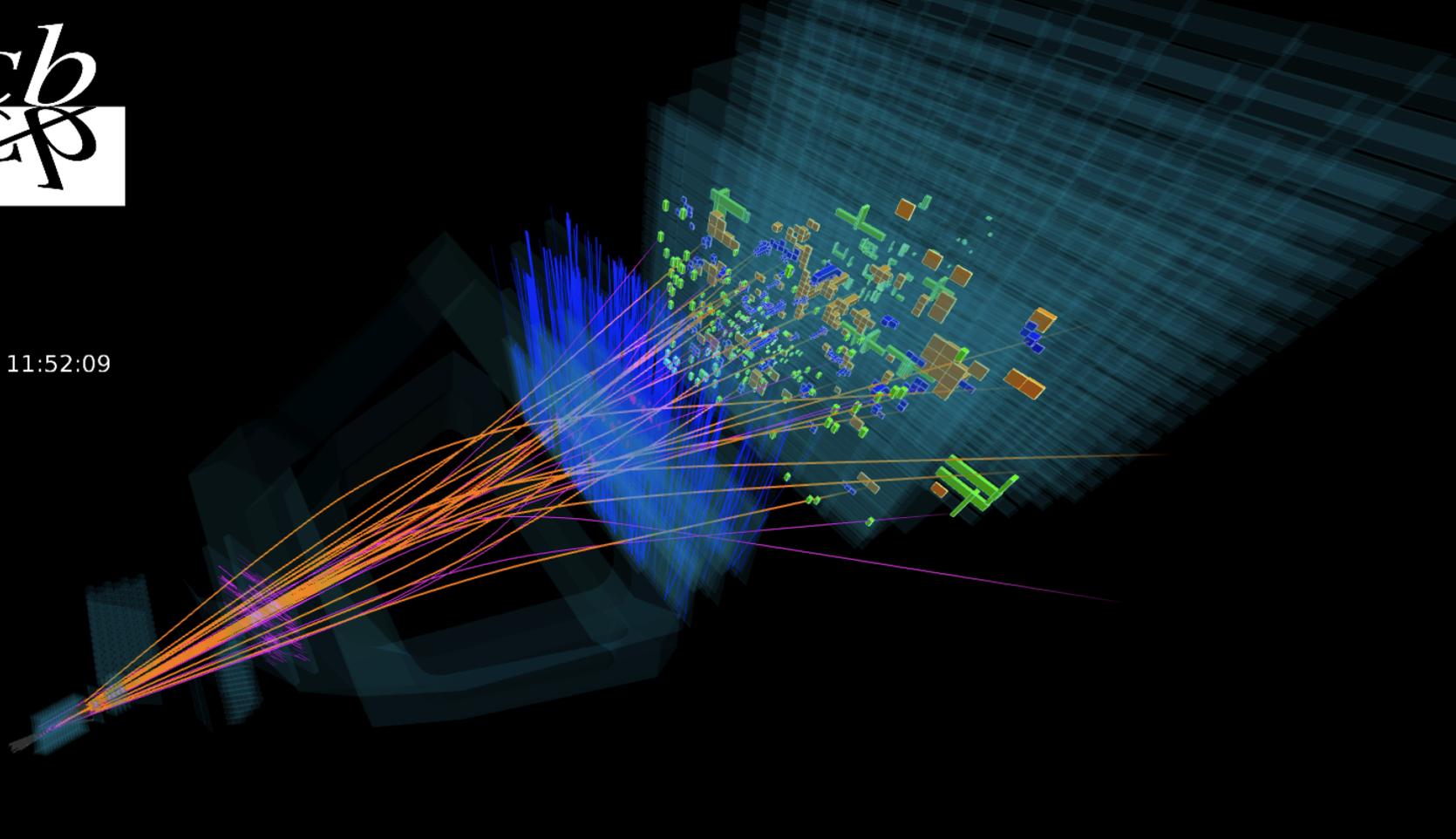




Event 41383468
Run 153460
Wed, 03 Jun 2015 11:52:09



LHCb-PISA

Preventivo locale 2016

Giovanni Punzi

1/7/2015

Composizione del gruppo

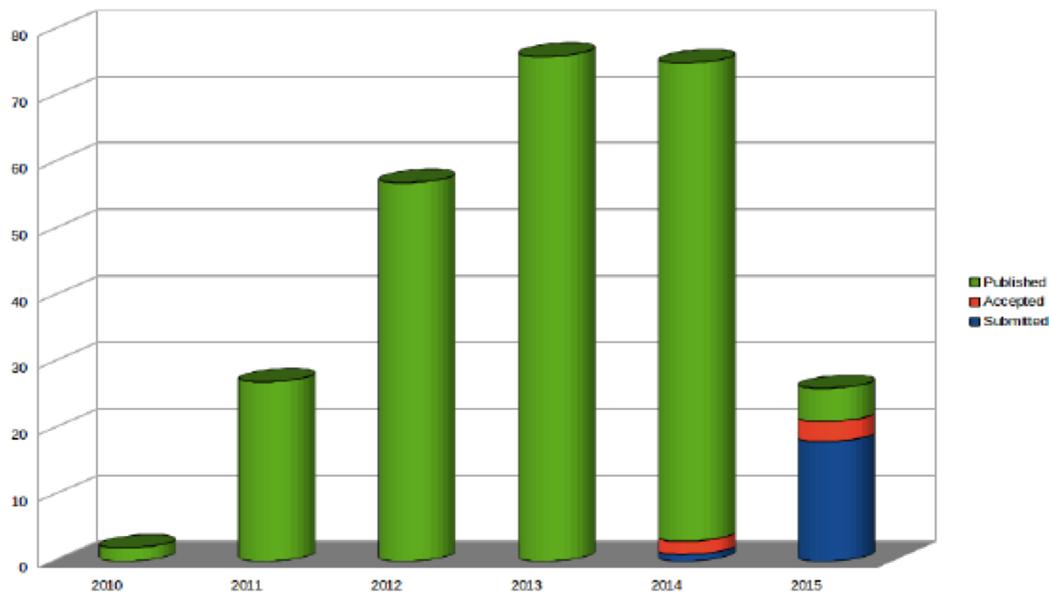
- Gruppo “nuovo”
 - Inizio 2013 con 2 FTE
(a fine Run-I)
- Laureati 3 studenti magistrali
+ 1 in corso

		%	
Franco	Bedeschi	70	staff
Riccardo	Cenci	55	pdoc
Alberto	Lusiani	70	staff
Pietro	Marino	100	dott
Michael	Morello	60	staff
Giovanni	Punzi	70	staff
Franco	Spinella	10	tecn
Matteo	Rama	100	staff
Simone	Stracka	70	RTD
John	Walsh	100	staff
<i>FTE</i>		7.05	9

LHCb Publication status

- Now close to 250th publication
- Highest papers/author ratio at LHC
- Still more Run-I analyses in the pipeline

Publication status, as of Monday 8/6/2015



263 papers in total,
integrating over
published, accepted
and submitted

ATLAS 435
CMS 438
ALICE 115

Pisa group helped producing several papers

- 19 institutional reviews

+8 papers recently refereed/under ref by Pisa people

Some Physics Highlights

Analisi angolare $B \rightarrow K^{*0}(ee, \mu\mu)$

- Analisi angolare di $K^{*0}ee$ a q^2 molto piccoli $[0.0004, 1.0] \text{ GeV}^2/c^4$

