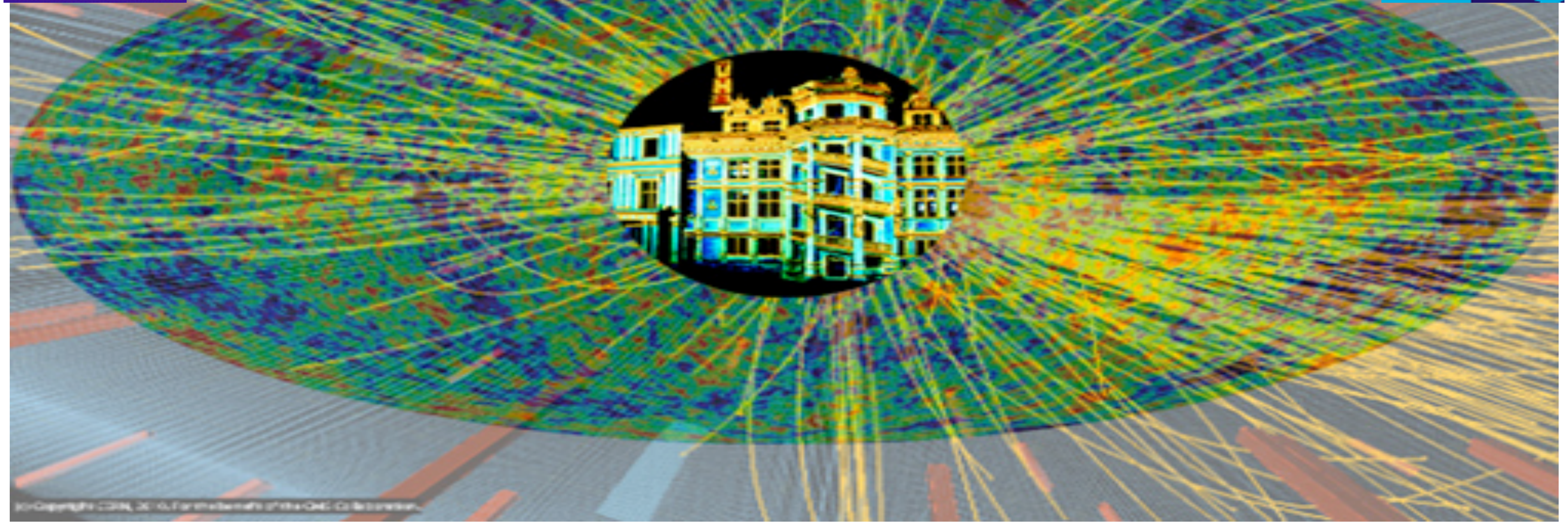
23$^{\text{èmes}}$ rencontres de Blois, may 29- june 3 2011



Search for New Physics through rare heavy flavour decays at LHCb

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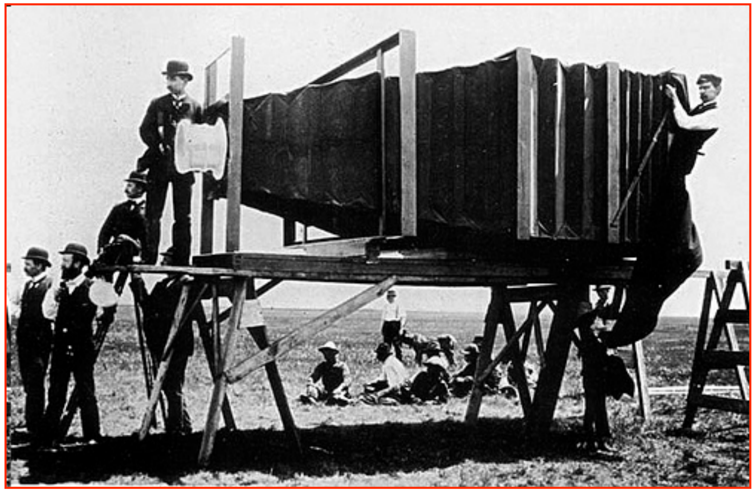
On behalf of the LHCb collaboration

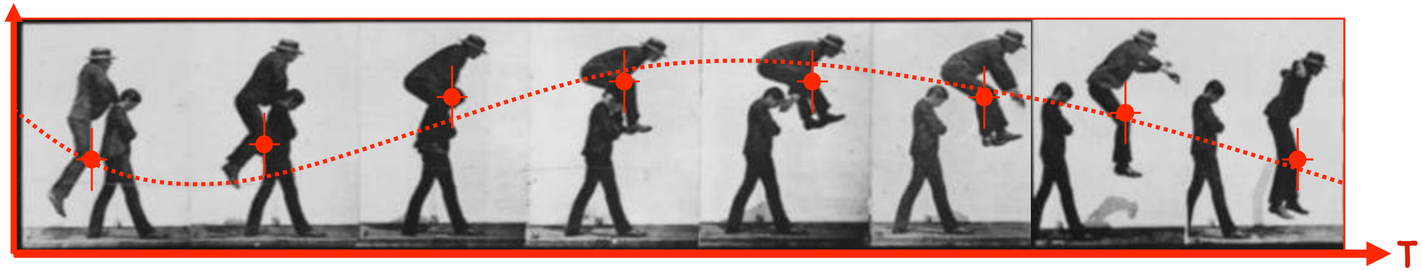
Outline

Heavy flavour rare decays

The LHCb detector



Probing rare decay dynamics



CKM metrology : state of the art

Quark flavour physics described
by the KM mechanism within Standard Model

Current flavour data is consistent with this scheme

CKM metrology lesson :

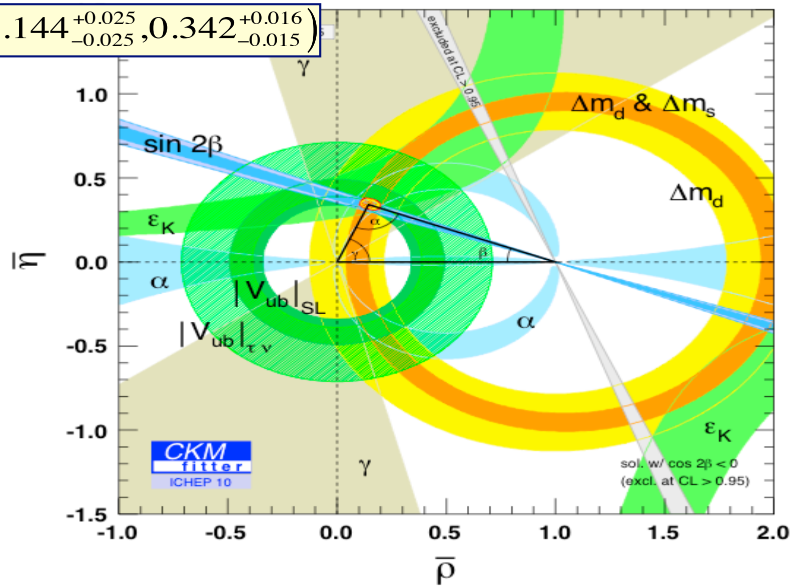
> The KM mechanism
> IS
> the dominant source of CP violation
> in the B_d and B_s system

$B_{d,s}$ Unitarity triangles apex :

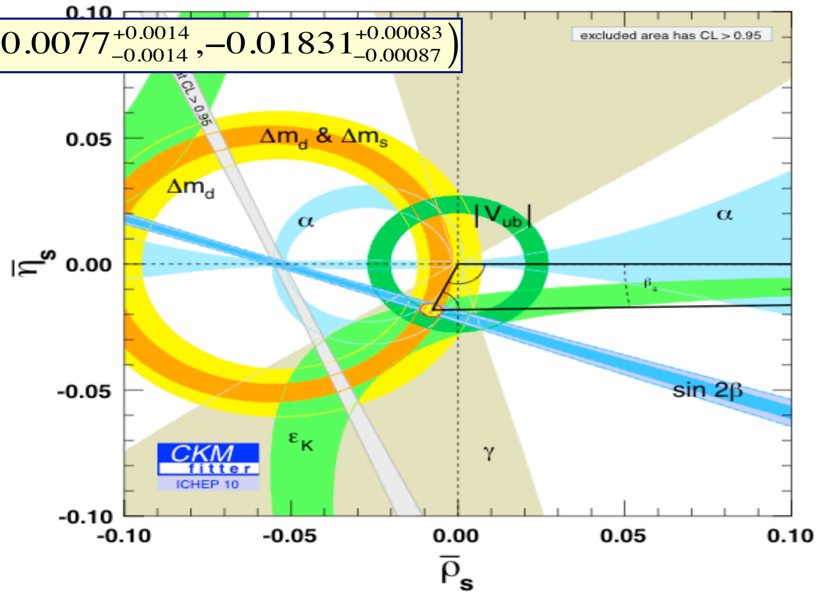
$$\frac{\sigma_{\bar{\eta}}}{\bar{\eta}} \approx \frac{\sigma_{\bar{\eta}_s}}{\bar{\eta}_s} \approx 4.5\%$$

$$\frac{\sigma_{\bar{\rho}}}{\bar{\rho}} \approx \frac{\sigma_{\bar{\rho}_s}}{\bar{\rho}_s} \approx 17\%$$

$$(\bar{\rho},\bar{\eta}) = \left(0.144^{+0.025}_{-0.025}, 0.342^{+0.016}_{-0.015}\right)$$



$$(\bar{\rho}_s,\bar{\eta}_s) = \left(-0.0077^{+0.0014}_{-0.0014}, -0.01831^{+0.00083}_{-0.00087}\right)$$



CKM metrology : state of the art

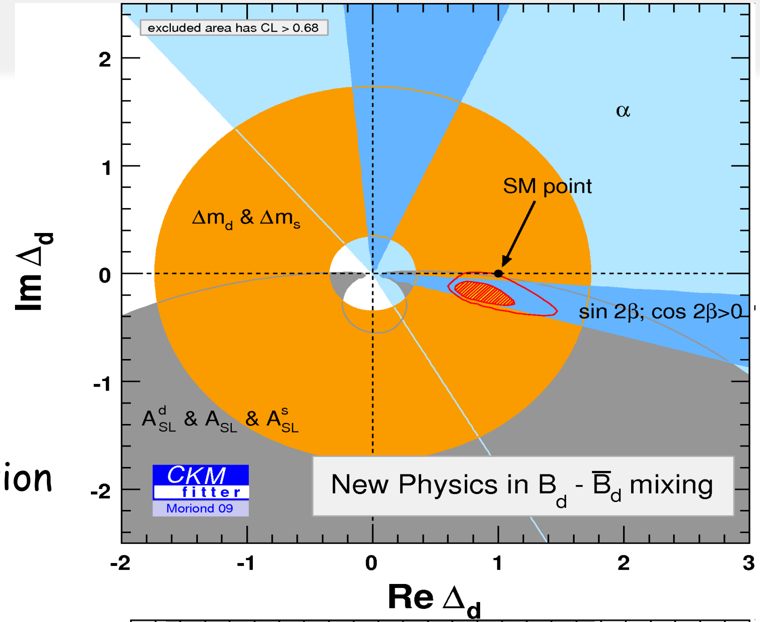
… but still room for sizeable contribution from New Physics

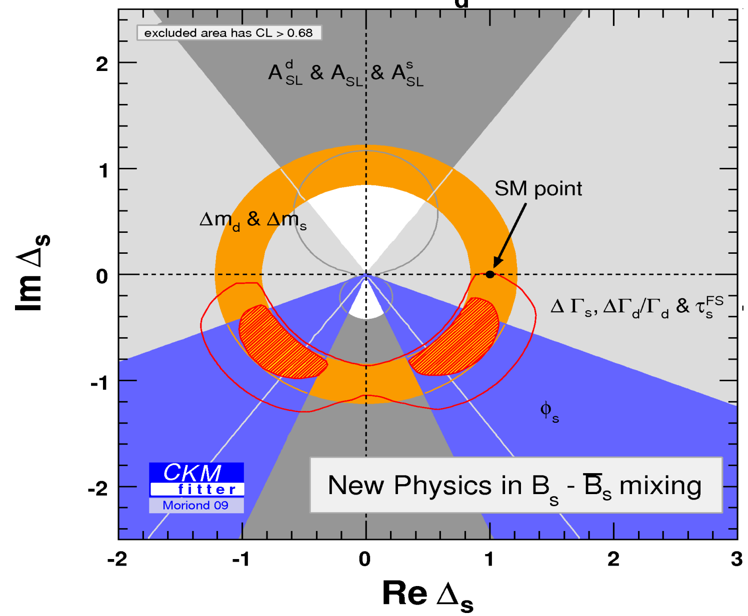
e.g. : model independent parametrization for NP in ΔF=2 transition

$$\langle B_q^0 | M_{12}^{SM+NP} | \overline{B}_q^0 \rangle \equiv \Delta_q^{NP} \cdot \langle B_q^0 | M_{12}^{SM} | \overline{B}_q^0 \rangle$$

$$\Delta_q^{NP} = \mathrm{Re}(\Delta_q) + i\ \mathrm{Im}(\Delta_q) = |\Delta_q| e^{i\phi^{\Delta_q}} = r_q^2 e^{2i\theta_q} = 1 + h_q e^{2i\sigma_q}$$

