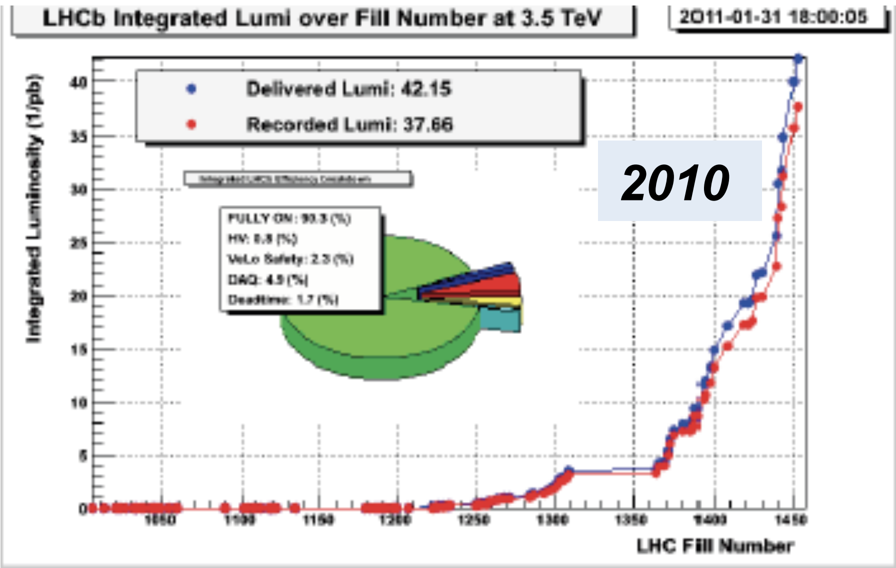
Status of the LHCb experiment

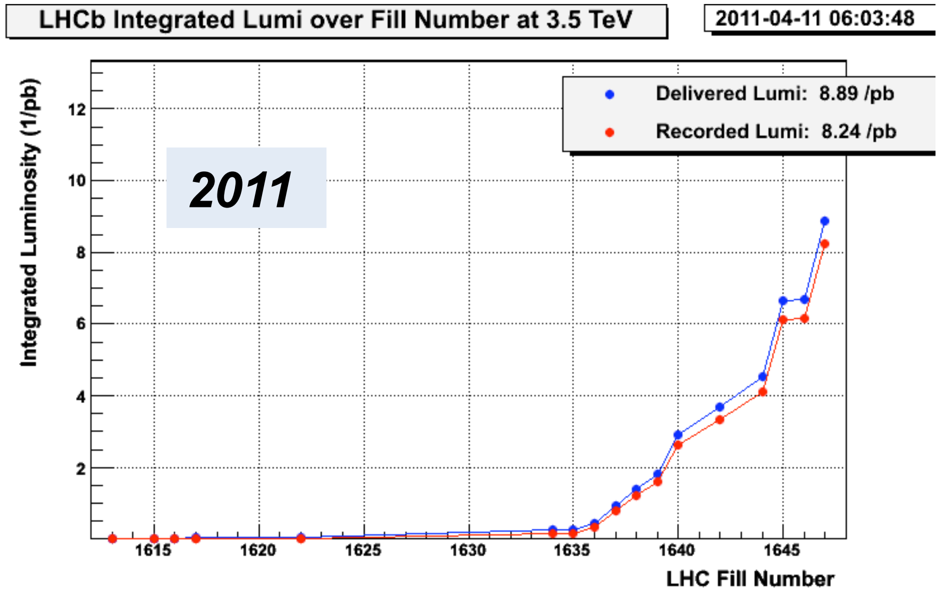
Andrey Golutvin (Imperial College & ITEP & CERN)
on behalf of the LHCb Collaboration

Outline:

- ***Subsystems***
- ***LHCb operations***
  - ***At the Pit***
  - ***Data processing & Computing***
- ***Detector performance***
- ***Physics results from 2010***
- ***Preparation of the LHCb upgrade***
- ***Financial and collaboration matters***

LHCb operation



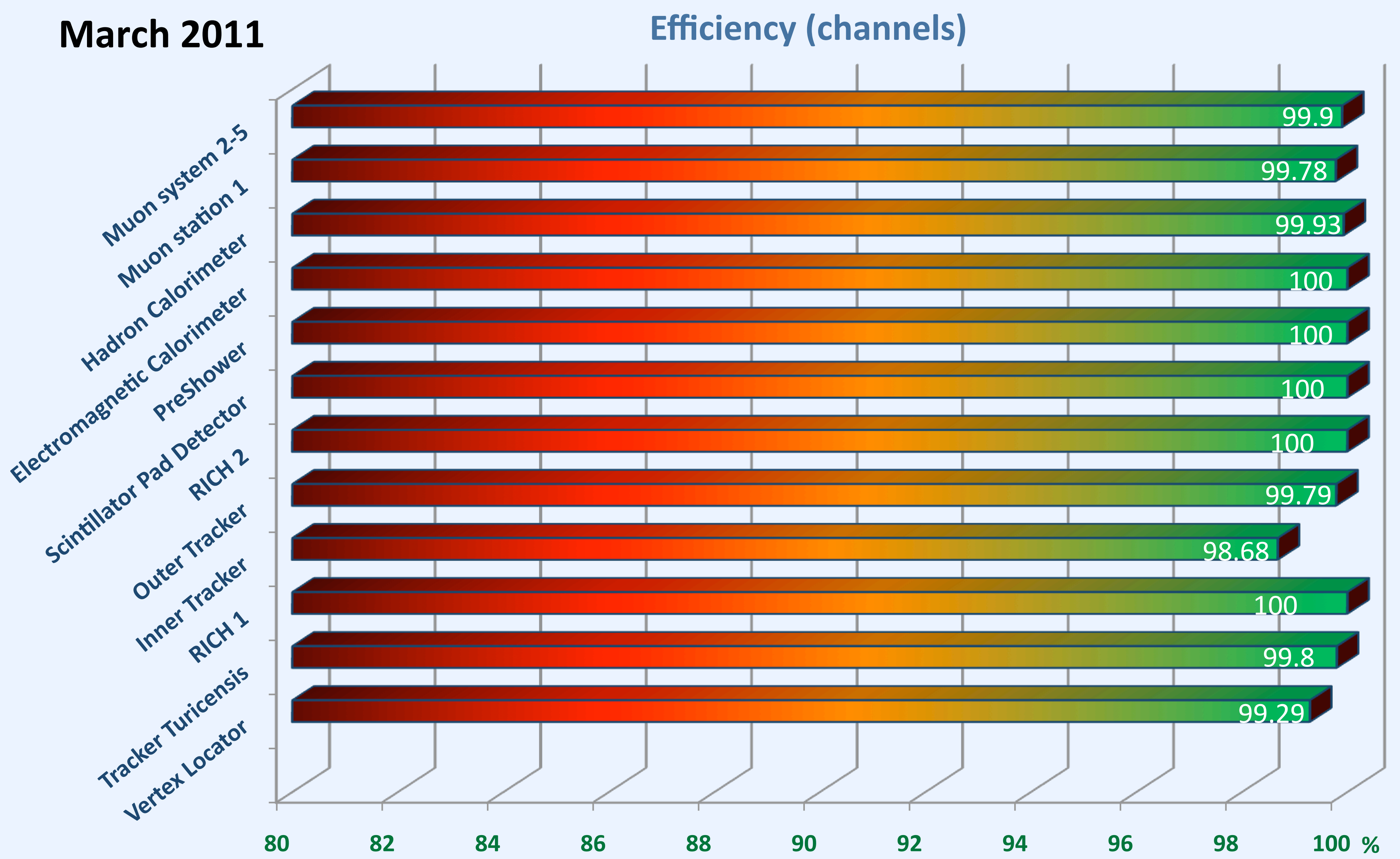


LHCb limitations: ✓ *limit the number of visible pp-collisions/bunch crossing to μ_{max} ~ 2 (2.5 at start-up)*

✓ *limit the peak luminosity to L ~ $3 \cdot 10^{32}$ cm^{-2} s^{-1}*

- → *need to increase number of bunches to ≥700 to reach "nominal" LHCb luminosity*
- → ***luminosity leveling essential to keep μ and lumi to optimal value***
- → *will run with flat luminosity throughout most of the year, so cannot "catch-up" on integrated luminosity during the year*
- → *need to continue to increase number of bunches (even at nominal lumi) to reduce μ*
- → *expect **≥200 pb^{-1} by end of June and ~1 fb^{-1} by the end of 2011***

Detector status



Note that for the RICHes the "channels" are given in HPDs

Activities during 2010 / 2011 Technical Stop

- ***Silicon Tracker**: Exchange and repair of modules with broken bonds*
- ***RICH**: Replacement of ~7% of HPDs*
- ***Outer Tracker**: Repair FE, disconnect a few broken channels*
- ***CALO**: Replacement of a few PMTs*
- ***MUON**: Replacement of a few non-fully operational chambers*

Overall very small changes in the detector

Major improvement of the HLT farm

HLT: Addition of 100 boxes (400 nodes)
for a total of 50 subfarms × 27 nodes
× (8 to 20) HLT tasks running
= 24600 HLT tasks !

A lot of work also on infrastructure, maintenance and safety

Detector related concerns & Plans

- ❑ *Breaking (at a low frequency) VCSELs*
  → *Order new VCSELs of a different production type and test these under radiation*

- ❑ *High current in some Tracker Turicensis modules*
  → *Careful monitoring of the problem*
  → *Continue further investigation in situ and on a test module*

- ❑ *Uncertainty in the long term behavior of the gain loss in the Outer Tracker remains main concern*
  → *Periodic threshold / HV scans in order to measure 2D gain maps and monitor aging effects*

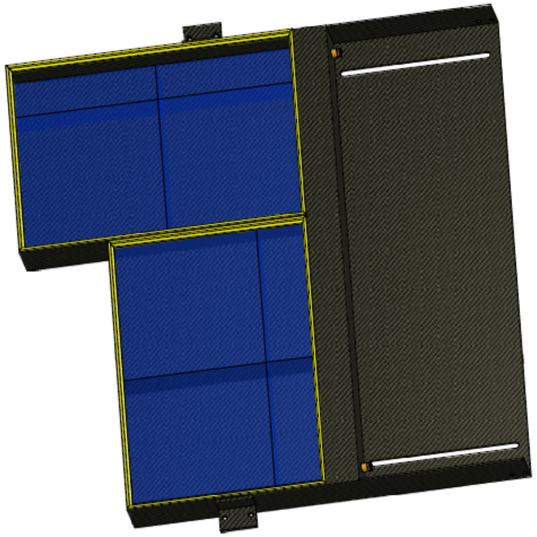
- ❑ *Design and construction of the aerogel box*

- ❑ *Complete the VELO spare during first half of 2011*

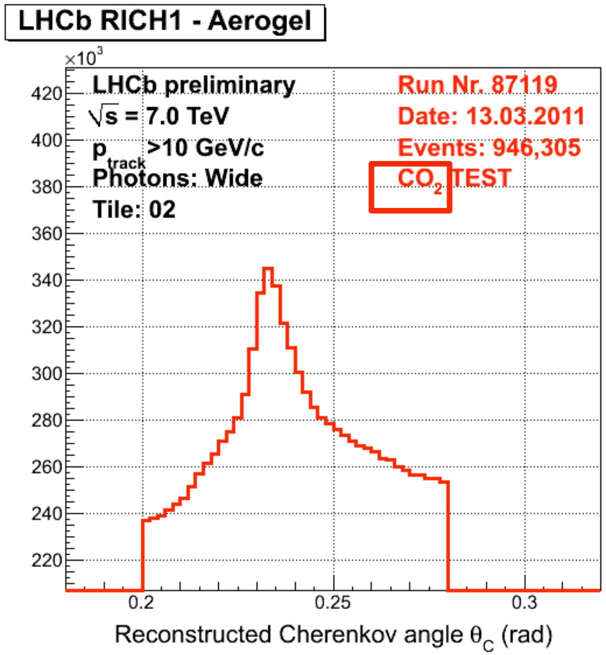
Status of Aerogel (RICH 1)

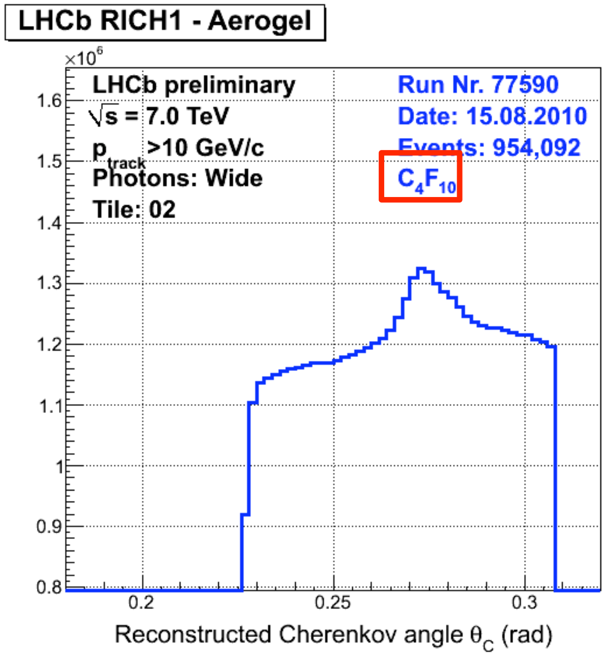
The Box:

- *Company found that promised to respect the specification*
- *The same for the O-ring to be placed between the window and the carbon fiber box*
- *A couple of month to receive the prototype*
- *Pressure tests for this box will then follow*
- *Engineering Review envisaged for May 2011*



Very fresh results: Data taken with CO_2 as radiator:





Alignment for the tracking not yet done

→ *can not give numbers now, but improvement clearly visible !*

Operations at the LHCb Pit

- ***LHCb detector is fully operational and in good shape***

- *LHCb detector is efficiently operated by only two people on duty (complemented by weekly experts-on-call for each subsystem).*
  Weekly appointed "Run Chief" oversees the global strategy for data taking.
  LHCb central shifter situation is acceptable but requires attention during the year

- *High Level Trigger framework completely revised to improve reliability and speed*

- ***"Luminosity leveling" is vital for LHCb in order to maximize integrated luminosity collected in the optimal conditions.***
  → Highest priority is given to its commissioning
  Looks very encouraging !

