
Summary

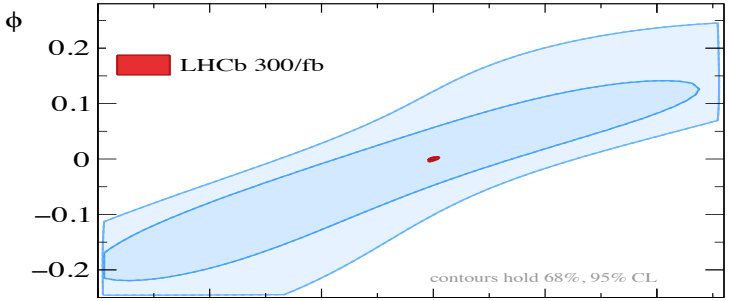
- Precision measurements to scrutinize the Standard Model
- Precision measurements only way to reach very high mass scales
- Precision measurements are not yet precise enough



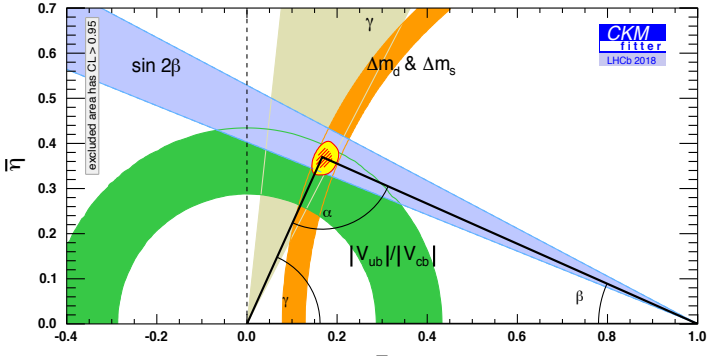


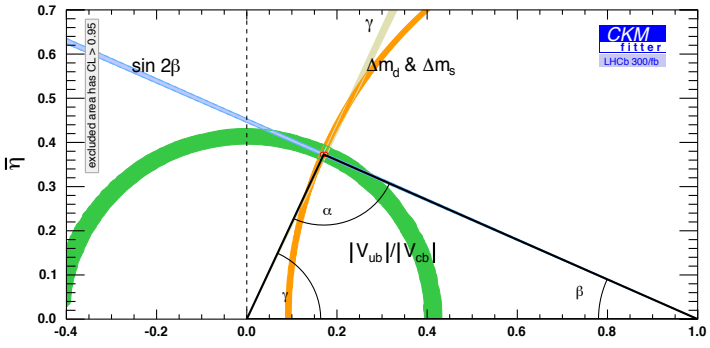
Rare Decays





Charm





Beauty

Thanks!

Some links

- Twiki
  - https://twiki.cern.ch/twiki/bin/viewauth/LHCbPhysics/LHCbPhysics
  - https://twiki.cern.ch/twiki/bin/view/LHCbPhysics/LHCbPhysicsAnalysisTopicsByWorkingGroup
- Constitution
  - https://twiki.cern.ch/twiki/bin/view/LHCbPhysics/LHCbPhysicsOrganisation
- Analysis database
  - http://lhcb-wg.web.cern.ch/lhcb-WG/
- EB status
  - https://lhcb-publications-stats.web.cern.ch/lhcb-publications-stats/active.html
- Upcoming conference deadlines
  - https://twiki.cern.ch/twiki/bin/view/LHCbPhysics/UpcomingDeadlines
- Publication rules
  - https://lhcb.web.cern.ch/lhcb_page/collaboration/organization/editorial_board/PublicationProcedureNovember2011.pdf
- Guidelines for high-profile analyses
  - https://indico.cern.ch/event/715188/contributions/2948291/attachments/1623378/2584231/Guidelines_high_impact_analyses_FINAL.pdf

Deadlines?

- Implications Workshop just ended

Conference	WG sign-off (typical)	WG sign-off (last possible)	Assign EB reviewer	Approval presentation for PAPER	Latest date for PAPER 1st circulation	Approval presentation for CONF	Latest date for CONF circulation	Practice talks	Start of conference
		030	035 (NEW, tbd)	040	050				
Autumn 2020 conferences									
Implications (virtual confirmed)	7 Jun 2020	7 Sep 2020	w/c 21 Sep 2020	w/c 5 Oct 2020	12 Oct 2020	w/c 12 Oct 2020	19 Oct 2020	w/c 19 Oct 2020	28 Oct 2020
CKM (cancelled)									30 Nov 2020
Winter 2021 conferences									
Initial Stages (IFT)	3 Aug 2020	2 Nov 2020	w/c 16 Nov 2020	w/c 30 Nov 2020	3 Dec 2020	w/c 7 Dec 2020	11 Dec 2020	w/c 4 Jan 2021	10 Jan 2021
La Thuile	15 Oct 2020	15 Jan 2021	w/c 1 Feb 2021	w/c 15 Feb 2021	19 Feb 2021	w/c 22 Feb 2021	26 Feb 2021	w/c 1 Mar 2021	8 Mar 2021
Moriond	29 Oct 2020	29 Jan 2021	w/c 15 Feb 2021	w/c 1 Mar 2021	4 Mar 2021	w/c 8 Mar 2021	10 Mar 2021	w/c 15 Mar 2021	20 Mar 2021
Summer 2021 conferences									
Quark Matter	17 May 2021	16 Aug 2021	w/c 30 Aug 2021	w/c 13 Sep 2021	16 Sep 2021	w/c 20 Sep 2021	22 Sep 2021	w/c 27 Sep 2021	3 Oct 2021

