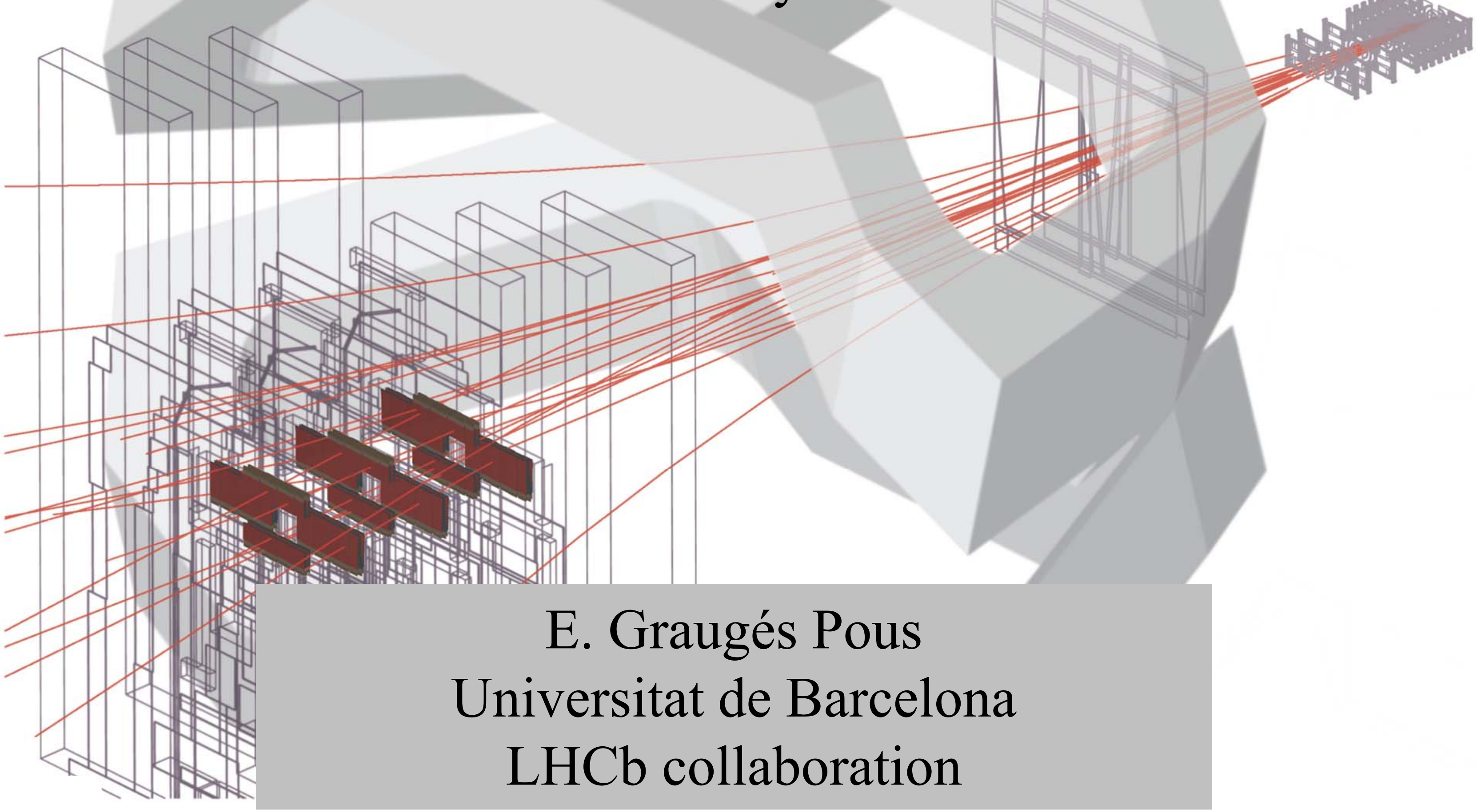
Status of LHCb

Prometeo Workshop – UV/IFIC

17th January 2012



E. Graugés Pous
Universitat de Barcelona
LHCb collaboration

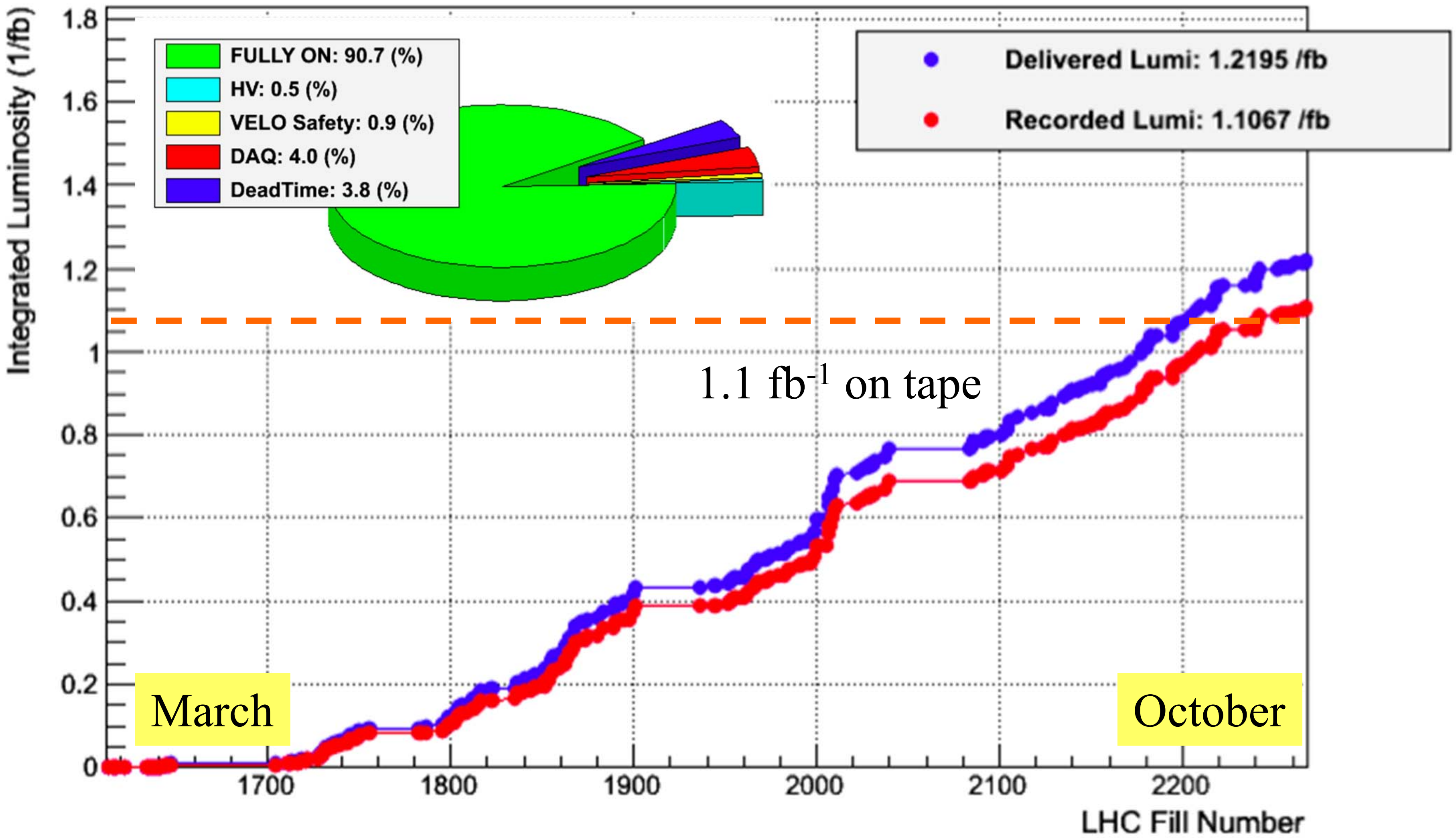
Outline

- Detector status and operations in 2011 (and 2012)

- Physics Results

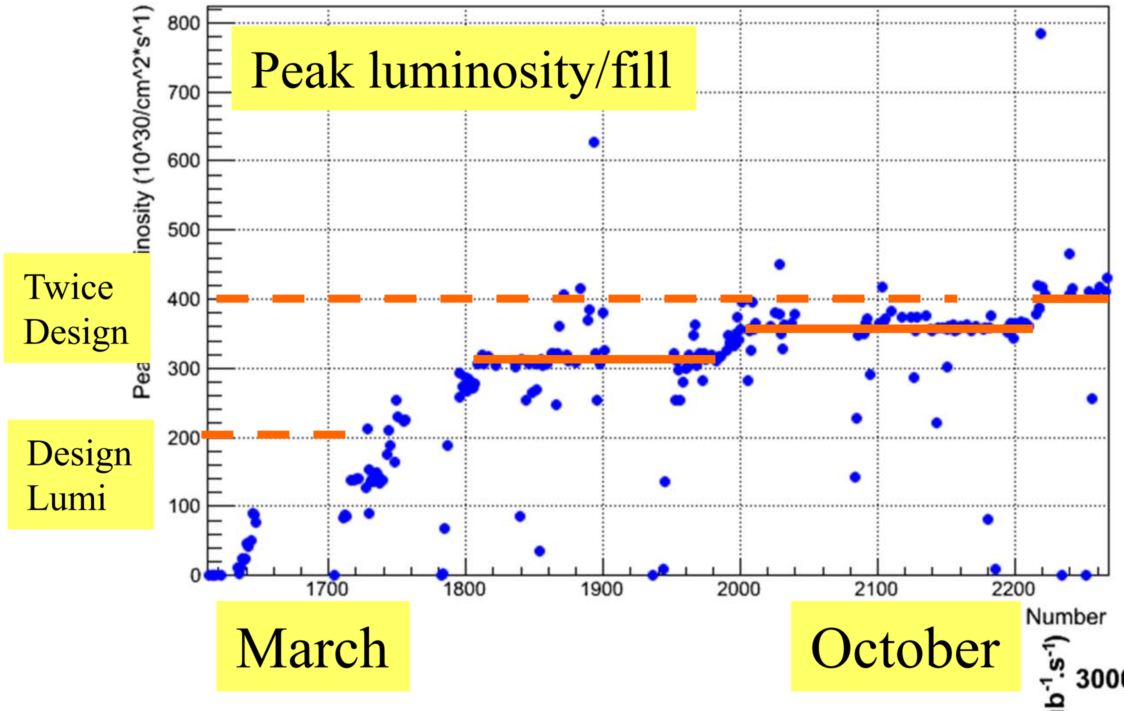
  - Recent highlights + prospects for the Winter Conferences,

2011 Running



Data taking efficiency close to 91 % including data quality

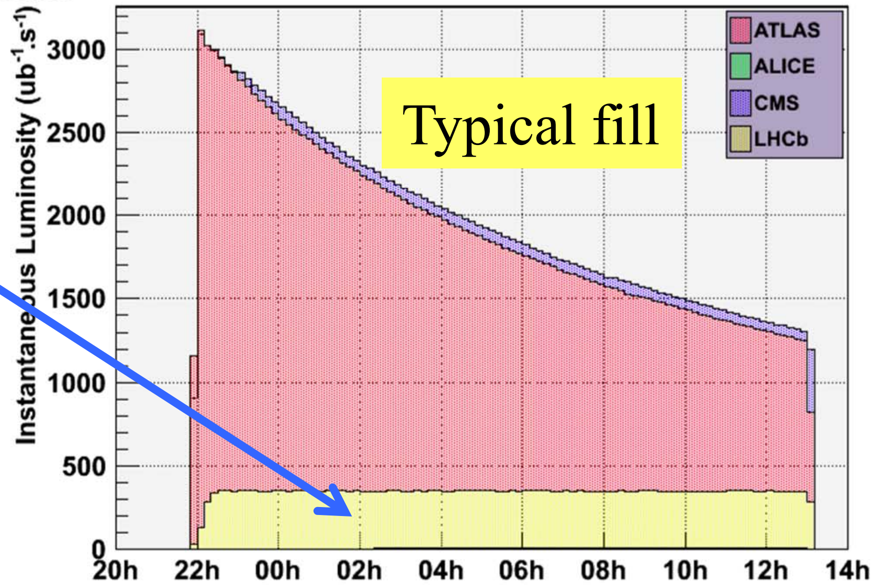
2011 Running



LHCb Technical Proposal :
14 TeV, ν= 0.4
10^7 s @ <L> = 2 x 10^{32} cm^{-2}s^{-1}
with 2622 bunches = 2 fb^{-1}/year

2011: 0.46 x 10^7 s with 1.22 fb^{-1}
7 TeV, ν= 1.6
<L> ~ 2.65 x 10^{32} cm^{-2}s^{-1} with
half the number of bunches

Luminosity levelling a great success



A nominal LHCb year !

LHCb 2012 data taking

LHC running conditions

- 4 TeV (b-bbar cross section increases by ~ 15%)
- L ~ 4 10^{32} $cm^{-2}s^{-1}$
- Bunch spacing 50 ns (ok, pileup is not an issue for LHCb)
- LHC crossing angle in LHCb in the vertical plane (fully symmetric with magnet swaps) → useful for future (when spacing=25 ns)

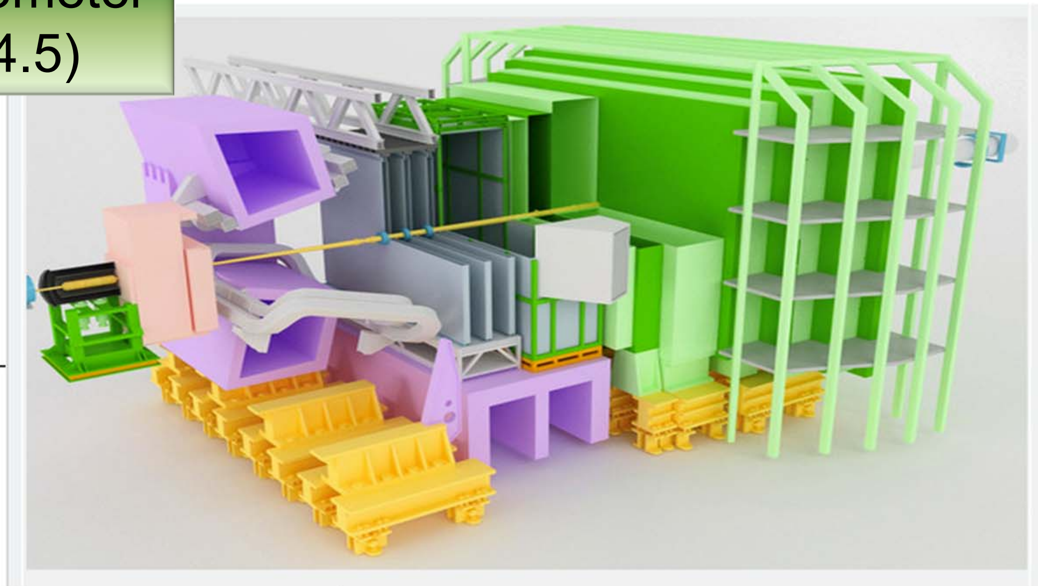
LHCb running conditions

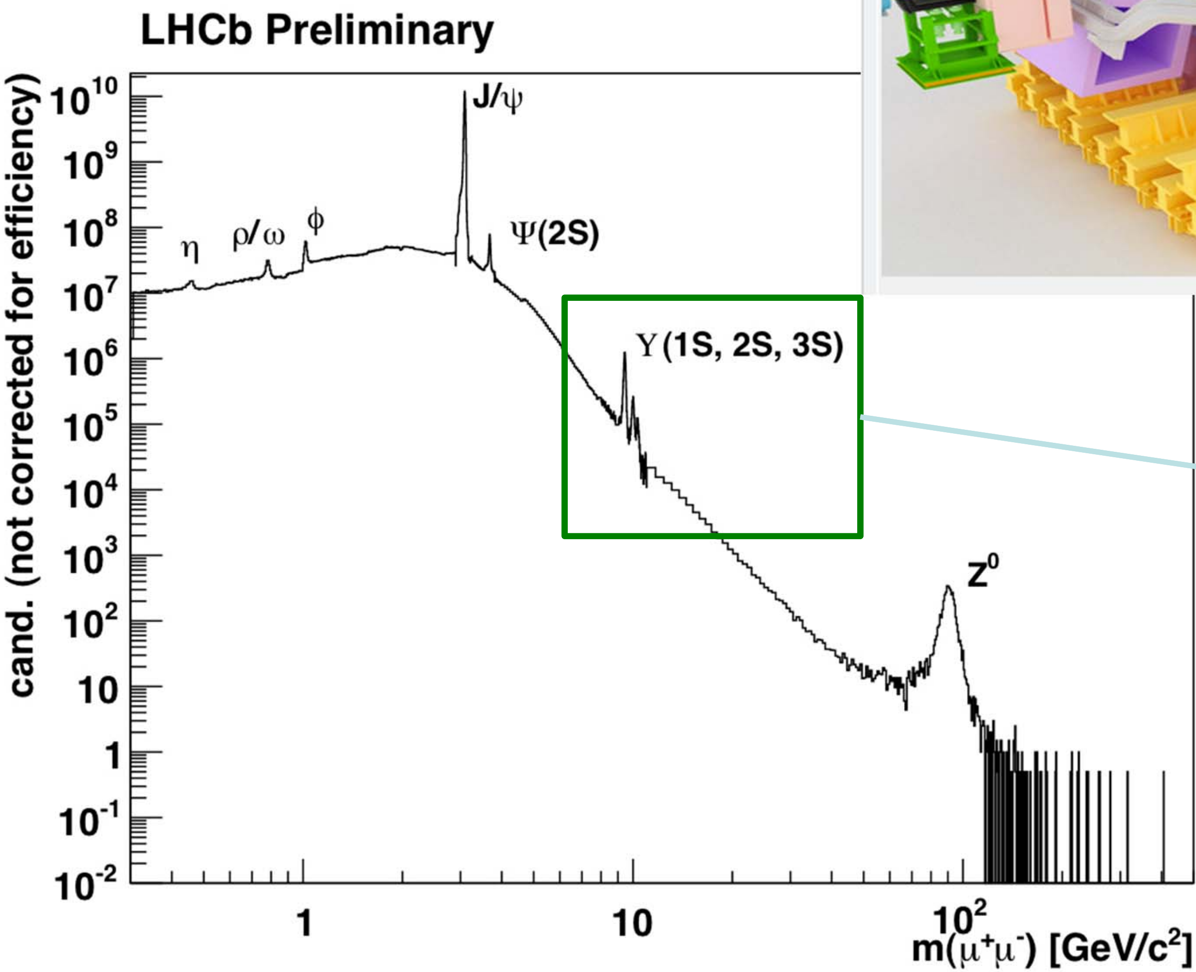
- Keep detector efficiency and data quality high
- L0 output ~ 1 MHz (maximum allowed)
- HLT output ~ 3 kHz (or more, with enhanced farm [+10%] and better HLT trigger)

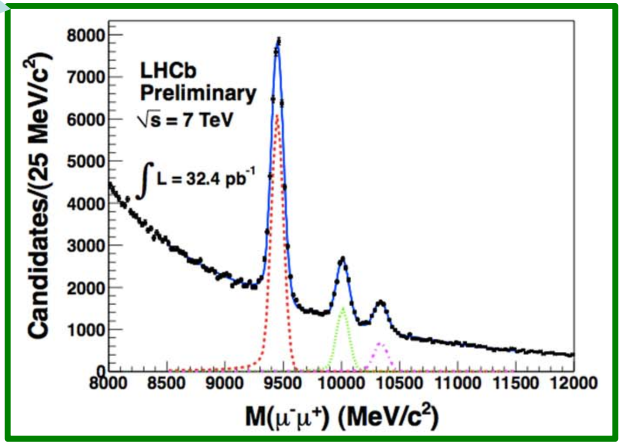
  → increase in yields of charm and in hadronic channels

Considering the experience of 2011 → target of ≥ 1.5/fb on tape in 2012

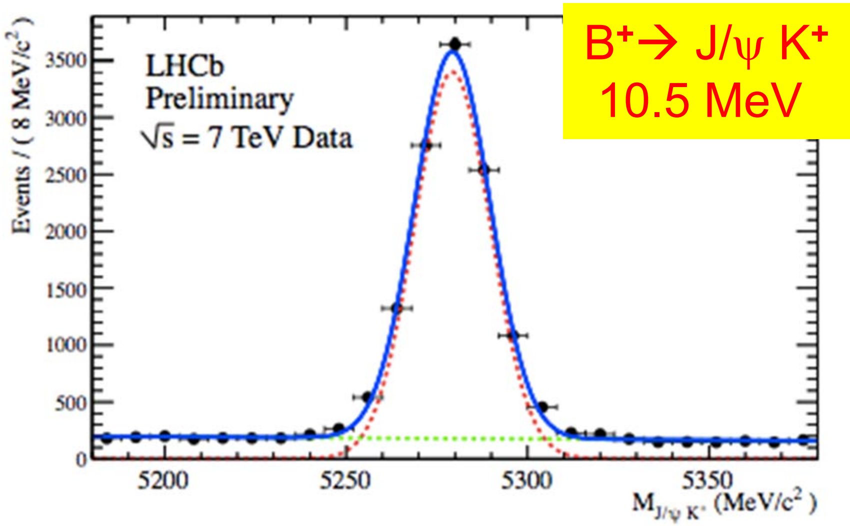
LHCb: a general purpose spectrometer in the forward direction ($2<\eta<4.5$)