Data Processing

- *A total of 155 TB of raw data collected in 2010*

- *Reconstruction and stripping of raw data done at Tier1 sites (50% user jobs, 25% simulation, 25% reconstruction)*
  The CPU usage efficiency – 85% at Tier1 and 90% at Tier2

- *Several reconstruction and stripping cycles (more than foreseen in steady state)*

- *Computing model has been updated to accommodate changing running conditions. The average event sizes increased by 60% and the trigger output rate by 50%*

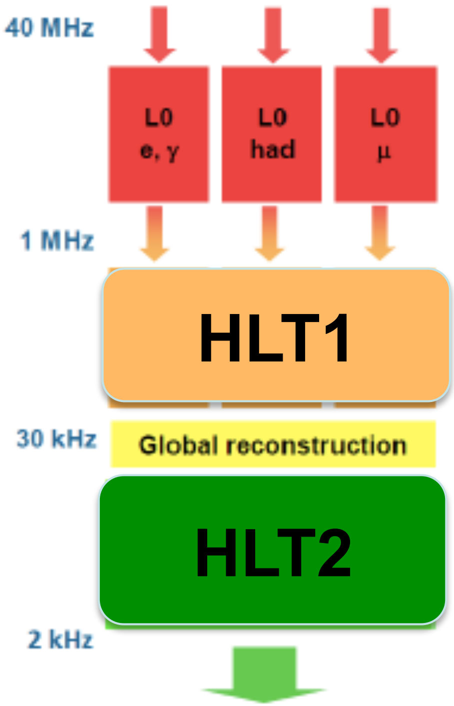
Shortfall in CPU and disk space resources in 2011 / 2012
→ Delay in processing
→ Require additional resources in 2012, in particular disk space

Detector performance

LHCb detector is ready for the core measurements in 2011 !

- *Flexible and efficient trigger*
- *Vertex and Impact Parameter (IP) resolution*
- *Tracking & PID*
- *Proper time resolution*
- *Flavour tagging*

Trigger



Physics analysis

L0

Trigger efficiencies very close to expectations

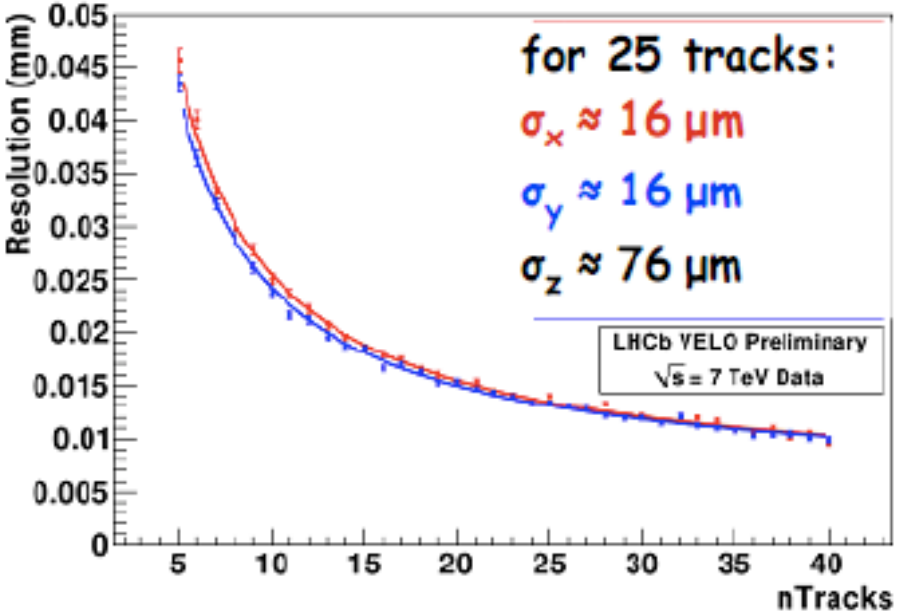
Trigger efficiencies L0xHLT1 determined on data using the tag-and-probe methods:

	Muon trigger (J/ψ)	Hadron trigger (D^0)
Data	94.9±0.2%	60±4%
MC	93.3±0.2%	66%

LHCb trigger is fully functional and was capable to cope with harsh running conditions in 2010

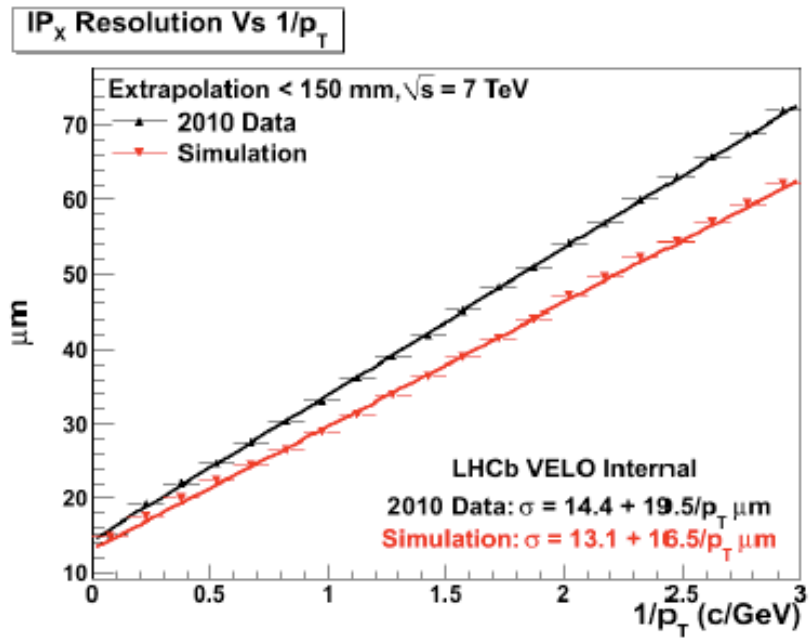
The extension of LHCb physics programme to accommodate charm physics requires higher trigger output rate of 3 kHz

Primary Vertex (PV) & Impact Parameter (IP) resolution



Primary vertex resolution:
~ 15 (75) µm in transversal
(longitudinal plane)

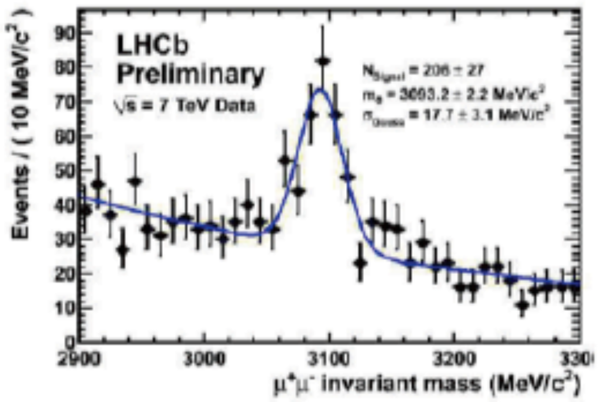
Best IP resolution ~15 µm



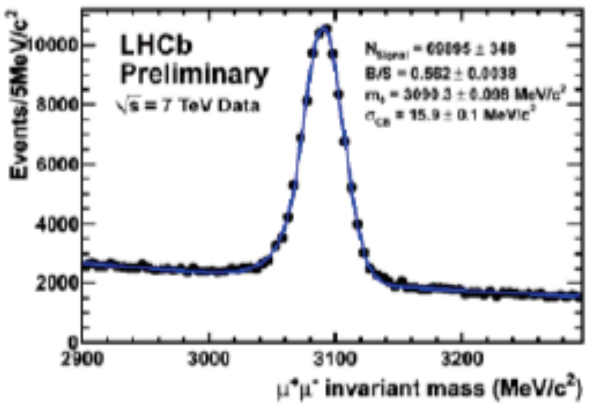
Tracking: excellent mass resolution demonstrated

Evolution of $J/\psi \rightarrow \mu^+\mu^-$ mass resolution with time (MC ~ 12 MeV/c^2)

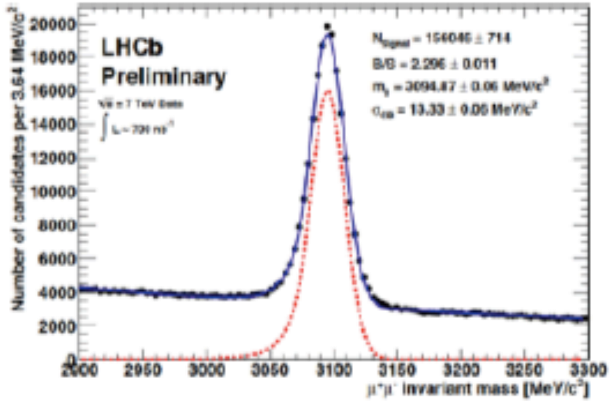
May: $\sigma \sim 18$ MeV/c^2



August: $\sigma \sim 16$ MeV/c^2

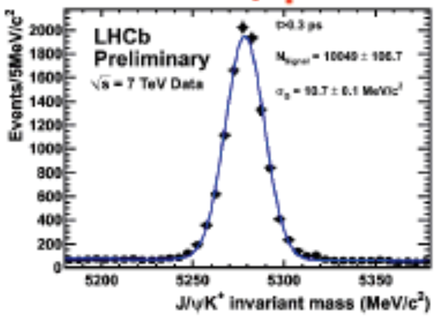


November: $\sigma \sim 13$ MeV/c^2



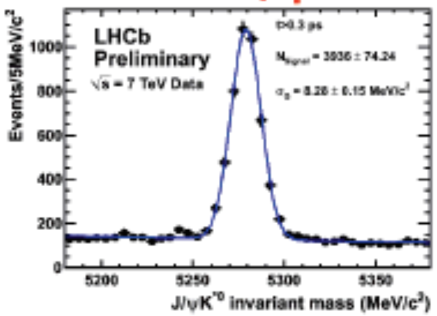
Different B hadron species in $J/\psi X$ final states