- Valori delle osservabili angolari in accordo con SM

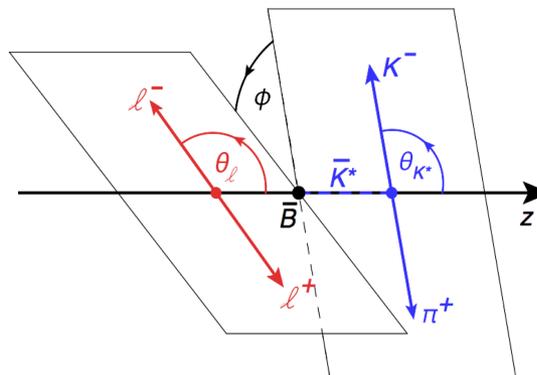
- Vincoli su $C_7^{(1)}$, sensibili alle variabili angolari a basso q^2 , competitivi con quelli misurati con i decadimenti radiativi

- Update dell'analisi angolare di $K^{*0}\mu\mu$

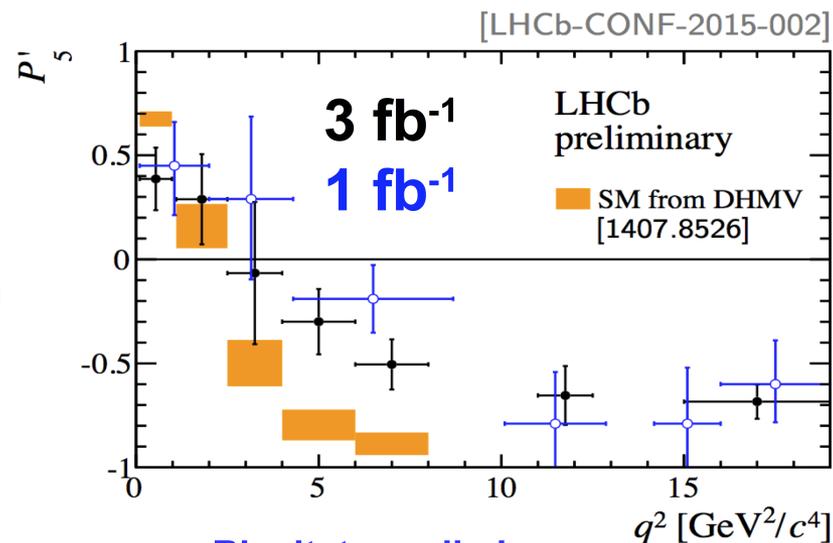
- Compatibile con precedente misura su 1 fb^{-1} [[PRL 111, 191801 \(2013\)](#)]

- Confermata la discrepanza di P_5' (3.7σ dai soli due bins $[4-8] \text{ GeV}^2/c^4$)

Publicato su [JHEP04 \(2015\) 064](#)



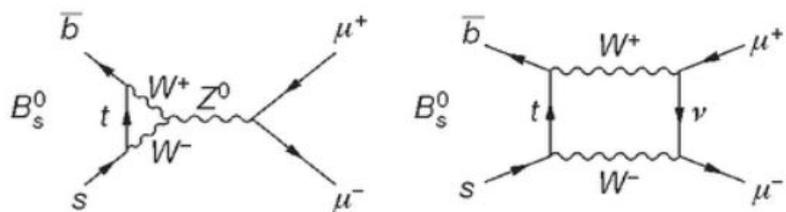
obs.	result
F_L	$+0.16 \pm 0.06 \pm 0.03$
$A_T^{(2)}$	$-0.23 \pm 0.23 \pm 0.05$
A_T^{Re}	$+0.10 \pm 0.18 \pm 0.05$
A_T^{Im}	$+0.14 \pm 0.22 \pm 0.05$



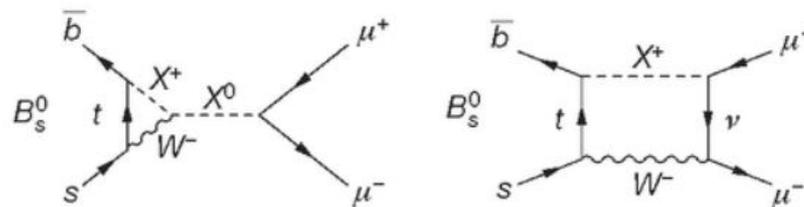
Risultato preliminare
presentato a Moriond 2015

Misura di $BF(B_{s,d} \rightarrow \mu^+ \mu^-)$

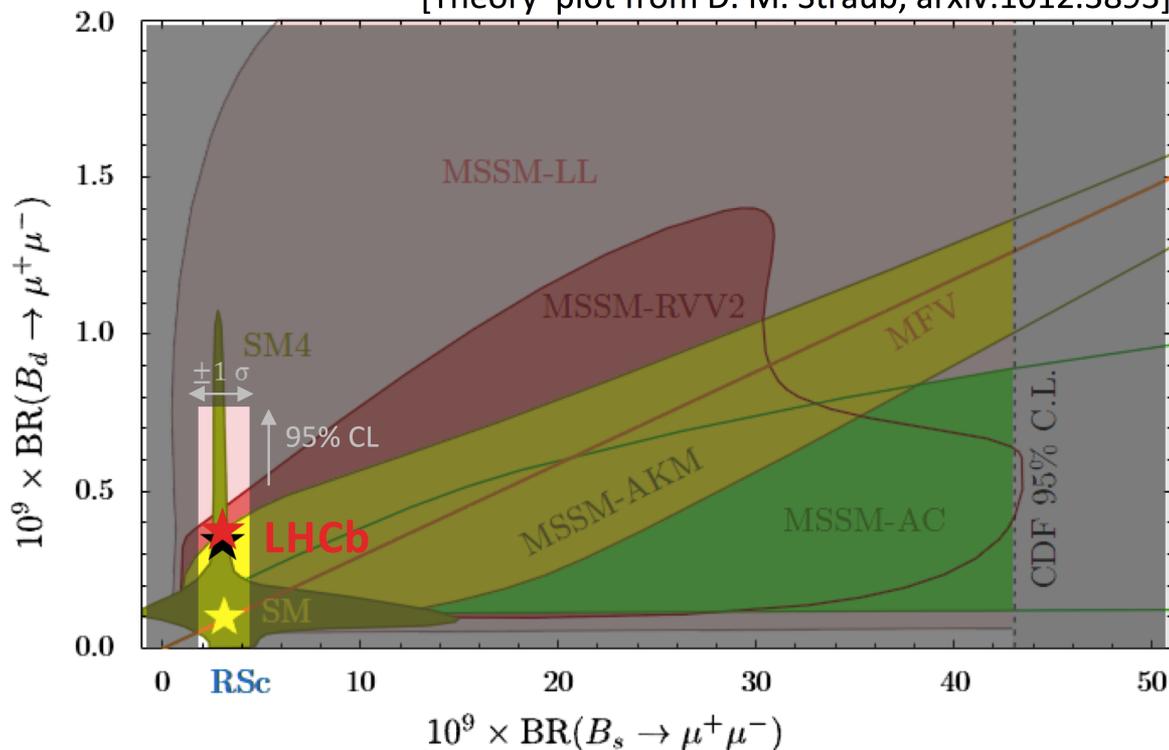
leading diagrams in SM



example of BSM diagrams



[Theory plot from D. M. Straub, arxiv:1012.3893]



LHCb ha pubblicato la misura sui dati del Run1 nel 2013

Consistente con MS. Significatività B_s 4.0σ , UL su B_d **PRL 111, 101805 (2013)**