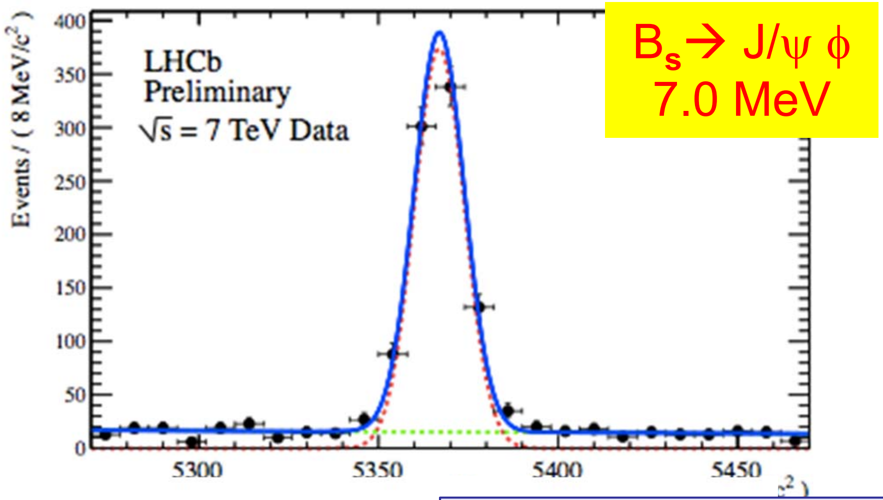


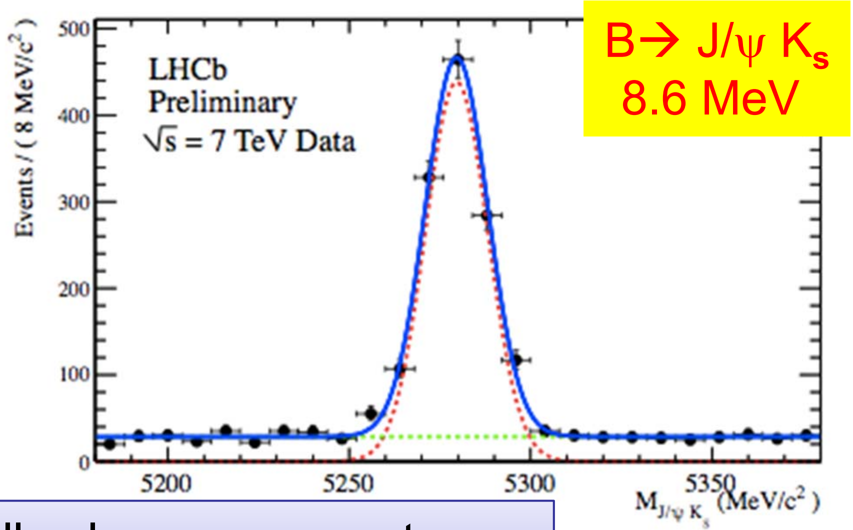


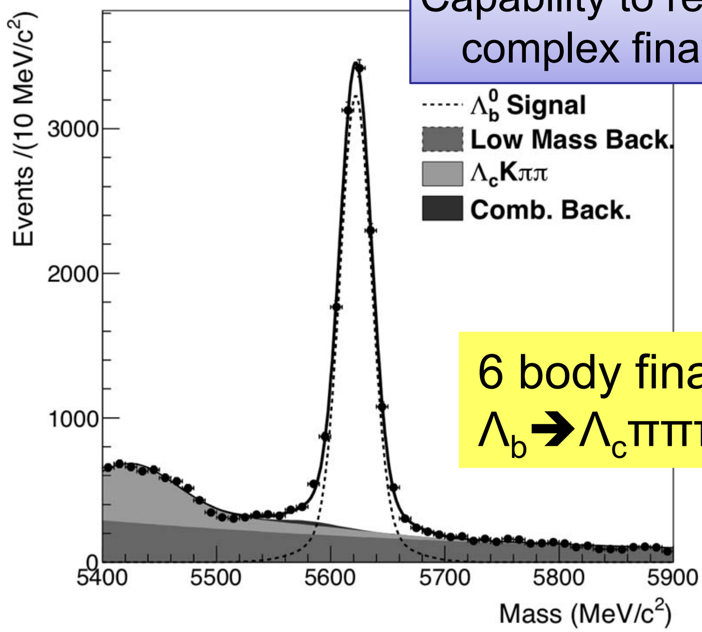


B mesons mass resolution









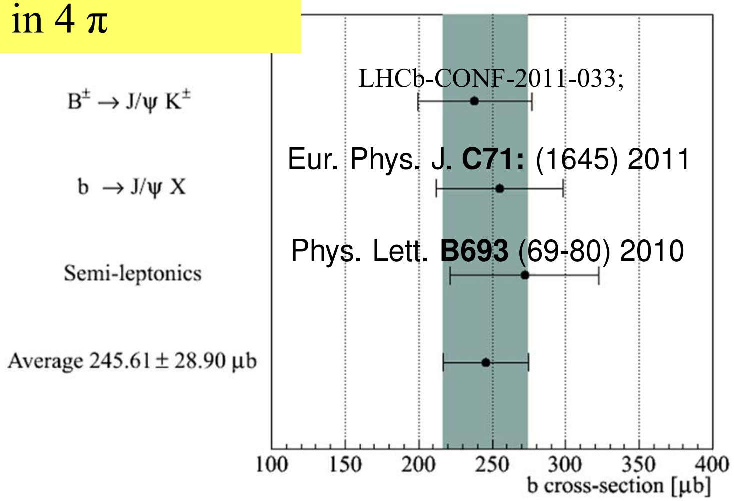
Capability to reconstruct complex final states

6 body final state
$\Lambda_b \rightarrow \Lambda_c \pi\pi\pi$

All values very near to Monte Carlo expectations

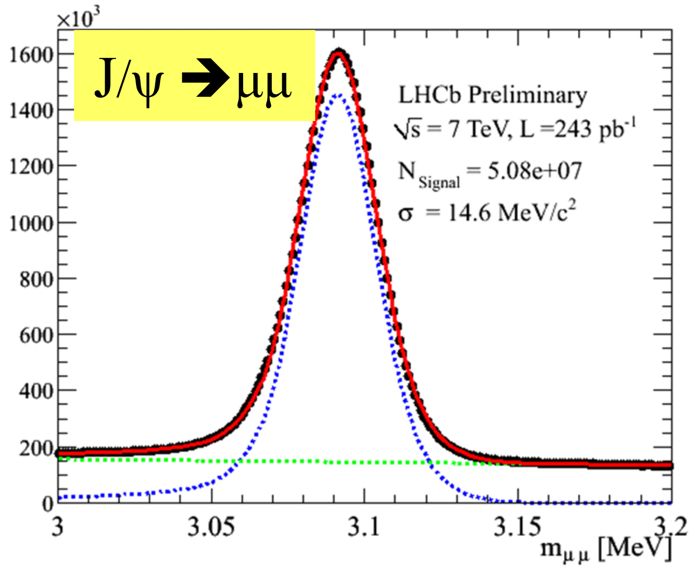
In other words…

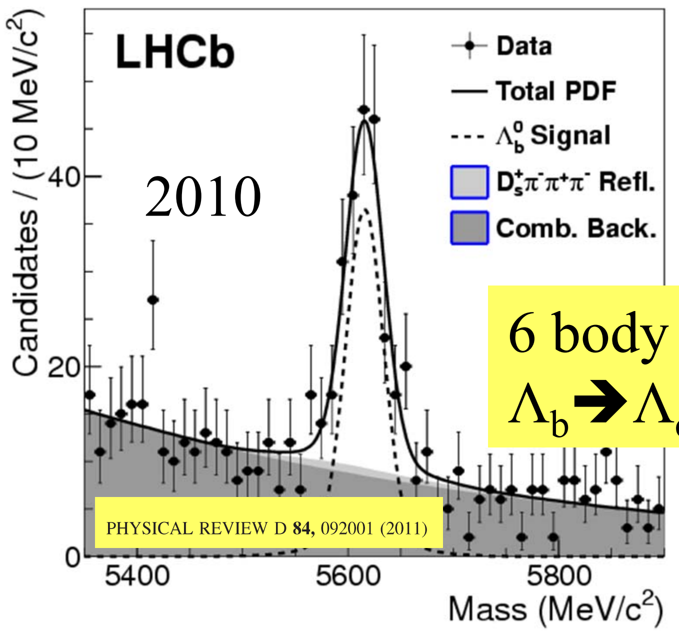
b cross-section in 4 π



- 10^{11} b decays in our acceptance
- 10^{12} D decays in our acceptance
- 2 × 10^{8} inclusive J/ψ triggers on tape for the full dataset !

J/ψ ➔ μμ



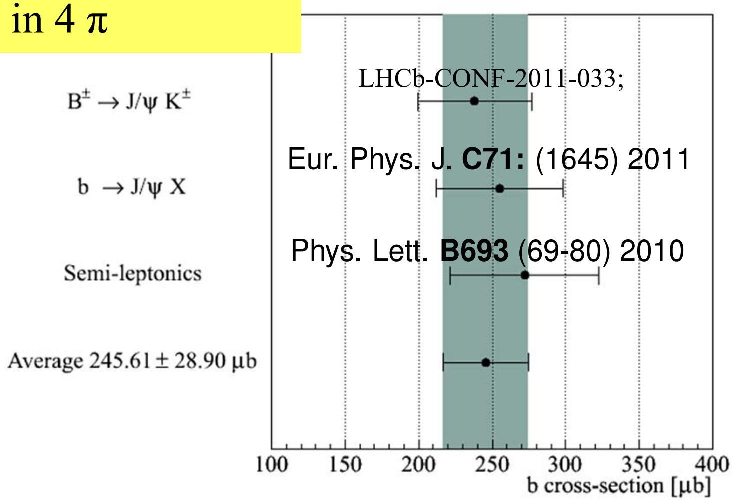


6 body mode Λ_b ➔ $\Lambda_c \pi\pi\pi$

Huge samples on tape for data mining !

In other words…

b cross-section in 4 π



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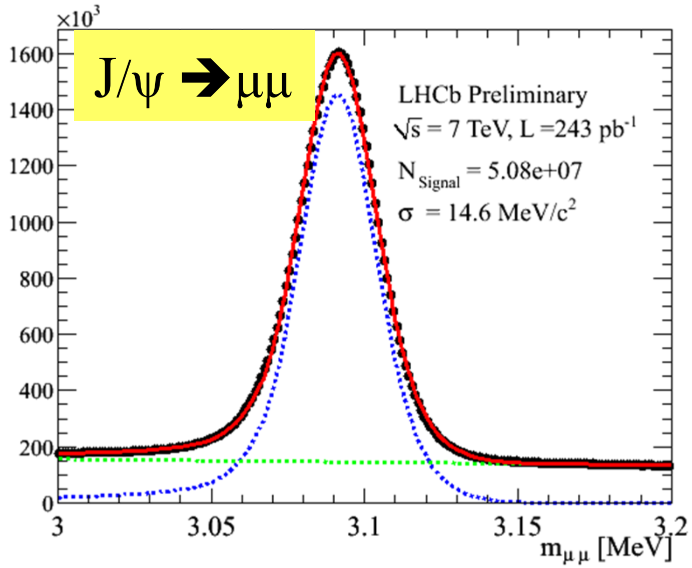
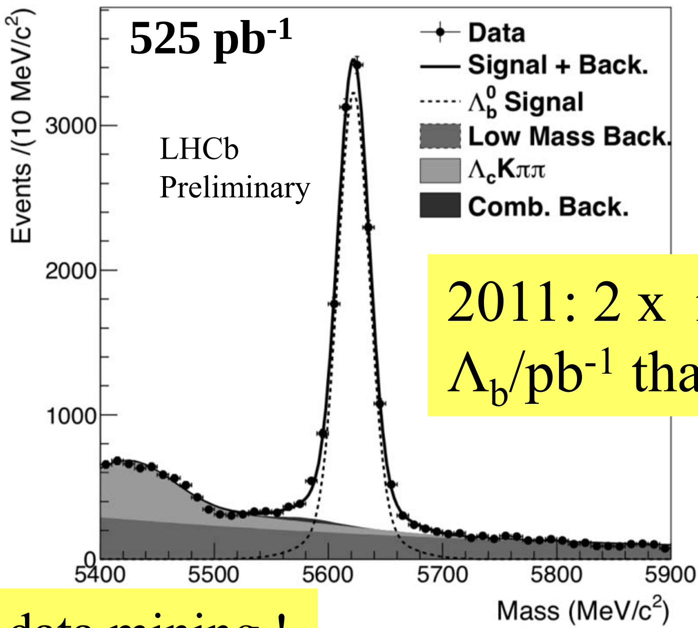


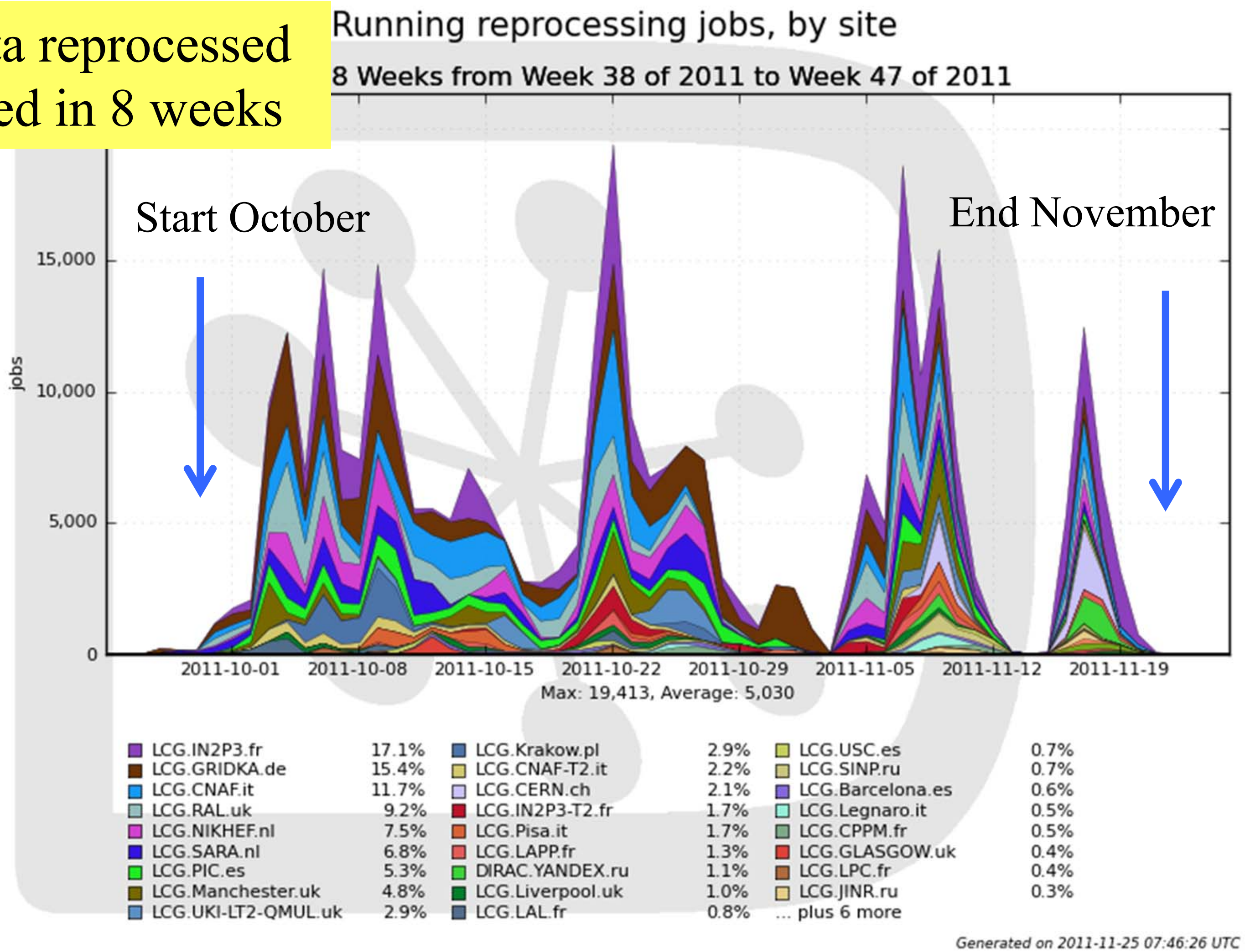


2011: 2 x more Λ_b/pb^{-1} than 2010

Huge samples on tape for data mining !

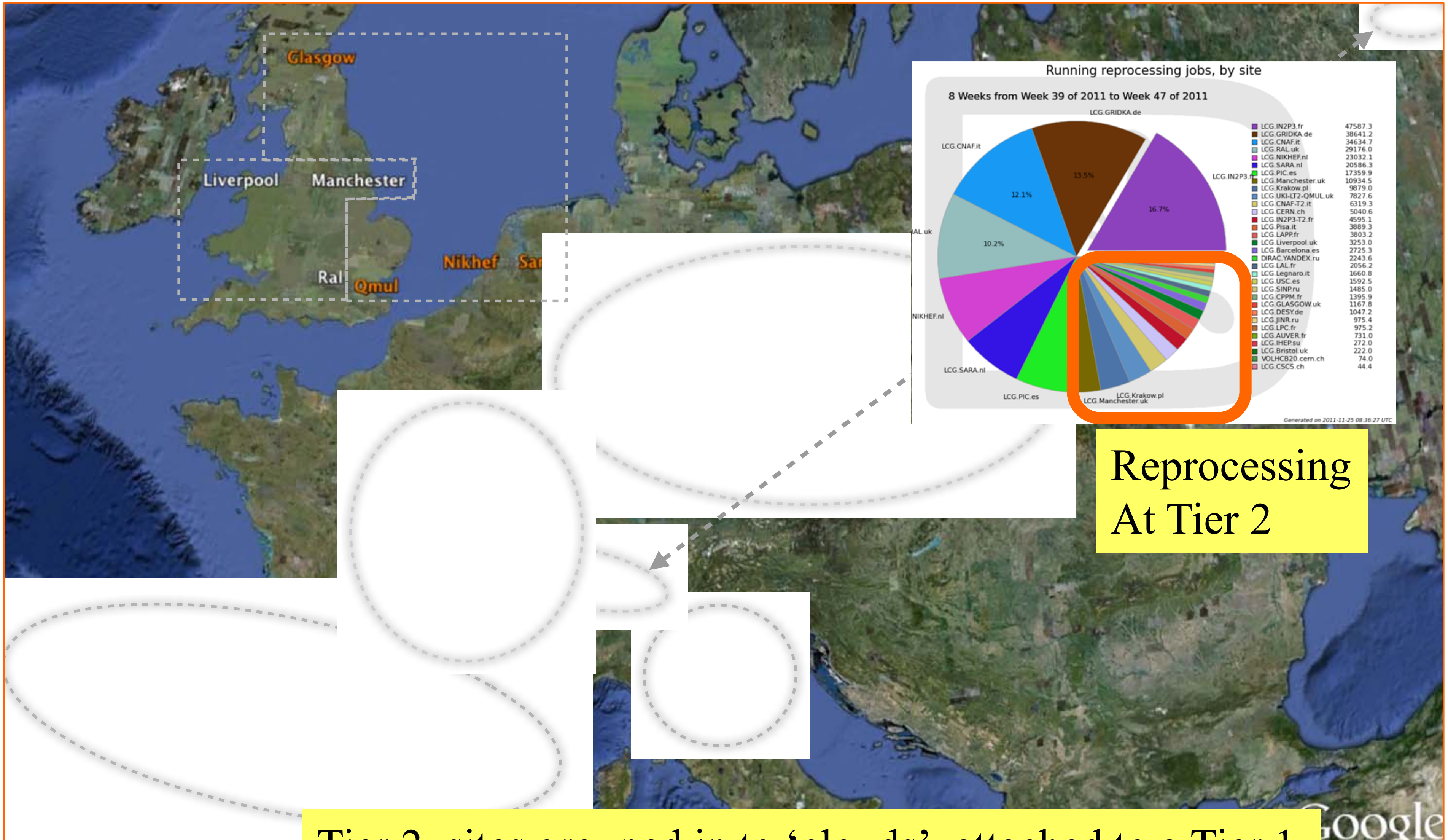
2011 Reprocessing

2011 data reprocessed completed in 8 weeks



CERN not used for reprocessing (dedicated to processing incoming data)
Around 25 % of reprocessing jobs ran on Tier 2 sites

2011 Reprocessing



Tier 2 sites grouped in to ‘clouds’, attached to a Tier 1
Data shipped to from Tier 1 to 2 where job ran

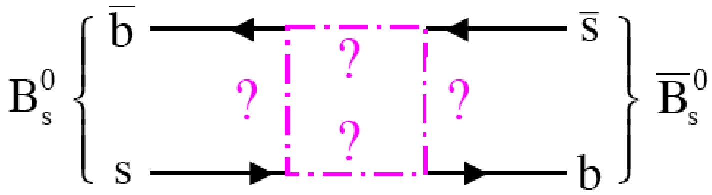
Physics Results

Expect many new and updated results with the full reprocessed 2011 dataset (~1.1 fb^{-1}) for the Winter Conferences

- Today highlights from analyses based on 2010 dataset (40 pb^{-1}) and early 2011 (~ 300 - 600 pb^{-1})
  - Led to 67 conference contributions
- Already yielded 20 papers submitted to journals
- Expect another ~ 20 papers more by early this year 2012

Physics Results

LHCb designed to search for New Physics in flavour sector: Probe the effect of New Particles in loop processes