$B^+ \rightarrow J/\psi K^+$



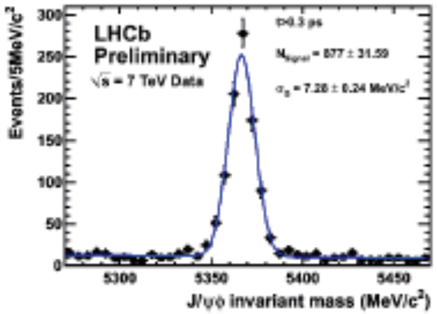
σ~11 MeV/c^2

$B^0 \rightarrow J/\psi K^{*0}$



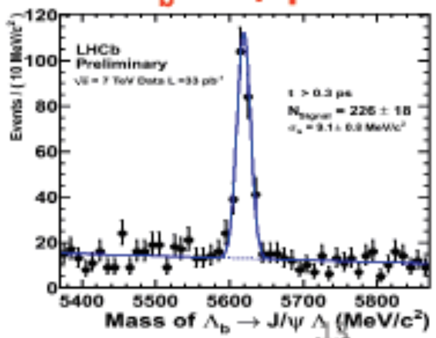
σ~8 MeV/c^2

$B_s \rightarrow J/\psi\phi$



σ~7 MeV/c^2

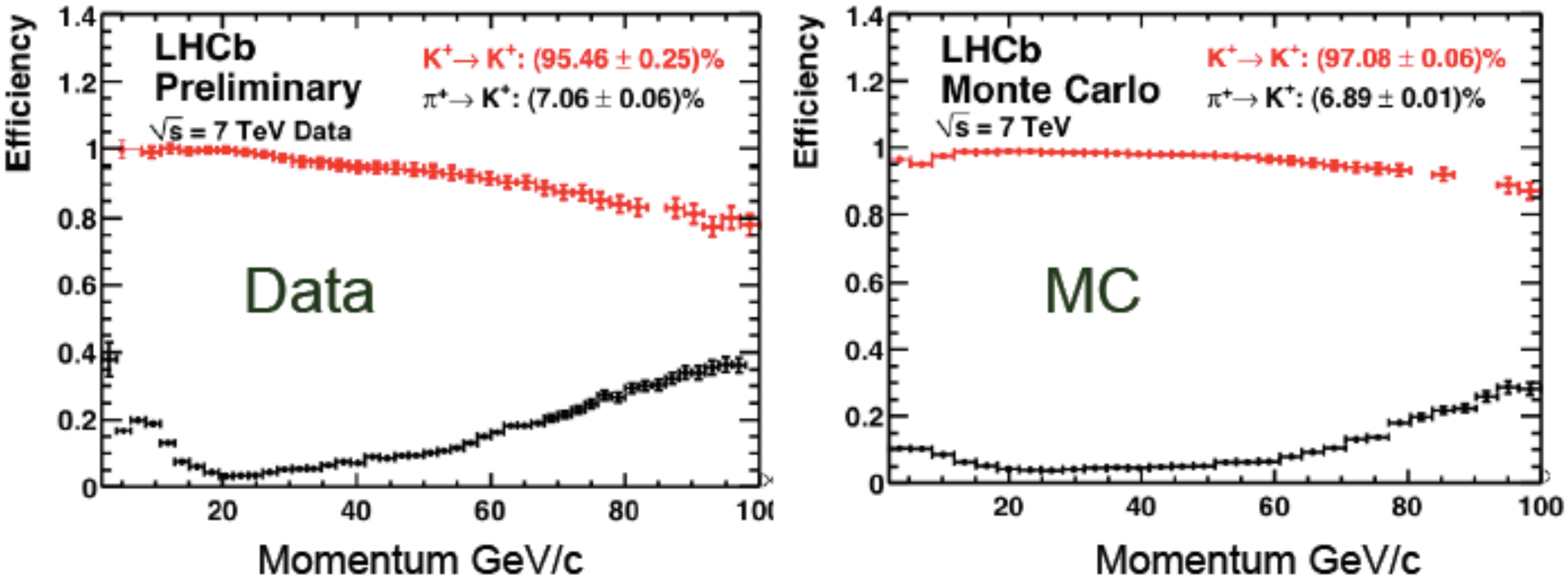
$\Lambda_b \rightarrow J/\psi\Lambda$



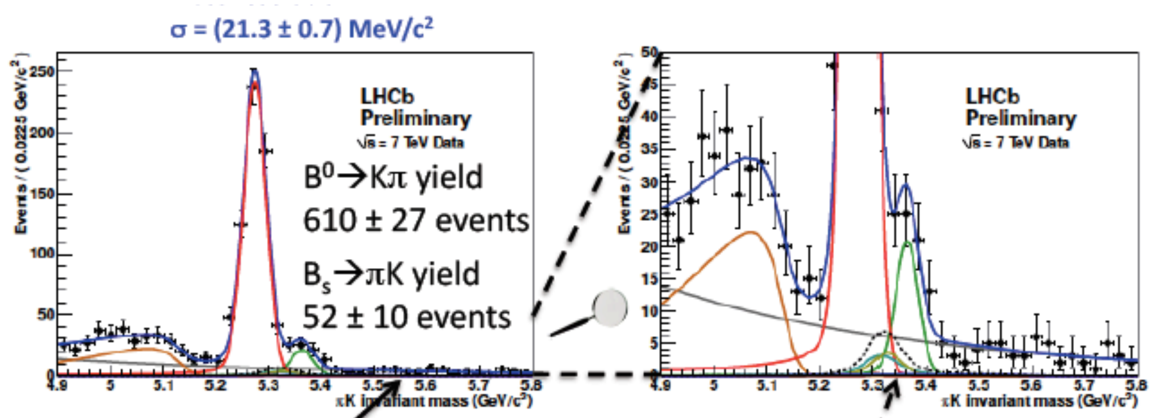
σ~9 MeV/c^2

Signals are as clean as at the e^+e^- - machines !!!

PID with RICH



Clean reconstruction of various hadronic decay channels of $D_{(s)}$ and $B_{(s)}$ mesons



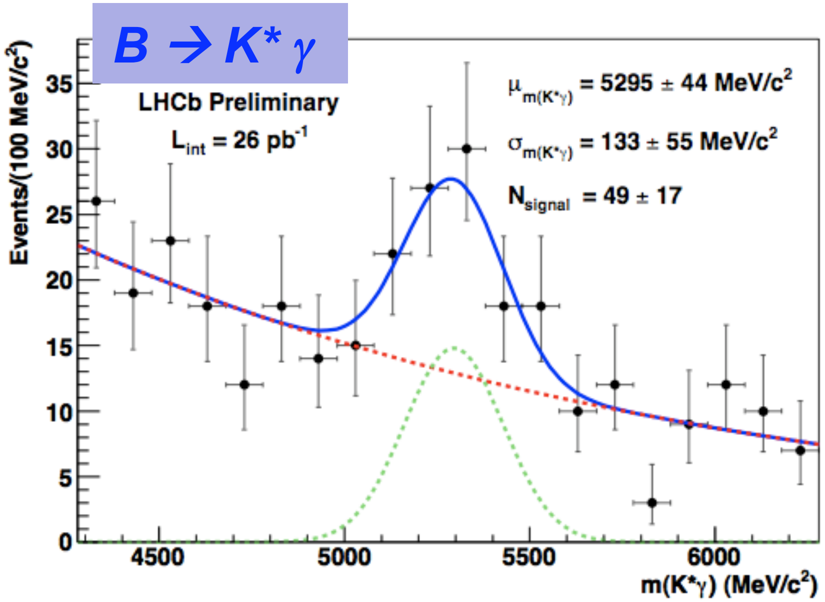
Tighter kinematic and PID selection cuts provide strong suppression of combinatorial background events

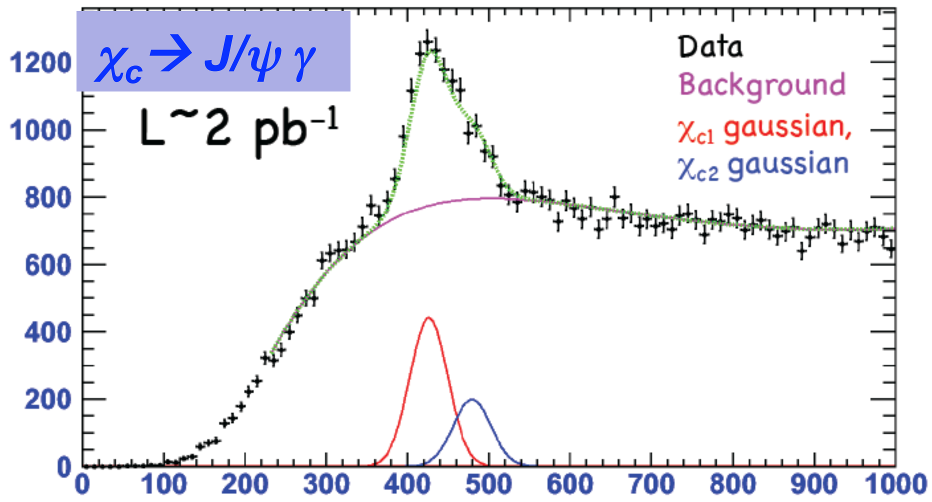
$B^0 \to \pi\pi$
$B_s \to KK$

Dashed curve is basically the sum of these two modes: their lineshapes are fixed from MC

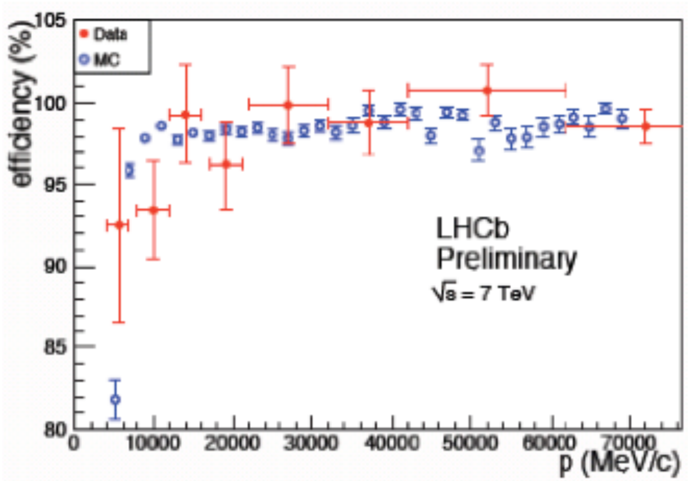
PID with Calorimeter and MUON

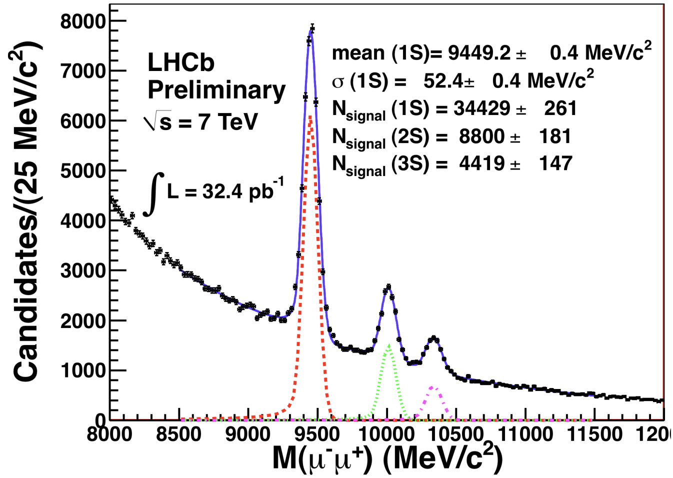
Photon PID: Important for B,D reconstruction and spectroscopy studies



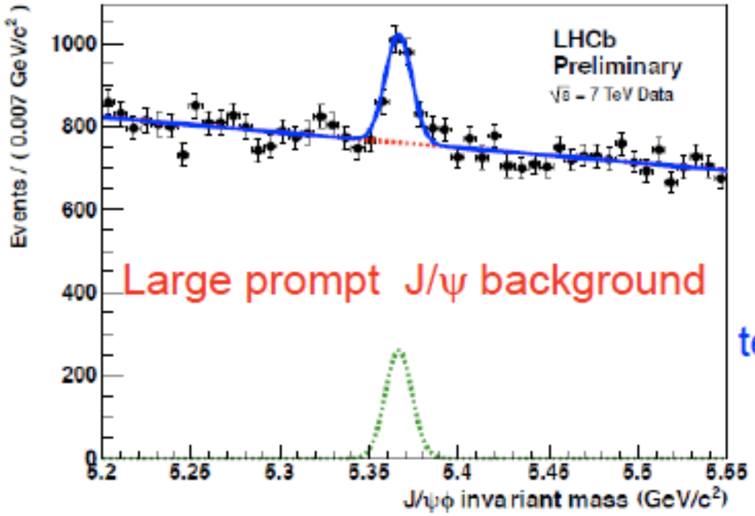


Excellent Muon PID is vital for the LHCb key measurements with dimuons

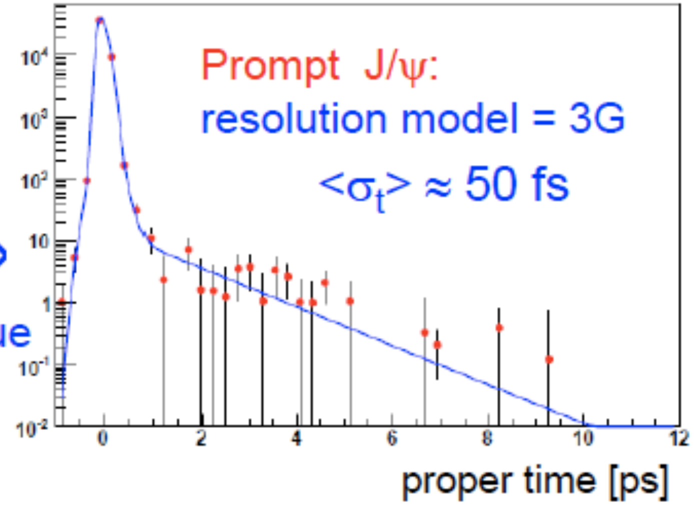




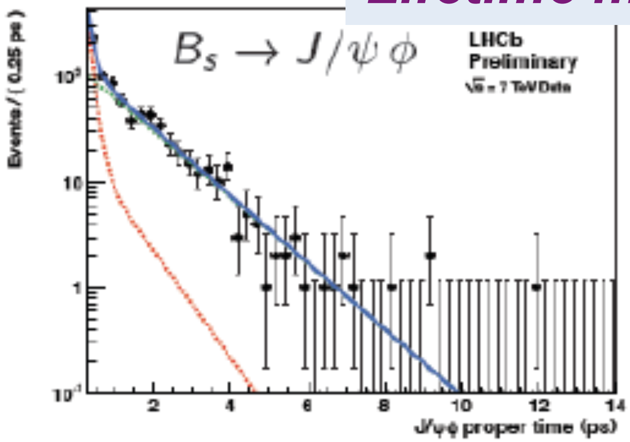
Proper time resolution

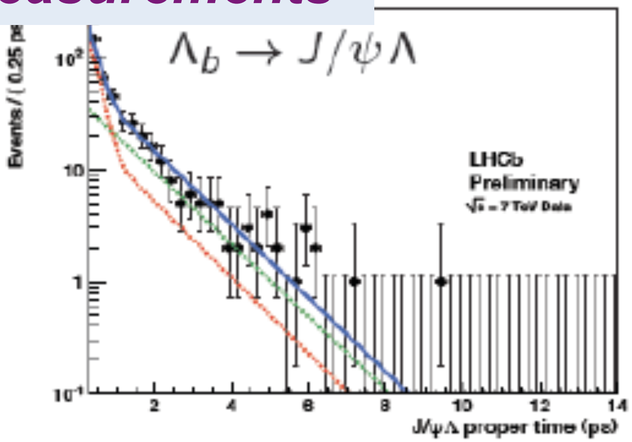


sPlot technique



Lifetime measurements





Decay channel	Yield	LHCb result τ[ps]*	PDG τ[ps]
$B^+ \to J/\psi K^+$	6741 ± 85	$1.689 \pm 0.022_{stat.} \pm 0.047_{syst.}$	1.638 ± 0.011
$B^0 \to J/\psi K^{*0}$	2668 ± 58	$1.512 \pm 0.032_{stat.} \pm 0.042_{syst.}$	1.5252 ± 0.009
$B^0 \to J/\psi K^0_S$	838 ± 31	$1.558 \pm 0.056_{stat.} \pm 0.022_{syst.}$	1.525 ± 0.009
$B^0_s \to J/\psi\phi$	570 ± 24	$1.447 \pm 0.064_{stat.} \pm 0.056_{syst.}$	1.477 ± 0.046
$\Lambda_b \to J/\psi\Lambda$	187 ± 16	$1.353 \pm 0.108_{stat.} \pm 0.035_{syst.}$	$1.391^{+0.038}_{-0.037}$

Flavour Tagging (LHCb)

Same Side K tagger studies are in progress. Need larger data samples.