3 wks

https://twiki.cern.ch/twiki/bin/viewauth/LHCbPhysics/UpcomingDeadlines

1) Results for CKM, Lepton Photon

ReportM	Title	Approval
PAPER-2021-040	First Observation of $\Lambda^0_b \to D^+ p\pi^-\pi^-$ and $\Lambda^0_b \to D^{*+} p\pi^-\pi^-$ decays	19 Oct (→ CKM)
PAPER-2021-041	Measurement of the charm mixing parameter y_{CP} in prompt D^0 meson decays	26 Oct (→ CKM)
PAPER-2021-042	Search for the rare decay $B^0 \to \phi\mu^+\mu^-$	26 Oct (→ CKM)
PAPER-2021-043	First observation of the decays $B_{(s)} \to D^{*0} K \pi$	26 Oct (→ CKM)
PAPER-2021-044	**Measurement of $B(\Lambda_b \to \Lambda_c \tau\nu)$ and $R(\Lambda_c)$ with τ three-prong decays**	**2 Nov (→ LP)**
PAPER-2021-045	Observation of ω contribution in the $X(3872) \to \pi^+\pi^- J/\psi$ decays	9 Nov
PAPER-2021-046	Λ^+_c over D^0 production in peripheral PbPb collisions at $\sqrt{s_{NN}}$=5.02 TeV	10 Nov
PAPER-2021-047	Study of $B^+ \to J/\psi\eta K^+$	16 Nov
QEE-DY-ZAngular	Measurement of angular coefficients of Drell-Yan $\mu^+\mu^-$ pairs in Z boson mass	23 Nov ?
Bnoc-Bto3hCPV	Direct CP violation in $B^\pm \to h^\pm h^+ h^-$ using 2015-2018 data	23 Nov ?
Charm-D02mumu	Search for the $D^0 \to \mu^+\mu^-$ decay with Run 1-2 data	30 Nov ?
IFT-pi0-pPb-8TeV	Nuclear modification of π^0 production in pPb collisions at $\sqrt{s_{NN}}$=8.16 TeV	30 Nov ?
CHARM-BaryonSpectroscopyDp	Charmed baryons spectroscopy with $D^0 p$ and $D^+ p$ final states	30 Nov ?
BnoC-Bd2ppbarKpi	Search for CP violation using T -odd correlations in $B^0 \to p\bar{p}K^+\pi^-$ decays	30 Nov ?
Charm-Lc2pKpi-AmAn	Amplitude analysis of $\Lambda^+_c \to pK^-\pi^+$ decays from semileptonic production	Dec ?
Charm-D2ETAHCPV	Measurement of direct CP asymmetries in $D^+_{(s)} \to \eta^{(\prime)}\pi^+$ decays with Run2 data	Dec ?
BandQ-B2LcLcK	Study of the $B^+ \to \Lambda_c^+ \Lambda_c^- K^+$ decay	Dec ?
RD-B02KstTauMu	Search for the lepton flavour violating decay $B^0 \to K^{0*}\tau\mu$	Dec ?
RD-Bu2KTauMu	Search for the lepton-flavour violating decays $B^+ \to K^+\tau^\pm\mu^\mp$	Dec ?
RD-Rphipi	**Test of lepton flavour universality using $D^+_{(s)} \to \pi^+\varphi(\ell^+\ell^-)$ decays**	**Jan ?**
RD-RX	**Test of lepton flavour universality with $b \to s\ell^+\ell^-$ decays**	**Jan ?**
SLB-DandDstarTauNu	**Simultaneous extraction of the BF ratios $R(D)$ and $R(D^*)$ with Run 1**	**Jan ?**

Deadlines?

- We start to worry ~now about Moriond...

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"Moriond" ?

This was not a conference or a school, but a gathering ("rencontre") of minds. The name of what became a series of meetings reflects this original motivation. Held in Moriond village, the very first of the Rencontres de Moriond was a resounding success. (1965)

The 20 participants included theorists and experimenters of all ages, from France, Italy (Frascati) and Germany (DESY).

The time was well filled with fruitful but relaxed discussions, culinary experiments, skiing, and evenings spent listening to music performed by the scientists themselves.

Gradually, the Rencontres de Moriond became known as the annual fair of the high-energy physics community.

https://cerncourier.com/a/40-great-years-of-the-rencontres-de-moriond/

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(20 ?!)

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(culinary??)

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