1. Quarkonia

1. Heavy b baryons

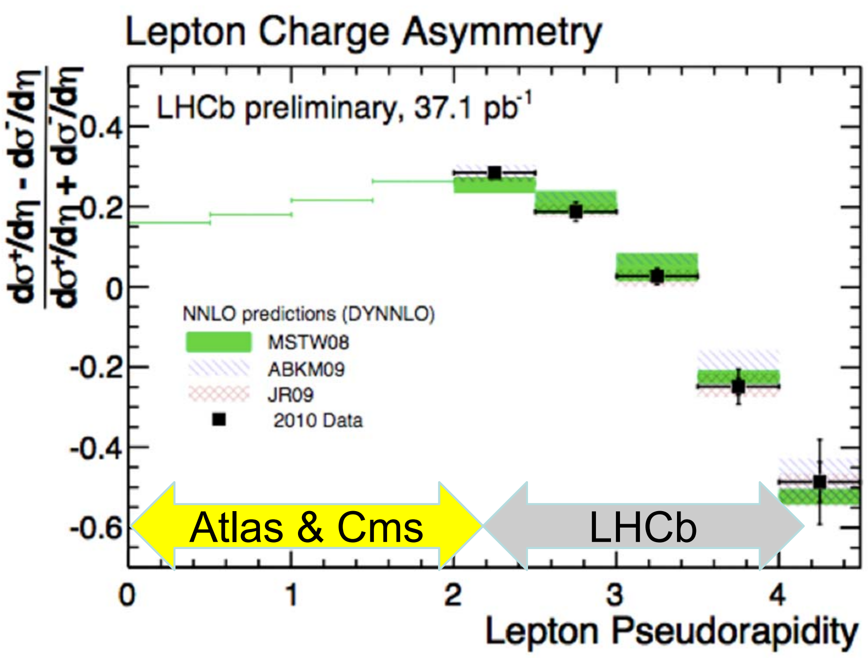
2. ϕ_s and CP violation in B_s mixing, etc…

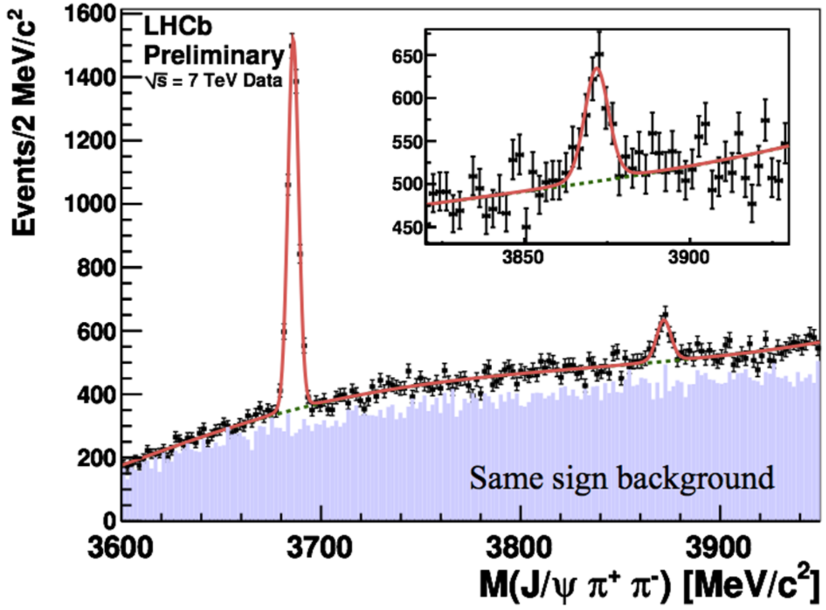
3. Rare decays

4. ΔA(CP) and evidence for CP violation in charm

LHCb is not only flavor physics …

Search for exotic qq bound states:
X(3872), Z, etc…





Studies of Electroweak phenomena:
W charge asymmetry for PDF
Determination
in a range complementary to GDP

+ quarkonia, charm spectroscopy, soft QCD, long lived particles, Majorana neutrinos …

Quarkonia

Study of quarkonia production provide important tests of NRQCD

Published results on 2010 data on J/ψ production and observation of double J/ψ production

- $\psi(2S)$ cross-section
- χ_c production ratio using $\chi_c \rightarrow J/\psi\gamma$

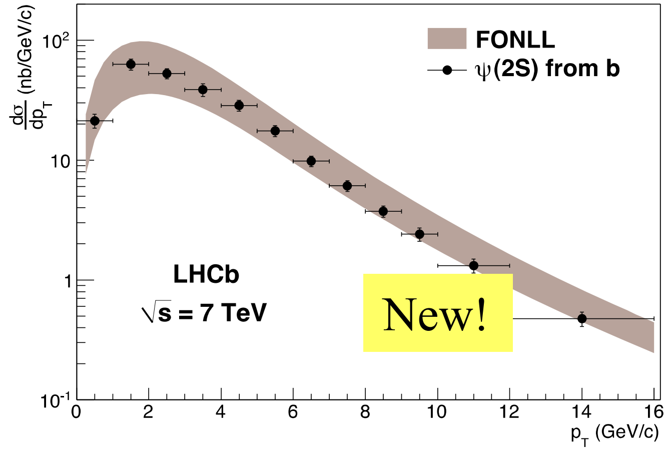
} New results today

Quarkonia: ψ(2S)

- Results for prompt ψ(2S) presented at Summer conferences (LHCb-CONF-2011-026), pt < 16 GeV, 2 < y < 4.5

- Now extended to include b ➔ ψ(2S) X

- Paper in preparation



$$\sigma_{\text{prompt}}(\psi(2S)) = 1.41 \pm 0.01 \pm 0.12^{+0.20}_{-0.39} \quad \mu\text{b}$$
$$\sigma_{\text{b}}(\psi(2S)) = 0.25 \pm 0.01 \pm 0.02 \quad \mu\text{b}$$

Inclusive b ➔ J/ψ and ψ(2S) can be used to extract B(b ➔ ψ(2S) X)

$$B(b \to \psi(2S)X) = (2.71 \pm 0.17\ (stat, syst) \pm 0.24\ (BR)) \times 10^{-3}$$

Good agreement with CMS-BPH-10-014

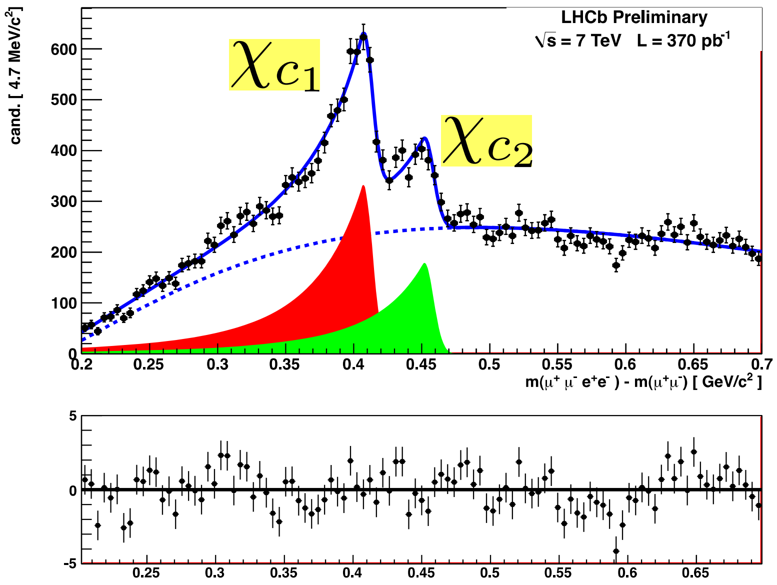
$$B(b \to \psi(2S)X) = (3.08 \pm 0.18\ (stat, syst) \pm 0.42\ (BR)) \times 10^{-3}\ \text{[CMS]}$$

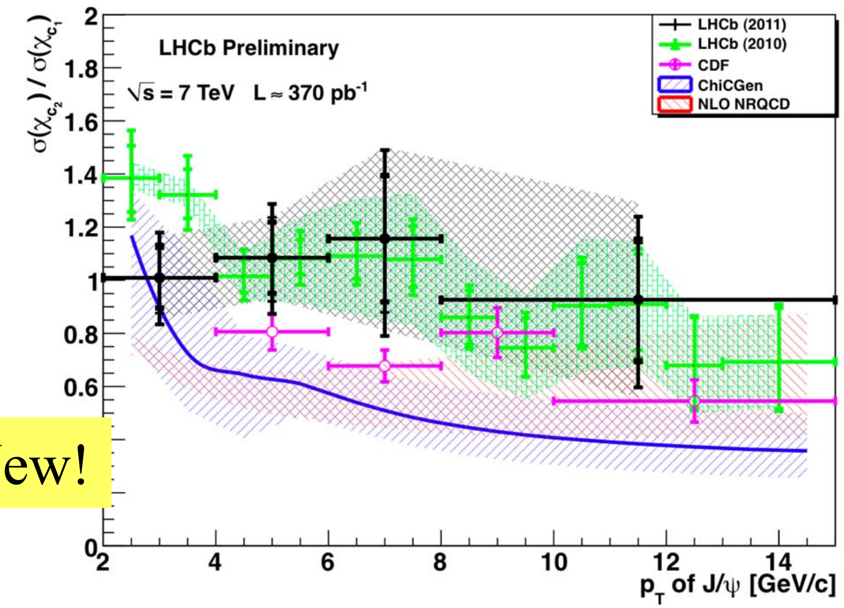
$$B(b \to \psi(2S)X) = (4.8 \pm 2.4) \times 10^{-3} \text{[PDG]}$$

Quarkonia: χ_c

$$\frac{\sigma(\chi_{c_2})}{\sigma(\chi_{c_1})}$$ Test of production mechanism

2010 result based on with photons reconstructed using the calorimeter (LHCb-CONF-2011-020, paper to be submitted soon)
2011 analysis using converted photons, lower statistics, but peaks distinguishable by eye





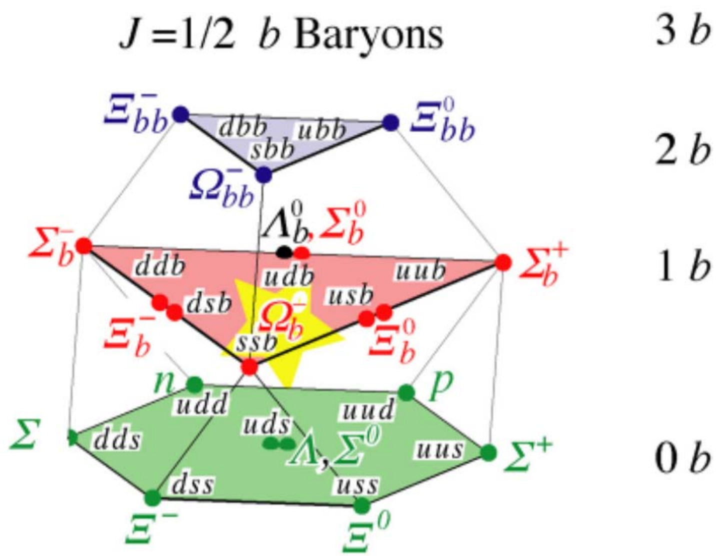
New!

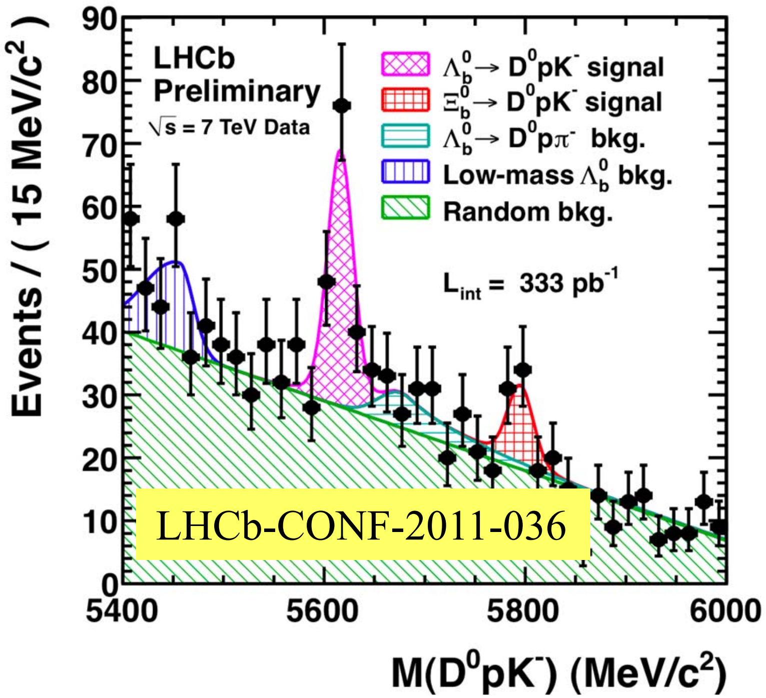
Result consistent with 2010 photon analysis

Heavy b baryons

Dataset contains large samples of heavy baryons Λ_b, Ξ_b, Ω_b

Wealth of measurements (masses, lifetimes, branching ratios, CP asymmetries, ..)





LHCb-CONF-2011-036

EPS results, observation $\Lambda_b \rightarrow D^0pK$

$$R_{D^0pK^-} = \frac{\mathcal{B}(\Lambda_b^0 \to D^0 p K^-)}{\mathcal{B}(\Lambda_b^0 \to D^0 p \pi^-)} = 0.112 \pm 0.019\,^{+0.011}_{-0.014}$$

$$m(\Xi_b^0) - m(\Lambda_b^0) = (181.8 \pm 5.5 \pm 0.5)\ MeV/c^2$$

Paper to follow based on full dataset

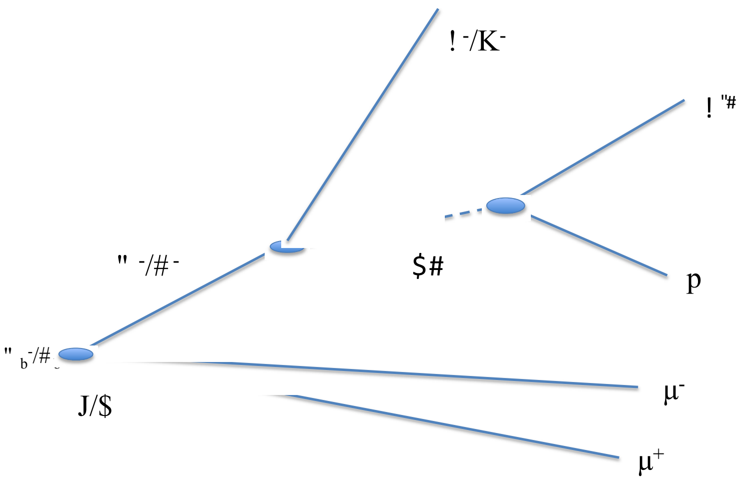
Ξ_b^- and Ω_b^- baryons

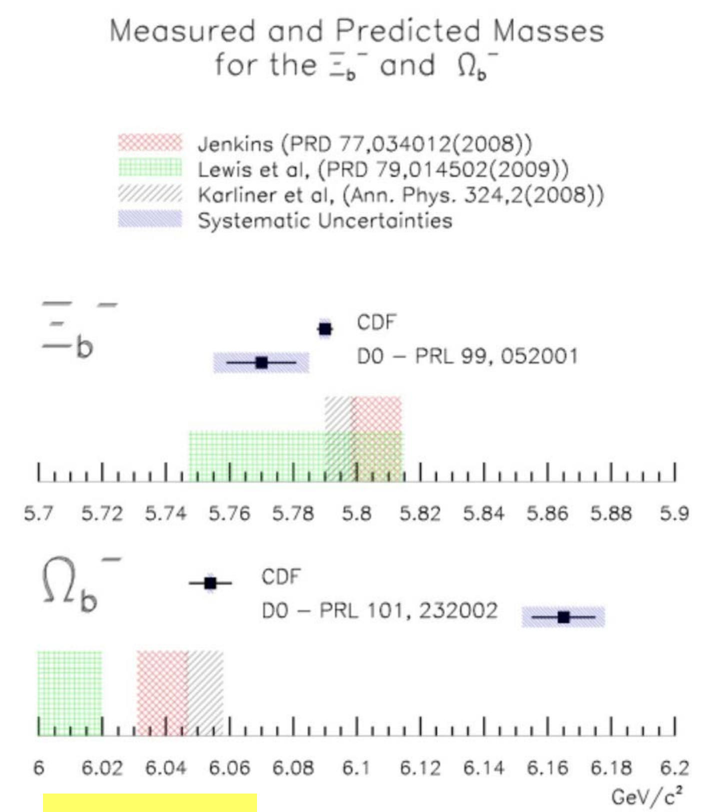
First observations of Ξ_b and Ω_b baryons were made by CDF and D0

Measured mass for Ξ_b are in good agreement

Large discrepancy for Ω_b (CDF vs D0)

First LHCb study (building on b-hadron mass measurements in LHCb-CONF-2011-27)



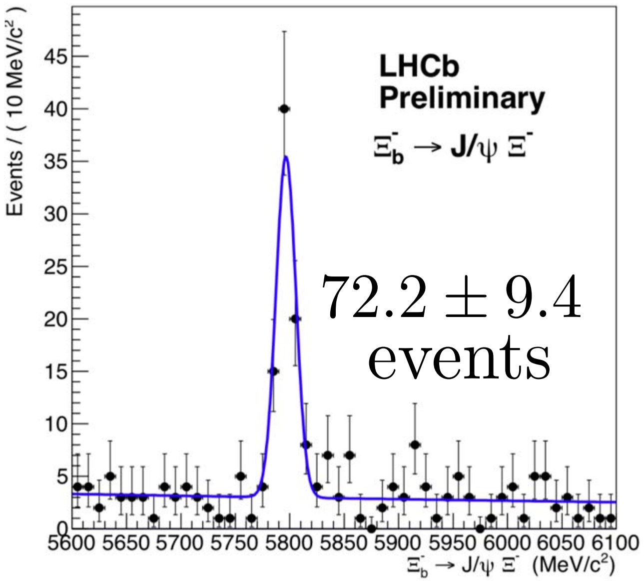


Theory

Ξ_b^- and Ω_b^- baryons

Based on 576 pb^{-1} of data

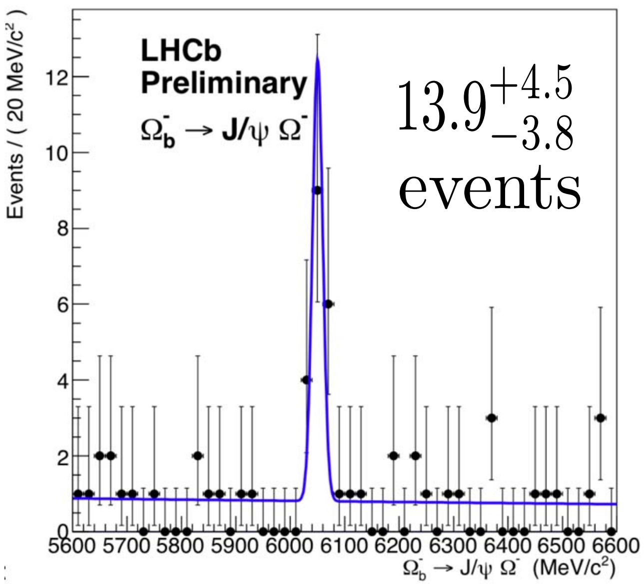
LHCb-CONF-2011-060

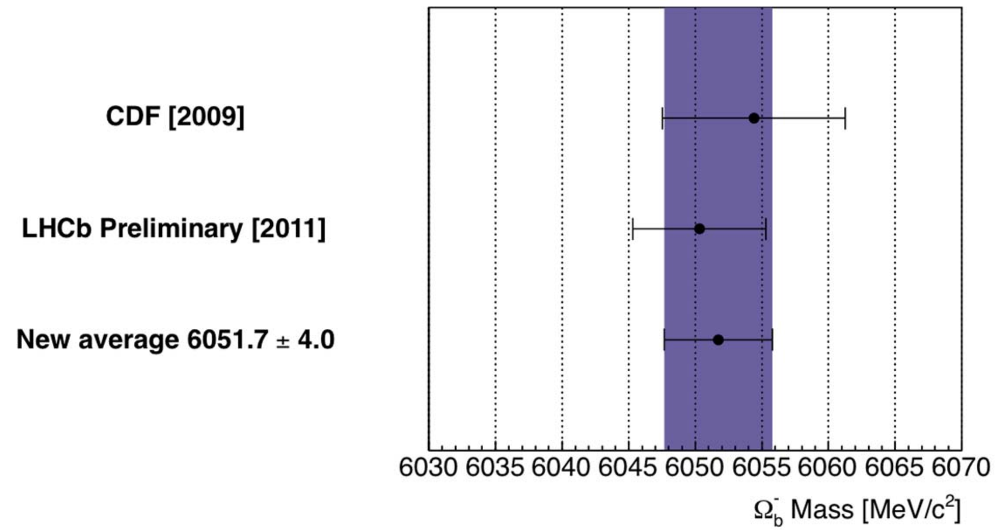


$$M(\Xi_b^-) = 5796.5 \pm 1.2\ (stat) \pm 1.2\ (syst)\ MeV/c^2$$

$$M(\Omega_b^-) = 6050.3 \pm 4.5\ (stat) \pm 2.2\ (syst)\ MeV/c^2$$

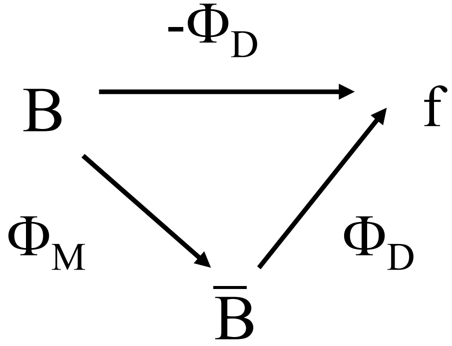
World best measurements

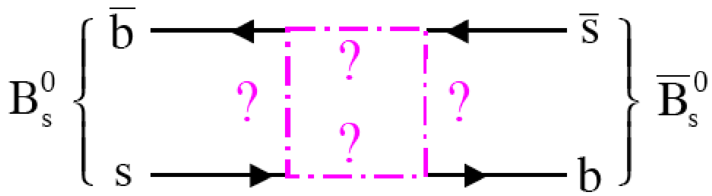




LHCb resolves Ω_b anomaly in favour of CDF

CP violation in B_s decays: ϕ_s





New Particles ?