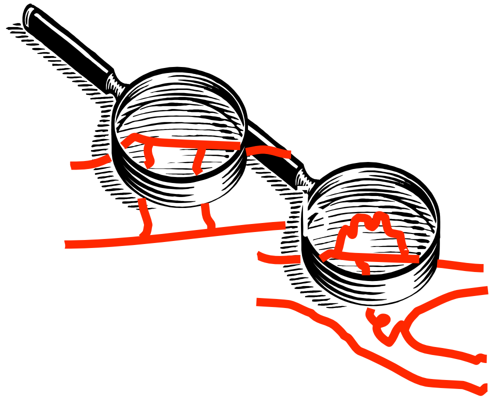
The prefered (SM+NP) Δ^{NP} value is currently ~ 2σ from SM for both B_d and B_s systems





Rare decays as a probe for NP

Loop-mediated decays
are sensitive indirect probe to the NP
heavy particles
that may propagate within the loop



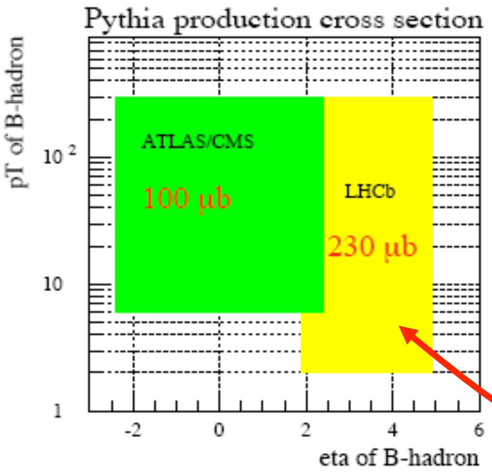
LHCb has a very good potential in resolving several those rare decays

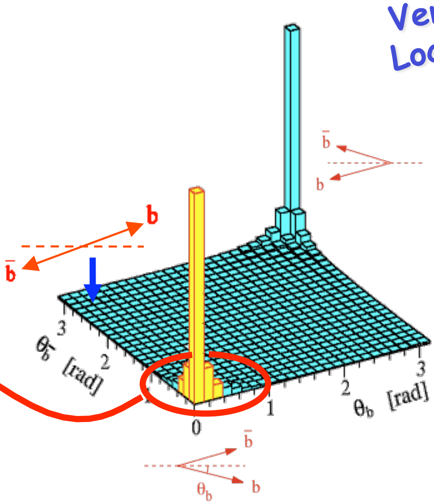
… this talk will mainly focus on :

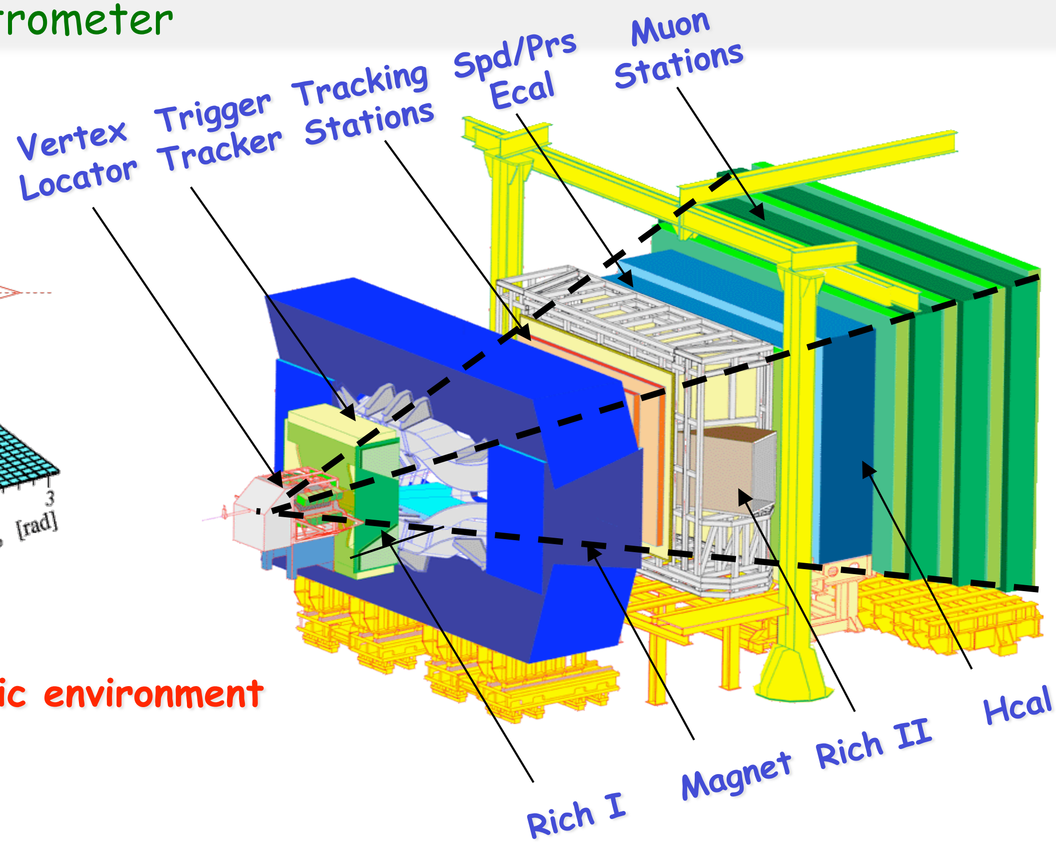
- Search for $B_s \to \mu^+\mu^-$: SM-expected BR= $(3.073^{+0.070}_{-0.190}) \times 10^{-9}$ *[CKMFitter ICHEP2010]*
- Dynamics of $B_d \to K^*\mu^+\mu^-$ decay : BR= $(1.15 \pm 0.15) \times 10^{-6}$ *[HFAG 2010]*
- Photon polarization from $B_s \to \varphi\gamma$: BR= $(5.7^{+2.1}_{-1.8}) \times 10^{-5}$ *[Belle,PRL100 121801, 2008]*

The LHCb detector

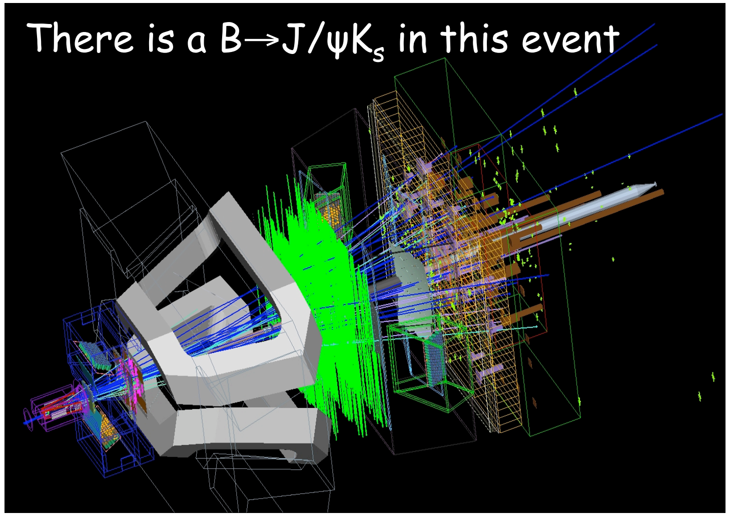
- LHCb detector : single arm forward spectrometer
  - 1.9 < η < 4.9







- Main challenge :
  - Perform precision measurements in hadronic environment



- Large multiplicity : ~30 particles for hard pp collisions
- Background from high inelastic X-section of 80 mb
- Small Branching Ratio for B meson decay

… but …

- 100 kHz bb rate
- Access to all b species : B_d, B_u, B_s, B_c, Λ_b, Ξ_b…

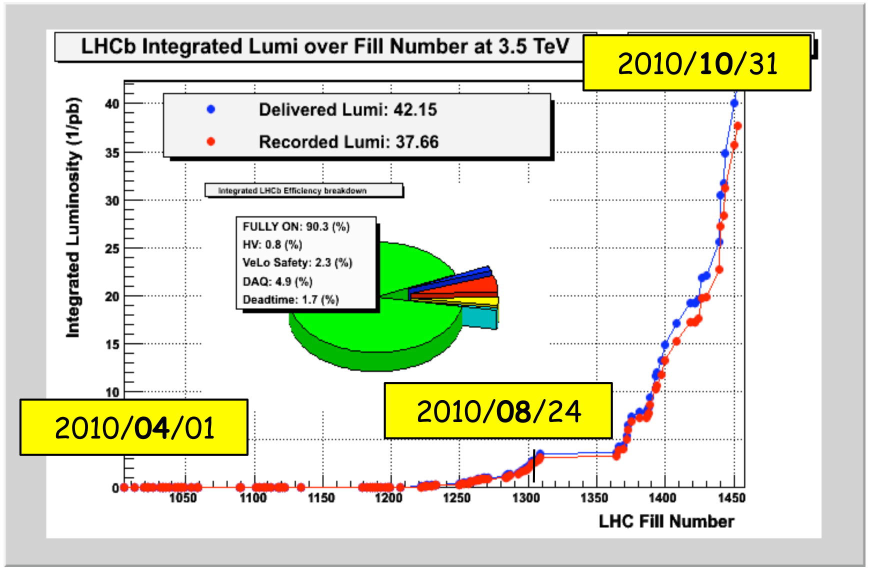
LHCb operation

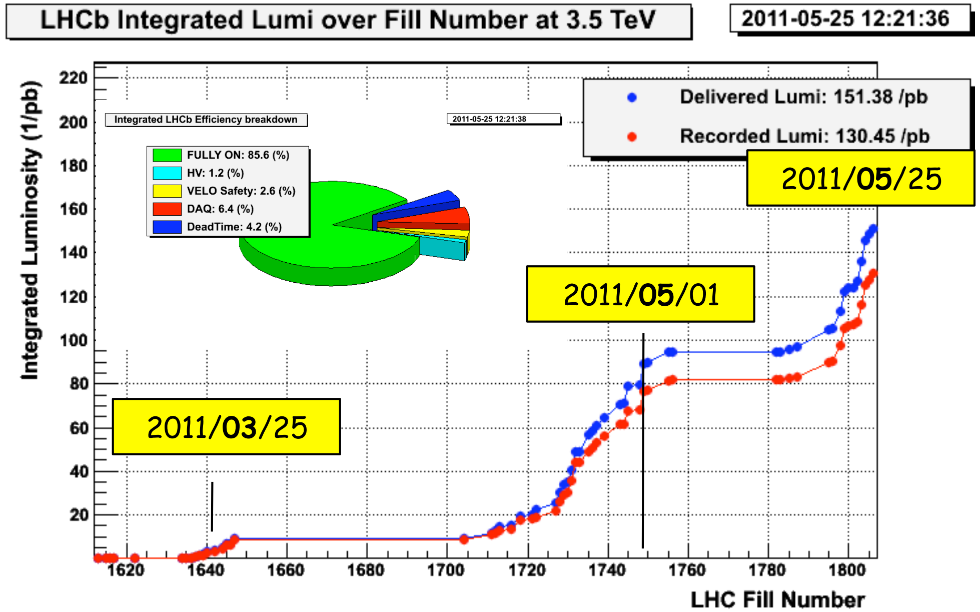
LHC delivers $\sqrt{s}$=7 TeV pp collisions since spring 2010