Misura di $BF(B_{s,d} \rightarrow \mu^+ \mu^-)$

giugno 2015

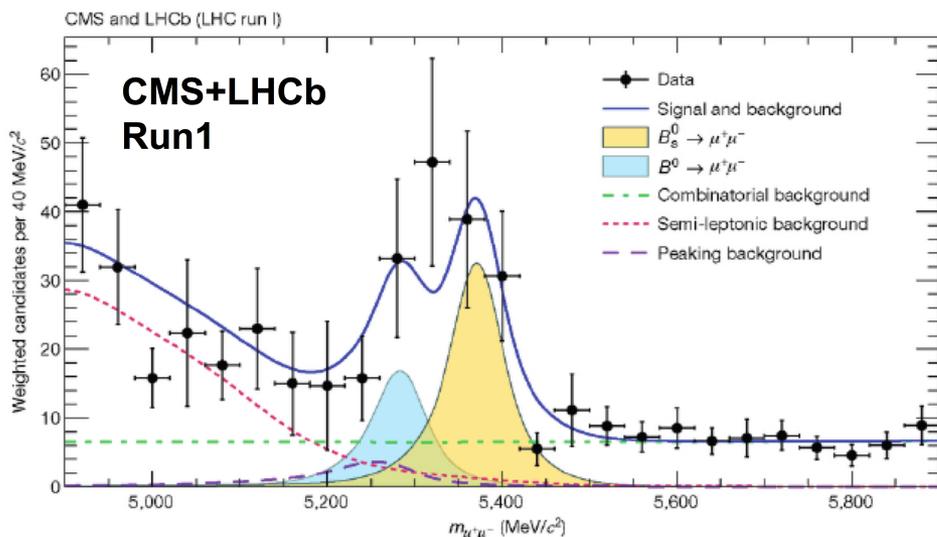
LETTER

OPEN

doi:10.1038/nature14474

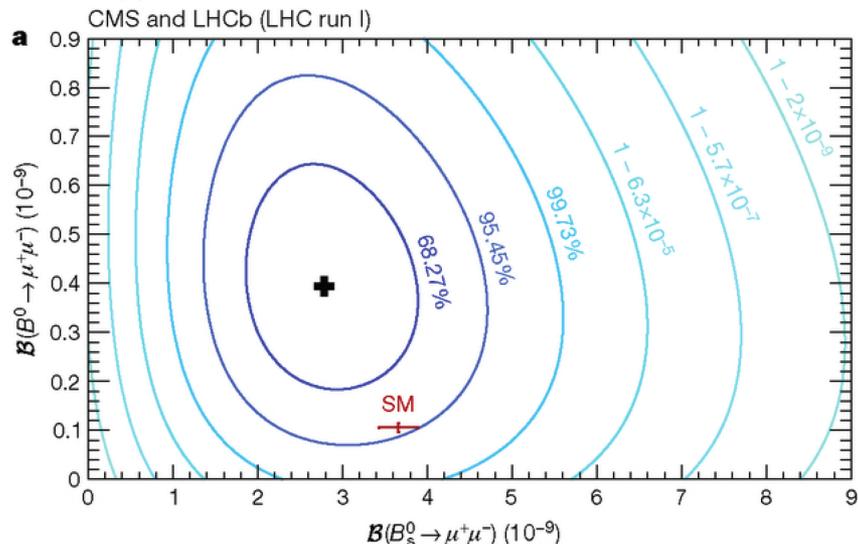
Observation of the rare $B_s^0 \rightarrow \mu^+ \mu^-$ decay from the combined analysis of CMS and LHCb data

The CMS and LHCb collaborations*



$$BF(B_s \rightarrow \mu\mu) = (2.8_{-0.6}^{+0.7}) \times 10^{-9} \quad S = 6.2 \sigma$$

$$BF(B_d \rightarrow \mu\mu) = (3.9_{-1.4}^{+1.6}) \times 10^{-10} \quad S = 3.0 \sigma$$

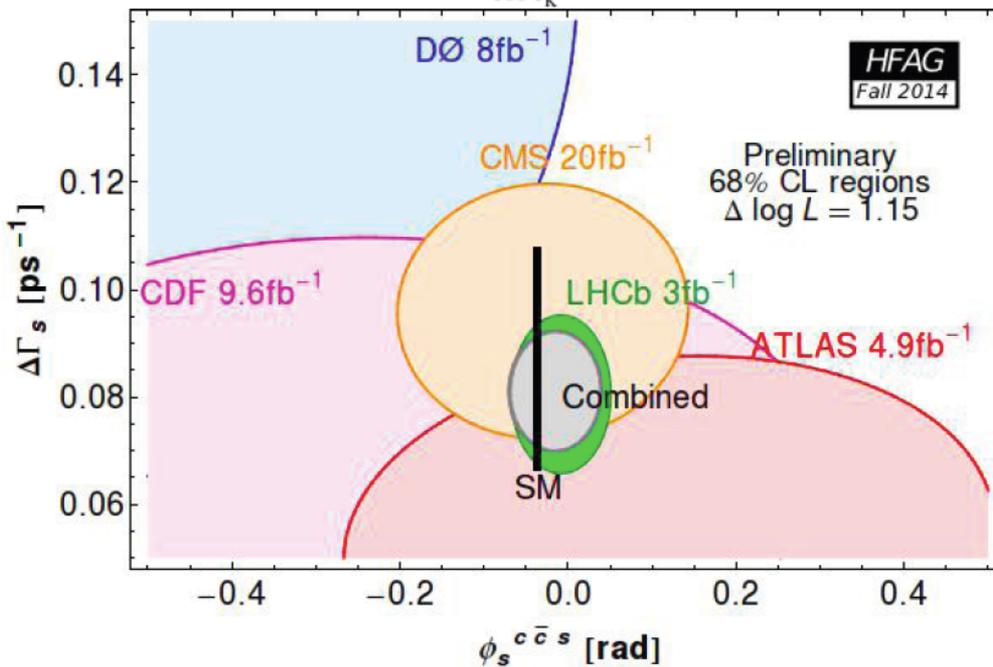
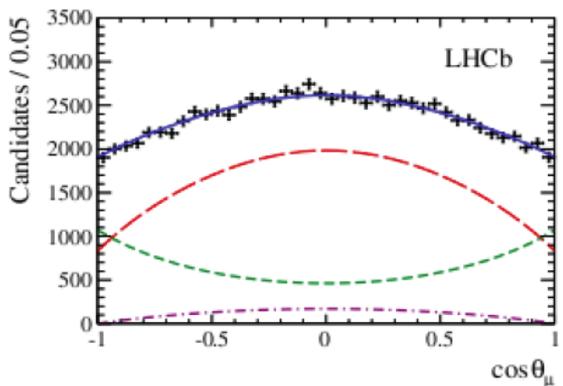
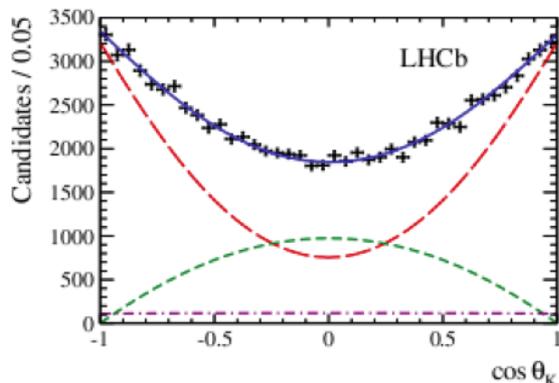
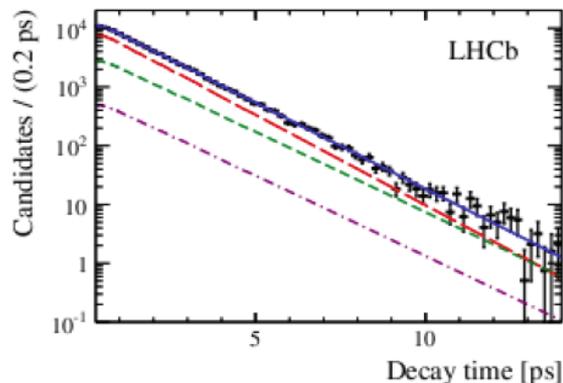


Ancora consistente con SM...

Another classic of hadron colliders

φ_s from $B_s \rightarrow J/\psi\varphi$ (etc.)