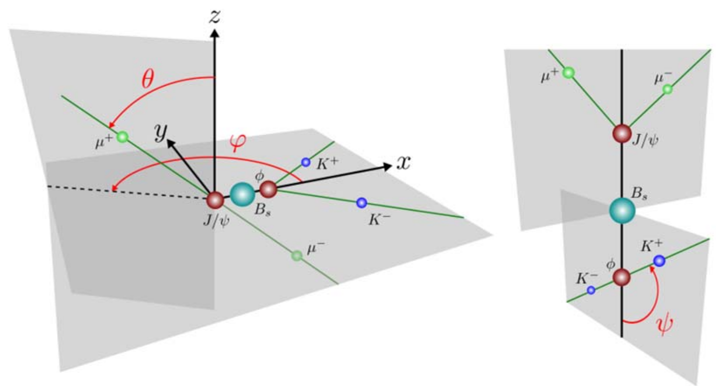
Study the CP violation in interference between decay and mixing in B_s decays

Observable phase $\phi_s = \Phi_M - 2\,\Phi_D$

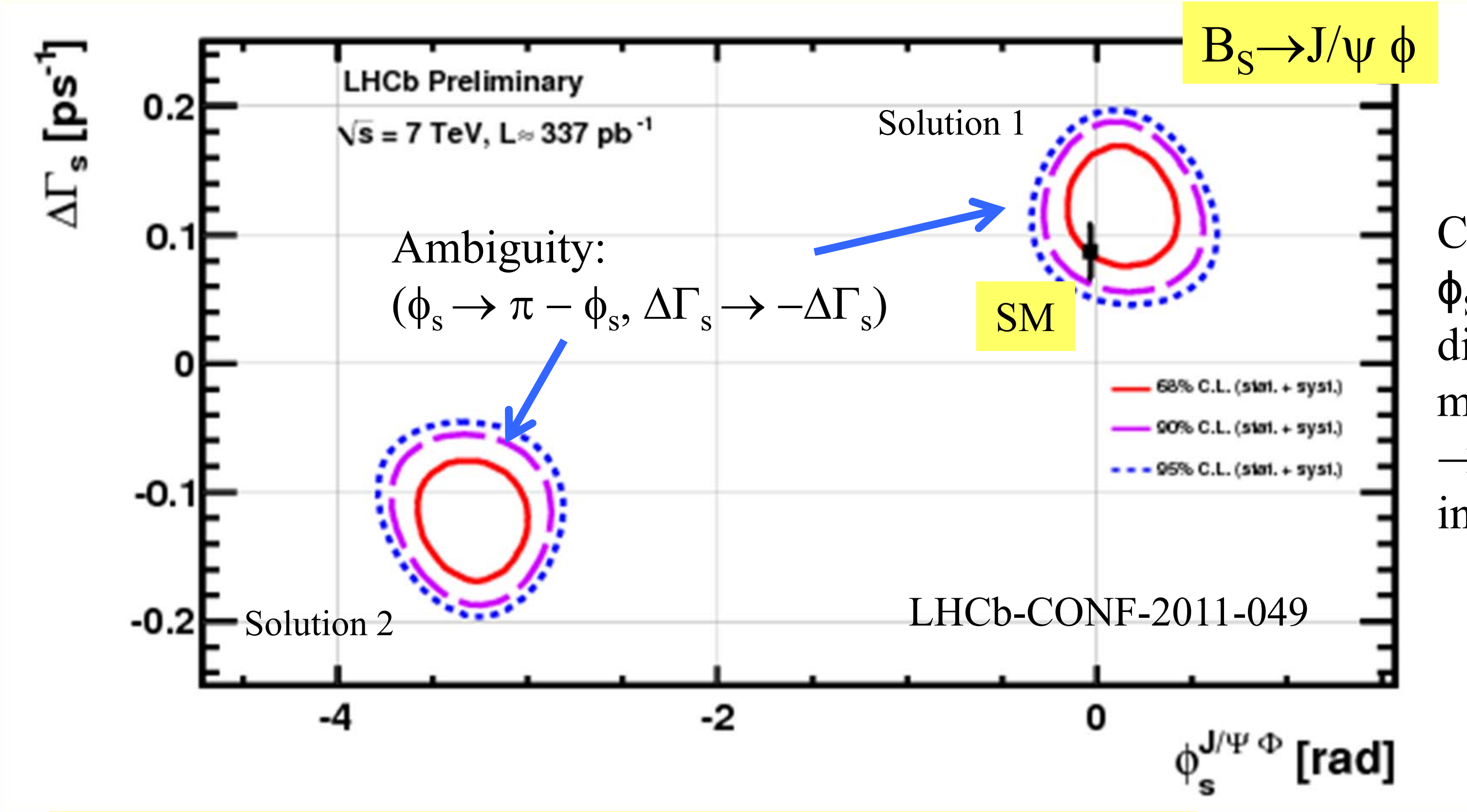
In the Standard Model expected to be small
$\phi_s = -\,0.036$ radian

New Physics can modify and enhance ϕ_s

- Golden mode: $B_s \rightarrow J/\psi\ \phi$
- Vector-Vector final state: Admixture of CP eigenstates: Angular analysis needed
- LP Analysis with ~350 pb^{-1}, 8000 cand.
- Side-analysis: Δm_s world's best measured



ϕ_s



Correlation between ϕ_S and width difference of the B_s mass eigenstates
→ Plot contours in (ϕ_s *vs* $\Delta\Gamma_s$) plane

$$\phi_s = 0.13 \pm 0.18(stat) \pm 0.07(syst)\ rad$$

$$\Delta\Gamma_s = 0.123 \pm 0.029(stat) \pm 0.011(syst)\ rad$$

Papers on this and the $B_S \to J/\psi f0$ mode will be submitted soon

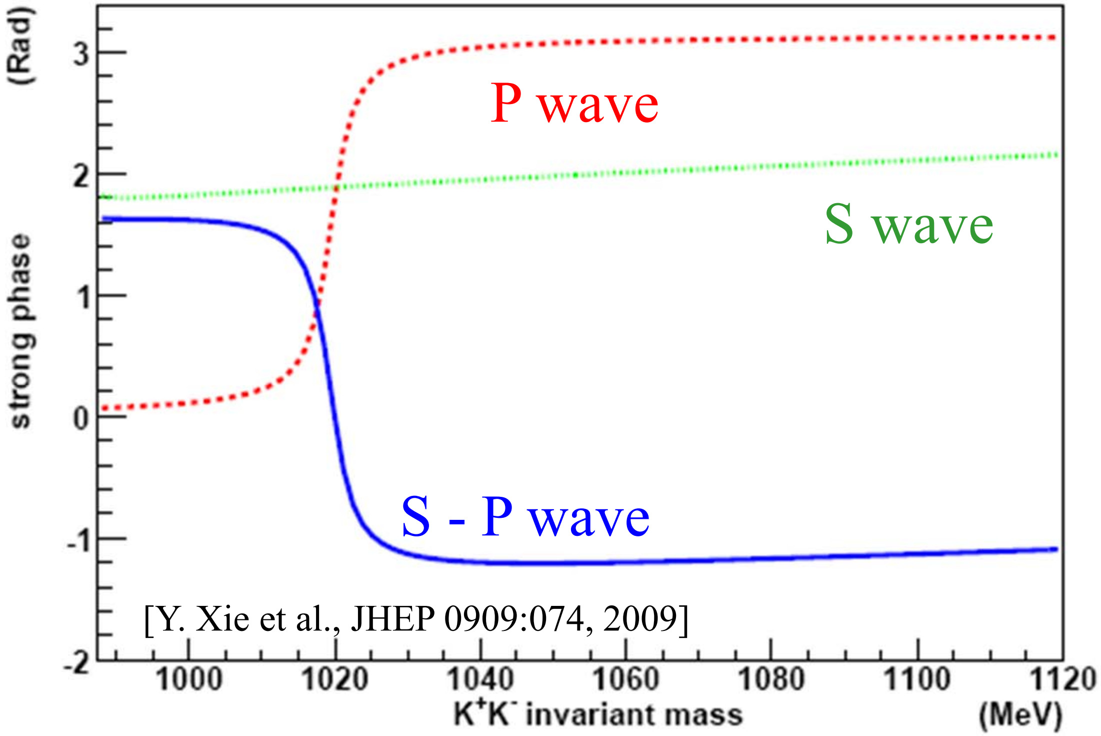
ϕ_s: Ambiguity Resolution

Use few % S wave KK present in the sample

$$(\phi_s, \Delta\Gamma_s, \delta_\parallel - \delta_0, \delta_\perp - \delta_0, \delta_s - \delta_0) \longleftrightarrow (\pi - \phi_s, -\Delta\Gamma_s, \delta_0 - \delta_\parallel, \pi + \delta_0 - \delta_\perp, \delta_0 - \delta_s)$$

K^+K^- P-wave:
Phase of Breit-Wigner increases rapidly across $\phi(1020)$ resonance

K^+K^- S-wave:
Phase of Flatté amplitude for $f_0(980)$ relatively flat (similar for non-resonance)

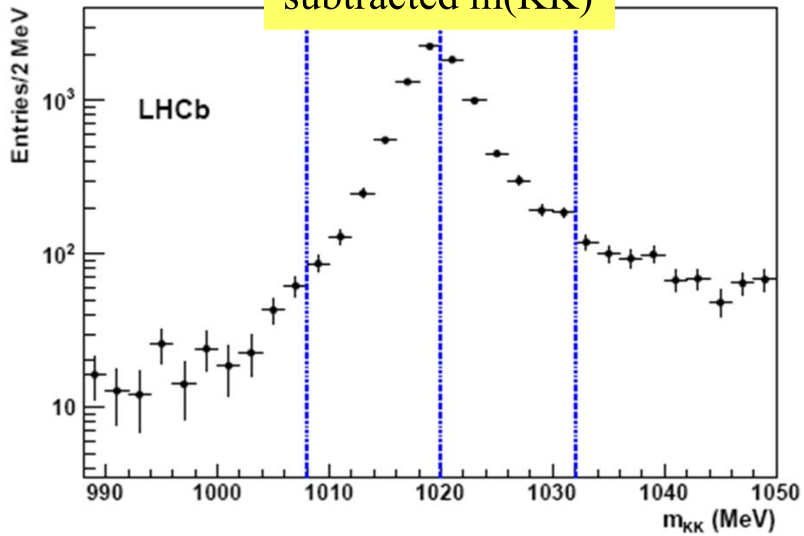


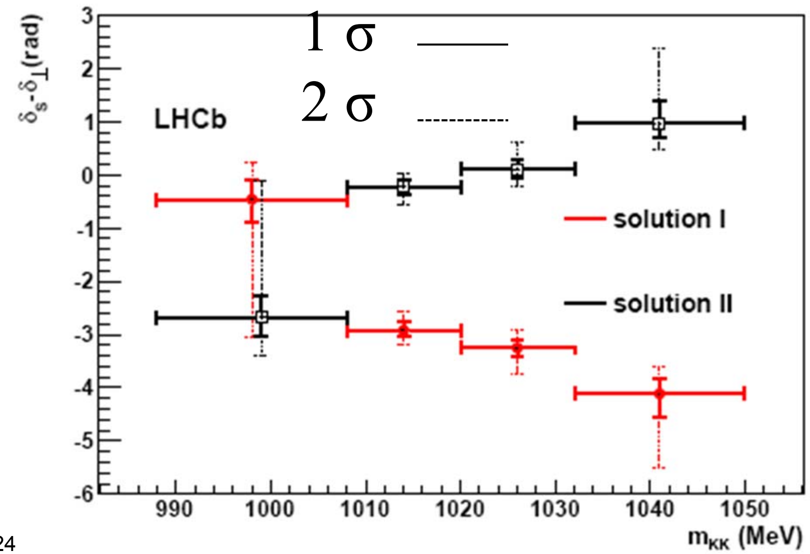
Choose the solution with a decreasing trend of δ_s- δ_P vs m_{KK} in the $\phi(1020)$ mass region

Similar to Babar measurement of sign of cos(2β), PRD 71, 032005 (2007)

ϕ_s: Ambiguity Resolution

Background subtracted m(KK)





New!

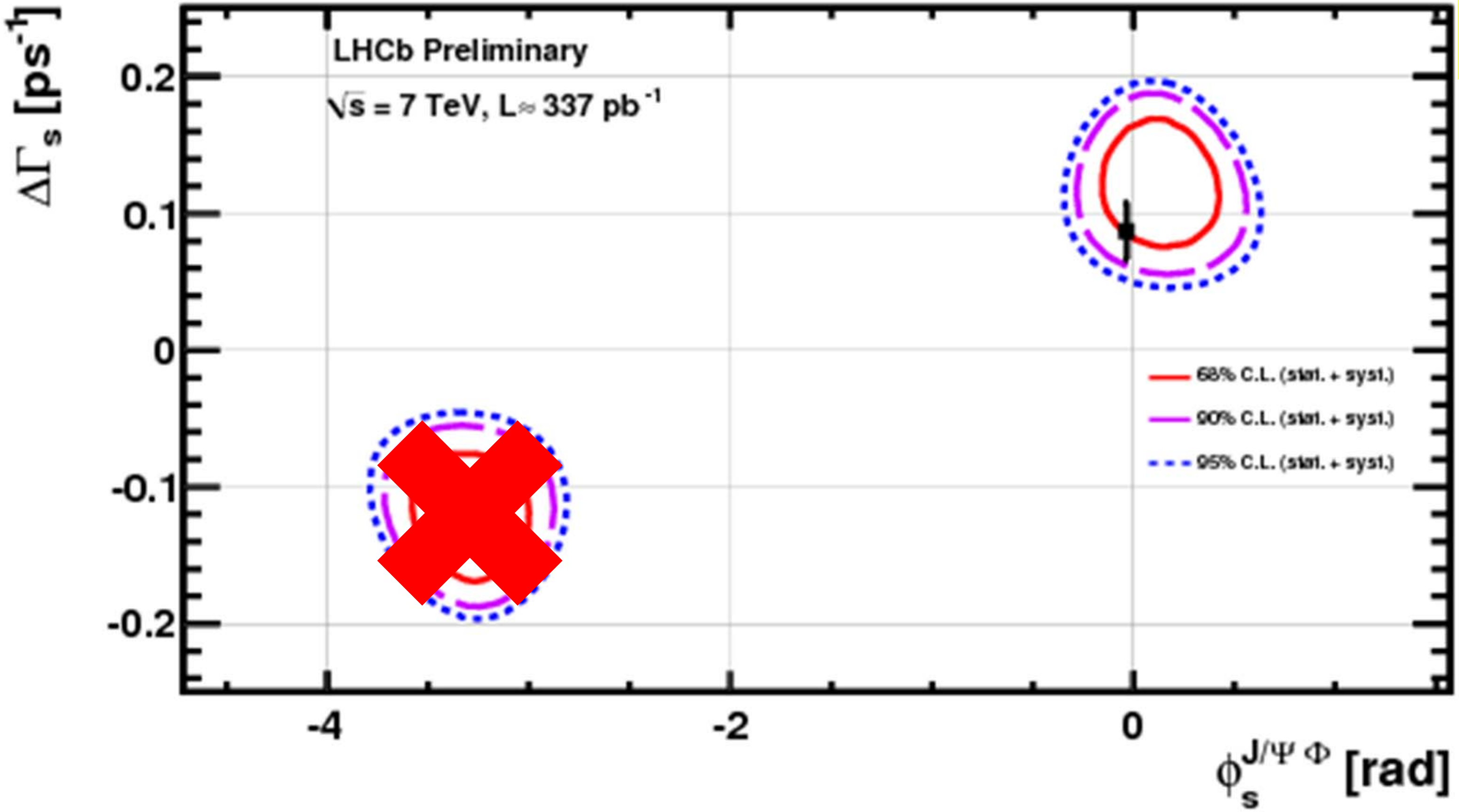
Dataset used for the LP result (350 pb^{-1}), open up m(KK) mass cut

Perform analysis in four bins of m(KK) and extract phase dependence

m_{KK} interval	N_{sig}	N_{bkg}	W_p
(988, 1008) MeV	251 ± 21	1675 ± 43	0.700
(1008, 1020) MeV	4569 ± 70	2002 ± 49	0.952
(1020, 1032) MeV	3952 ± 66	2244 ± 51	0.938
(1032, 1050) MeV	726 ± 34	3442 ± 62	0.764

Solution I displays the expected decreasing trend

ϕ_s: Ambiguity Resolution



New!

Data favour the Standard Model solution

Paper in preparation

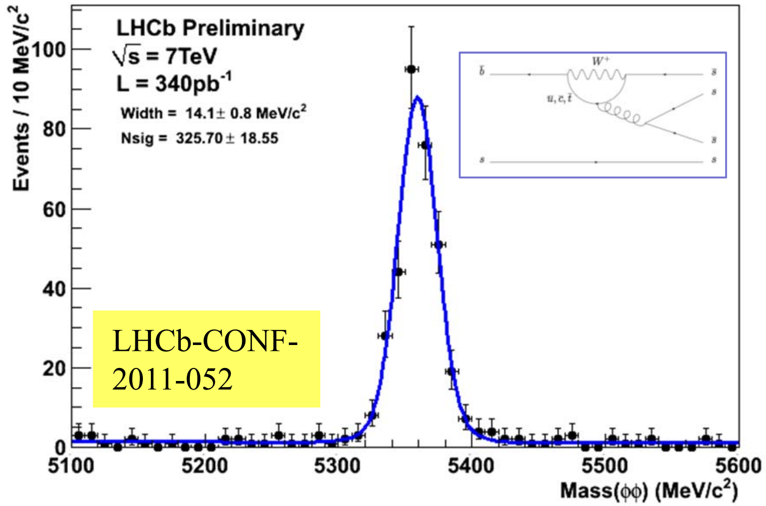
ϕ_s+ related topics: Outlook

Results expected for Winter Conferences

Updates on ϕ_s in $B_S \to J/\psi\phi$ and $B_S \to J/\psi f0$

For $B_S \to J/\psi\phi$ precision of 0.1 expected

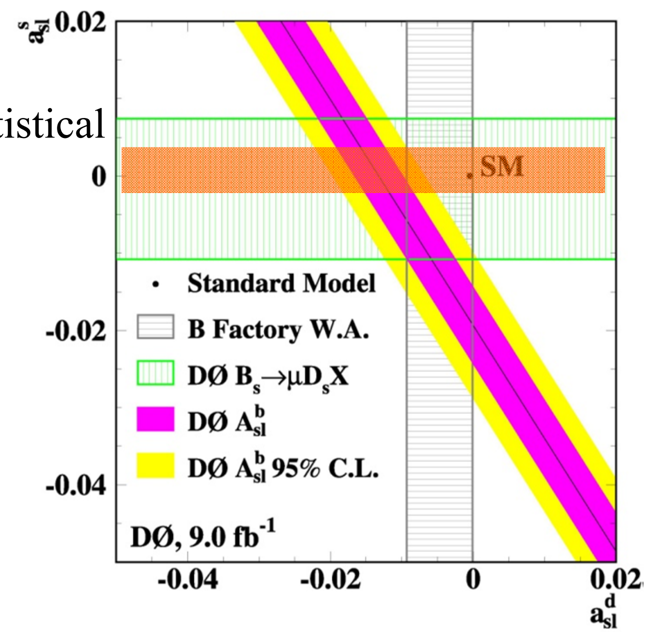
Update of Triple product asymmetry in analysis in $B_S \to \phi\phi$



Semi-leptonics

Is Standard Model ϕ_s like compatible with D0 a_{sl} measurement ?

0.25% statistical precision



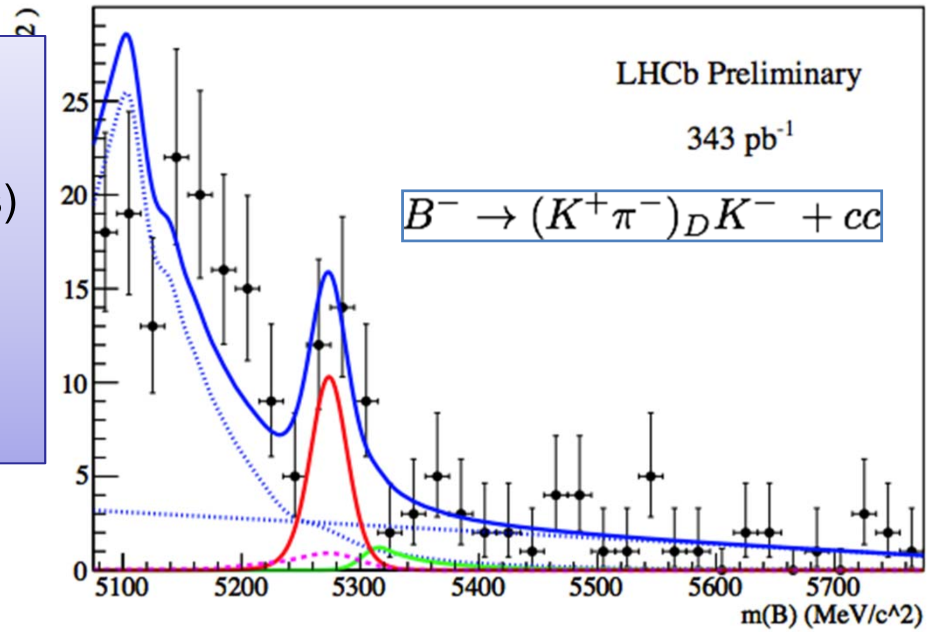
Time integrated method to extract a^s_{sl} using B_s ➔ $D_s(\phi\pi)$ $\mu\nu$ X being studied.