The machine performance improves daily : ~~912~~ colliding bunches reached last week >1000

Instantaneous luminosity at LHCb is now close to design : ~~2.10^{32}~~ cm^2s^{-1} 3.10^{32} cm^2s^{-1}

with an average visible pp interaction per bunch crossing of O(2)





LHCb collected 37.5 pb^{-1} in 2010 with an efficiency of O(90%)

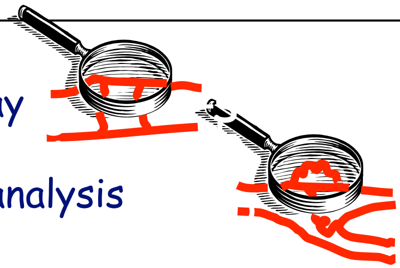
Integrated luminosity was doubled in the first month of 2011 data taking

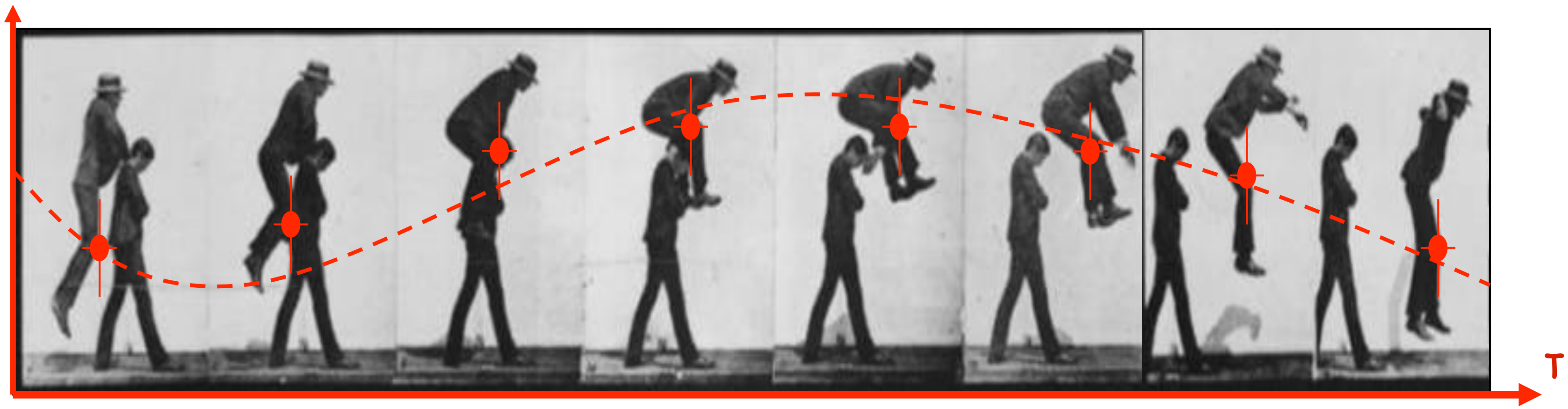
-> today 2011 recorded luminosity ~~~130 pb~~$^{-1}$ 163 pb^{-1}

Aim at collecting ~1 fb^{-1} by the end of 2011

Probing rare decay dynamics

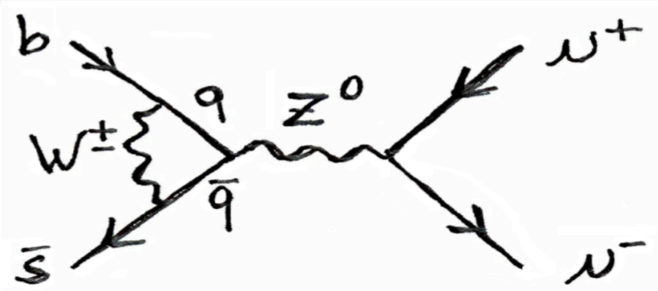
- Branching Ratio of very rare decay : NP in $B_{s,d} \to \mu\mu$
- Decay dynamics through angular analysis : NP in $B_s \to K^*\mu\mu$
- Time-dependent decay rate : photon polarization in $B_s \to \varphi\gamma$





Search for $B_{s,d} \to \mu^+\mu^-$

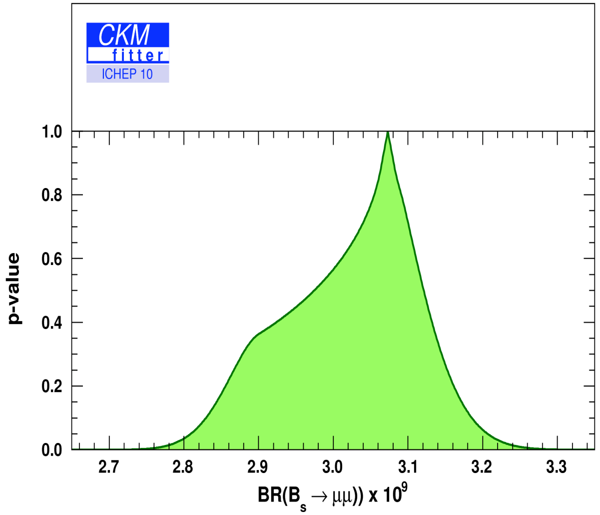
- Z-penguin suppressed diagram



  - SM-expected Branching Ratio :

$$B_{SM}(B_s \to \mu^+\mu^-) = (3.073^{+0.070}_{-0.190}) \times 10^{-9}$$ [CKMFitter ICHEP2010]

$$B_{SM}(B_d \to \mu^+\mu^-) = (10.8^{+0.4}_{-0.9}) \times 10^{-11}$$

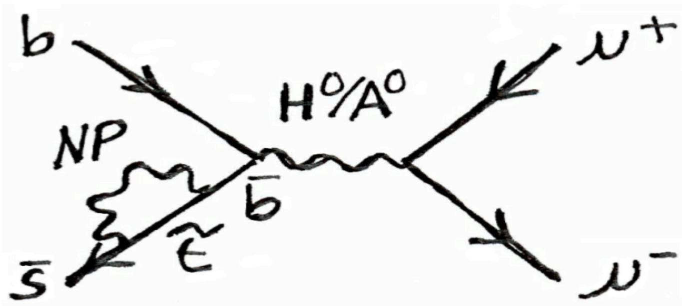


  - Current limits (@ 95% CL):

$B(B_s \to \mu^+\mu^-) < 51\times10^{-9}$ (D0) [PLB 693 539 (2010)]
$B(B_s \to \mu^+\mu^-) < 43\times10^{-9}$ (CDF) [CDF note 9892 (2009)]
$B(B_d \to \mu^+\mu^-) < 7.6\times10^{-9}$ (CDF)

  - Very sensitive to NP

e.g. probe two Higgs doublet models
MSSM BR ~ $\tan^6\beta/m^4_H$



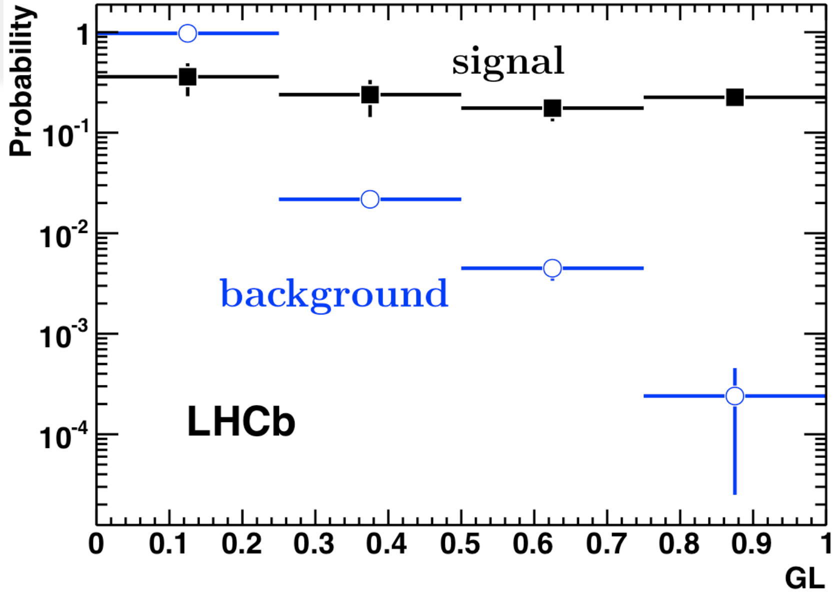
Search for $B_{s,d}\to\mu^+\mu^-$

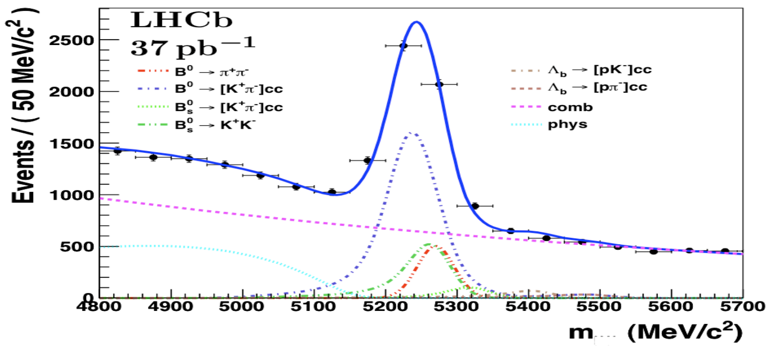
- LHCb analysis strategy :

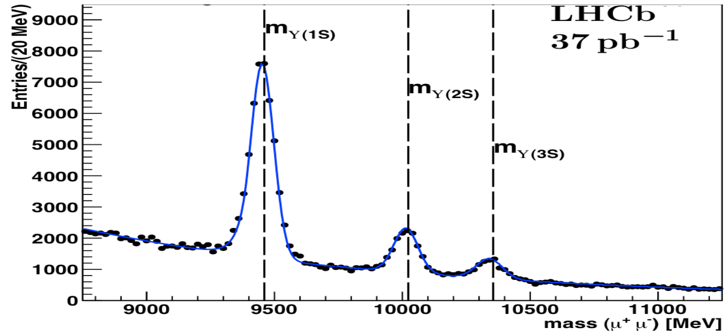
  - Event selection based on 2D Likelihood :
    - Geometrical & kinematical Likelihood (GL) :
      Impact Parameter, B vertex, Isolation
    - Invariant mass Likelihood
      modelled with a Crystal Ball

  - Data driven calibration
    - Geometrical likelihood
      - trained on MC ($B_{s,d}\to\mu^+\mu^-$ vs $bb\to\mu^+\mu^-X$)
      -calibrated on data using $B_{s,d}\to hh$ for signal and mass side-bands for background
    - Invariant mass Likelihood
      -average from $B_{s,d}\to K^+\pi^-$ (K^+K^-)
      - resolution from interpolation of the di-muon resonances ($J/\psi,\psi(2S),\Upsilon$'s) and inclusive $b\to hh'$

$$\sigma = (26.71 \pm 0.95)\, MeV/c^2$$

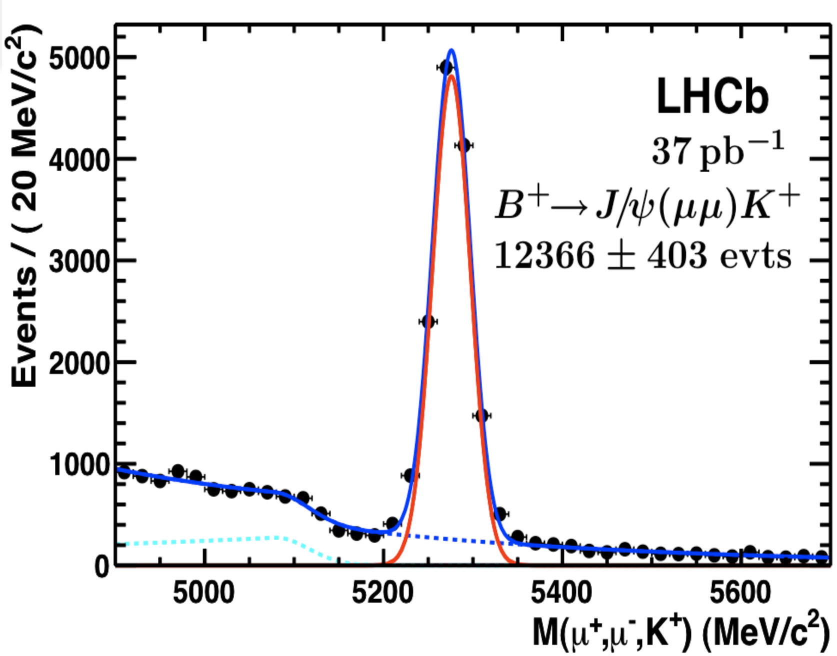






Search for $B_{s,d} \to \mu^+\mu^-$

- LHCb analysis strategy (con't):
  - Normalisation
    - Use know normalisation channels to derive BR from the event yield