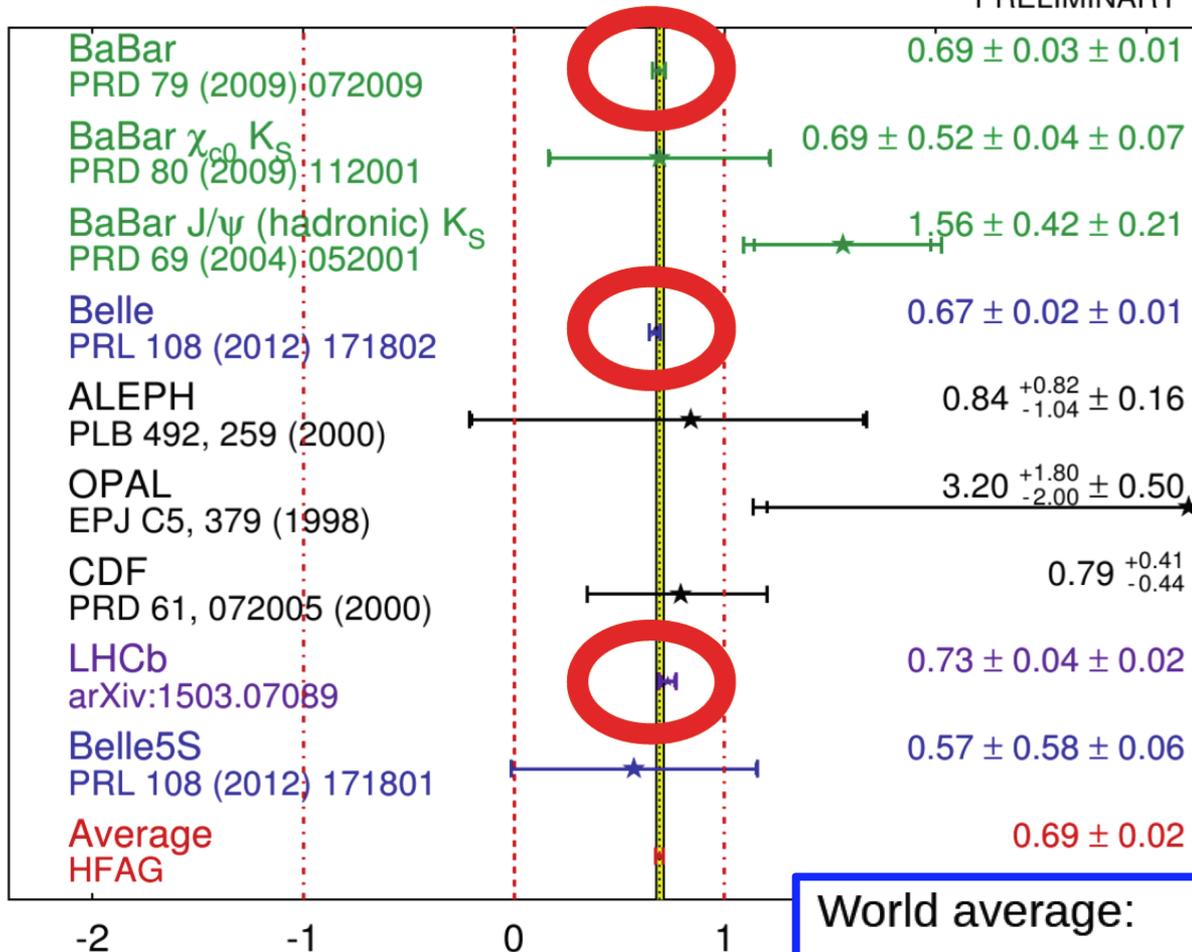
Latest LHCb results
PRL 114 (2015) 041801



But also...

$$\sin(2\beta) \equiv \sin(2\phi_1)$$

HFAG
Moriond 2015
PRELIMINARY

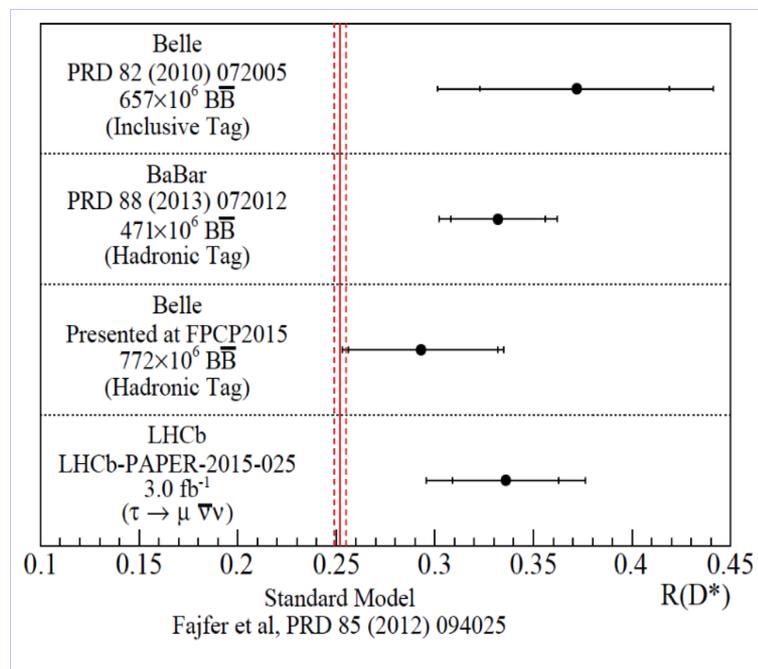
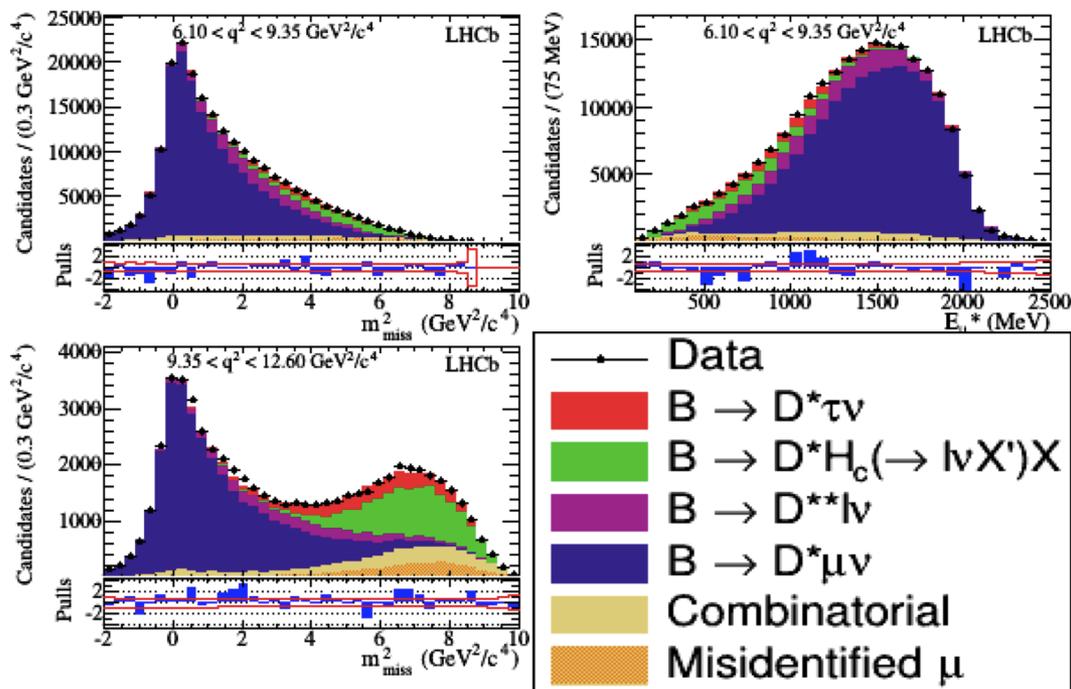