Performance measured on data

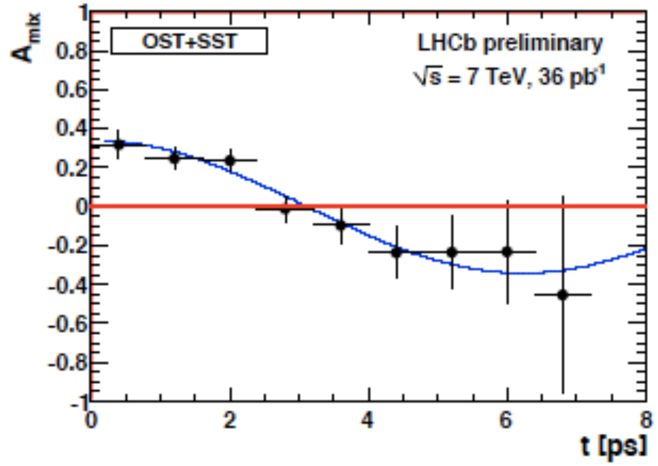
OS	ϵ_{tag} (%)	ω (%)	ϵ_{eff} (%)
$B^0 \to D^{*-}\mu^+\nu_\mu$	18.3±0.2	33.6±0.8	1.97±0.18
$B^+ \to J/\psi K^+$	15.4±0.3	32.2±1.2	1.97±0.31
$B^0 \to J/\psi K^{*0}$	15.8±0.7	30.0±6.6	2.52±0.82
SSπ+OS	**ϵ_{tag} (%)**	**ω (%)**	**ϵ_{eff} (%)**
$B^0 \to D^{*-}\mu^+\nu_\mu$	28.9±0.2	34.2±0.8	2.87±0.32
$B^+ \to J/\psi K^+$	23.0±0.5	33.9±1.1	2.38±0.33
$B^0 \to J/\psi K^{*0}$	26.1±0.9	33.6±5.1	2.82±0.87

$B_d^0 - \bar{B}_d^0$ oscillations

$$\Delta m_d = 0.499 \pm 0.032(\mathrm{stat}) \pm 0.003(\mathrm{sys})\ ps^{-1}$$

($\Delta m_d = 0.507 \pm 0.005\ ps^{-1}$ world average, PDG [1])

$B^0 \to D^-(K^+\pi^-\pi^-)\pi^+$ 6k (signal)

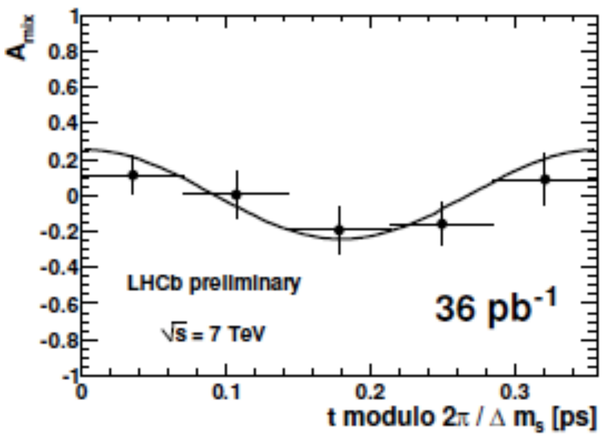


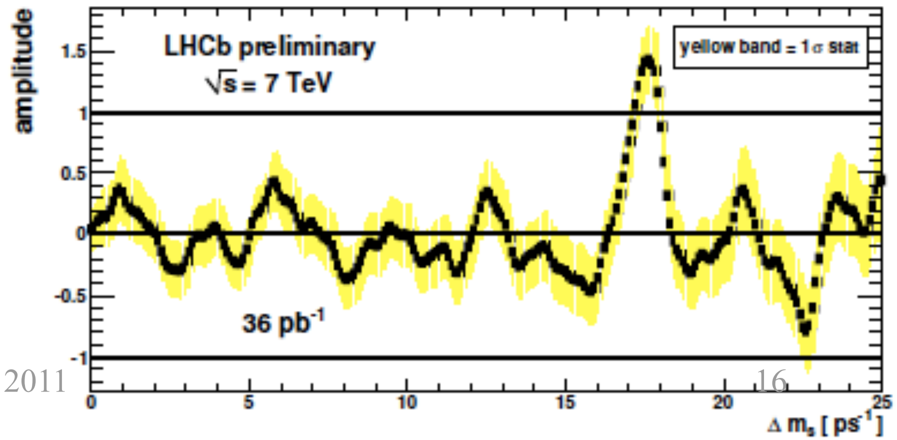
$B_s^0 - \bar{B}_s^0$ oscillations

$$\Delta m_s =^a 17.63 \pm 0.11(\mathrm{stat}) \pm 0.04(\mathrm{sys})\ ps^{-1}$$

($\Delta m_s = 17.77 \pm 0.10(\mathrm{stat}) \pm 0.07(\mathrm{sys})\ ps^{-1}$ CDF, 2006

asymmetry modulo $2\pi / \Delta m_s$





Physics results from 2010 Run

- ***Production studies***

- ***Core LHCb measurements***

  - B_s mixing phase

  - $B_s \rightarrow \mu\mu$

  - $B_d \rightarrow K^*\mu\mu$

  - Towards the measurement of the UT angle gamma (reconstruction of hadronic B decays)

  - CPV studies in charm sector

Production measurements

- *Many results reported on open b and c-production at LHC and exclusive b-hadron cross-sections (including B_c production). LHC luminosity is known to 3.5% accuracy.*
  First evidence for D^0 production asymmetry at LHC

  → ***Important testing ground for QCD calculations !***

- ***Cross-sections are large as expected (charm > 20 × beauty)***
  → ***More confidence to LHCb projections in heavy flavour physics***

- *Extensive studies of J/ψ, Upsilon and other quarkonia started; polarization studies are still to come…*
  Double J/ψ production observed by LHCb.
  → ***Understanding of onia production mechanism in progress !***

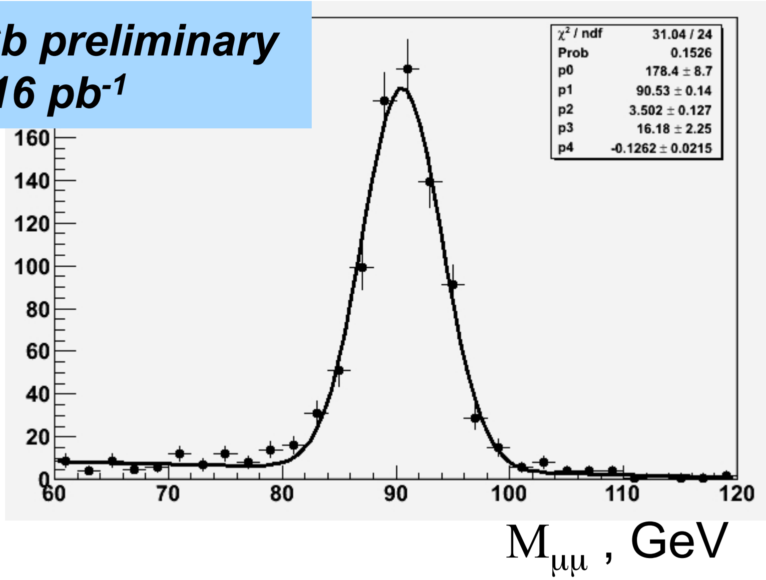
- ***Very interesting possibilities to study W/Z in the forward direction***

  Experiments are requested to provide data in the ATLAS / CMS / LHCb rapidity overlapping region

Z & W in the forward direction

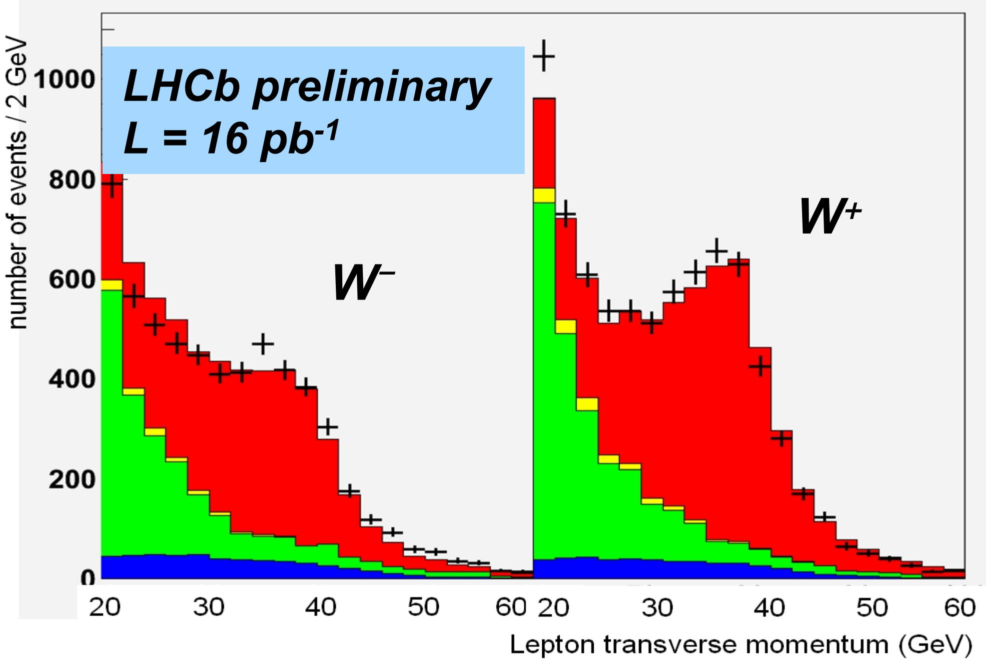
Z: 2 μ, each with P_t > 20 GeV/c

LHCb preliminary
L = 16 pb^{-1}



W: single isolated μ with P_t > 20 GeV/c & small P_t opposite

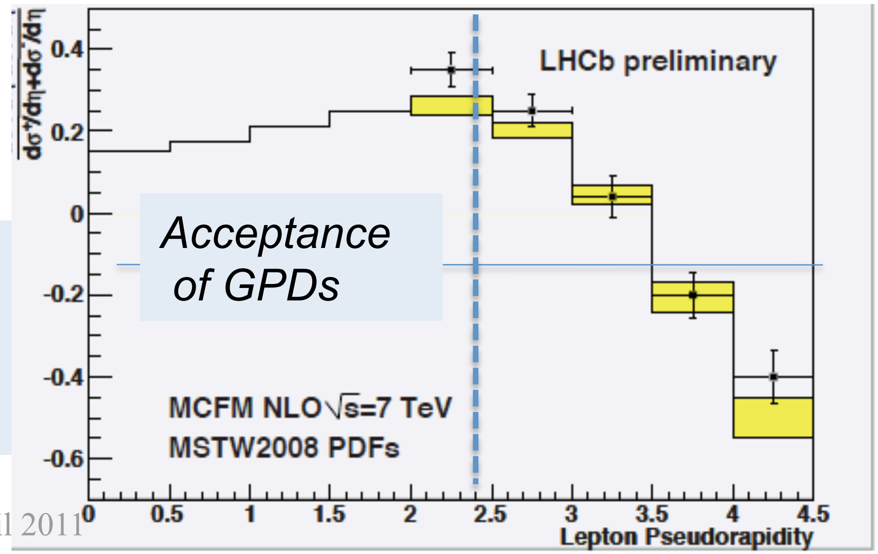
LHCb preliminary
L = 16 pb^{-1}



- Measurement of A_{FB} in future
  In LHCb acceptance Z production occurs predominantly through collision of valence and sea quark, so axis of A_{FB} measurement is well defined, and dilution low.