$B_u \to J/\psi(\mu^+\mu^-)K^+$
$B_s \to J/\psi(\mu^+\mu^-)\Phi(K^+K^-)$
$B_d \to K^+\pi^-$

-> complementary in term of trigger, PID, final state reconstruction, B species

$$B(B_{s,d} \to \mu^+\mu^-) = \left(\frac{B_{norm}}{N_{norm}} \cdot \frac{\varepsilon_{sig}^{rec,sel,trig}}{\varepsilon_{norm}^{rec,sel,trig}} \cdot \frac{f_{q_{norm}}}{f_{s,d}}\right) \cdot N_{B_{s,d} \to \mu\mu} = \alpha_{s,d} \cdot N_{B_{s,d} \to \mu\mu}$$

Using 37 pb^{-1} (2010) data :

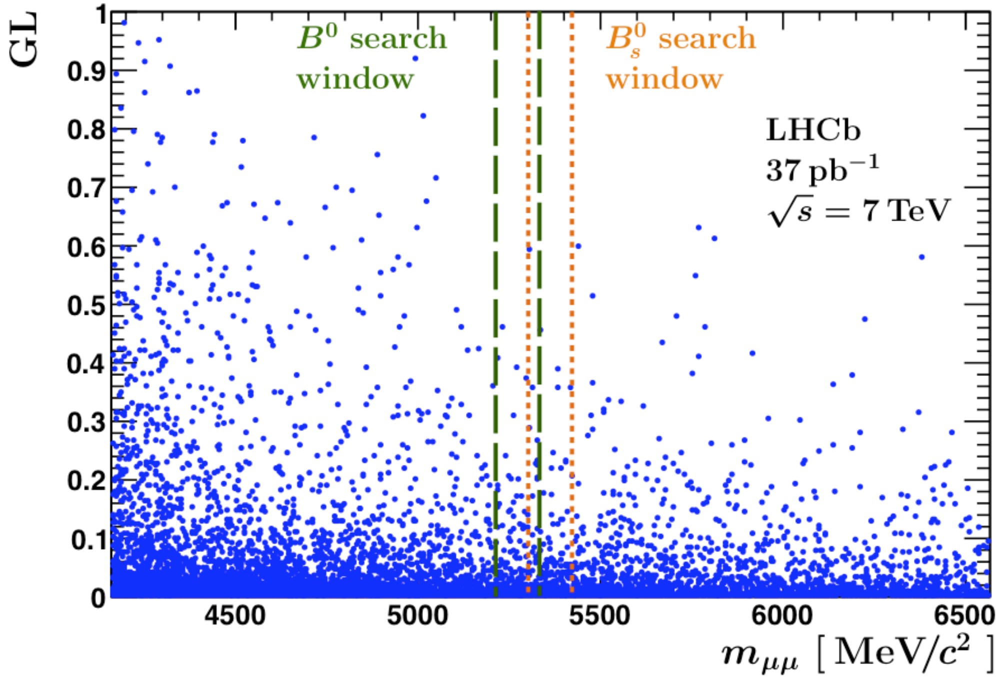
All three reference channels give consistent value

Weighted average :

$$\alpha_s = (8.6 \pm 1.1) \times 10^{-9},$$
$$\alpha_d = (2.24 \pm 0.16) \times 10^{-9}.$$

Search for $B_{s,d} \to \mu^+\mu^-$

- (blind) analysis result on 2010 data :



Observed distribution of events

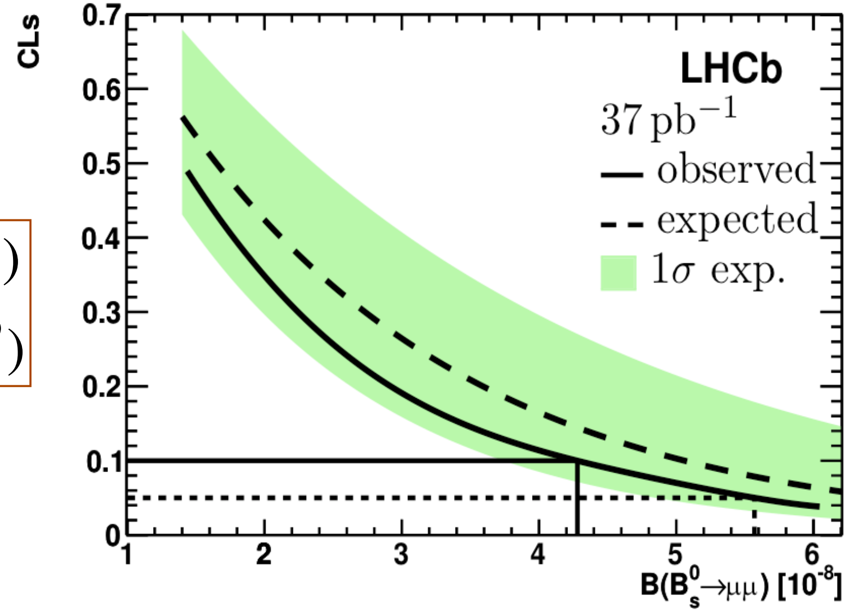
$B_s \to \mu\mu$	GL bin [0, 0.25]	[0.25, 0.5]	[0.5, 0.75]	[0.75, 1]
Mass bin (MeV/c^2) [−60, −40]	39	2	1	0
[−40, −20]	55	2	0	0
[−20, 0]	73	0	0	0
[0, +20]	60	0	0	0
[+20, +40]	53	2	0	0
[+40, +60]	55	1	0	0
sum	335	7	1	0
bkg exp.	329	7.36	1.51	0.081

95% CL limits :

$$B(B_s \to \mu^+\mu^-) < 56 \times 10^{-9} \quad (\text{exp. limit} : 65 \times 10^{-9})$$

$$B(B_d \to \mu^+\mu^-) < 15 \times 10^{-9} \quad (\text{exp. limit} : 18 \times 10^{-9})$$

« Search for the rare decays Bs→μμ and B0→μμ »
Physics Letter B 699 (2011) 330-340, The LHCb collaboration

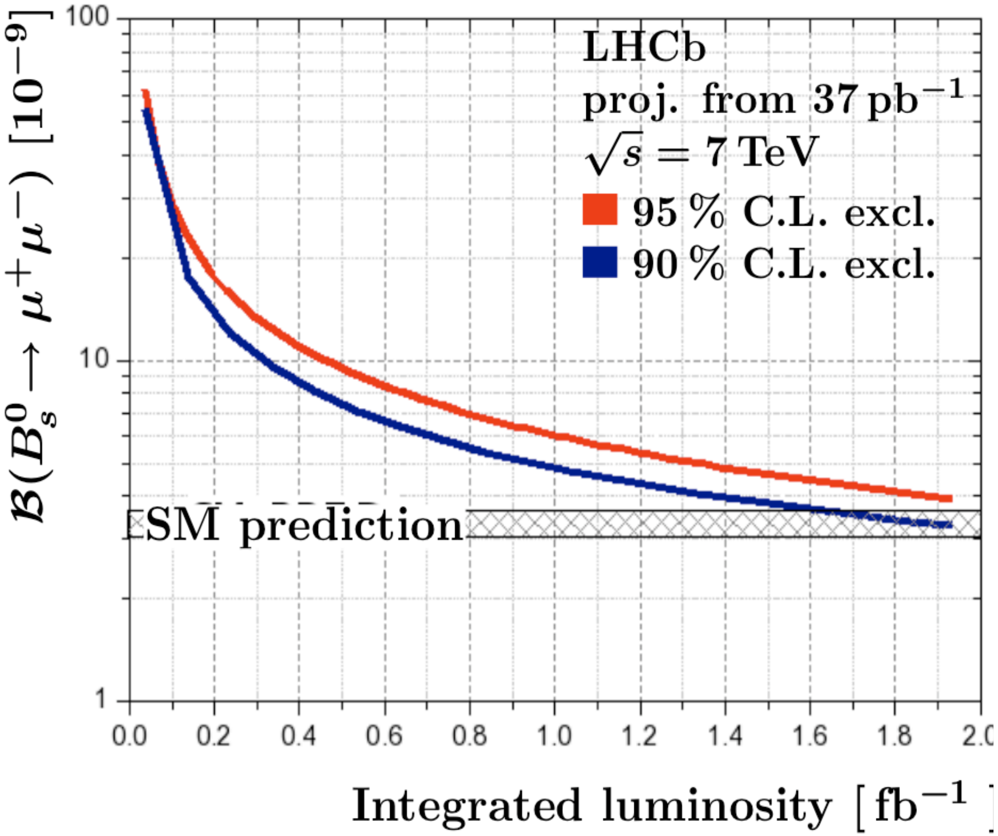


Search for $B_{s,d} \to \mu^+\mu^-$

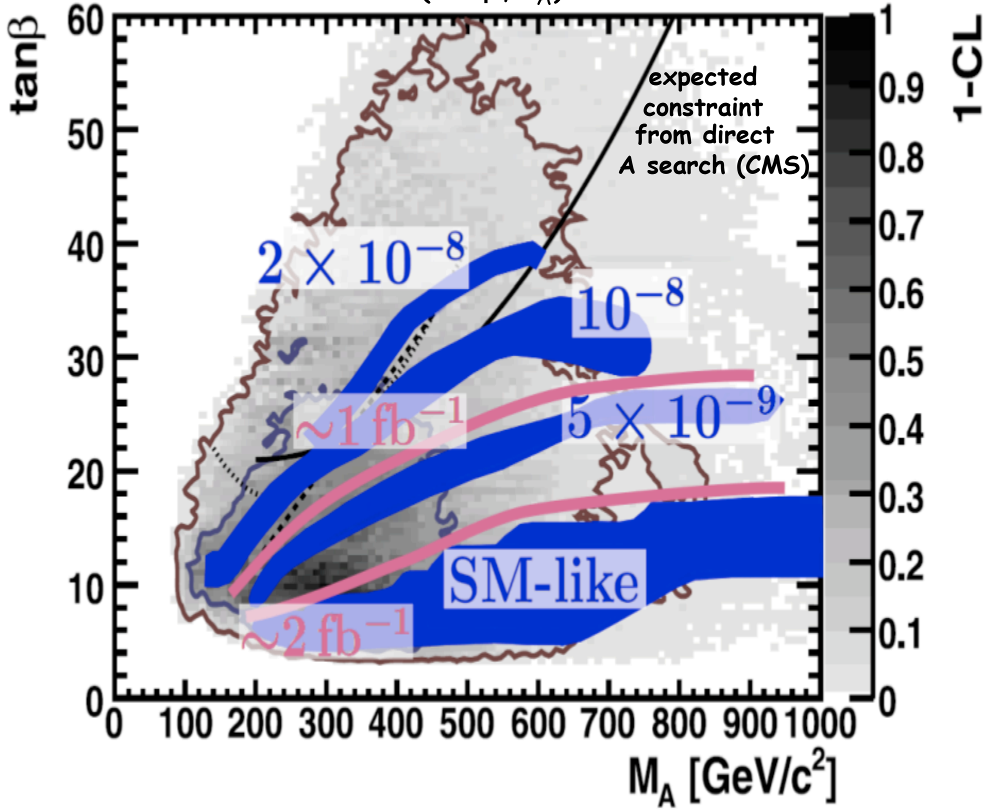
- LHCb perspective :

Extrapolation from the 37 pb^{-1} analyzed so far :

[Buchmueller et al., EJP C64, 391 (2009)]