World average:
 $\sin(2\beta) = 0.691 \pm 0.017$

The latest: $B \rightarrow D^* \tau \nu$

- Ratio of semileptonic branching fractions (tau/mu)
- Contribution comparable with e+e- experiments !
- tau \rightarrow mu nu nu - arXiv:1506.08614 [hep-ex]
- Tau 3-prong hadronic decays under way

$$\mathcal{R}(D^*) = 0.336 \pm 0.027(\text{stat}) \pm 0.030(\text{syst})$$



Misura di $|V_{ub}|$ da $\Lambda_b \rightarrow (p, \Lambda_c) \mu \nu_\mu$

- Prima osservazione di $\Lambda_b \rightarrow p \mu \nu_\mu$
- Misura del rapporto dei BF's della Λ_b ad alto q^2

$$\frac{\mathcal{B}(\Lambda_b \rightarrow p \mu^- \bar{\nu}_\mu)_{q^2 > 15 \text{ GeV}^2/c^4}}{\mathcal{B}(\Lambda_b \rightarrow \Lambda_c \mu \nu)_{q^2 > 7 \text{ GeV}^2/c^4}} = (1.00 \pm 0.04(\text{stat}) \pm 0.08(\text{syst})) \times 10^{-2}$$

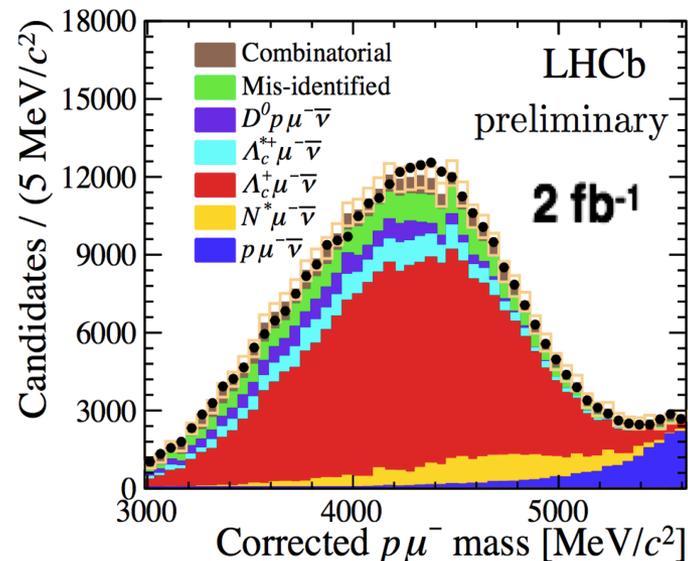
$$R_{\text{exp}} = R_{\text{theory}} (|V_{ub}|^2 / |V_{cb}|^2)$$

- Recente calcolo su reticolo di R_{theory} [\[arXiv:1503.01421\]](https://arxiv.org/abs/1503.01421)

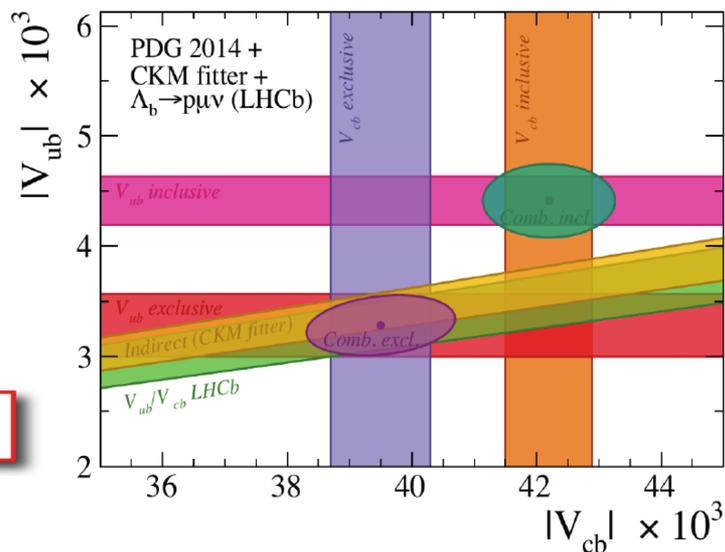
$$R_{\text{theory}} = 1.470 \pm 0.115(\text{stat}) \pm 0.104(\text{syst})$$

- Prima misura di V_{ub} utilizzando decadimenti barionici a un collider adronico
- Valore compatibile con la media delle misure esclusive ma non con quelle inclusive (3.5σ)

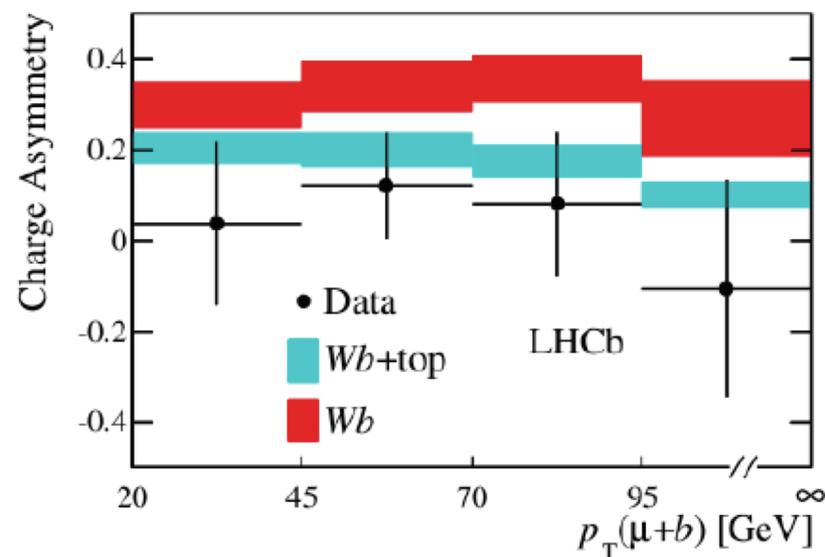
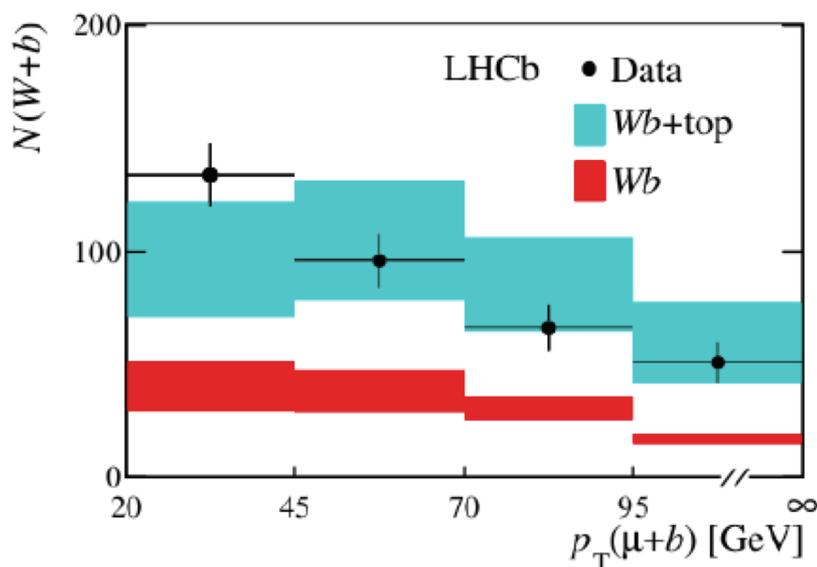
$$|V_{ub}| = (3.27 \pm 0.15(\text{exp}) \pm 0.17(\text{theory}) \pm 0.06(|V_{cb}|)) \times 10^{-3}$$



[arXiv:1504.01568](https://arxiv.org/abs/1504.01568)