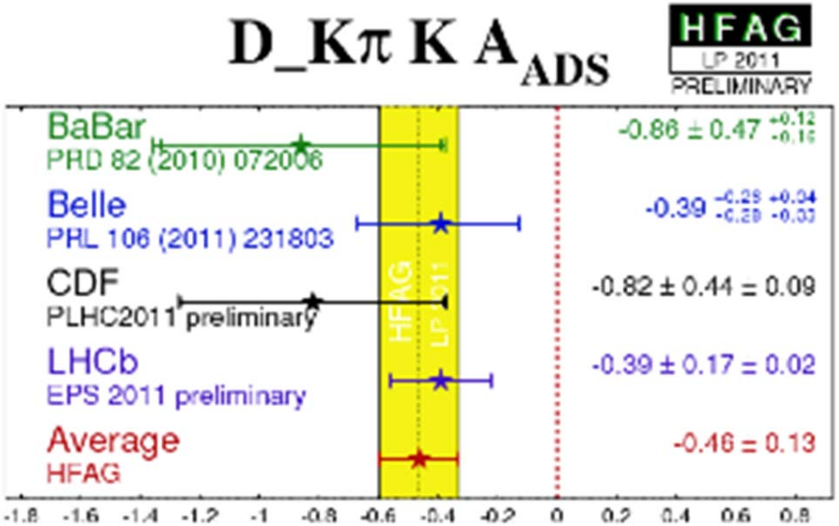
Towards the measurement of γ (tree diagrams)

- Time integrated ADS method
  (B→DK, interference between
  B and D suppressed decay modes)

- Very small branching ratio: ~ 10^{-7}

- LHCb data: world best



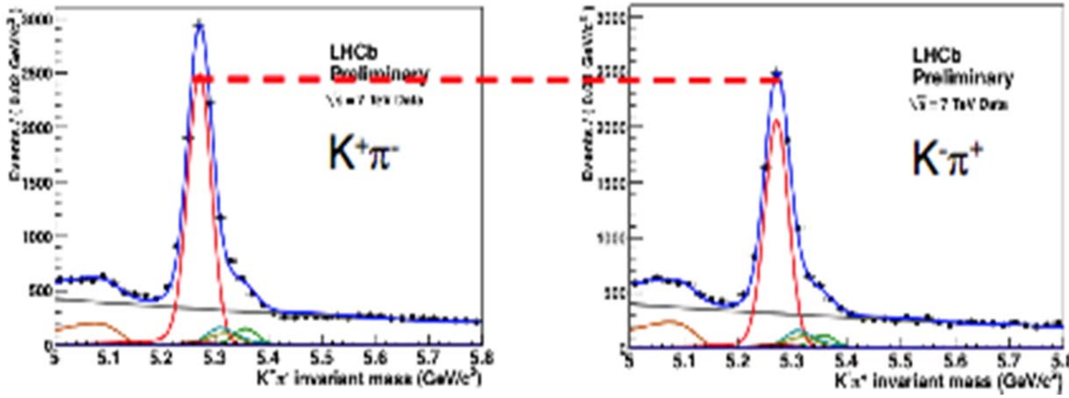


$$A = \frac{\Gamma(B^- \to f_D K^-) - \Gamma(B^+ \to \bar{f}_D K^+)}{\Gamma(B^- \to f_D K^-) + \Gamma(B^+ \to \bar{f}_D K^+)}$$

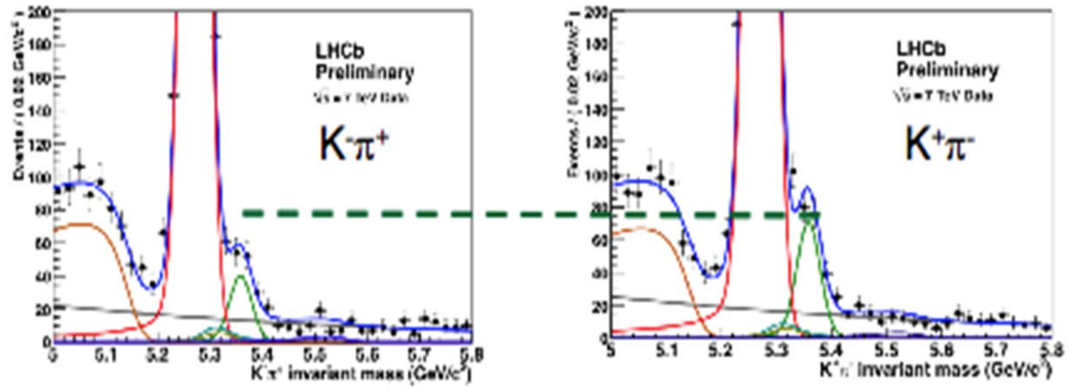
A_{ADS} = - 0.39 ± 0.17 ± 0.02
R_{ADS} =(1.66 ± 0.39 ± 0.24) 10^{-2}

Towards the measurement of γ (loop diagrams)

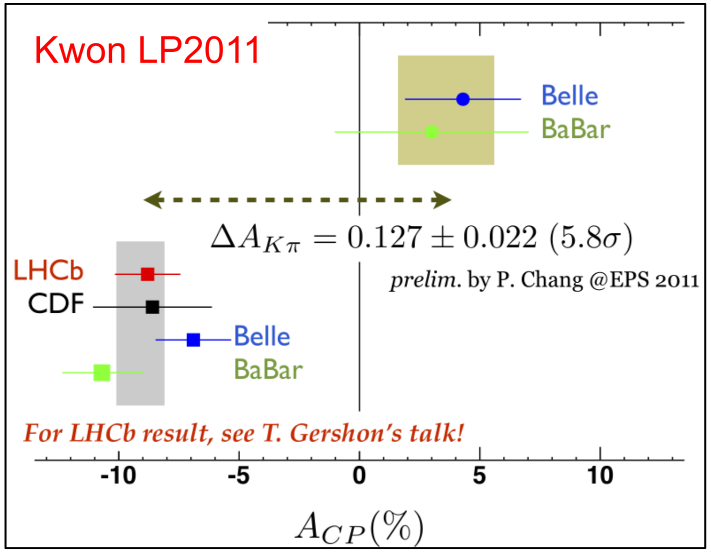
- Measurement of time integrated asymmetries in B→hh decays
- 1st evidence of CP violation in B_s system
- Best single measurement of A_{CP} (B_d) and new element for the A_{CP} "puzzle"



$$A_{CP}\left(B^0 \to K^+\pi^-\right) = -0.088 \pm 0.011 \pm 0.008$$

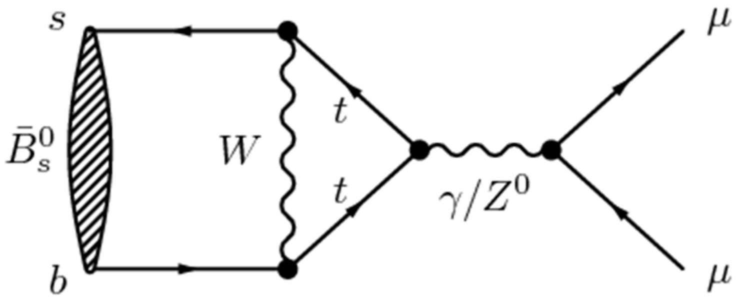


$$A_{CP}\left(B_s^0 \to \pi^+K^-\right) = 0.27 \pm 0.08 \pm 0.02$$



Next step: time dependent asymmetries

$B_{s,d} \rightarrow \mu\ \mu$



Helicity suppressed FCNC decay.
Small in Standard Model, but well predicted

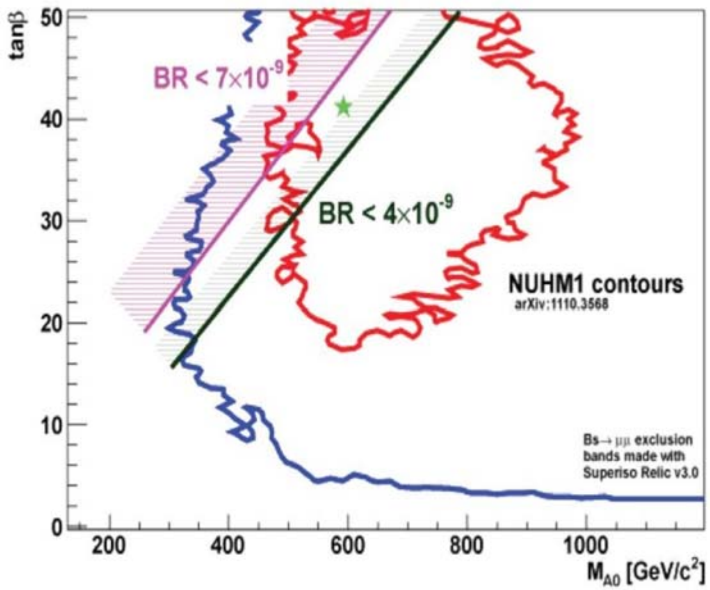
$$B(B_s \to \mu^+\mu^-) = (3.2 \pm 0.2) \times 10^{-9}$$

SM

$$B(B_d \to \mu^+\mu^-) = (1.0 \pm 0.1) \times 10^{-10}$$

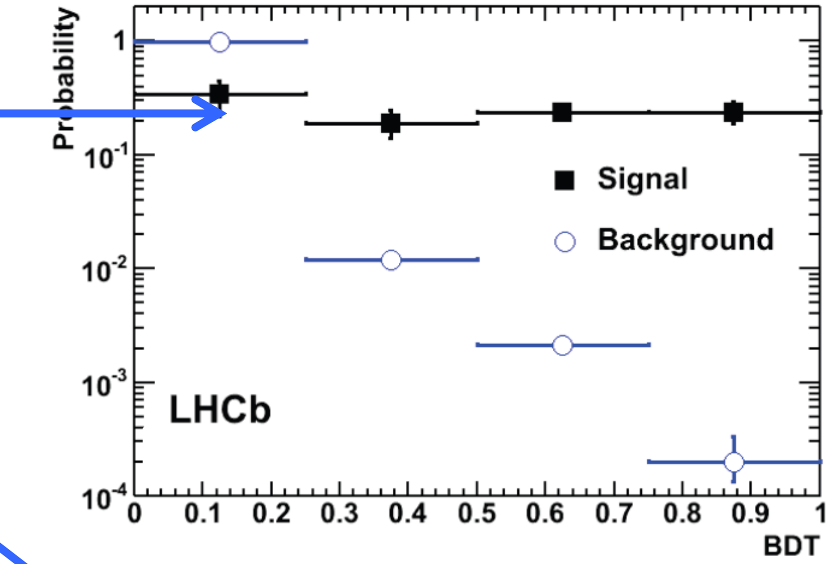
Sensitive to New Physics contributions: e.g.
can be enhanced in Susy models with high tanβ

Result on 400 pb^{-1} (2010 + early 2011) will be submitted to journal in next days

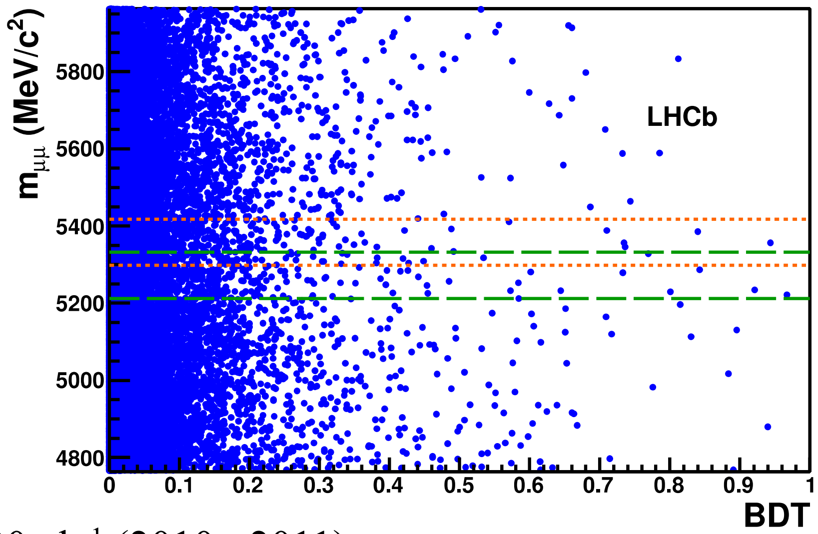


$B_{s,d} \rightarrow \mu\,\mu$

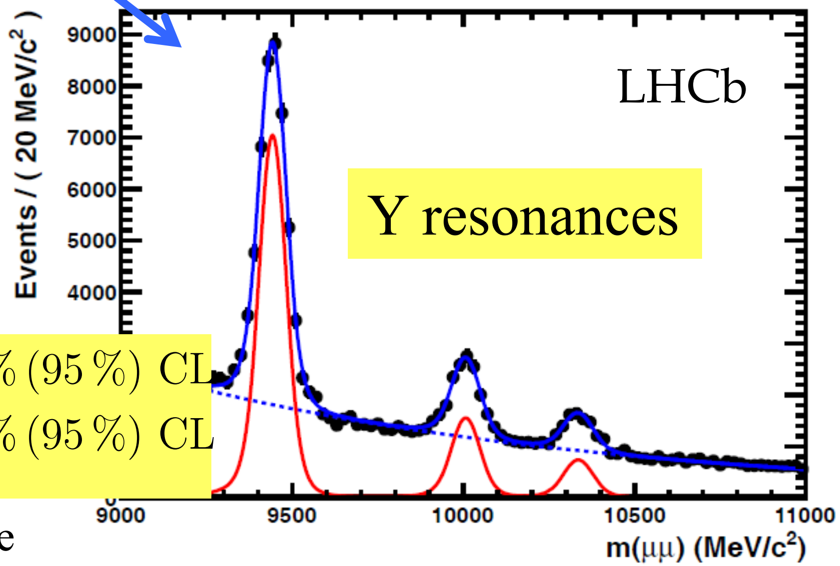
Boosted Decision tree combining geometric and kinematic information



Invariant mass: modelled for signal using Υ and J/ψ. σ ~ 25 MeV/c^2



400 pb^{-1} (2010+ 2011)



$$\mathcal{B}(B_s^0 \to \mu^+\mu^-)(2010+2011) \quad < \quad 1.2\,(1.4)\times 10^{-8} \text{ at } 90\,\%\,(95\,\%) \text{ CL}$$
$$\mathcal{B}(B^0 \to \mu^+\mu^-)(2010+2011) \quad < \quad 2.6\,(3.2)\times 10^{-9} \text{ at } 90\,\%\,(95\,\%) \text{ CL}$$

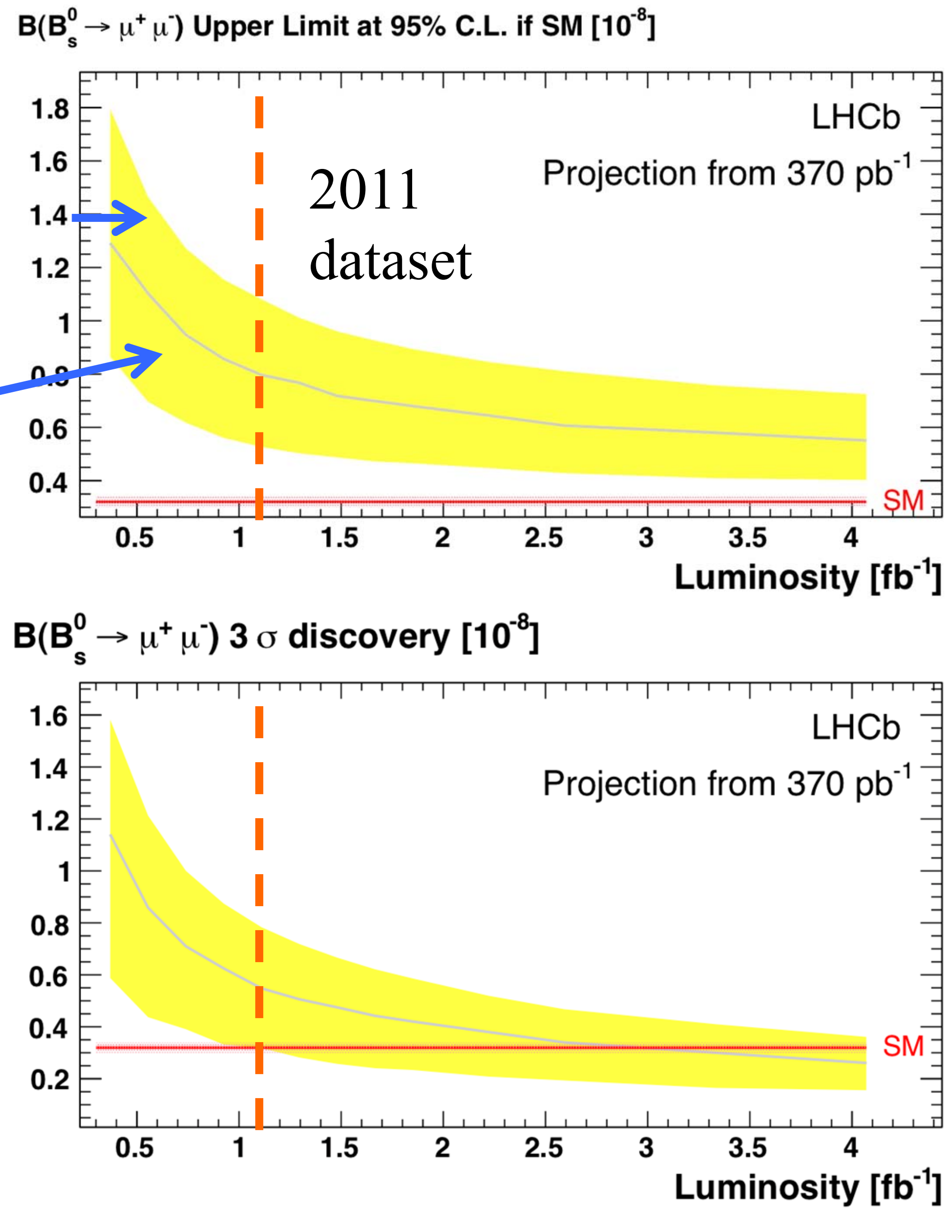
Best upper limits to date

$B_s \rightarrow \mu\,\mu$: Prospects

Aim to have a result using the full 2011 dataset for the Winter conferences

Limit in case of the Standard Model

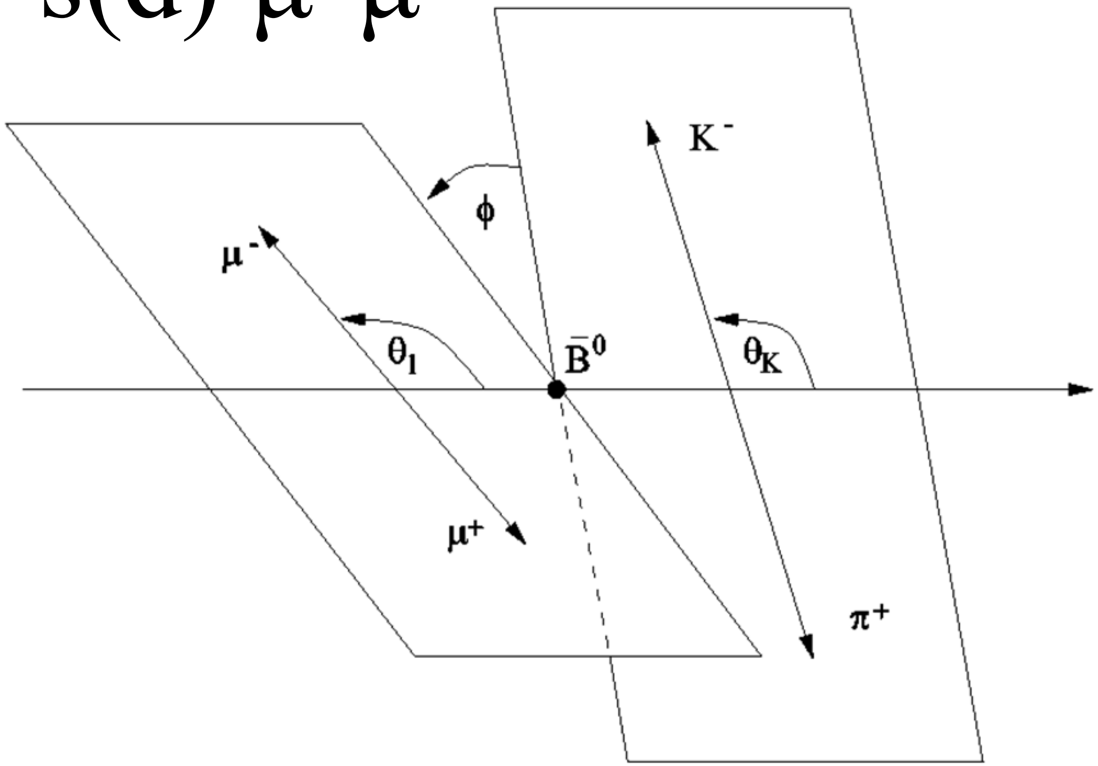
If a signal exists at the SM level we could have a 3σ measurement by the Winter conferences, certainly by the end of the 2012 run.