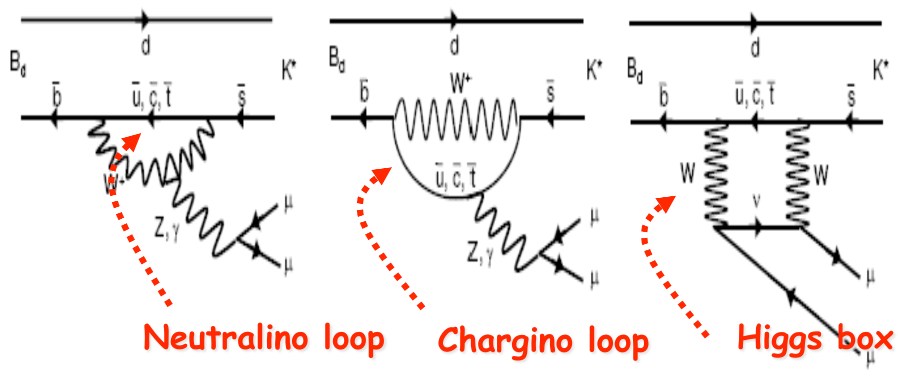
data constraint on (tanβ,m_A) in NUHM1 model



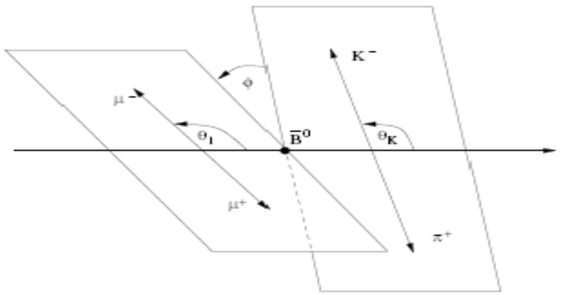
LHCb will explore an interesting region in the 2011-2012 long run

Dynamics of $B_d \to K^* \mu^+ \mu^-$

- Suppressed FCNC in b→s EW-penguin transition
  - BR = $(1.09 \pm 0.12)\,10^{-6}$ [Babar,Belle,CDF - HFAG 2010]

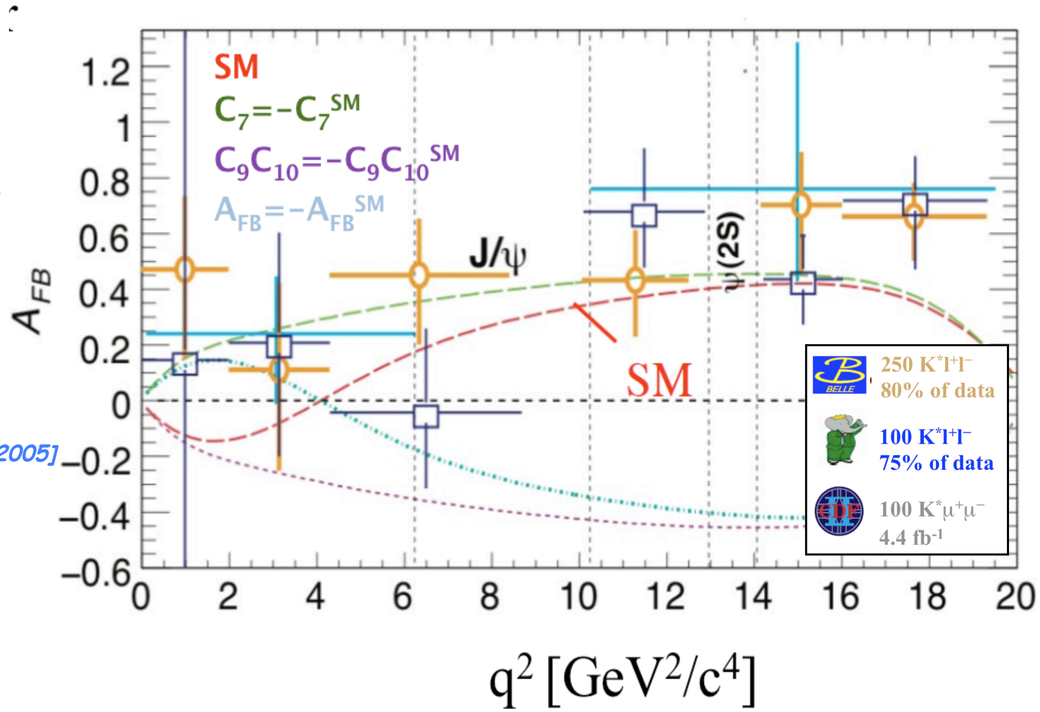


- Lepton angular distribution affected by NP



- Several observable to test the dynamics
  - $q^2 = m^2_{\mu+\mu-}$ distribution
  - $A_{FB}(q^2)$: forward-backward asymmetry in Θ_μ
- Zero-crossing point $A_{FB}(s_0) = 0$ prediction depends on Wilson Coefficient C_7 & C_9

$$q_0^2 = (4.36^{+0.33}_{-0.31})\ GeV^2/c^4$$ [Beneke et al. EPJC41:173-188;2005]

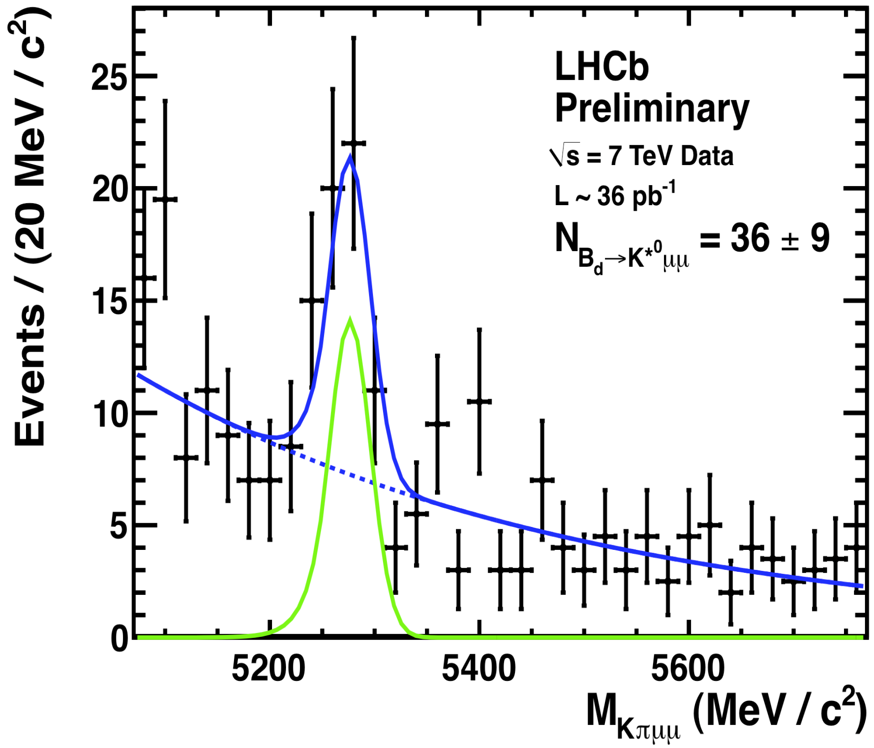


$B^0 \to K^* \mu^+ \mu^-$ observed

LHCb prospects :

Clean observation of 36±9 events in 36 pb^{-1} (2010 data) close to expectation

With 300 pb^{-1} (summer conference) LHCb expects to be competitive with existing measurements



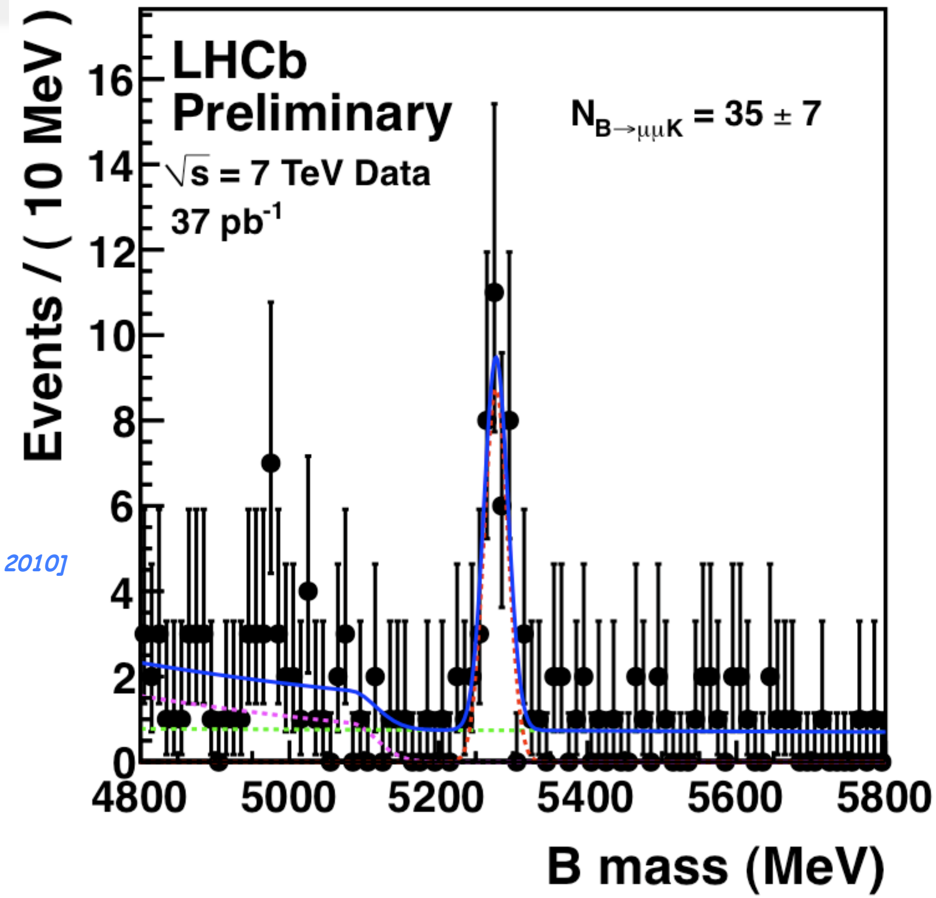
Main experimental difficulty will be to control the bias introduced by the detector acceptance, trigger & selection

good MC/data agreement so far for the same final state control channel $B_s \to J/\psi(\mu^+\mu^-)K^*$

$B^+ \to K^+\mu^+\mu^-$ observed

$B^+ \to K^+\mu^+\mu^-$ observed

Clean observation of 35±7 events in 36 pb^{-1} (2010 data)



Rarest B decay at LHCb so far

$B(B^+ \to K^+\mu^+\mu^-) \sim (4.3\pm0.5)\times10^{-7}$ *[Babar, Belle - HFAG 2010]*

Motivation :

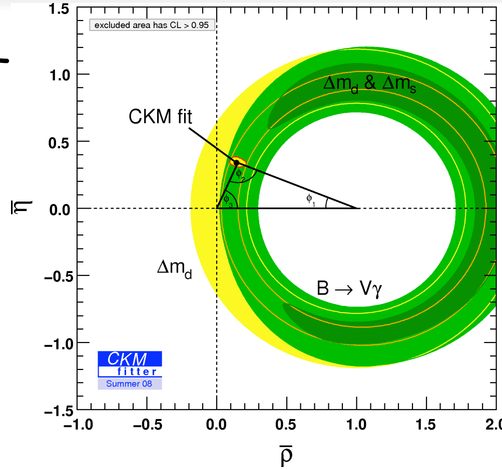
Test SM prediction $B(B\to Kee)/B(B\to K\mu\mu)\sim1$

Cross-check to $K^*\mu\mu$: no forward-backward asymmetry expected

Photon polarization in b→sγ

- Radiative b→qγ FCNC penguin (q=d,s) :

BR & asymmetry of exclusive mode provides a direct constraint on UT



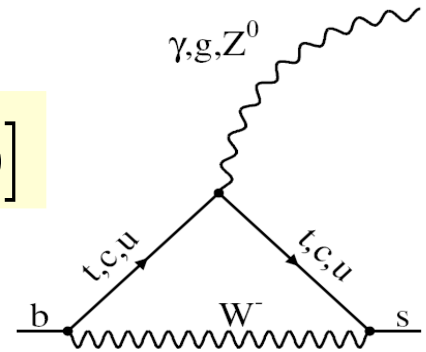
Right-handed photon is suppressed by (m_q/m_b) within SM

$$\tan\Psi = \left|\frac{A(B_q \to f^{CP}\gamma_R)}{A(B_q \to f^{CP}\gamma_L)}\right|$$ is a sensitive parameter for NP search