- Knowledge of PDF
  Will help to improve accuracy on A_{FB} and M_W.
  LHCb is complementary to GPDs and may provide vital input with high statistics data samples.

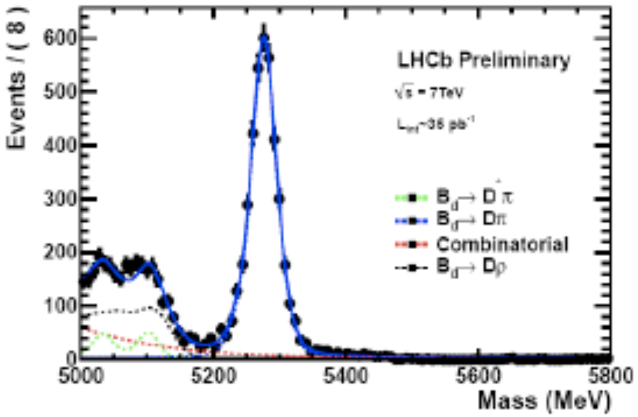
Switch-over in W⁺/W⁻ in LHCb acceptance

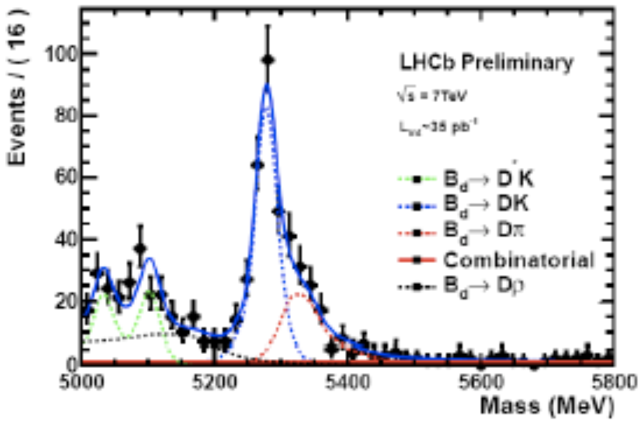


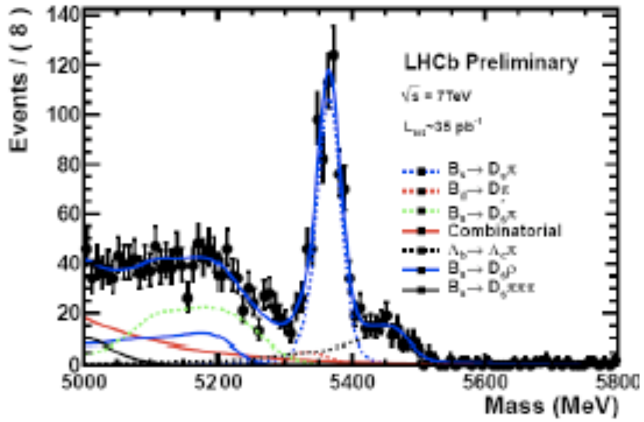
Measurements of f_d / f_s fragmentation fraction (LHCb)

In particular important to measure BR($B_s \rightarrow \mu\mu$)

$N(B^0 \rightarrow D^-\pi^+) = 4109 \pm 75$	$N(B^0 \rightarrow D^-K^+) = 253 \pm 21$	$N(B_s^0 \rightarrow D_s^-\pi^+) = 670 \pm 34$







- fragmentation fractions, f_s/f_d:
  - $B^0 \rightarrow D^-K^+$: $f_s/f_d = 0.242 \pm 0.024 \pm 0.018 \pm 0.016$
  - $B^0 \rightarrow D^-\pi^+$: $f_s/f_d = 0.249 \pm 0.013 \pm 0.020 \pm 0.025$
  - $B^0 \rightarrow D^-h^+$: $f_s/f_d = 0.245 \pm 0.017 \pm 0.018 \pm 0.018$
  - $B^0 \rightarrow D^-X\mu^+ \nu$: $f_s/f_d = 0.260 \pm 0.008 \pm 0.026$

(stat) (sys) (theo)

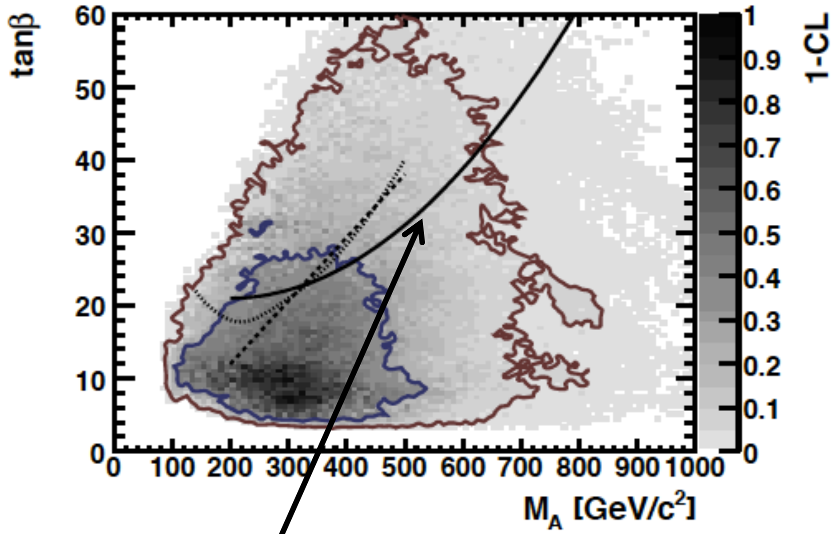
Search for $B_s \rightarrow \mu\mu$

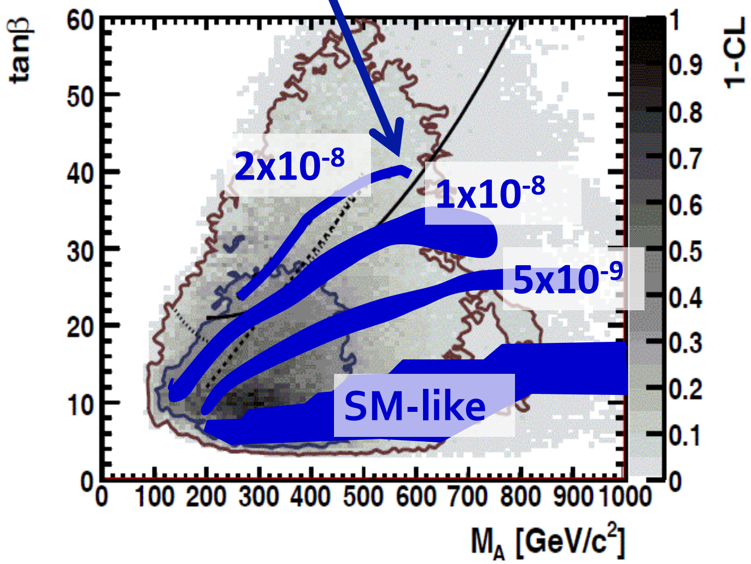
- Super rare decay in SM with well predicted $BR(B_s \rightarrow \mu\mu) = (3.2\pm0.2)\times10^{-9}$
  $BR(B_d \rightarrow \mu\mu) = (1.1\pm0.1)\times10^{-10}$
  (Buras et al., arXiv:1007.5291)

- Sensitive to NP, in particular new scalars
  In MSSM: $BR \propto \tan^6\beta / M^4_A$

Regions compatible with $BR(B_s \rightarrow \mu\mu) = 2x10^{-8}, 1x10^{-8}, 5x10^{-9}$ and SM

LHCb calculation using F. Mahmoudi, SuperIso, arXiv: 08083144

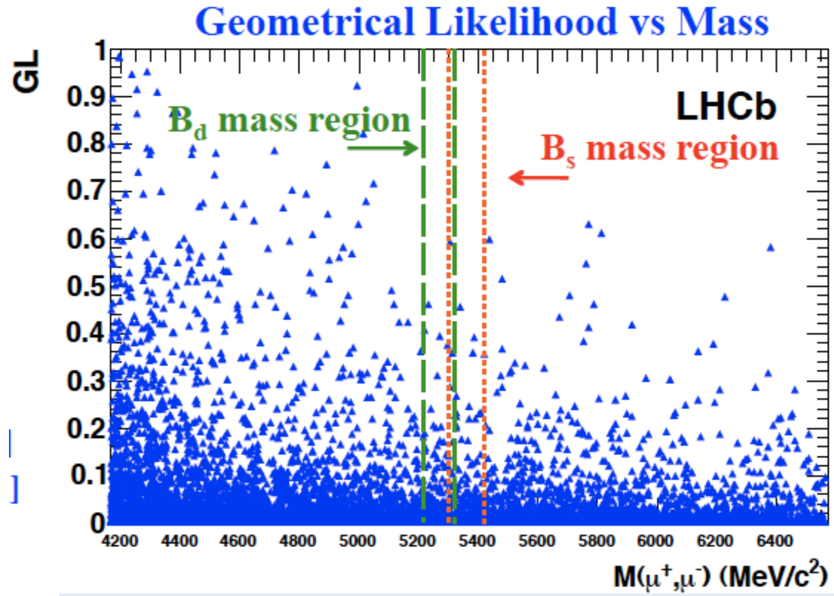




*5σ discovery contours for observing the heavy MSSM Higgs bosons H, A in the three decay channels **H,A→τ⁺τ⁻ → jets (solid line), jet+μ (dashed line), Jet+e (dotted line)** assuming 30-60 fb^{-1} collected by CMS.* *O. Buchmuller et al, arxiv:0907.5568]*

$B_s \rightarrow \mu\mu$

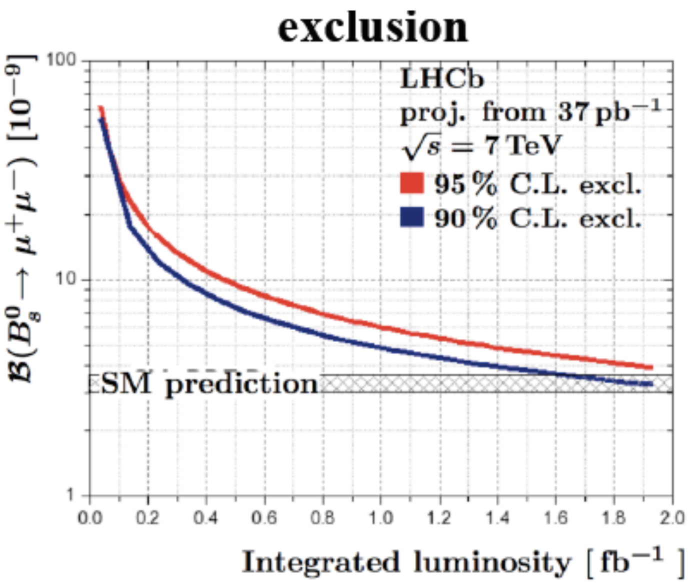
LHCb UL is based on 0 events in the most sensitive signal bins

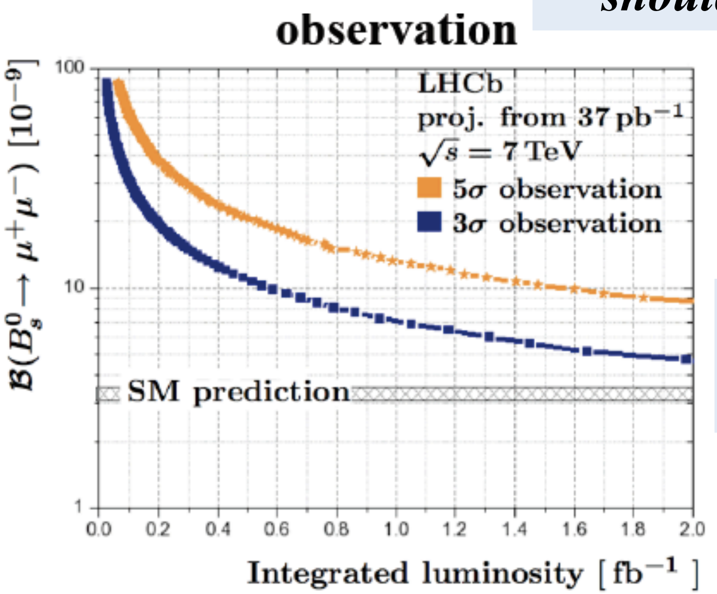


		@ 90% CL	@ 95% CL
LHCb	Today, 37 pb^{-1}	< 43 $x10^{-9}$	< 56 $x10^{-9}$
D0	World best, 6.1 fb^{-1} PLB 693 539 (2010)	< 42 $x10^{-9}$	< 51 $x10^{-9}$
CDF	Preliminary, 3.7 fb^{-1} Note 9892	< 36 $x10^{-9}$	< 43 x 10^{-9}

LHCb prospects for the 2011/2012 LHC Run

ATLAS and CMS in particular should be very competitive !!!