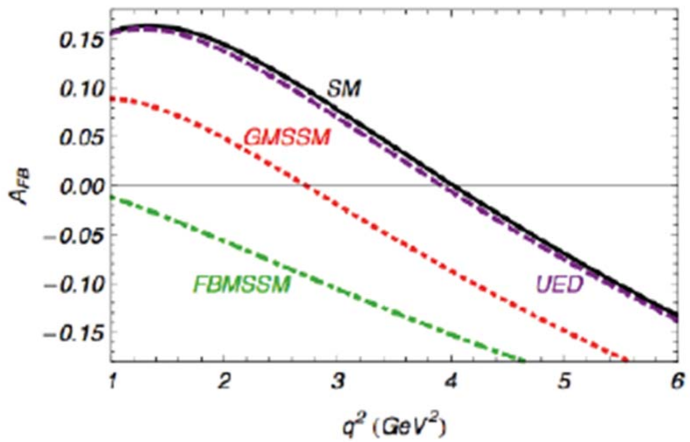


$b \rightarrow s(d)\, \mu^+\mu^-$

$B^0 \rightarrow K^*l^+l^-$

- Flavour changing neutral current decay:
  - $Br(B^0 \rightarrow K^*l^+l^-) = (3.3 \pm 1.0) \times 10^{-6}$
- Described by
  - three angles: θ_l, ϕ, θ_k
  - $\mu\mu$ invariant mass: q^2
- Excellent probe of helicity structure of New Physics
- Esp. lepton forward-backward asymmet A_{FB} vs. q^2

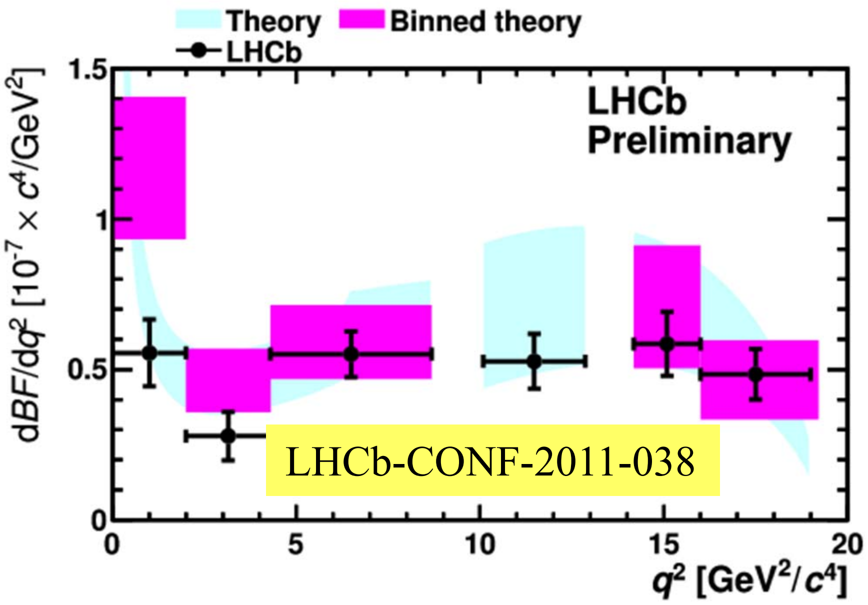




W.Altmannshofer et al. [JHEP 0901:019 (2009)]

b ➔ s(d) $\mu^+\mu^-$

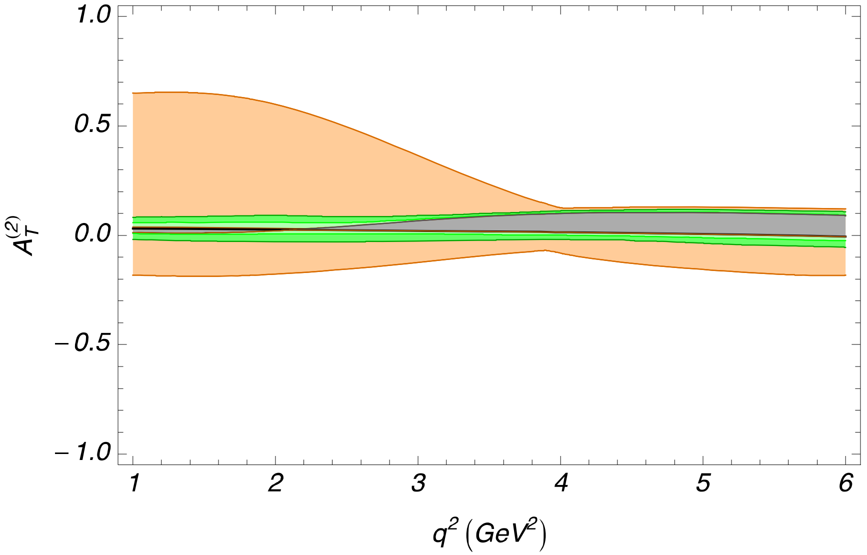
Results for the B_d ➔ $K^*\mu^+\mu^-$ presented At summer conferences based on 300 pb^{-1} of data [Paper appearing soon]



Worlds most precise determination of forward backward asymmetry

Wealth of new measurements possible for the Winter conferences:

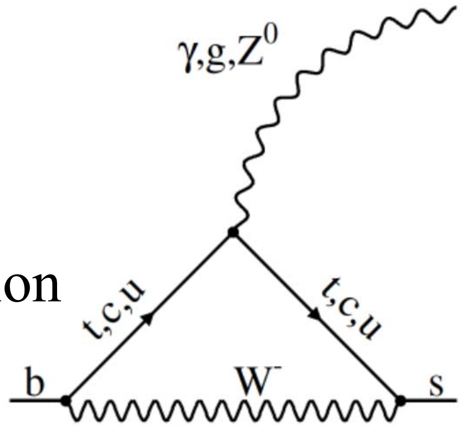
New observables in B_d ➔ $K^*\mu^+\mu^-$ (e.g. $A_T^{\ 2}$)



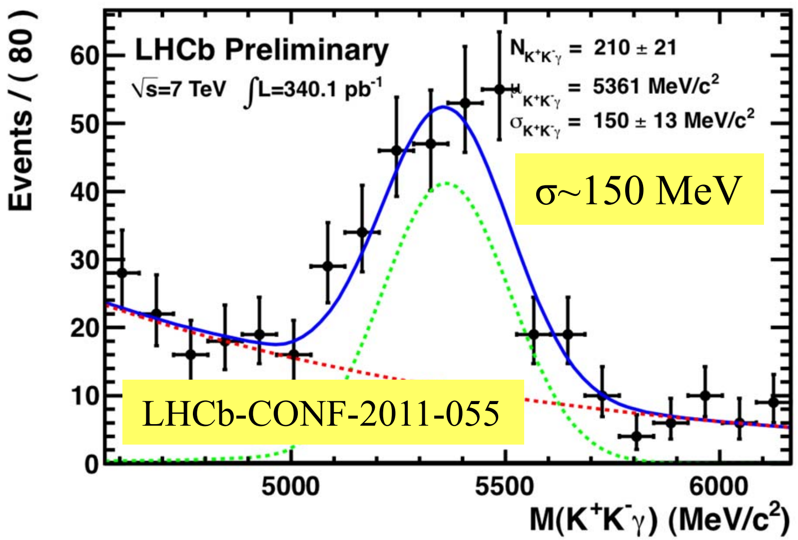
Other modes e.g. B_s ➔ $\phi\mu^+\mu^-$

Radiative Penguins

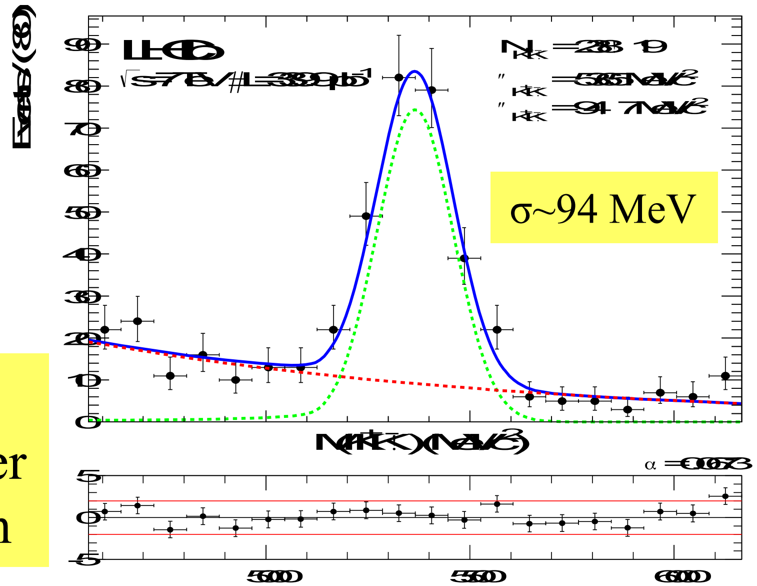
Important goal of LHCb is to probe for NP through isospin and CP asymmetries in exclusive radiative Penguins. e.g. is $B_s \to \varphi\gamma$



These modes profit from improved calorimeter calibration



Improved calorimeter calibration



CP violation in Charm

CP-violating asymmetries in charm provide a unique probe of physics beyond the Standard Model (SM)

- SM charm physics is (almost) CP conserving
- New Physics can enhance CP-violating observables

CP violation in charm not observed

CERN seminar (Des'2011), paper submitted to PRL

http://arxiv.org/abs/1112.0938

CP violation in Charm

$$A_{\rm raw}(f) \equiv \frac{N(D^{*+} \to D^0(f)\pi^+) - N(D^{*-} \to \overline{D}^0(\bar{f})\pi^-)}{N(D^{*+} \to D^0(f)\pi^+) + N(D^{*-} \to \overline{D}^0(\bar{f})\pi^-)}$$

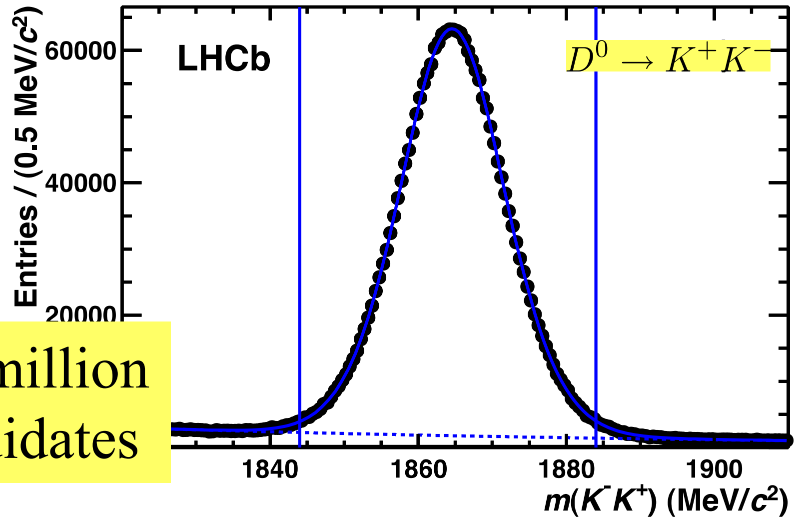
D flavour tagged with slow pion from D*

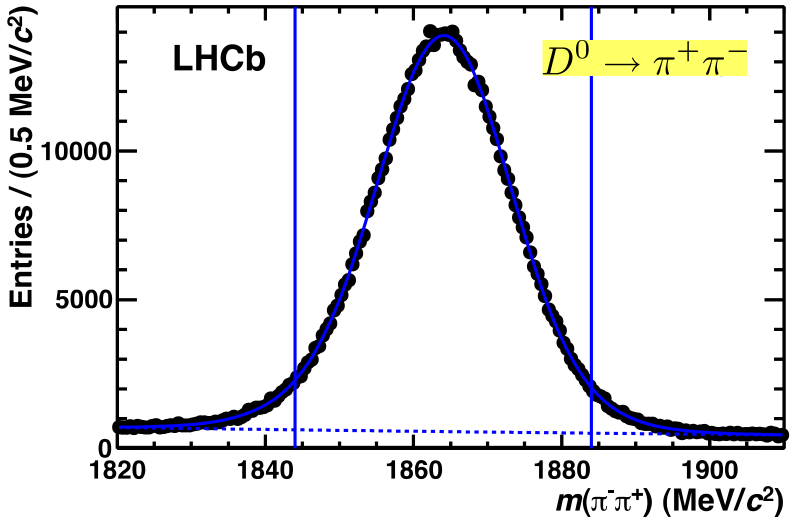
Physics Detector Production

$$A_{\rm RAW}(f)^* = A_{CP}(f) + A_{\rm D}(f) + A_{\rm D}(\pi_{\rm s}) + A_{\rm P}(D^{*+})$$

1 kHz of trigger bandwidth allocated to charm

$$\Delta A_{CP} \equiv A_{CP}(K^-K^+) - A_{CP}(\pi^-\pi^+), \\ = A_{\rm RAW}(K^-K^+)^* - A_{\rm RAW}(\pi^-\pi^+)^*$$



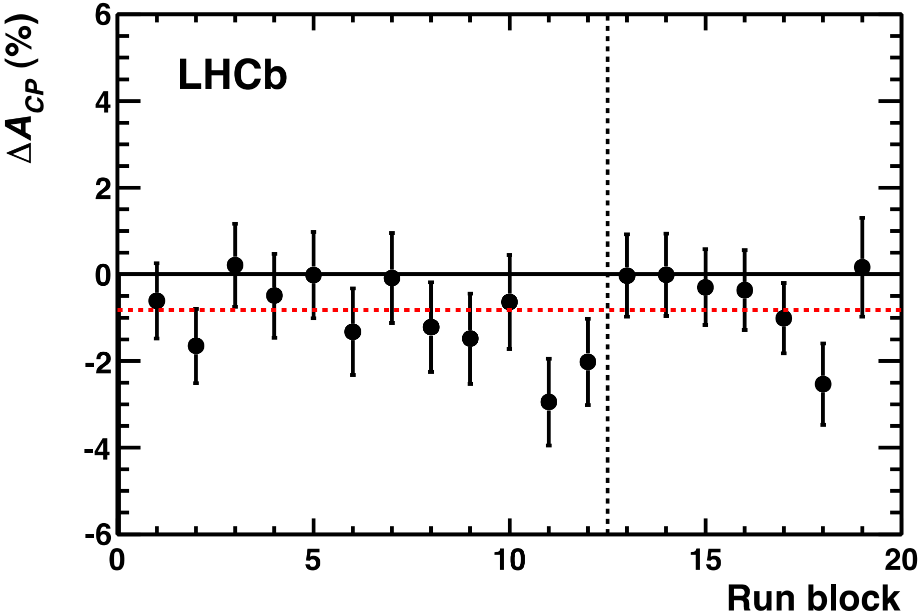


1.4 million candidates

CP violation in Charm

$$\Delta A_{CP} = (-0.82 \pm 0.21 \pm 0.11)\%$$

First 3.5σ evidence for CP violation in charm sector!

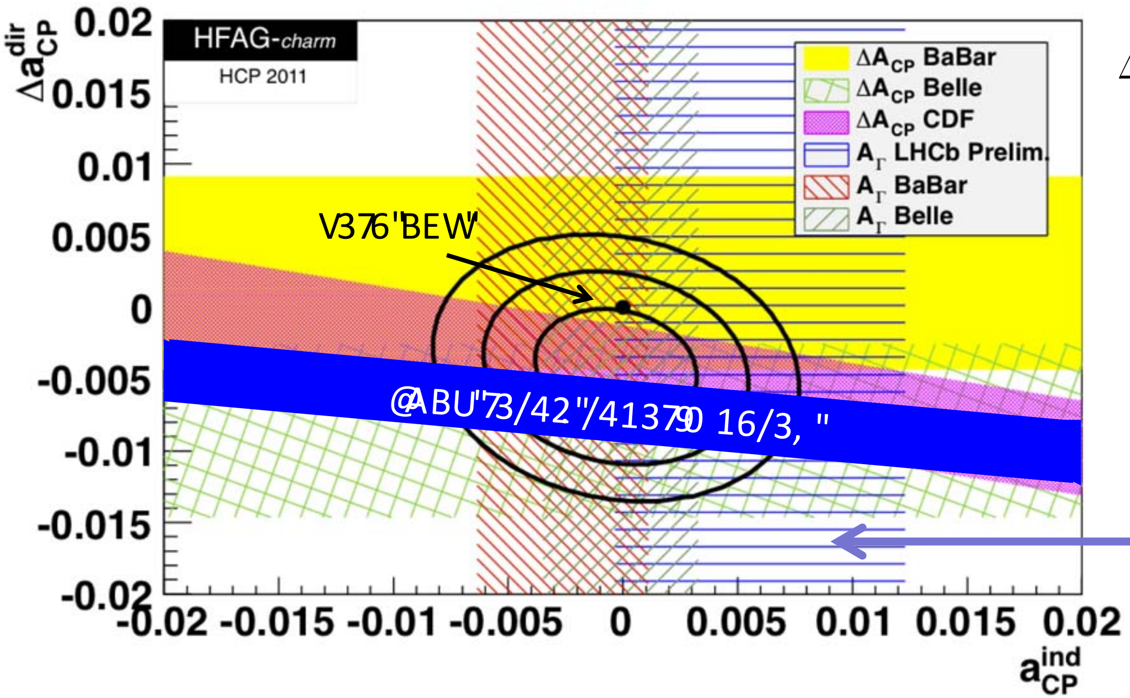


Analysis based on 60 % of collected data. Update on full dataset for Winter Conferences.

In addition parallel measurement possible using semi-leptonic B decays to tag D flavour

Result stable over time different magnet polarities and changing cuts

CP violation in Charm



$$\Delta A_{CP} \equiv A_{CP}(K^-K^+) - A_{CP}(\pi^-\pi^+)$$
$$= [a_{CP}^{\rm dir}(K^-K^+) - a_{CP}^{\rm dir}(\pi^-\pi^+)] + \frac{\Delta\langle t\rangle}{\tau} a_{CP}^{\rm ind}$$

Measure essentially direct CP

2010 LHCb study
of indirect CP violation
[LHCb-CONF-2011-046]

Result attracting theoretical interest

Before LHCb result consensus measurement at this level signified NP (Phys Rev D75 (2007) 036008])

Conclusion now being revisited (e.g arXiv:1111.5000)

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“40 MHz” upgrade scheme = higher bandwidth, fully software trigger = higher yields

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Goals:

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NOW: intense R&D ongoing to prepare TDR in 2013

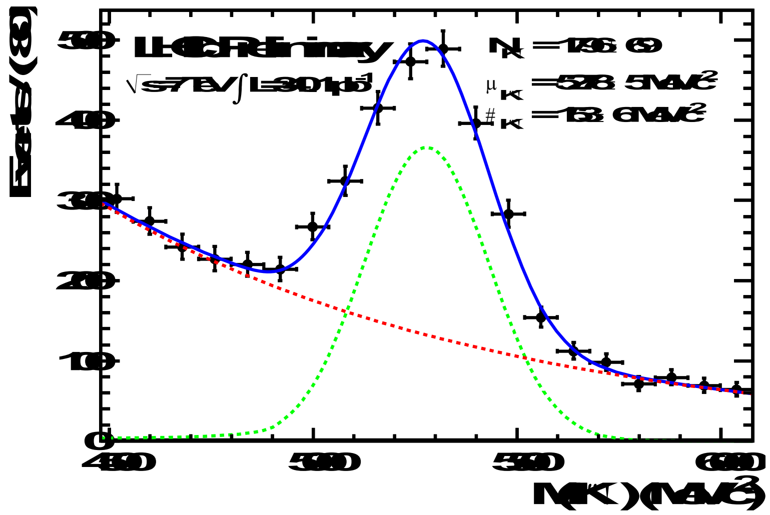
Summary

- Data mining of the huge 2011 dataset started
  - Not just $B_{u,d,s}$ also B_c and b baryons
  - Not just charged: first results with photon/calorimeter modes
- Many new results for the Winter conferences
  - + papers on results from the Summer
- Thanks to the machine for giving us precious (BEAUTYful) data (almost every day)
- Already working on a possible upgrade of LHCb

Backup

$B^0 \to K^*\gamma$ and $B_s \to \phi\gamma$

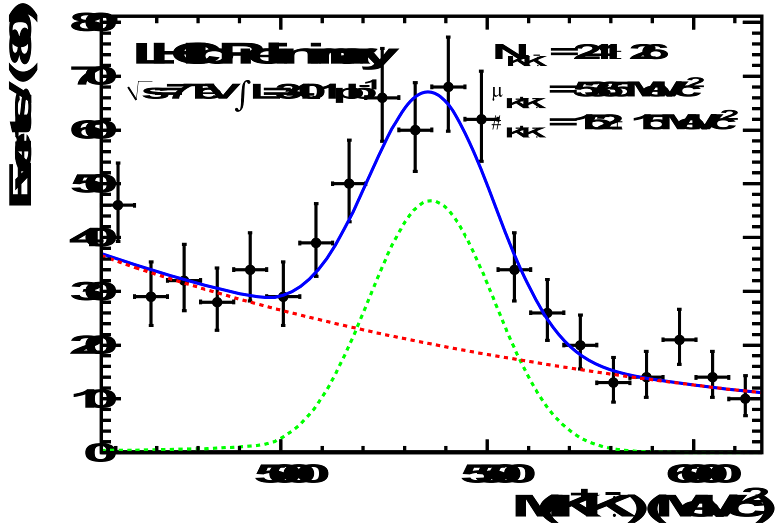
- First analysis with calorimetric objects
- First studies of radiative Penguins at an hadronic machine