- Time-dependent decay rate for b→qγ is sensitive to Ψ

$$\Gamma(\overset{(-)}{B}_q \to f^{CP}\gamma) = |A|^2 e^{-\Gamma_q\tau}\left[\cosh(\Delta\Gamma_q\tau/2) + A_q^{\Delta}\sinh(\Delta\Gamma_q\tau/2) \pm C_q\cos(\Delta m_q\tau) \mp S_q\sin(\Delta m_q\tau)\right]$$

$$A_s^{\Delta} \approx \sin(2\psi) \approx 0.1 \text{ within SM}$$



$b \to s\gamma_L + (m_s/m_b) \times s\gamma_R$

- No sensitivity to A^{Δ} in B_d due to very small ΔΓ/Γ
- $B_s \to \Phi\gamma$ is a promising channel for the extraction of $A^{\Delta}\sim\sin(2\Psi)$
- Reliable theoretical prediction at NNLO → probe for NP in loop

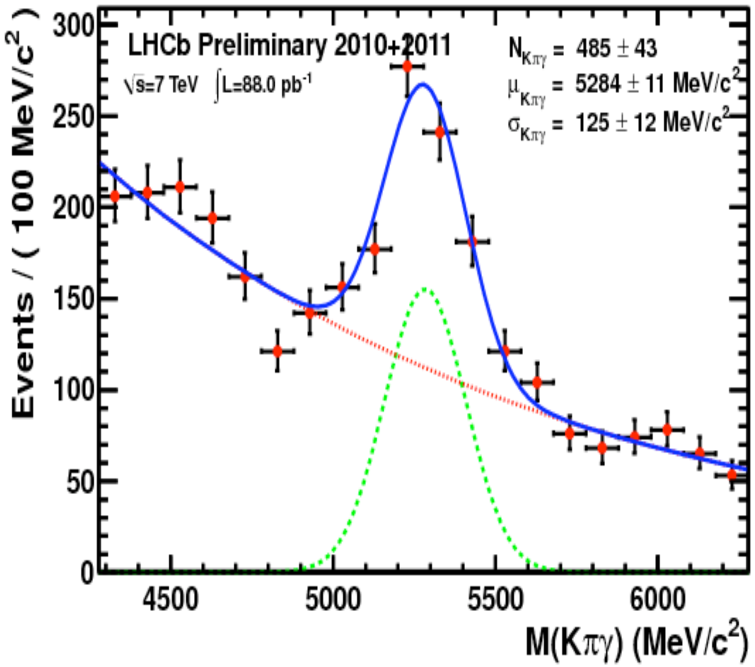
Photon polarization in b→sγ

- LHCb prospect with radiative decays
  - $B^0 \to K^*(K\pi)\gamma$ is observed

$B(B^0 \to K^*\gamma) = (43.3 \pm 1.5) \times 10^{-6}$ *[Babar,Belle, Cleo - HFAG 2010]*

reference channel for other radiative decays
(calorimeter energy, photon trigger)

Mass resolution dominated by
calorimeter energy resolution



Production rate in LHCb :

$(6.1 \pm 0.7)\ B^0 \to K^*(K\pi)\gamma\ /\ pb^{-1}$

-> expect O(6k) the end of 2011

-> measurement of the direct CP asymmetry by the end of year

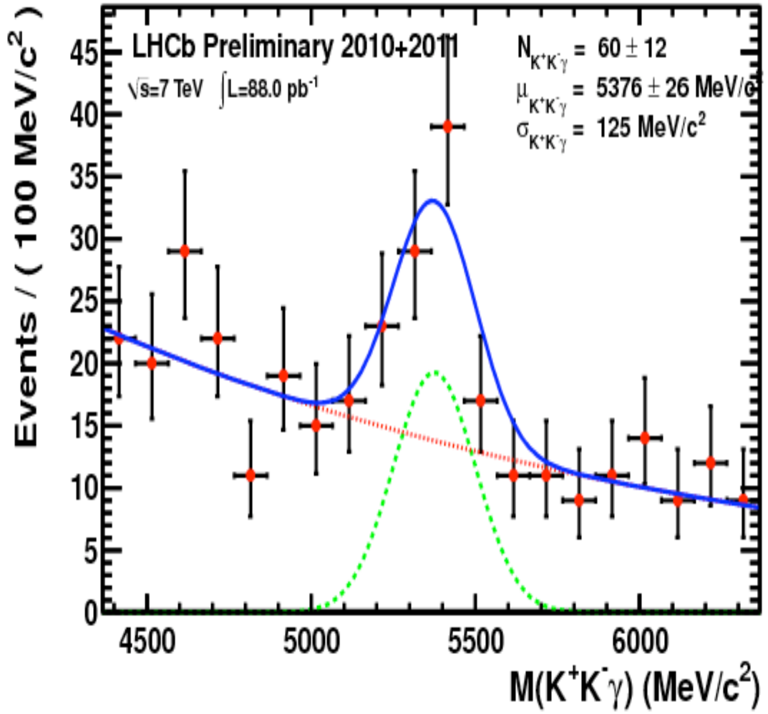
$A_{CP}(K^*\gamma)$ predicted less than 1% in SM
$A_{CP}(K^*\gamma) = (-1.6 \pm 2.3)\%$ *[Babar, PRL 103, 211802, 2009]*

Photon polarization in $b \to s\gamma$

- LHCb prospect with radiative decays (con't)
  - Evidence for $B_s \to \Phi(KK)\gamma$ in LHCb

first observed by Belle at $\Upsilon(5s)$ (35% accuracy on BR)

$$B(B_s \to \Phi\gamma) = (57^{+21}_{-18}) \times 10^{-6}$$ [Belle, PRL100,121801,2008]



LHCb production rate :

$(0.68 \pm 0.14)\ B_s \to \Phi(KK)\gamma\ /\ pb^{-1}$

-> O(700) $B_s \to \Phi\gamma$ by the end of 2011

→ measurement of the Branching Fraction ratio $B(B_s \to \Phi\gamma)/B(B^0 \to K^*\gamma)$ by this summer

Summary

With the limited statistics of 37 pb^{-1} collected in 2010, LHCb already has shown its very good potential to search NP manifestation in rare decays

From

Competitive limit from the very rare $B_{s,d} \to \mu^+\mu^-$ decay

Physics Letter B 699 (2011) 330-340, the LHCb collaboration

$$B(B_s \to \mu^+\mu^-) < 56\times10^{-9} \quad (\text{exp. limit} : 65\times10^{-9})$$
$$B(B_d \to \mu^+\mu^-) < 15\times10^{-9} \quad (\text{exp. limit} : 18\times10^{-9})$$

@ 95% CL

close to the world best limits from Tevatron

to

Several rare signal have been observed

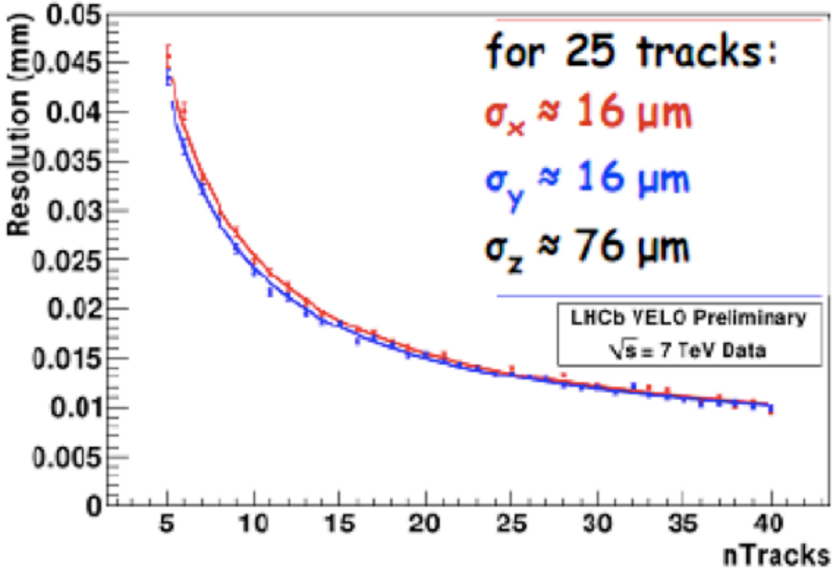
$B^0 \to K^*\mu^+\mu^-$, $B^+ \to K^+\mu^+\mu^-$, $B^0 \to K^*\gamma$, $B_s \to \Phi\gamma$

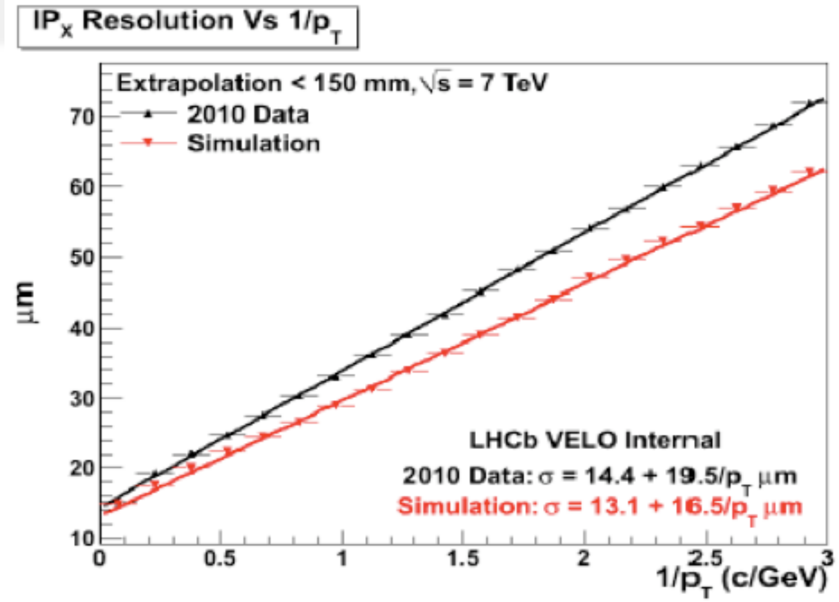
Interesting new results are expected with 2011 run