Very exciting sensitivity expected

B_s mixing phase

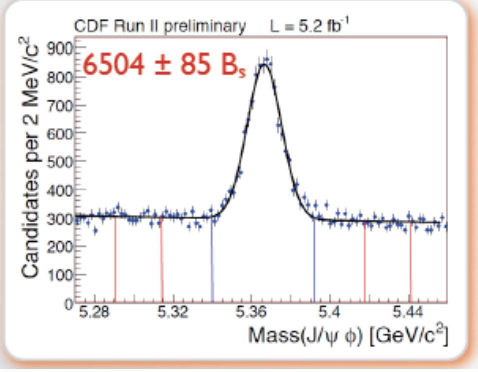
$\phi_s^{J/\psi\phi} = -2\beta_S$ *in SM is the* B_s *meson counterpart of* 2β

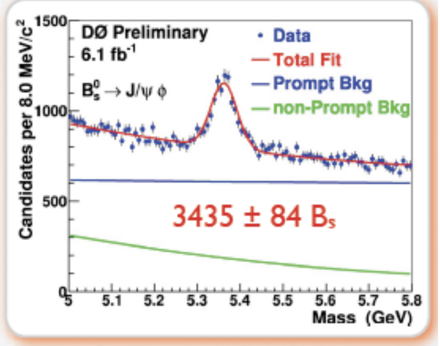
penguin contribution $\leq 10^{-3}$

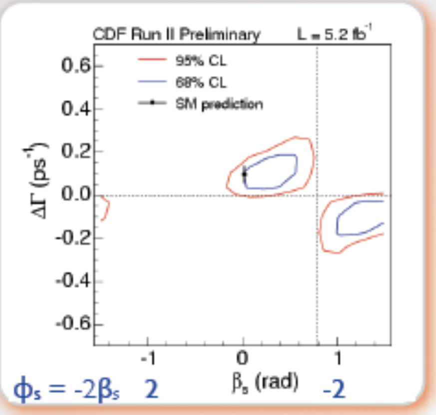
$\phi_s^{J/\psi\phi}$ *is not really constrained so far*

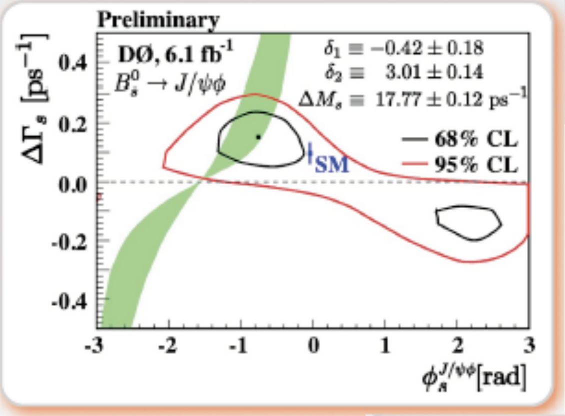
Theoretical uncertainty is very small: $-2\beta_s = -0.0368 \pm 0.0017$ *(CKMfitter 2007)*

- CDF: based on **5.2 fb^{-1}** with improved particle Id, NN, flavour tagging (SST) and contribution of S-wave included.
- DØ: based on **6.1 fb^{-1}** with improved selection and no same side tagger anymore.







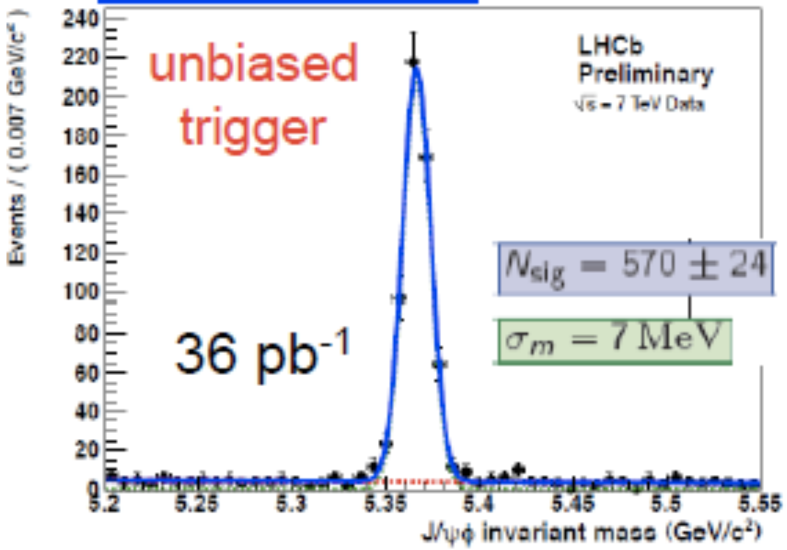


CDF: $\phi_s \in [-\pi, -1.78] \cup [-1.36, 0.26] \cup [2.88, \pi]$ @ 95 % C.L.
0.8σ deviation from SM central point

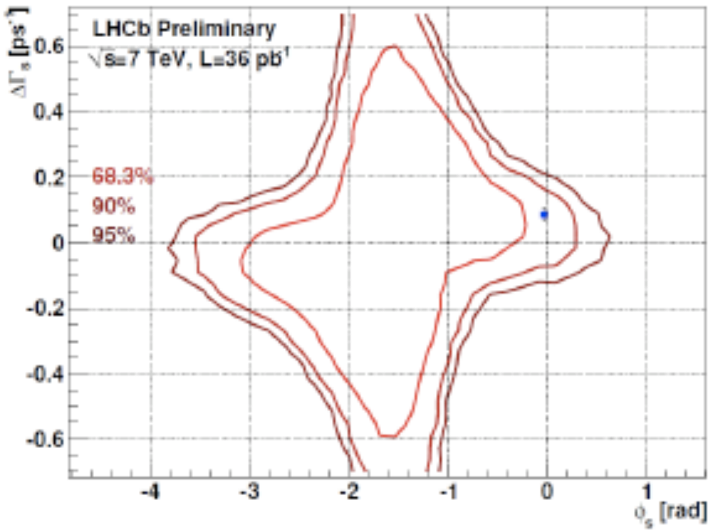
DØ: $\phi_s \in [-1.65, 0.24]$, $\Delta\Gamma_s \in [0.014, 0.263]$ ps^{-1}
and $\phi_s \in [1.14, 2.93]$, $\Delta\Gamma_s \in [-0.235, -0.040]$ ps^{-1} @ 95 % C.L.
1.1σ deviation from SM central point

B_s mixing phase

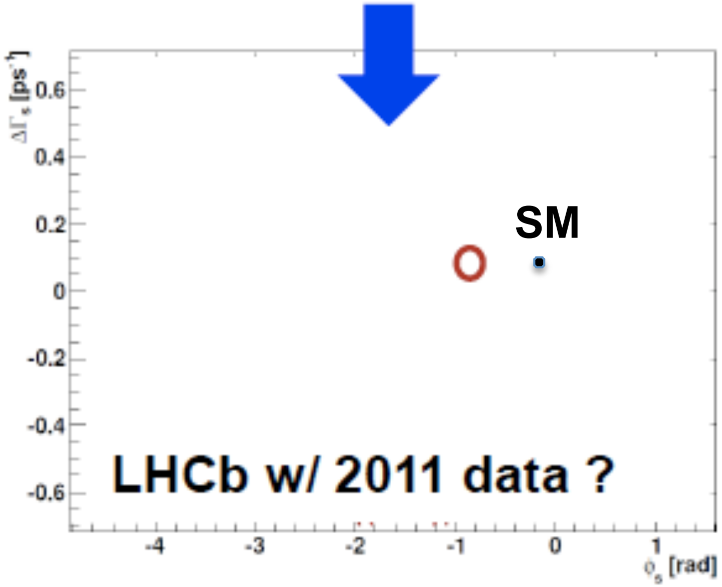
$B_s \to J/\psi\,\phi$



$\phi_s \in$ [-2.7, -0.5] rad at 68% CL
$\phi_s \in$ [-3.5, 0.2] rad at 95% CL



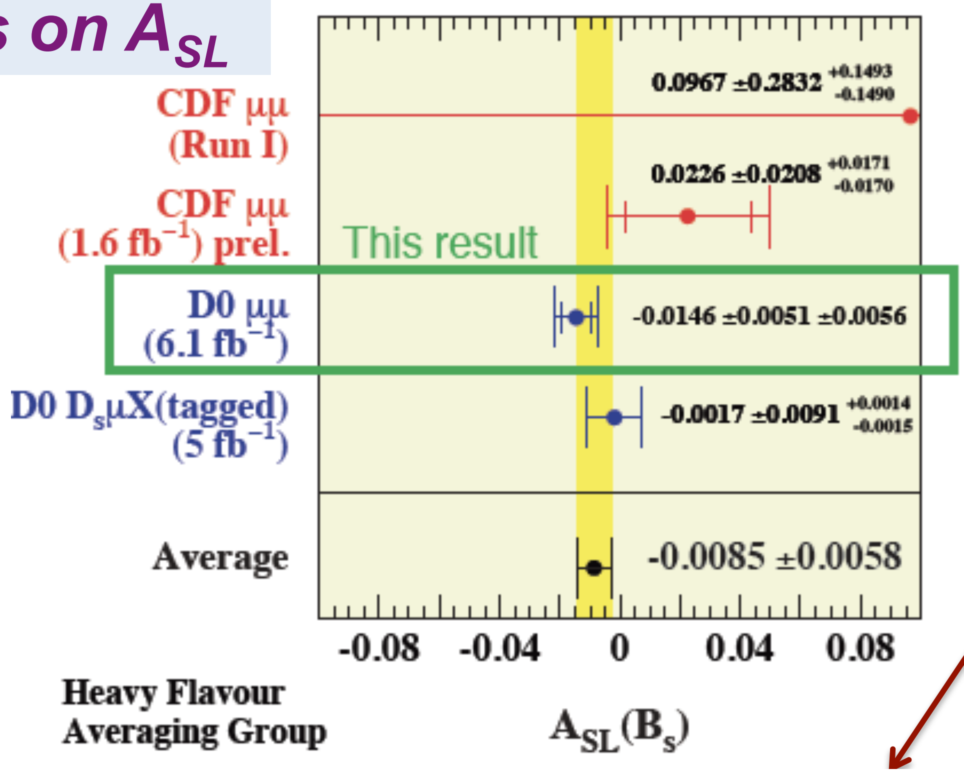
	LHCb 36 pb^{-1}	CDF 5.2 fb^{-1}
$B_s \to J/\psi\,\phi$	836	6500
Proper time resolution	50 fs	100 fs
OS tagging power	$2.2 \pm 0.5\%$	$1.2 \pm 0.2\%$
SS tagging power	work ongoing	$3.5 \pm 1.4\%$



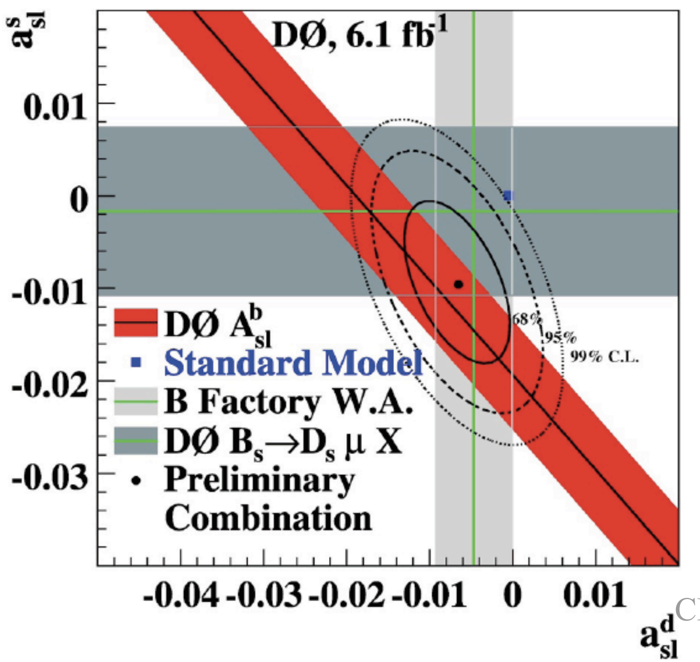
SS tagging will significantly improve sensitivity
→Exciting prospects for the nearest future
Expect $\sigma(\phi_s) \sim 0.1$ with about 1 fb^{-1}

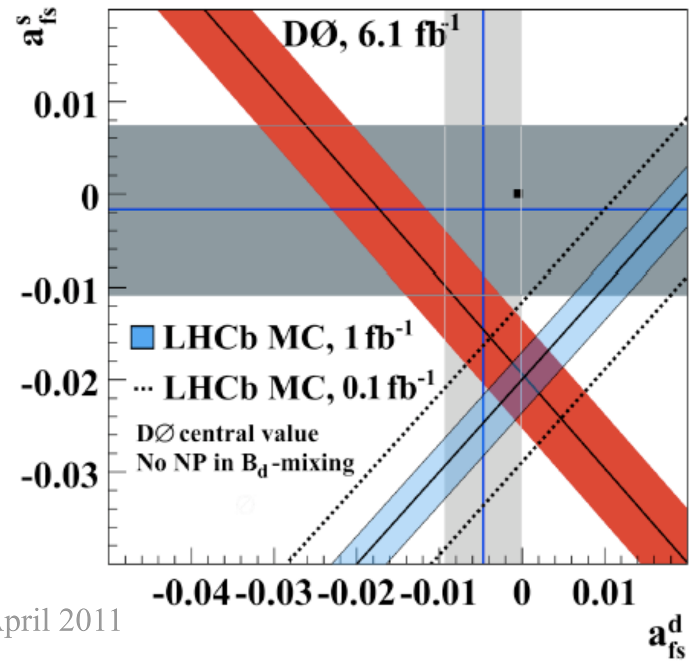
Future prospects on A_{SL}

- *CDF measurement*
- *D0 update (with 9 fb^{-1}) IP cut and improved data selection*
- *LHCb prospects (with 1 fb^{-1})*