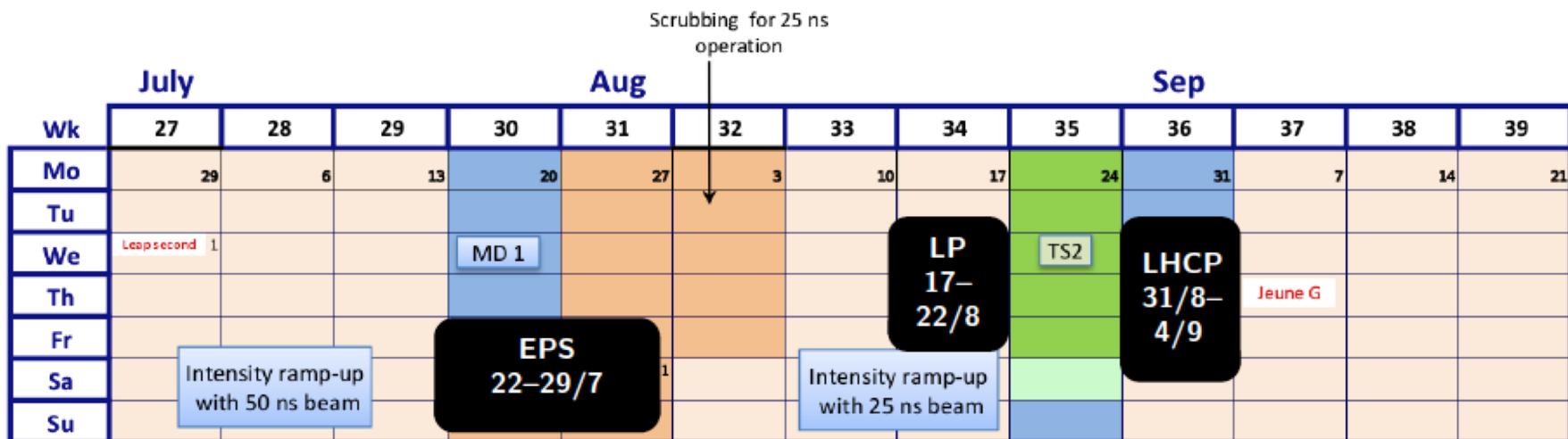
Even more unusual: forward top production at LHCb



- W + b jet sample

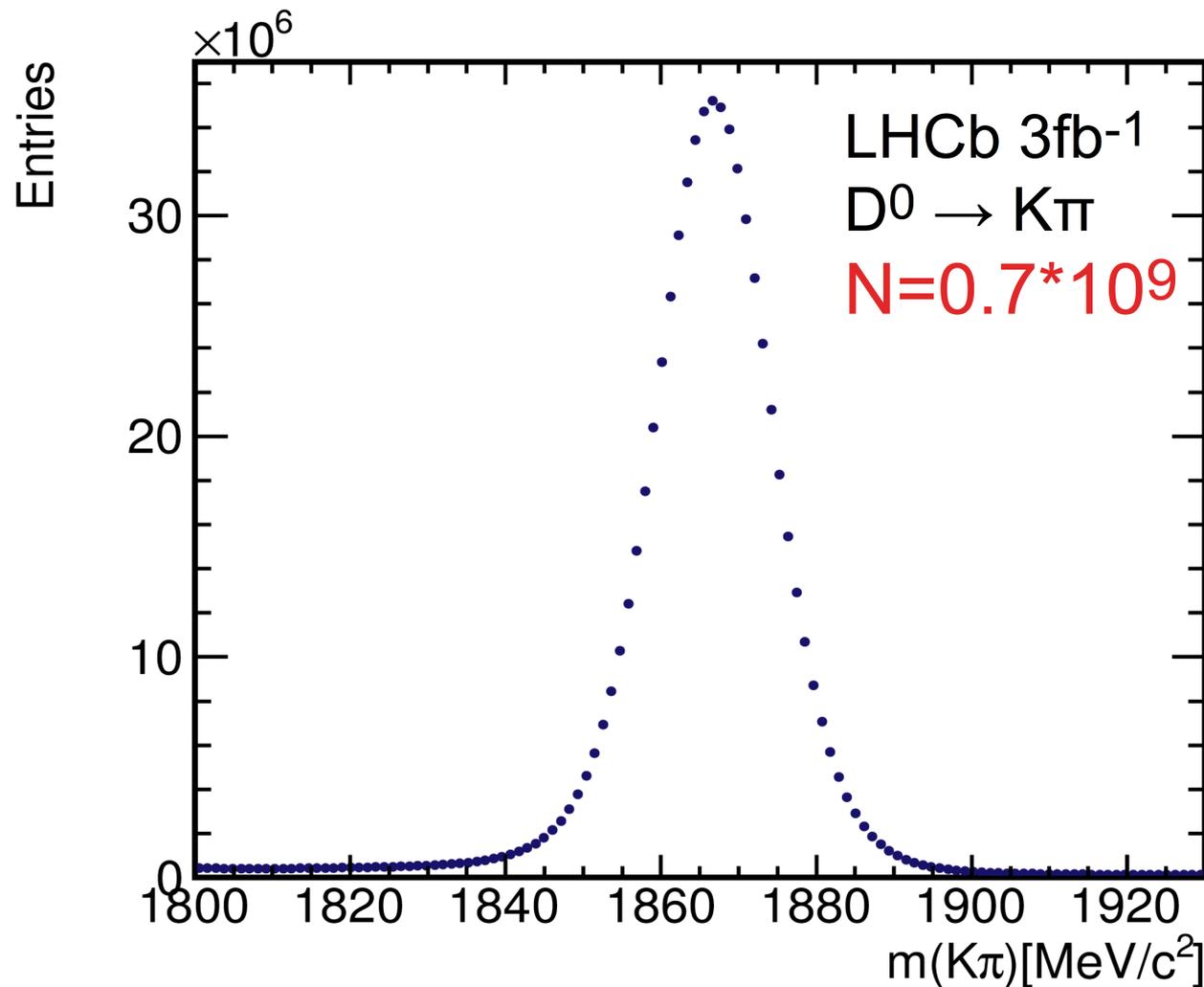
- 5.4 sigma observation: [ArXiv:1506.00903](https://arxiv.org/abs/1506.00903)

Verso il Run II



Entering the “Gev” scale

(1 miliardo di *eventi* - non eV...)



Preparazione al Run II

- Starting up now
- Attesa di aumento di statistica (6 fb^{-1}) + aumento cross sections
- Soprattutto importante la banda verso disco
- Detector consolidation, ma soprattutto:
- Nuovo sistema di trigger
 - 2x computing power
 - PBs of buffering
 - Calibrazione in tempo reale
 - Analisi in tempo reale → no raw data (“turbo stream”)