BACKUP

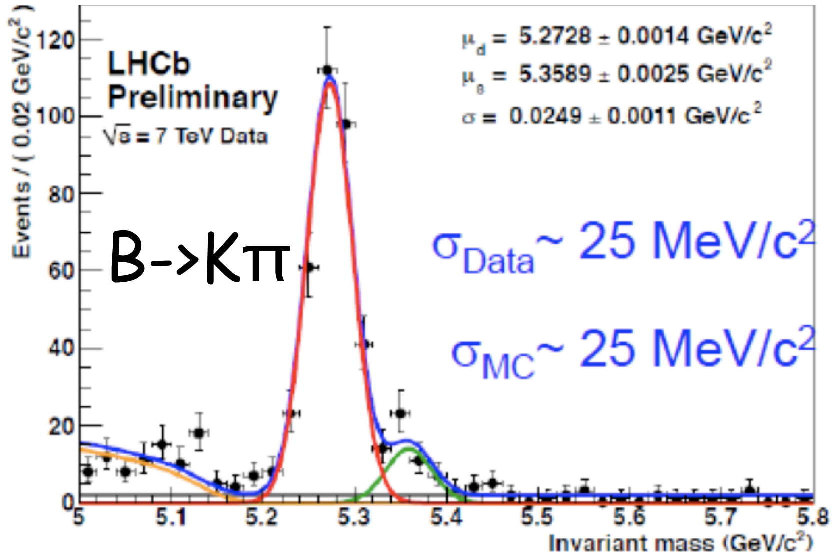
LHCb performance

Precise vertex determination

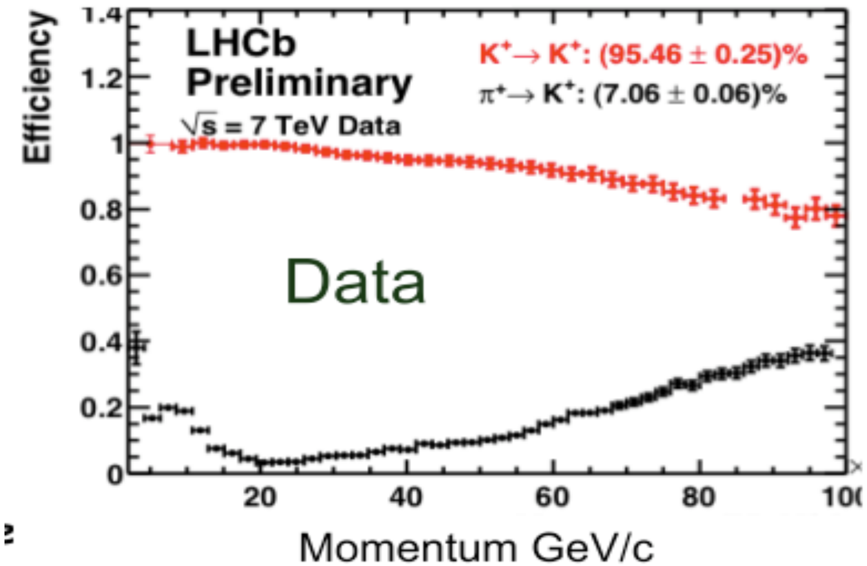




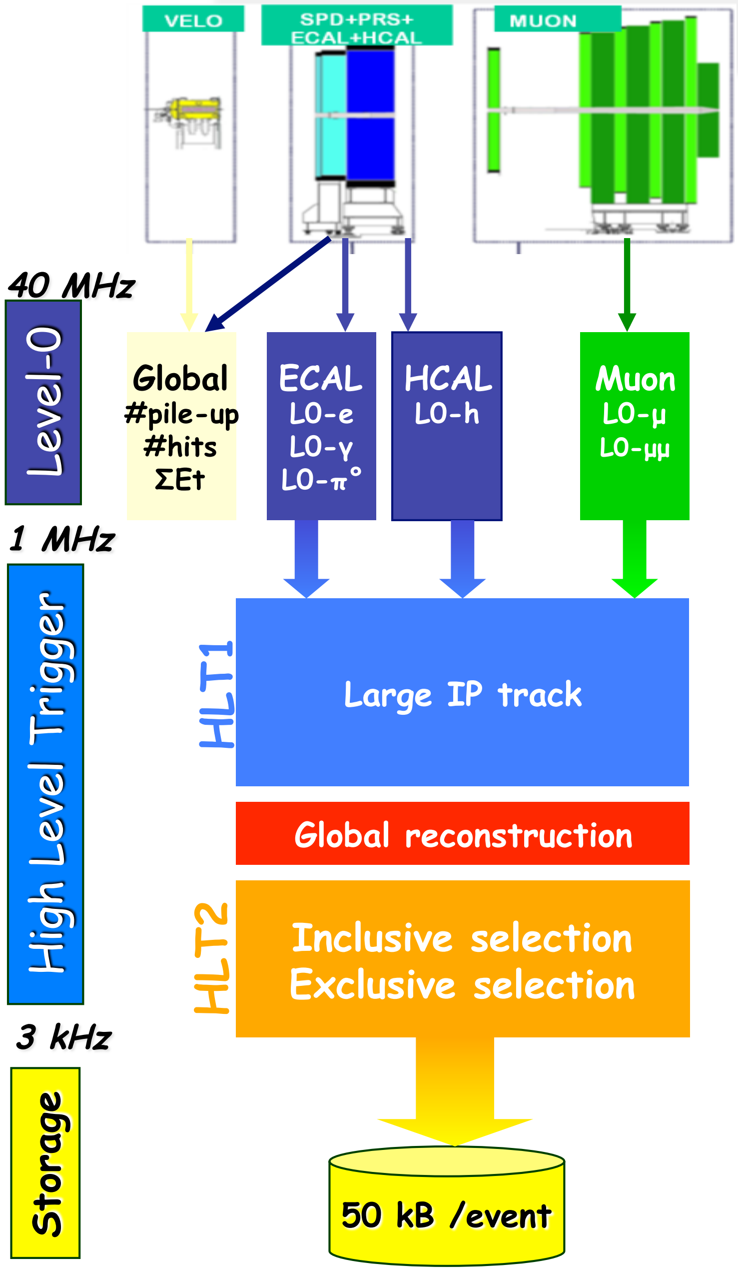
Excellent mass resolution



Efficient Particle Identification



The LHCb Trigger



The trigger strategy is a sensitive part of the rare decay selection and reconstruction

Level-0 Trigger (Hardware)

- Fully synchronous (40 MHz) custom electronics
  - Visible interaction rate 10 MHz → 1MHz
- Identification of highest P_T : h, e, γ, π° and μ candidates
  - typical threshold : μ ~ 1 GeV/c - h, e, γ, π° ~ 3-4 GeV/c
  - typical bandwdith : Hadron/Ecal/Muon ~ 700/200/100 kHz

High-Level Trigger (Software)

- 2000 multi-processor boxes farm.
- **HLT1 :**
  - add info from tracking, Vertex Locator
  - add impact parameter and lifetime cuts
- **HLT2 :**
  - global event reconstruction exclusive & inclusive selections

Storage @ 3 kHz

Trigger performance

- Trigger typical performance

	ε(L0)	ε(HLT)	ε(total)
Hadronic	50%	80%	40%
Electromagnetic	70 %	60%	40%
Muon	90%	80%	70%

ε corrected for acceptance and selection

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%

Search for $B_{s,d} \to \mu^+\mu^-$

	$\mathcal{B}$ $(\times 10^{-5})$	$\frac{\epsilon^{REC}_{norm}\epsilon^{SEL\|REC}_{norm}}{\epsilon^{REC}_{sig}\epsilon^{SEL\|REC}_{sig}}$	$\frac{\epsilon^{TRIG\|SEL}_{norm}}{\epsilon^{TRIG\|SEL}_{sig}}$	N_{norm}	$\alpha_{B^0_s\to\mu^+\mu^-}$ $(\times 10^{-9})$	$\alpha_{B^0\to\mu^+\mu^-}$ $(\times 10^{-9})$
$B^+ \to J/\psi(\mu\mu)K^+$	5.98 ± 0.22	0.49 ± 0.02	0.96 ± 0.05	$12,366 \pm 403$	8.4 ± 1.3	2.27 ± 0.18
$B^0_s \to J/\psi(\mu\mu)\phi(KK)$	3.4 ± 0.9	0.25 ± 0.02	0.96 ± 0.05	760 ± 71	10.5 ± 2.9	2.83 ± 0.86
$B^0 \to K^+\pi^-$	1.94 ± 0.06	0.82 ± 0.06	0.072 ± 0.010	578 ± 74	7.3 ± 1.8	1.99 ± 0.40

Summary of the factors and their uncertainties needed to calculate the normalization factors ($\alpha_{B^0_{(s)}\to\mu^+\mu^-}$) for the three normalization channels considered. The trigger efficiency and number of $B^0 \to K^+\pi^-$ candidates correspond to only TIS events, as described in the text.

Normalization factors: systematic uncertainties

	ε(REC)xε(SEL)	ε(TRIG)	fd/fs	N	BR	total
$B^\pm \to J/\psi K^\pm$	4%	5%	13%	3%	4%	15%
$B_s \to J/\psi\phi$	8%	5%	--	9%	26%(*)	28%
$B^0_d \to K\pi$	7%	14%	13%	13%	3%	23%

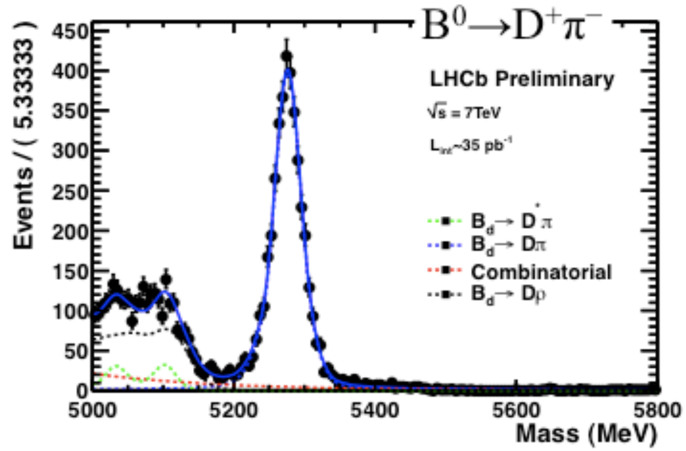
(*) from Belle @ Υ(5S): arXiv:0905.4345

f_d/f_s: present and future

Currently use HFAG average of LEP/Tevatron: f_d/f_s=3.71±0.47

13% accuracy

http://www.slac.stanford.edu/xorg/hfag/osc/end_2009/#FRAC



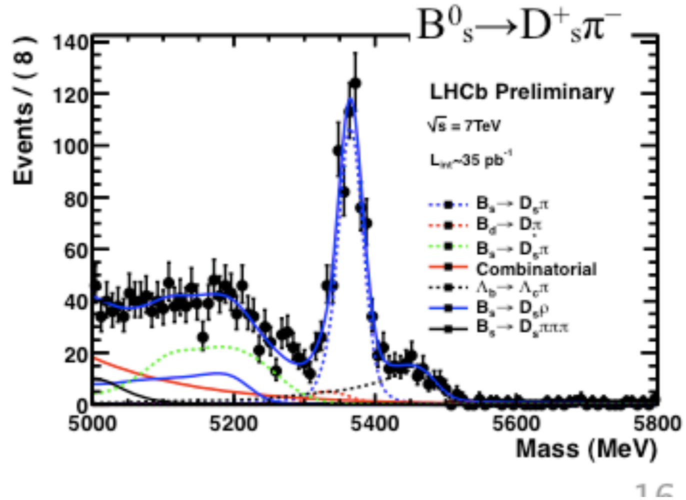
Preliminary results from LHCb

1) f_d/f_s from relative yields of $B^0 \to D^+K^-$ (and $B^0 \to D^+\pi^-$) to $B^0_s \to D^+_s\pi^-$, 35 pb^{-1} :

f_d/f_s=4.02±0.52 using $B^0 \to D^+\pi^-$

Fleischer et al., Phys.Rev.D83,014017(2011)

LHCb-CONF-2011-013



2) f_d/f_s from semileptonic decays, 3 pb^{-1} :

f_d/f_s=3.84±0.34

Search for $B_{s,d} \to \mu^+\mu^-$

Geometrical Likelihood Bins

$B_s \to \mu\mu$ search window

Invariant Mass bins (MeV/c^2)

Invariant mass bin (MeV/c^2)		GL bin [0, 0.25]	GL bin [0.25, 0.5]	GL bin [0.5, 0.75]	GL bin [0.75, 1]
[−60, −40]	Exp. bkg.	$56.9^{+1.1}_{-1.1}$	$1.31^{+0.19}_{-0.17}$	$0.282^{+0.076}_{-0.065}$	$0.016^{+0.021}_{-0.010}$
	Exp. sig.	$0.0076^{+0.0034}_{-0.0030}$	$0.0050^{+0.0027}_{-0.0020}$	$0.0037^{+0.0015}_{-0.0011}$	$0.0047^{+0.0015}_{-0.0010}$
	Observed	39	2	1	0
[−40, −20]	Exp. bkg.	$56.1^{+1.1}_{-1.1}$	$1.28^{+0.18}_{-0.17}$	$0.269^{+0.072}_{-0.062}$	$0.015^{+0.020}_{-0.009}$
	Exp. sig.	$0.0220^{+0.0084}_{-0.0079}$	$0.0146^{+0.0066}_{-0.0053}$	$0.0107^{+0.0036}_{-0.0026}$	$0.0138^{+0.0034}_{-0.0024}$
	Observed	55	2	0	0
[−20, 0]	Exp. bkg.	$55.3^{+1.1}_{-1.1}$	$1.24^{+0.17}_{-0.16}$	$0.257^{+0.069}_{-0.059}$	$0.014^{+0.018}_{-0.009}$
	Exp. sig.	$0.038^{+0.015}_{-0.014}$	$0.025^{+0.012}_{-0.010}$	$0.0183^{+0.0063}_{-0.0047}$	$0.0235^{+0.0059}_{-0.0042}$
	Observed	73	0	0	0
[0, 20]	Exp. bkg.	$54.4^{+1.1}_{-1.1}$	$1.21^{+0.17}_{-0.16}$	$0.246^{+0.066}_{-0.057}$	$0.013^{+0.017}_{-0.008}$
	Exp. sig.	$0.03761^{+0.015}_{-0.015}$	$0.025^{+0.012}_{-0.010}$	$0.0183^{+0.0063}_{-0.0047}$	$0.0235^{+0.0060}_{-0.0044}$
	Observed	60	0	0	0
[20, 40]	Exp. bkg.	$53.6^{+1.1}_{-1.0}$	$1.18^{+0.17}_{-0.15}$	$0.235^{+0.063}_{-0.054}$	$0.012^{+0.015}_{-0.007}$
	Exp. sig.	$0.0220^{+0.0084}_{-0.0081}$	$0.0146^{+0.0067}_{-0.0054}$	$0.0107^{+0.0036}_{-0.0027}$	$0.0138^{+0.0035}_{-0.0025}$
	Observed	53	2	0	0
[40, 60]	Exp. bkg.	$52.8^{+1.0}_{-1.0}$	$1.15^{+0.16}_{-0.15}$	$0.224^{+0.060}_{-0.052}$	$0.011^{+0.014}_{-0.007}$
	Exp. sig.	$0.0076^{+0.0031}_{-0.0027}$	$0.0050^{+0.0025}_{-0.0019}$	$0.0037^{+0.0013}_{-0.0010}$	$0.0047^{+0.0013}_{-0.0010}$
	Observed	55	1	0	0