NB: This is MC, scaled to real data

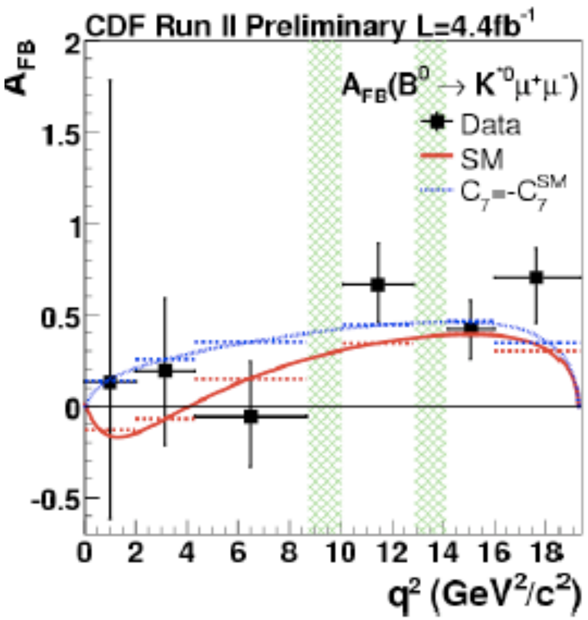


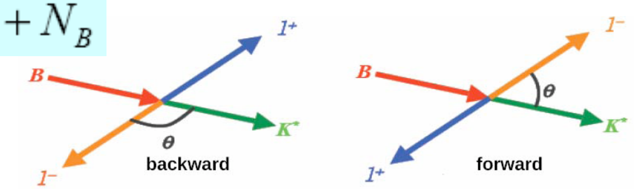


Helicity structure of the decay amplitudes in $B_d \to K^*\mu\mu$

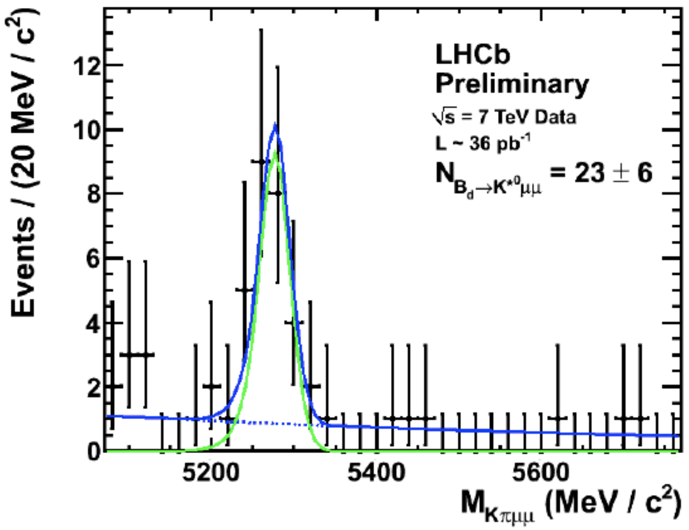
Forward backward asymmetry, A_{FB}, is extremely powerful observable for testing SM vs NP
Intriguing hint is emerging !!!

$$A_{FB}\left(s = m^2_{\mu^+\mu^-}\right) = \frac{N_F - N_B}{N_F + N_B}$$





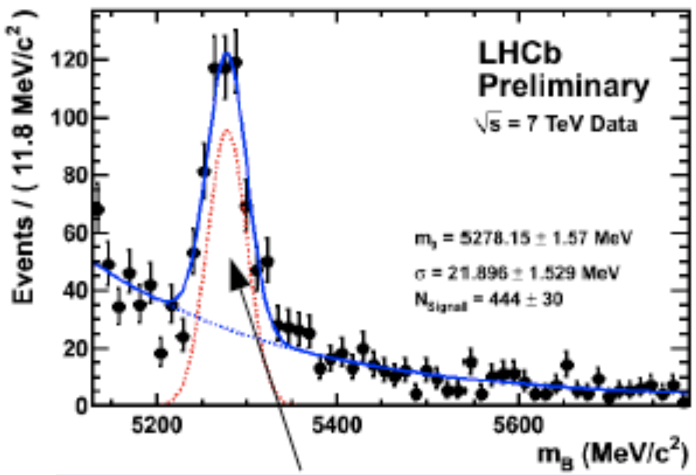
- *BELLE, BaBar and CDF consistent with each other and SM*
- *Flipped C_7 scenario looks however more favoured from A_{FB} data*



- *With 1 fb^{-1} LHCb expects ~1400 events, and should clarify existing situation. Expected accuracy in* ***A_{FB} zero crossing point is ~0.8 GeV^2 in 1 fb^{-1}***

Towards the measurement of the UT angle γ
Reconstruction of hadronic B decays

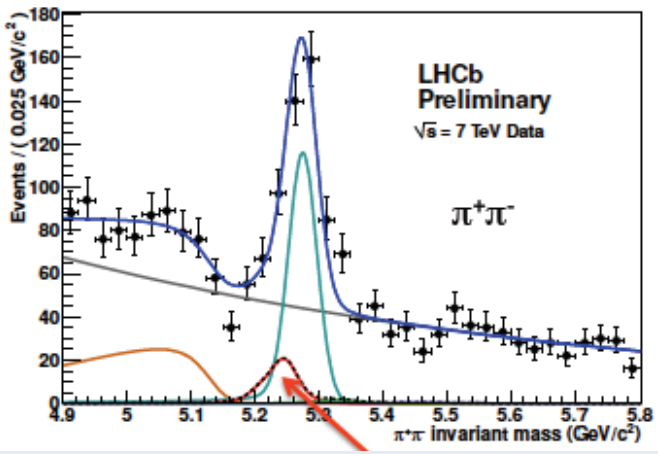
$B^{\pm} \rightarrow DK^{\pm}$ with $D \rightarrow \pi K$

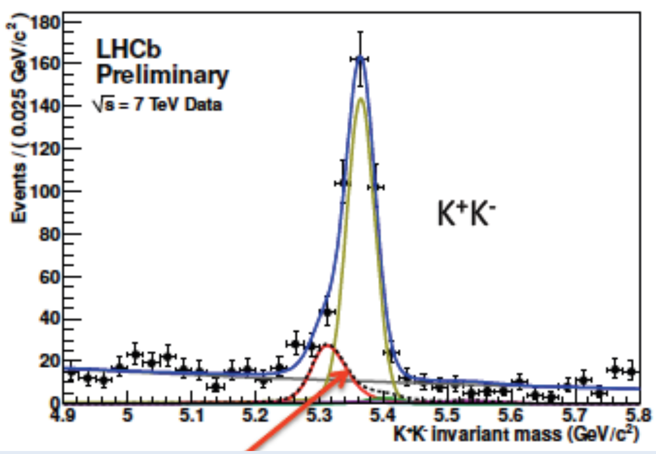


LHCb yield: 444 ± 30 / 34 pb^{-1}
CDF yield: 516 ± 37 / fb^{-1}

- *$B_s \rightarrow D_sK$ final state under study*
- *Expect world's first time-dependent CPV analysis for $B_s \rightarrow D_sK$ analysis in 2011*

Combined estimated sensitivity for γ in 2011/2012 Run is ~5°
(Current accuracy in γ ~20°)





- *LHCb yields: 275±24 $B_d \rightarrow \pi^+\pi^-$ & 333 ± 21 $B_s \rightarrow K^+K^-$ in 37 pb^{-1}*
c.f. CDF in 1 fb^{-1} 1121±63 $B_d \rightarrow \pi^+\pi^-$ and 1307±64 $B_s \rightarrow K^+K$

Direct CPV seen by LHCb:

LHCb preliminary:

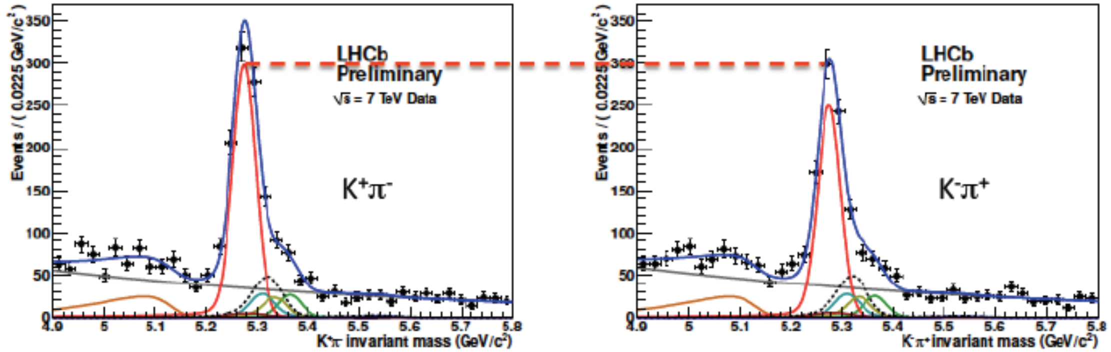
$$A_{CP}(B^0 \to K^+\pi^-) = -0.074 \pm 0.033 \pm 0.008$$

$$A_{CP}(B_s^0 \to \pi^+K^-) = 0.15 \pm 0.19 \pm 0.02$$

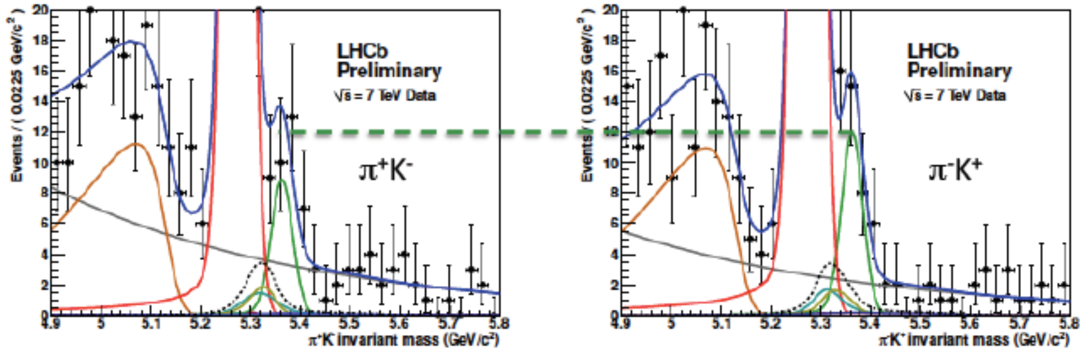
Competitive with world's best measurement by CDF:

$A_{CP}(B_s \to \pi^+K^-) = 0.39 \pm 0.15 \pm 0.08$

Raw CP asymmetry in $B^0 \to K\pi$ decays: -0.086 ± 0.033



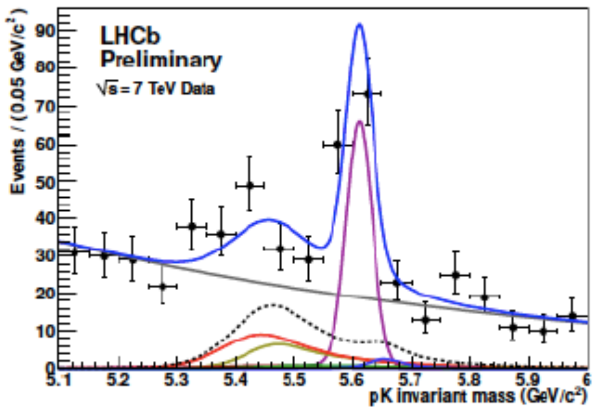
Raw CP asymmetry in $B_s \to \pi K$ decays: 0.15 ± 0.19



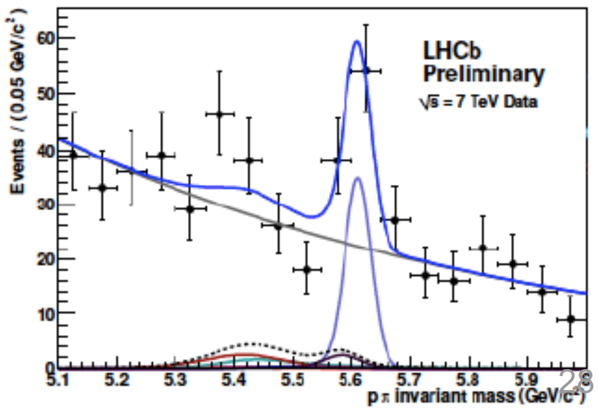
Excellent prospects for A_{CP} observation in Λ_b baryons with L ~ 1 fb^{-1}

LHCb yields in 37 pb^{-1} :