Largest $B_s \to \phi\gamma$ signal, measure:

$$\frac{B(B^0 \to K^{*0}\gamma)}{B(B_s^0 \to \phi\gamma)} = 1.52 \pm 0.15(stat) \pm 0.10(syst) \pm 0.12(f_s/f_d)$$

SCET predicts 1.0 ± 0.2 for this ratio
[Ali et al., EPJ C55:577 (2008)]



- Large improvement on mass resolution with latest ECAL calibration: 150 MeV → 100 MeV
- Next step: measure CP asymmetries

The "beauty" of charm

- LHCb can profit of the huge charm production cross section at the LHC (~6 mb):
  1 kHz out of 3 kHz of the HLT output are dedicated to charm

- Complication: evaluate production asymmetry coming from initial pp state

Indirect CPV A_Γ:
compare D^0 and $\overline{D}^0 \to KK$ lifetimes
[tagged samples]

Mixing parameter y_{CP}:
compare lifetime of $D^0 \to$ CP-eigenstate, (KK or ππ), to $D^0 \to$ non-eigenstate (Kπ)
[untagged samples]

$$A_\Gamma = \frac{\tau(\overline{D}^0 \to K^-K^+) - \tau(D^0 \to K^+K^-)}{\tau(\overline{D}^0 \to K^-K^+) + \tau(D^0 \to K^+K^-)}$$

$$y_{CP} = \frac{\tau(K^-\pi^+)}{\tau(K^+K^-)} - 1$$

Results presented at EPS, based ONLY on 2010 data (~35 pb^{-1})

$$A_\Gamma = (-0.59 \pm 0.59 \pm 0.21)\%$$

c.f. WA of $(0.12 \pm 0.25)\%$

$$y_{CP} = (0.55 \pm 0.63 \pm 0.41)\%$$

c.f. WA of $(1.11 \pm 0.22)\%$

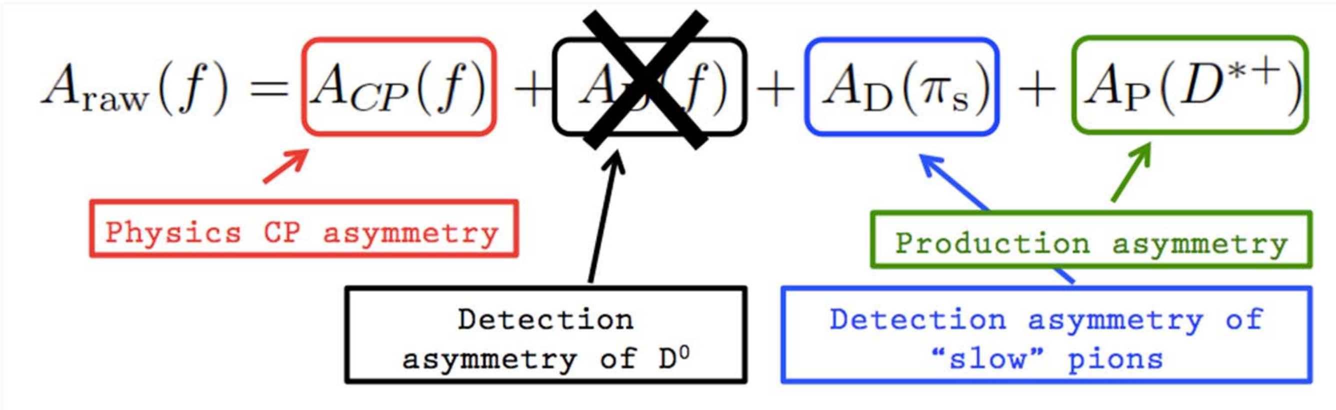
Evidence of CP violation in charm decays

- Measure CP asymmetry in Time Integrated $D^0 \rightarrow$ hh decays

$$A_{CP}(f) = \frac{\Gamma(D^0 \to f) - \Gamma(\overline{D}^0 \to f)}{\Gamma(D^0 \to f) + \Gamma(\overline{D}^0 \to f)}$$

f = KK or $\pi\pi$

D^0 tagged by $D^* \rightarrow D^0 \pi_{soft}$

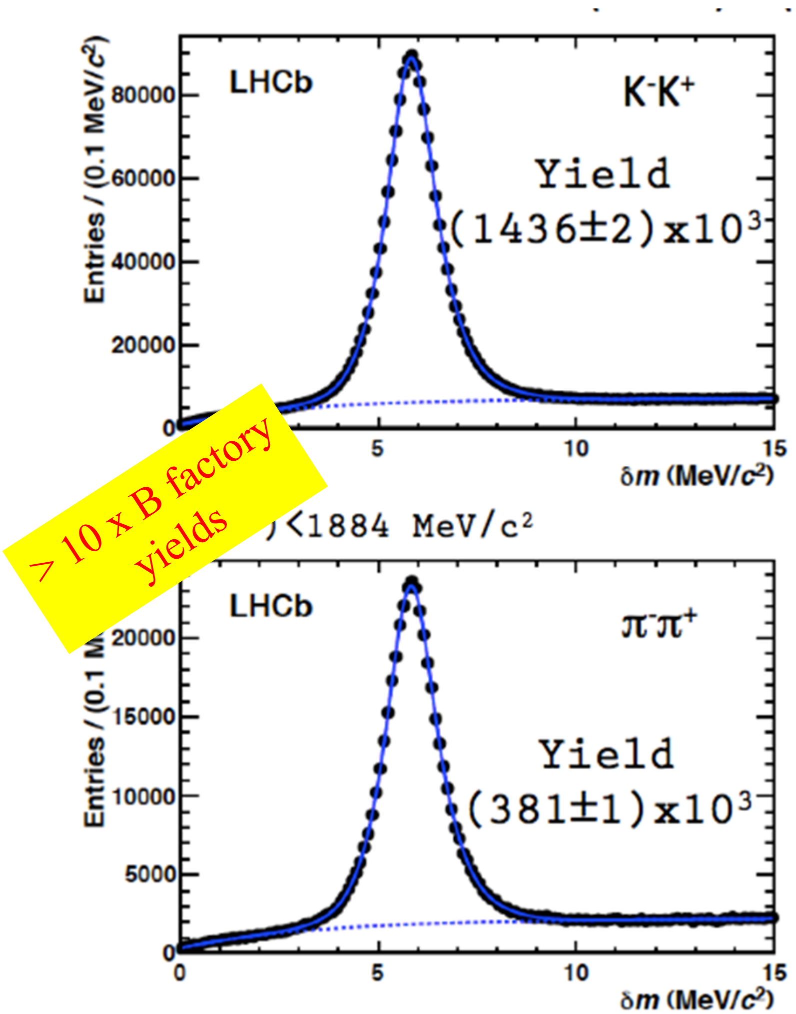


$$\Delta A_{CP} \equiv A_{raw}(KK) - A_{raw}(\pi\pi) = A_{CP}(KK) - A_{CP}(\pi\pi)$$

In the difference A(KK)-A($\pi\pi$) the production and the π_{soft} asymmetries cancel (at 1st order)

In first approximation, measuring ΔA_{CP} at LHCb, means measuring direct CPV

$$\Delta A_{CP} = \left[a_{CP}^{\rm dir}(K^-K^+) - a_{CP}^{\rm dir}(\pi^-\pi^+)\right]$$



The analysis (~0.6 /fb) takes into account
- Pt spectrum of π_{soft}
- η and L/R detector acceptance
- magnet polarities swaps
- run blocks, etc..

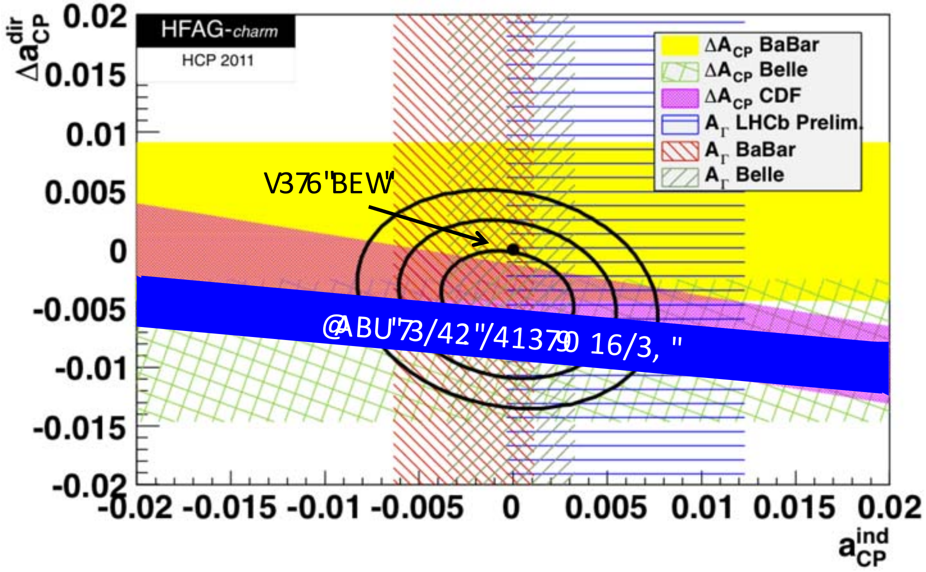
Fit of DACP value ompat in 216 “kinematic” bins
→ 3.5 s effect (ible with HFAG data) c

$$\Delta A_{CP} = [-0.82 \pm 0.21(\text{stat.}) \pm 0.11(\text{sys.})]\,\%$$

Significance: 3.5σ

Next steps:
- Update analysis with 1/fb
- Complementary analysis with B→D semileptonic tagging
- Search for CPV in other charm decays

CPV in charm: theoretical framework



- CP violation in charm is (was) expected to be very small: O(0.1%) or less

Grossman et al. [PRD 75, 036008 (2007)]
“ If direct CP violation is at the 1% level, its likely source is new physics. “

Grossman et al. [PRL 103, 071602 (2009)]
“ … any signal of CP violation requires new ph

- LHCb result generated a lot of theoretical interest

A deeper analysis of current constraints (eg D mixing) suggests less strong statements

Isidori et al. (arXiv:1111.4987)
“ … a sufficient QCD enhancement of penguin matrix element cannot be excluded …”

Brod et al. (arXiv:1111.5000)
“ … it is plausible that the standard model accounts for the measured value of ΔA_{CP} …”

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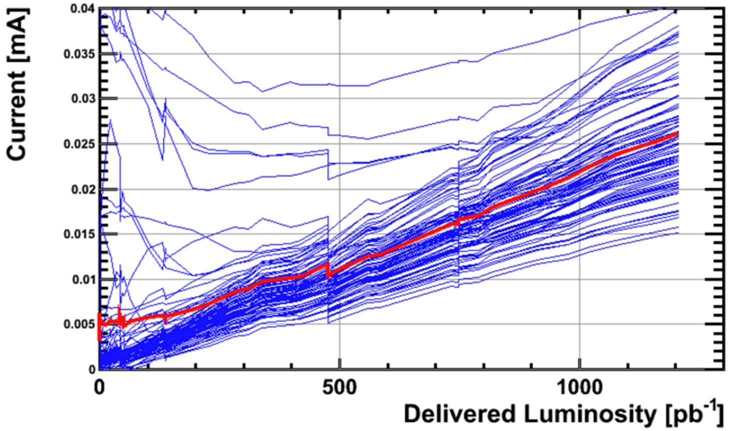
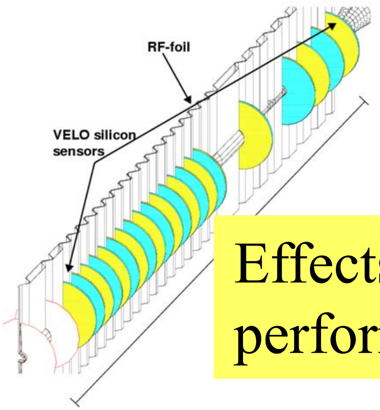
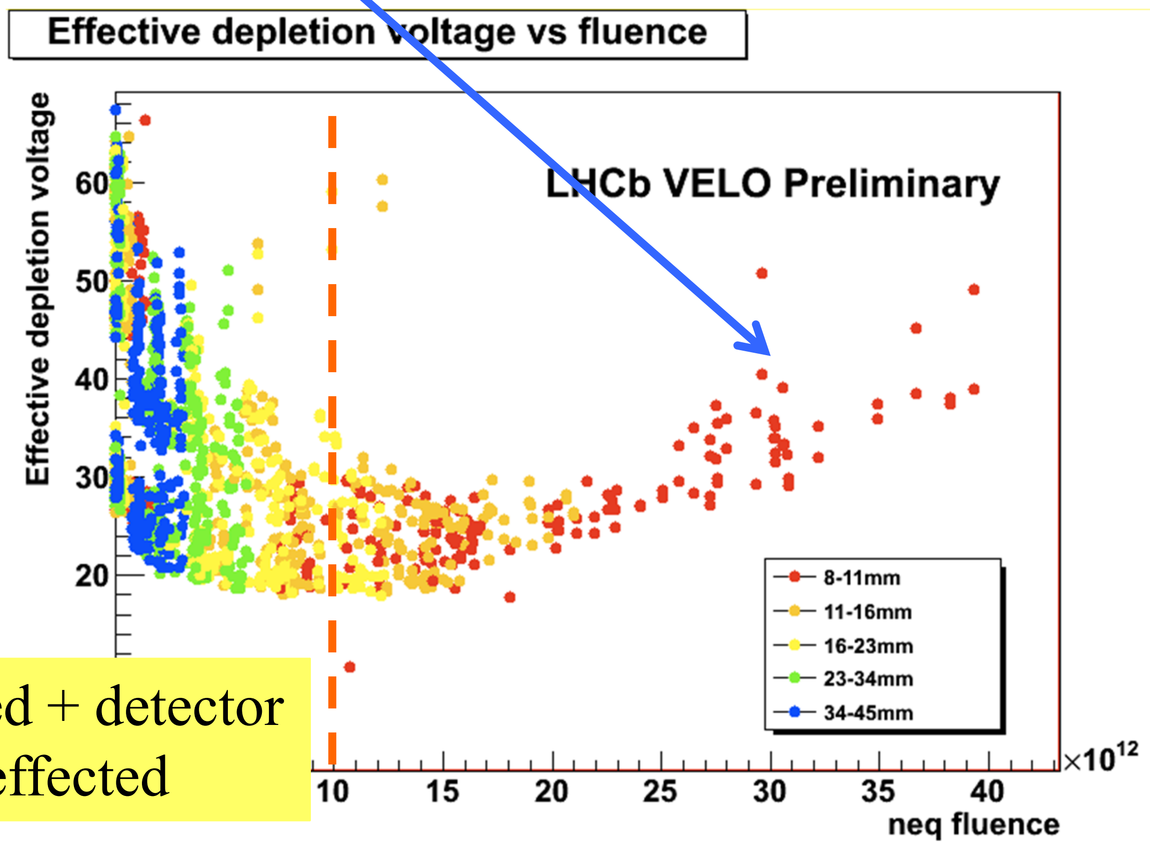
Radiation Effects

Radiation effects in Velo

Doses of up to 0.6 x 10^{14} 1 Mev n_{eq}
Mean current increases of 22 µA per fb^{-1}
Clear type inversion at inner sensor edge for sensors close to interaction point

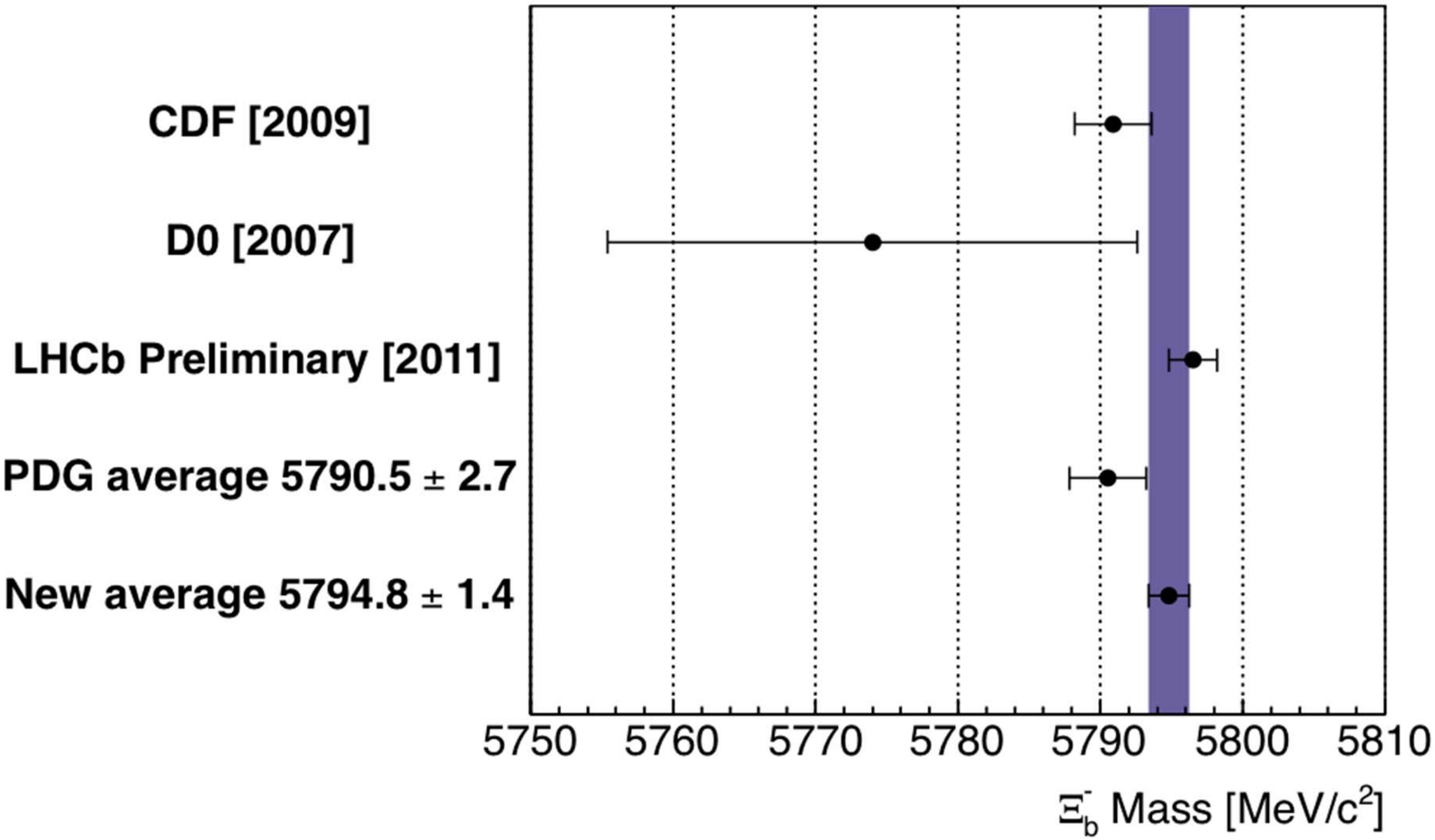






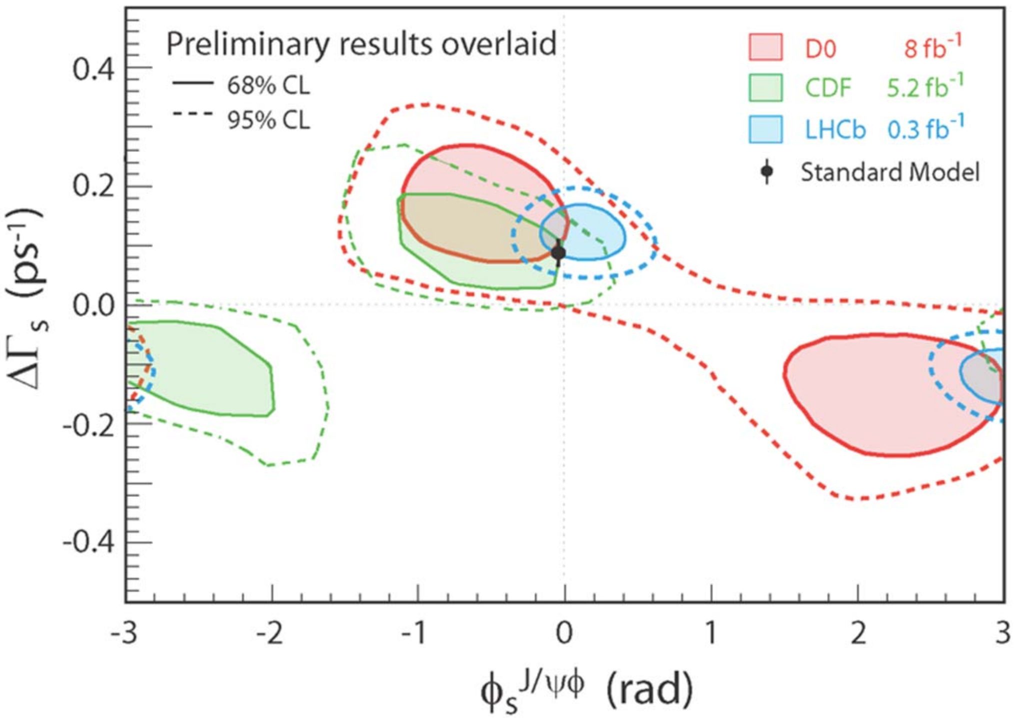
Effects as expected + detector performance not effected