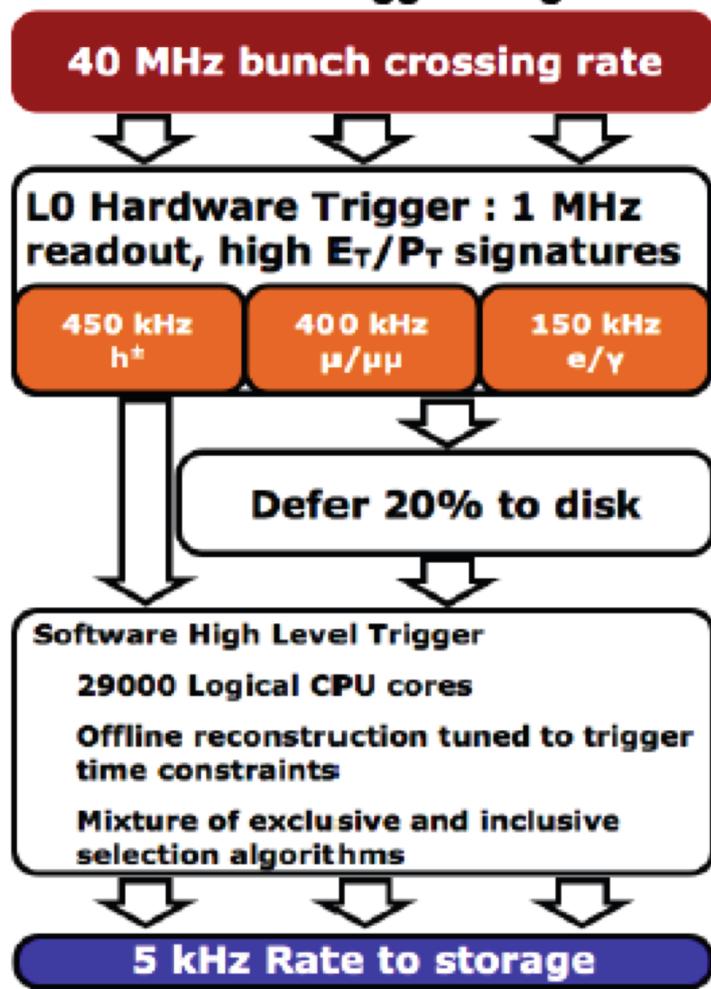
Challenging !

- Spingere la reiezione del fondo, e la sistematica a livelli mai visti in HEP su alcune misure

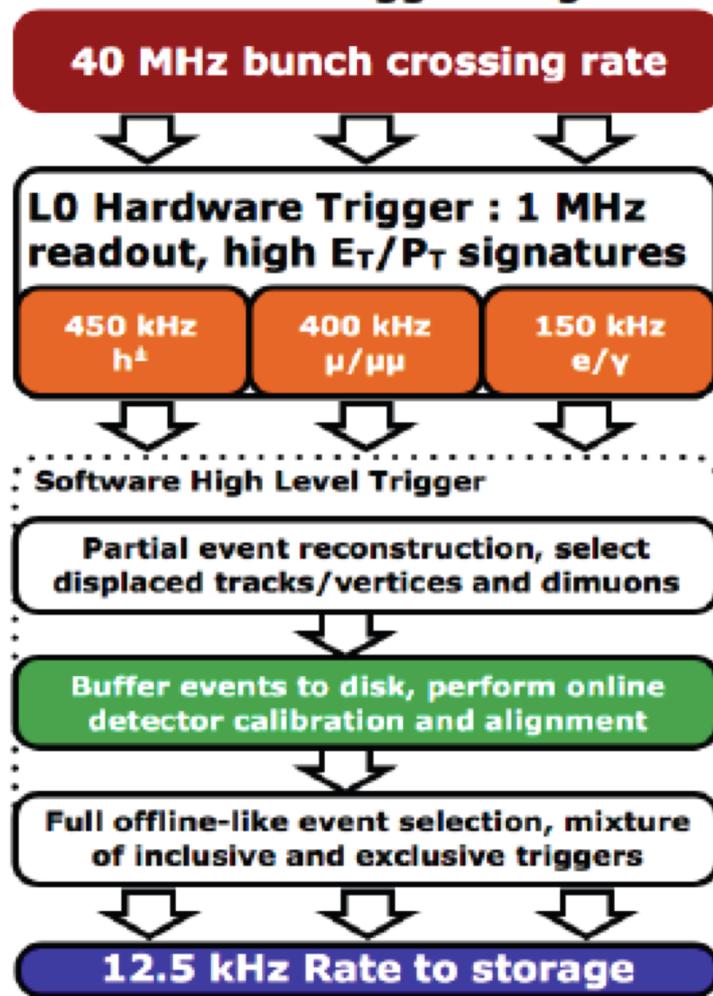
Gruppo di PISA fortemente implicato in queste preparazioni

New DAQ strategy in run II

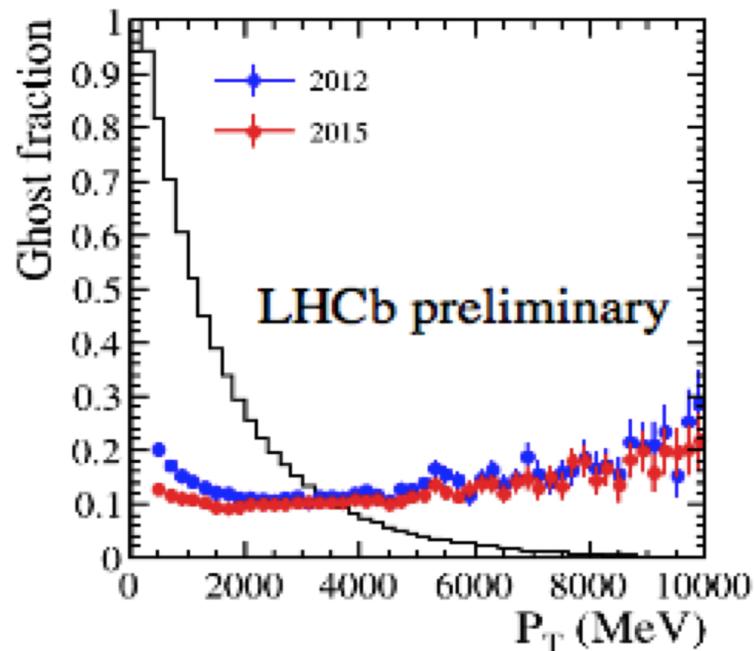
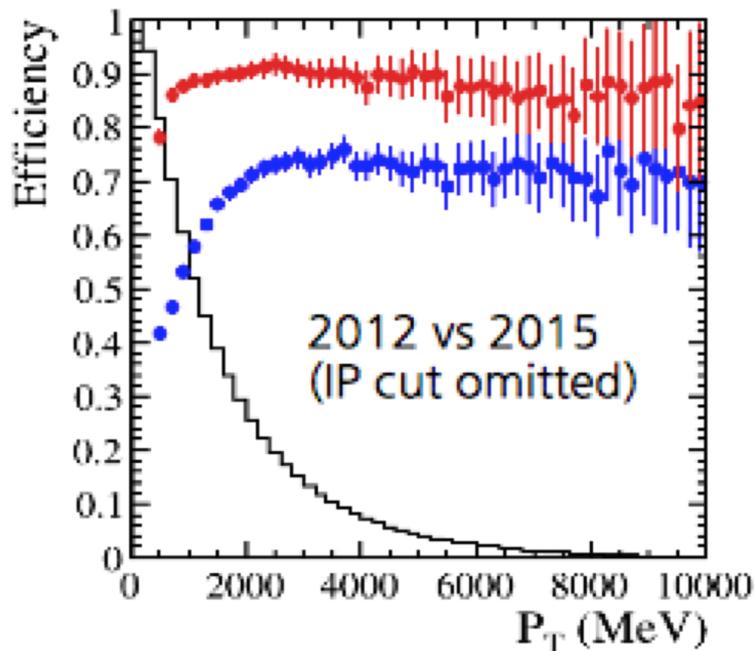
LHCb 2012 Trigger Diagram



LHCb 2015 Trigger Diagram



Improved HLT1 tracking in Run II

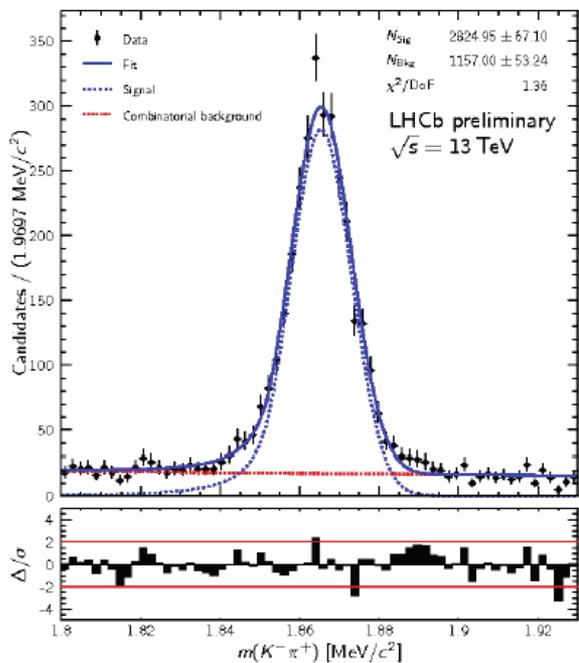


- Pisa responsibility (Morello, Stracka)