$\Lambda_b \to pK$ yield: 76 ± 12 events

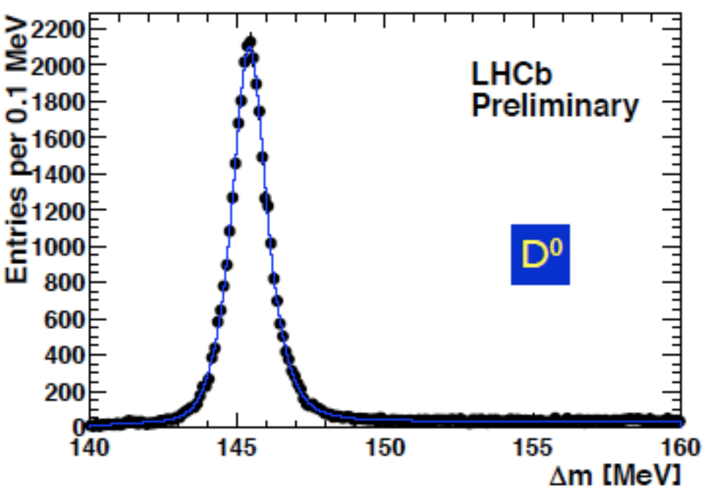


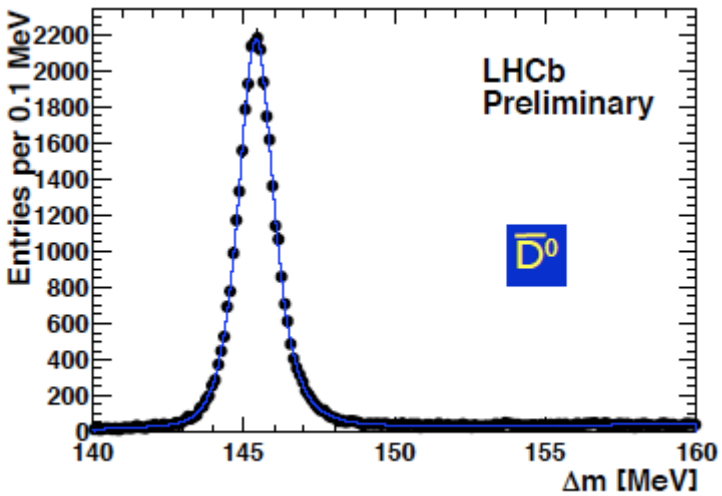
$\Lambda_b \to p\pi$ yield: 41 ± 10 events



CP Violation with charm

Excellent prospects for CPV studies: Expect about a few millions tagged $D^0 \rightarrow KK$ with $L \sim 1\ fb^{-1}$ → Very sensitive to CPV in D-mixing !

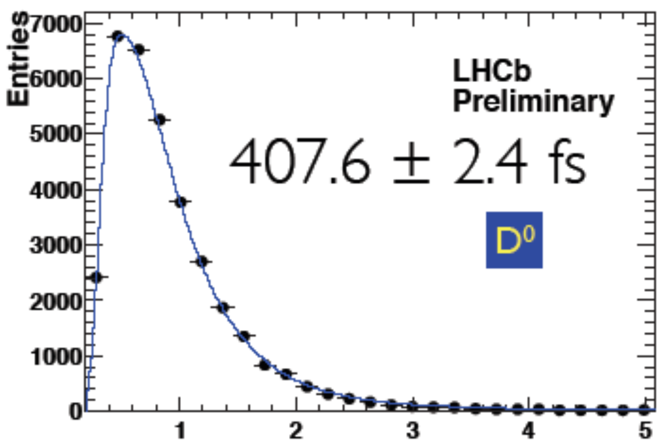


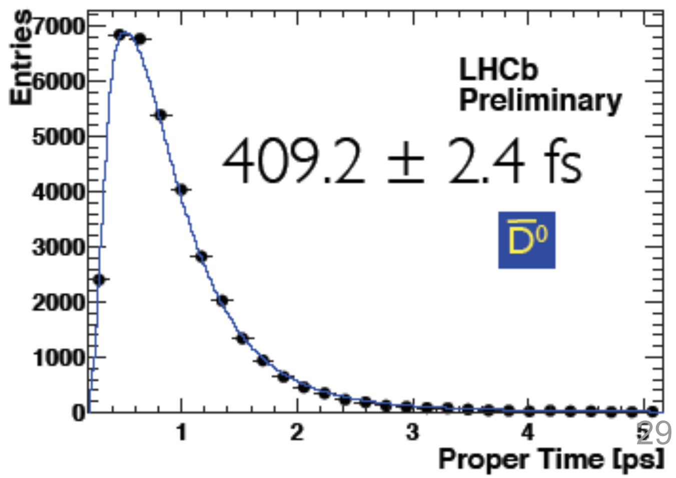


Sample sizes in low multiplicity decay modes with low mis-tag rate already similar to those of B-factories !

A_Γ is well in progress !

Control channel: ("A_Γ" in $D \rightarrow K\pi$)
"A_Γ" $= (-2 \pm 4) \times 10^{-3}$





CP Violation with charm

- *Time integrated CPV asymmetries in D→hh' decays:* $A_{CP}(f) = \frac{\Gamma(D^0 \to f) - \Gamma(\overline{D}^0 \to \bar{f})}{\Gamma(D^0 \to f) + \Gamma(\overline{D}^0 \to \bar{f})}$

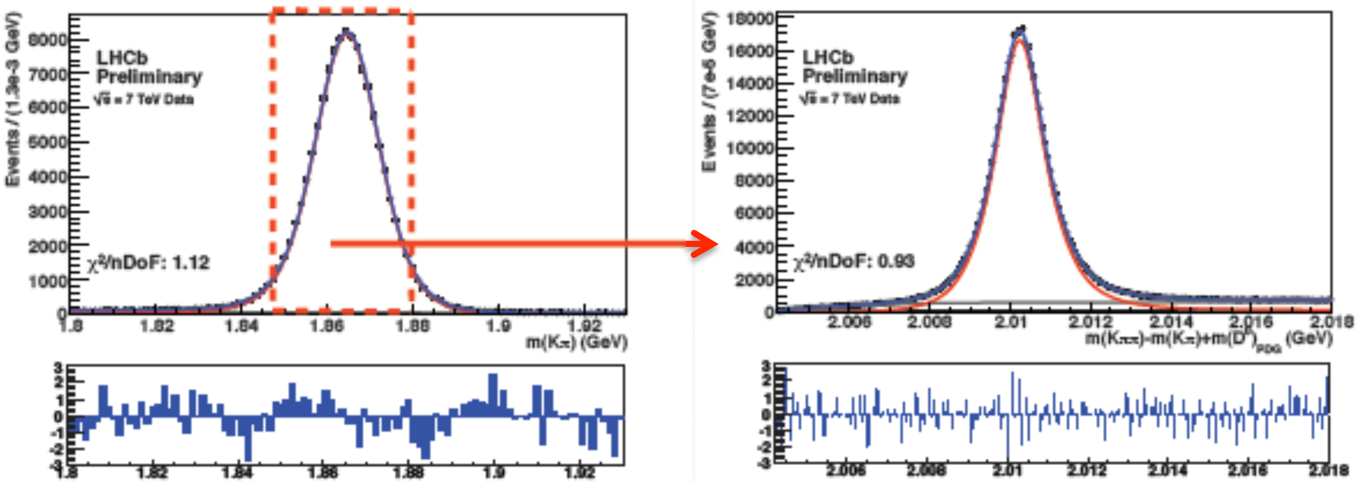
Expect mixing induced CPV to cancel out in the difference as well as many other systematics (e.g. production and tracking asymmetries):

$A_{CP}(KK) – A_{CP}(\pi\pi) = A_{CP}^{RAW}(KK)^* – A_{CP}^{RAW}(\pi\pi)^*$ (very clean measurement !)

Sensitivity to penguins is retained !

Measure raw asymmetries in flavour tagged samples

$$A_{CP}^{RAW}(f)^* = \frac{N(D^{*+} \to D^0(f)\pi^+) - N(D^{*-} \to \overline{D}^0(\bar{f})\pi^-)}{N(D^{*+} \to D^0(f)\pi^+) + N(D^{*-} \to \overline{D}^0(\bar{f})\pi^-)}$$



$A_{CP}(KK) – A_{CP}(\pi\pi)$ = -0.275 ± 0.701 ± 0.250)%

Expect a factor 5 better sensitivity with 2011 data

Preparations towards LHCb upgrade

Purpose of upgraded LHCb detector

→*collect ~50/fb with a general purpose detector in the forward region*

- *Which requires:*
  - ***running at luminosity of L ~ 1x10^{33} cm^{-2} s^{-1}***
  - ***with full software trigger (40 MHz)***
- *Physics program will include:*
  - ***Quark flavour physics (CORE program!)***
  - *Lepton flavour physics*
  - *Electroweak physics*
  - *Exotic searches*
- ***Aim***
  - *Run with current detector and collect ~5/fb till second long shutdown*
  - *Upgrade to 40 MHz in ~2018 and collect ~50/fb thereafter*

→ ***Submitted upgrade LOI to LHCC beginning of March***

→ ***Physics case well received!***

Sensitivities of the LHCb upgrade to key observables

Type	Observable	Current precision	LHCb (5 fb^{-1})	Upgrade (50 fb^{-1})	Theory uncertainty
Gluonic penguin	$S(B_s \to \phi\phi)$	-	0.08	0.02	0.02
	$S(B_s \to K^{*0}\bar{K}^{*0})$	-	0.07	0.02	< 0.02
	$S(B^0 \to \phi K_S^0)$	0.17	0.15	0.03	0.02
B_s mixing	$2\beta_s\ (B_s \to J/\psi\phi)$	0.35	0.019	0.006	~ 0.003
Right-handed currents	$S(B_s \to \phi\gamma)$	-	0.07	0.02	< 0.01
	$\mathcal{A}^{\Delta\Gamma_s}(B_s \to \phi\gamma)$	-	0.14	0.03	0.02
E/W penguin	$A_T^{(2)}(B^0 \to K^{*0}\mu^+\mu^-)$	-	0.14	0.04	0.05
	$s_0\, A_{\text{FB}}(B^0 \to K^{*0}\mu^+\mu^-)$	-	4%	1%	7%
Higgs penguin	$\mathcal{B}(B_s \to \mu^+\mu^-)$	-	30%	8%	$< 10\%$
	$\frac{\mathcal{B}(B^0 \to \mu^+\mu^-)}{\mathcal{B}(B_s \to \mu^+\mu^-)}$	-	-	$\sim 35\%$	$\sim 5\%$
Unitarity triangle angles	$\gamma\ (B \to D^{(*)}K^{(*)})$	$\sim 20^\circ$	$\sim 4^\circ$	0.9°	negligible
	$\gamma\ (B_s \to D_s K)$	-	$\sim 7^\circ$	1.5°	negligible
	$\beta\ (B^0 \to J/\psi\, K^0)$	1°	0.5°	0.2°	negligible
Charm CPV	A_Γ	2.5×10^{-3}	2×10^{-4}	4×10^{-5}	-
	$A_{CP}^{dir}(KK) - A_{CP}^{dir}(\pi\pi)$	4.3×10^{-3}	4×10^{-4}	8×10^{-5}	-

<u>Detector upgrade to 40 MHz requires:</u>

- ***Readout detector at 40MHz to run full software trigger***
- ***Replacement of all sub-detector Front-End electronics to 40 MHZ readout; RICH photo-detectors***
- *Replacement of all Si detectors directly attached to the current 1MHz electronics*
  - *VELO, IT, TT*
- *Remove some detectors due to increased occupancies at higher luminosity*
  - *RICH1-aerogel, M1, possibly PS&SPD*
- *Eventually improve PID at low momenta by introducing TORCH*

➔ ***R&D has started and is expected to <u>ramp-up significantly this year</u> towards producing TDRs in time for installing the detectors & electronics in 2018***

Collaboration matters

- *The status of the accounts healthy. No cash flow problems foreseen*

- ***New resources need to be spent on R&D for LHCb Upgrade***

- *Pierluigi Campana (INFN) will start his three years SpokesPerson mandate on June 1, 2011*

  - Roger Forty (CERN) has been appointed as Deputy SP

  - Burkhard Schmidt (CERN) has been appointed as Deputy SP

  - Andreas Schopper (CERN) has been appointed as the Upgrade Coordinator starting from June 1, 2011

  - Carmelo D’Ambrosio (CERN) has been appointed as the RICH Project Leader for two years starting from July 1, 2011

Conclusions

- ***LHCb has demonstrated excellent performance***

  - A concept of the forward spectrometer at the LHC has been proven with data

  - Heavy flavour resonances and mesons have been reconstructed (Z & W candidates as well); cross-sections measured

  - First measurements of the core LHCb physics programme have reached TEVATRON sensitivity

- *LHCb data sample should be increased by a factor of 25-30 by the end of 2011*

- ***Very interesting sensitivity reach in the nearest future is guaranteed !***
  - $B_s \rightarrow \mu\mu$
  - ϕ_s in $B_s \rightarrow J/\psi\phi$
  - A_{FB} in $B_d \rightarrow K^*\mu\mu$

- ***Long term future of LHCb looks healthy (if you help !!!)***
  LOI is being approved by LHCC