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Search for $B_{s,d} \to \mu^+\mu^-$

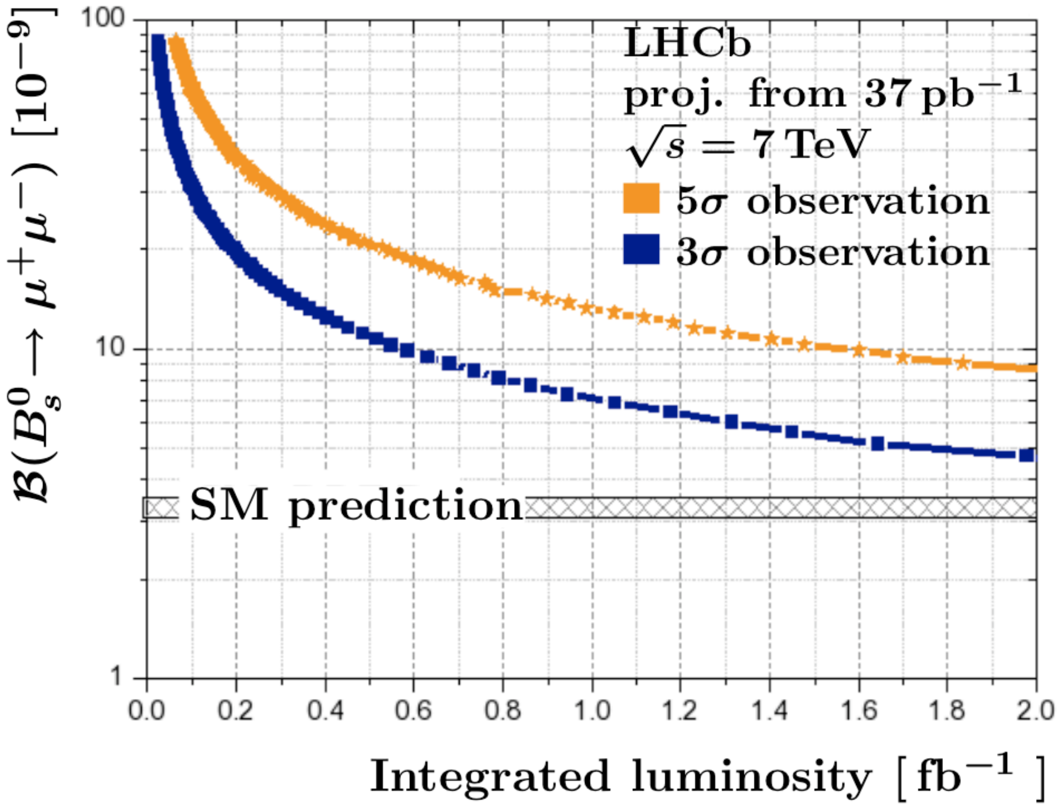
$B_d \to \mu\mu$ search window

Invariant Mass bins (MeV/c^2)		Geometrical Likelihood Bins [0, 0.25]	[0.25, 0.5]	[0.5, 0.75]	[0.75, 1]
[−60, −40]	Exp. bkg.	$60.8^{+1.2}_{-1.1}$	$1.48^{+0.19}_{-0.18}$	$0.345^{+0.084}_{-0.073}$	$0.024^{+0.027}_{-0.014}$
	Exp. sig.	$0.0009^{+0.0004}_{-0.0003}$	$0.0006^{+0.0003}_{-0.0002}$	$0.0004^{+0.0002}_{-0.0001}$	$0.0006^{+0.0002}_{-0.0001}$
	Observed	59	2	0	0
[−40, −20]	Exp. bkg.	$59.9^{+1.1}_{-1.1}$	$1.44^{+0.19}_{-0.17}$	$0.329^{+0.080}_{-0.070}$	$0.022^{+0.024}_{-0.013}$
	Exp. sig.	$0.0026^{+0.009}_{-0.009}$	$0.0017^{+0.0008}_{-0.0006}$	$0.0013^{+0.0004}_{-0.0003}$	$0.0016^{+0.0004}_{-0.0002}$
	Observed	67	0	0	0
[−20, 0]	Exp. bkg.	$59.0^{+1.1}_{-1.1}$	$1.40^{+0.18}_{-0.17}$	$0.315^{+0.077}_{-0.067}$	$0.020^{+0.022}_{-0.012}$
	Exp. sig.	$0.0045^{+0.0017}_{-0.0017}$	$0.0030^{+0.0014}_{-0.0011}$	$0.00219^{+0.00067}_{-0.00054}$	$0.00280^{+0.00060}_{-0.00045}$
	Observed	56	2	0	0
[0, 20]	Exp. bkg.	$58.1^{+1.1}_{-1.1}$	$1.36^{+0.18}_{-0.16}$	$0.300^{+0.073}_{-0.064}$	$0.019^{+0.021}_{-0.011}$
	Exp. sig.	$0.0045^{+0.0017}_{-0.0017}$	$0.0030^{+0.0014}_{-0.0011}$	$0.00219^{+0.00067}_{-0.00054}$	$0.00280^{+0.00060}_{-0.00045}$
	Observed	60	0	0	0
[20, 40]	Exp. bkg.	$57.3^{+1.1}_{-1.1}$	$1.33^{+0.17}_{-0.16}$	$0.287^{+0.070}_{-0.061}$	$0.017^{+0.019}_{-0.010}$
	Exp. sig.	$0.0026^{+0.0009}_{-0.0009}$	$0.0017^{+0.0008}_{-0.0006}$	$0.0013^{+0.0004}_{-0.0003}$	$0.0016^{+0.0004}_{-0.0002}$
	Observed	42	2	1	0
[40, 60]	Exp. bkg.	$56.4^{+1.1}_{-1.1}$	$1.29^{+0.17}_{-0.16}$	$0.274^{+0.067}_{-0.058}$	$0.016^{+0.018}_{-0.009}$
	Exp. sig.	$0.0009^{+0.0003}_{-0.0003}$	$0.0006^{+0.0003}_{-0.0002}$	$0.0004^{+0.0001}_{-0.0001}$	$0.0006^{+0.0002}_{-0.0001}$
	Observed	49	2	0	0

Search for $B_{s,d} \to \mu^+\mu^-$

- LHCb perspective :

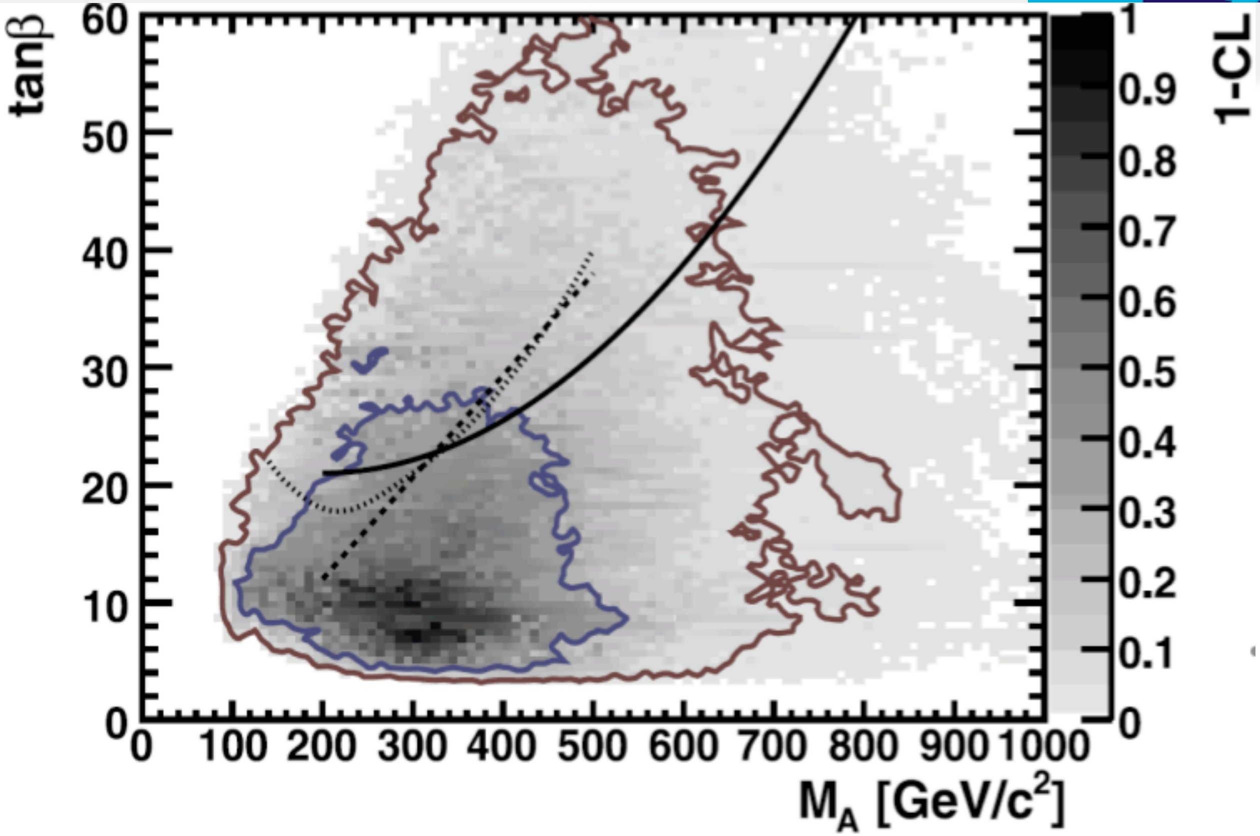
Extrapolation from the 37 pb^{-1} analyzed so far :



LHCb will explore an interesting region in the 2011-2012 long run

Correlation between $\tan\beta$ and M_A in the NUHM1 model.

Eur. Phys. J. C64, 391 (2009)



Direct Search:

5σ discovery contours for observing the heavy MSSM Higgs bosons H, A with

$$H, A \to \tau + \tau \to \text{jets (solid line)},$$
$$\to \text{jet} + \mu \text{ (dashed line)},$$
$$\to \text{jet} + e \text{ (dotted line)},$$

assuming 30 or 60 fb^{-1} collected by **CMS**.

Photon polarization in $B^0 \to K^*ee$

- Another way to measure the photon polarization :

  -> Angular analysis of the decay $B_d \to K^*ee$ decay in the low q^2 region

  [HFAG2010]

  $B(B^0 \to K^*ee) = (1.03^{+0.19}_{-0.17}) \times 10^{-6}$

  -> preliminary analysis of LHCb data indicates that O(100) are to be collected in 2 fb^{-1}

  -> expected to give a competitive measurement to $B^0 \to \Phi\gamma$

  -> additional information from $K^*\mu\mu$ at low q^2 could be used