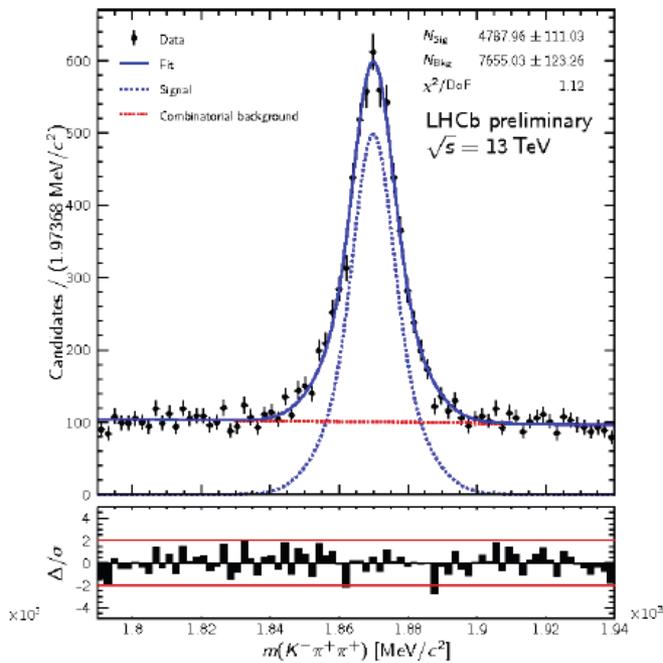
CERN-LHCb-INT-2015-005 "Studies towards an HLT1 tracking sequence for 2015"

Early charm signals from Run II

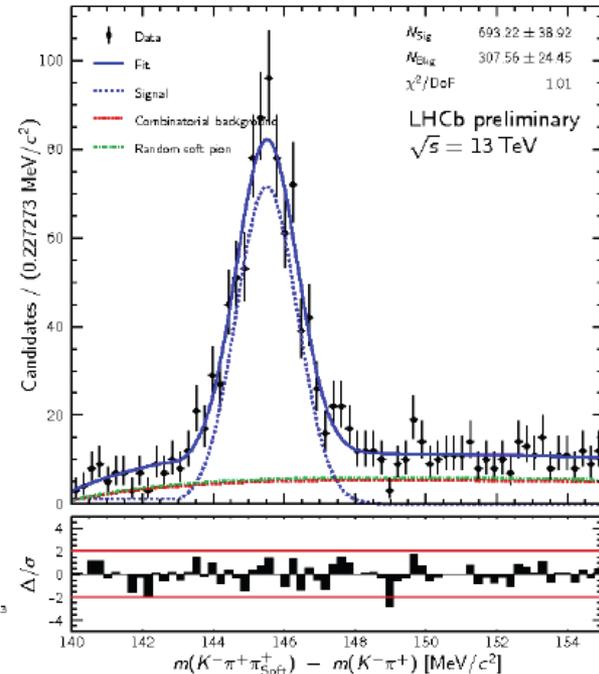
$D \rightarrow K\pi$



$D \rightarrow K\pi\pi$



$D^* \rightarrow D\pi; D \rightarrow K\pi$



Miglioramento $B \rightarrow \mu\mu$

- Preparazione aggiornamento dell'analisi sui dati Run2
- Aumento di statistica, ma soprattutto sfruttamento della esperienza accumulata
- Sviluppo di tecniche di analisi per una migliore caratterizzazione e selezione dei fondi ([Matteo Rama](#))

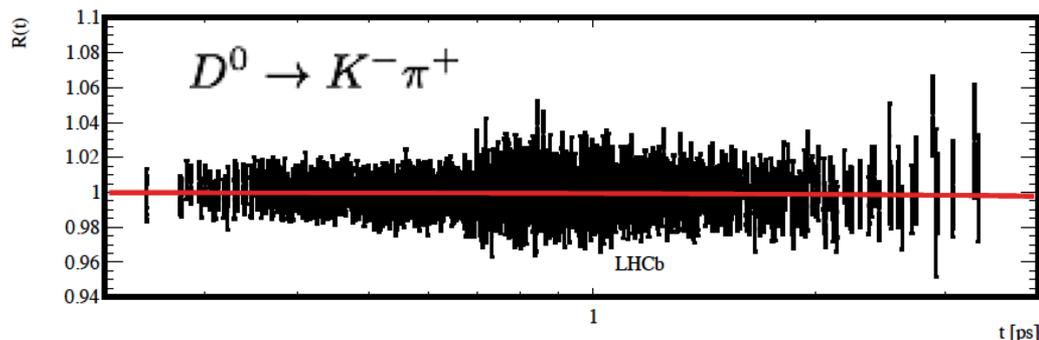
Challenge dei nuovi dati

- Coordinazione del Simulation group
 - Convener 2015 - 2017 [Riccardo Cenci](#)
 - Produzione, software, tuning...
 - Nuove sfide: tenere il passo con la quantita' dei dati (analisi recenti limitate dalla statistica del MC)
 - Precisione e tuning sempre piu' spinti

- Nuovi triggers [Simone Stracka](#)
 - Nuovo trigger su neutri
 - Liason del trigger B and quarkonia

Asimmetrie di carica

- Importante capire l'asimmetria di tracce cariche in LHCb
- possibilità di invertire la polarità del magnete durante il Run: ma cancellazione non perfetta
- campione di controllo dove violazione di CP trascurabile: $D^0 \rightarrow K^- \pi^+$
- errore syst. dovuto all'asimmetria di carica già importante
- con l'aumento di statistica sempre più importante il controllo l'asimmetria di carica



Errori sistematici su $A_{\Gamma}^{\text{bin}}(KK)$

Source	$A_{\Gamma}^{\text{bin}}(KK)$
Partially reconstructed backgrounds	± 0.09
Charm from b decays	± 0.55
Other backgrounds	± 0.40
Acceptance function	—
Magnet polarity	± 0.58
Total syst. uncertainty	± 0.89

Ruolo di Pisa nella

“charge-asymmetry task force”

- Michael. Morello, John Walsh

Analisi di Pisa in corso

- Misura time-dependent $A_{\Gamma}(D^0)$ con 3fb-1

$$\frac{N_{\bar{D}^0}(t)}{N_{D^0}(t)} = \left(1 + \frac{2A_{\Gamma}}{\tau_{KK}}t\right) \frac{1 - e^{-\Delta t/\tau_{\bar{D}^0}}}{1 - e^{-\Delta t/\tau_{D^0}}}$$

$$D^0 \rightarrow K^+K^-, \quad \bar{D}^0 \rightarrow \pi^+\pi^-$$

- Estrema precisione sistematica
 - Tesi dottorato [Marino](#) (rel. Morello)
-
- Misure di charm \rightarrow eta X
 - Novita' a macchine adroniche
 - Tesi magistrale [Mocci](#) (rel. Stracka)

Richieste Finanziarie

Preventivo LHCb-Pisa 2016		
Missioni IT		7 k€
ME metab. + turni	21 mu	80 k€
ME responsabilita'	7 mu	27 k€
TOTALE missioni		124 k€
CONSUMI	Metabolismo Pisa+CERN	10 k€