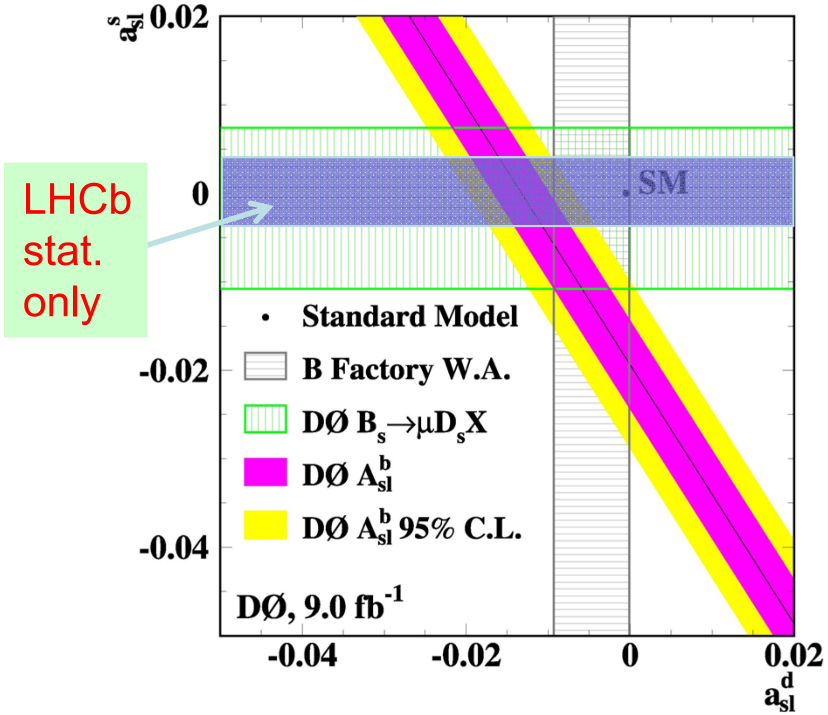
Ξ_b mass



CDF [2009]
D0 [2007]
LHCb Preliminary [2011]
PDG average 5790.5 ± 2.7
New average 5794.8 ± 1.4
5750
5760
5770
5780
5790
5800
5810
Ξ_b^- Mass [MeV/c^2]

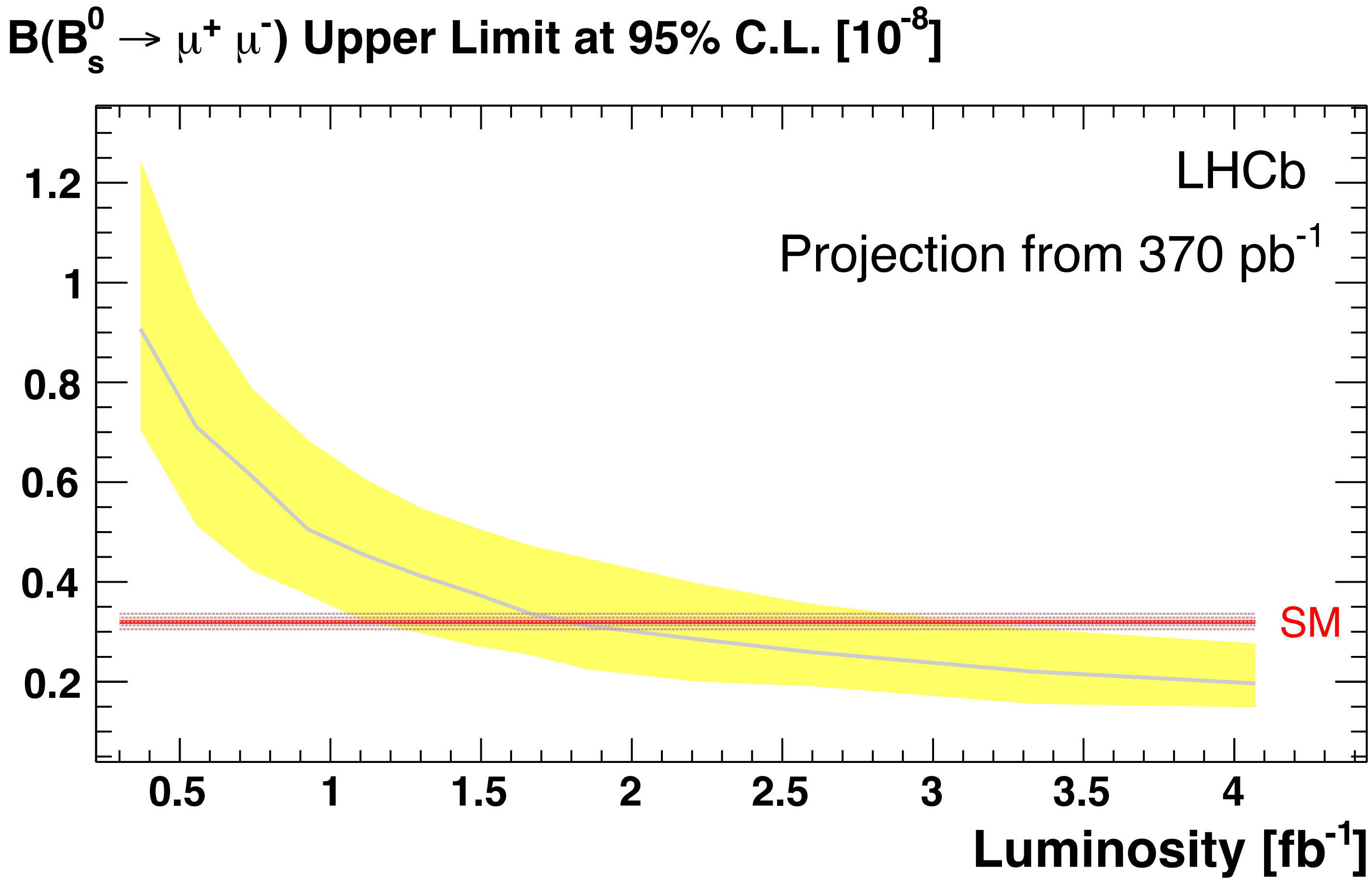
Status and perspectives of CPV measurements





- Previous tensions with SM observed by CDF and D0 not confirmed
- A_{SL} result from D0 to be tested soon by LHCb (with B_s ➔ $D_s(\phi\pi)\ \mu\nu\ X$)

$B_s \rightarrow \mu\,\mu$: Prospects



Exclusion background only case

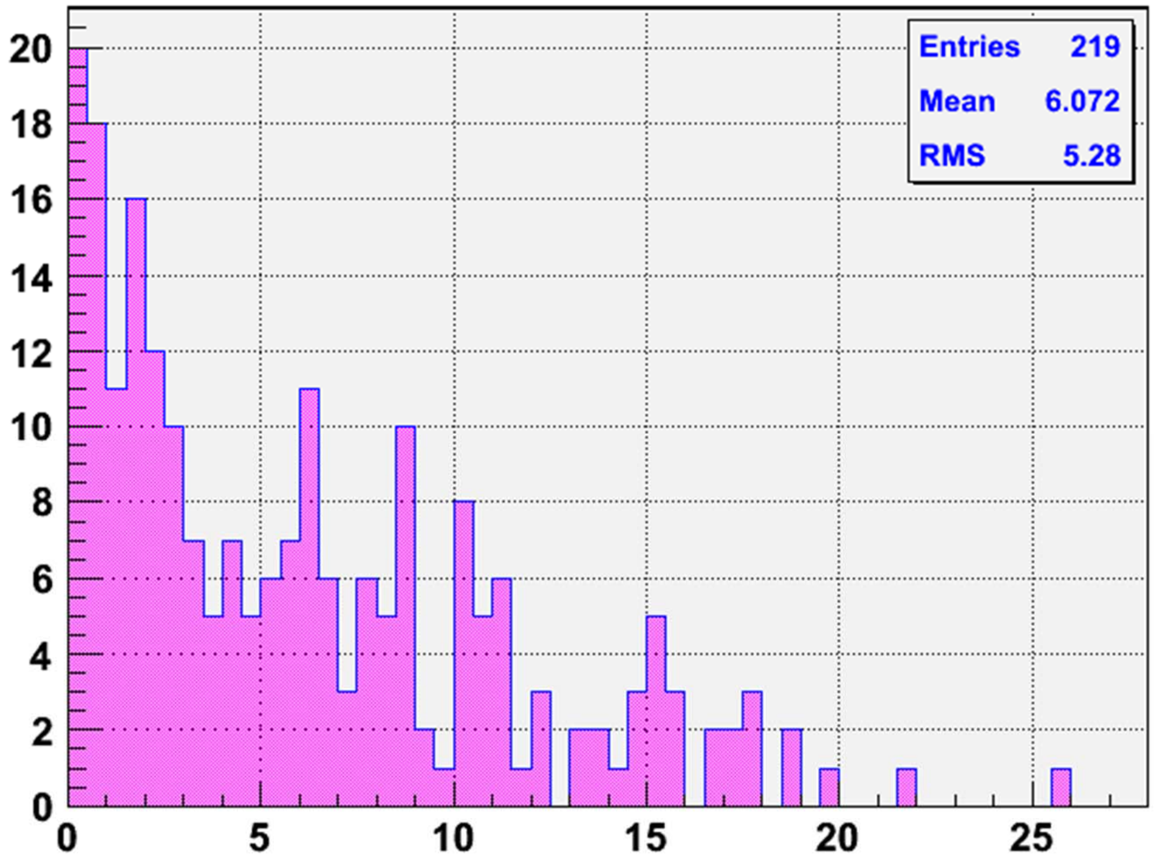
Time in beam

Luminosity ramp>$_{2011}$ ~ 20min

210 fills * 20min / 0.46 x 10^7 sec = 5.5%

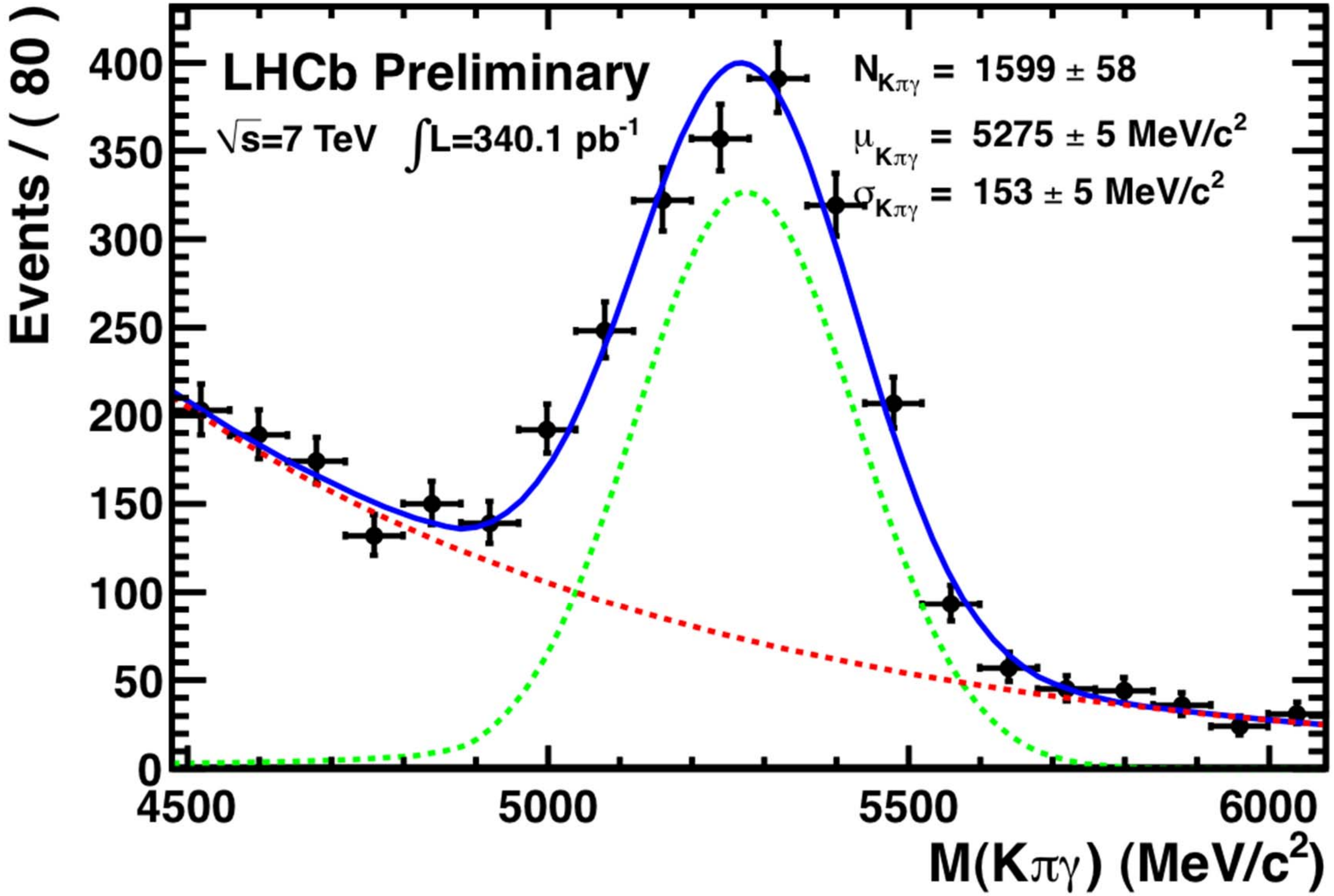
➔Heavy luminosity inefficiency with short fills!

➔Currently ~15min, continue to improve

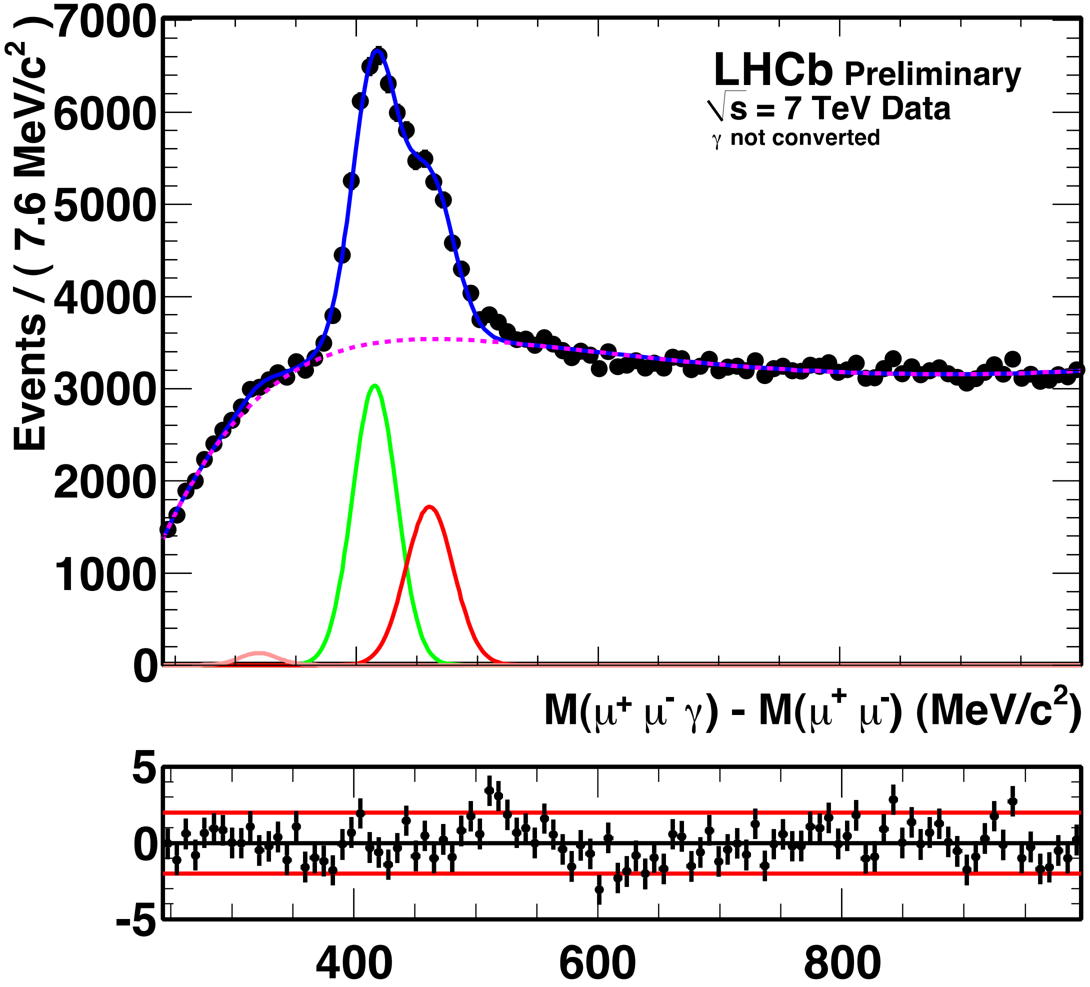


Time in Beam/hr

$B_d \rightarrow K^*\gamma$



Quarkonia: χ_c



CP violation in charm

Effect	Uncertainty
Fiducial cut	0.01%
Peaking background asymmetry	0.04%
Fit procedure	0.08%
Multiple candidates	0.06%
Kinematic binning	0.02%
Total	0.11%

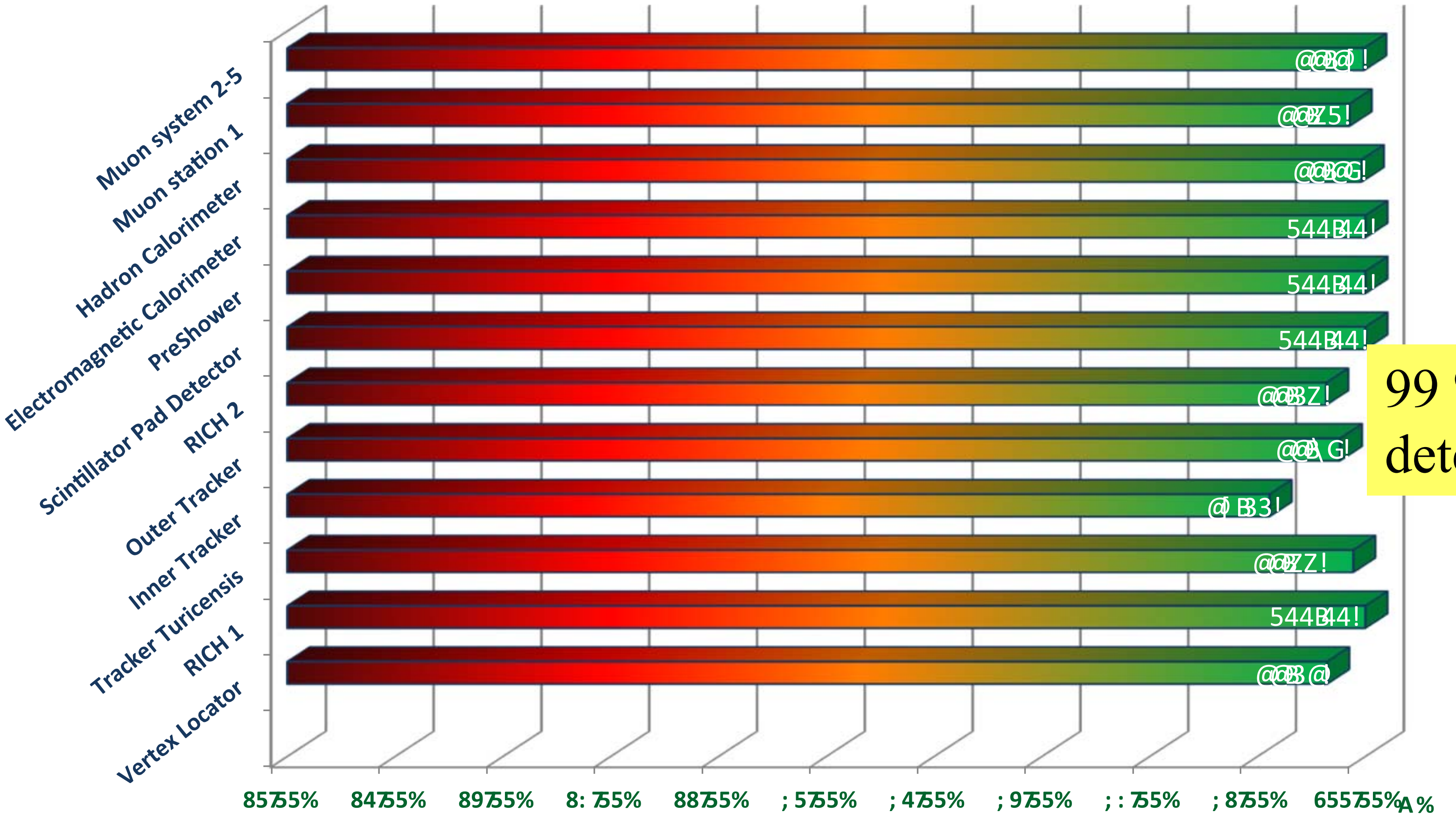
Systematics

2012 Running

Aim to collect at least 1.5 fb^{-1}: Realistic goal despite shorter running period

- 8 TeV then ~10-15% increase in b-bbar cross-section
- Run at $4 \times 10^{32}\ cm^{-2}s^{-1}$ with luminosity levelling
- Data with both magnet polarities: helped by move to vertical external crossing angle
- Aim to improve the running efficiency .
    - Reduced deadtime, improved HLT farm performance
- Long fills help us (takes ~ 15 minutes to ramp to full luminosity)

Detector Status



99 % working detector channels

Repair work scheduled during shutdown to return to 100 % efficiency

Detector Efficiency