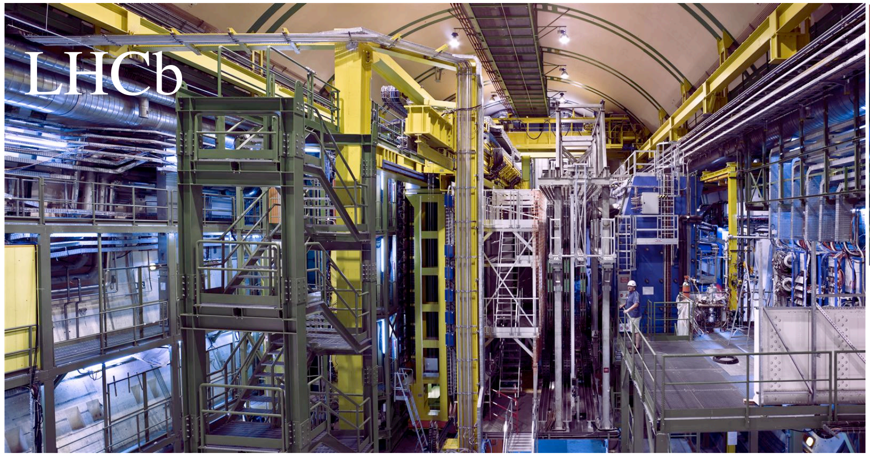


Physics with first LHCb data

Olivier Schneider

on behalf of LHCb

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Physics with first LHCb data

- Introduction
  - motivation and physics goals of LHCb
- Preliminary results
  - K_S production cross section (2009 data)
  - $\bar{\Lambda}/\Lambda$ production ratio (2010 data)
- First exciting look and prospects
  - open charm
  - quarkonium
  - open beauty
  - other beast
- Summary

LHCb detector status and performance given in plenary talk by A. Golutvin (+ F. Maciuc, D. Wiedner, P. Xing)

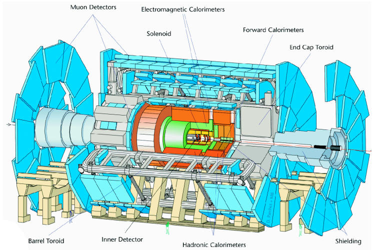
Details will be given in parallel sessions:

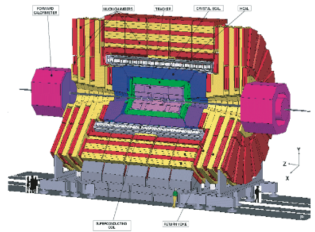
W. Bonivento	minimum bias
J. Marks	open charm
J. Cogan	J/ψ production
J. Serrano	rare decays with dimuons
G. Conti	CP violation in B decays

Two approaches to New Physics search

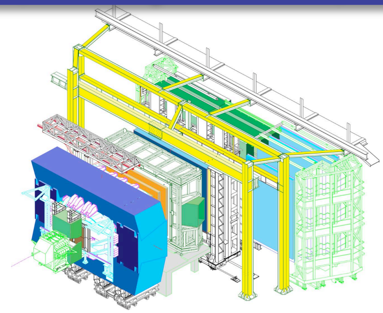
- New Physics (NP) models introduce new particles at the TeV scale or above, which could
  - be produced and observed directly as **real particles** with specific signatures
  - appear as **virtual particles in loop processes**, leading to observable deviations from the pure Standard Model expectations
- TeV scale accessible at LHC:
  - **"direct" and "indirect" approaches are complementary and both needed**

Direct searches in high p_T physics
(mostly ATLAS & CMS)





Indirect searches in flavour physics
(mostly LHCb)



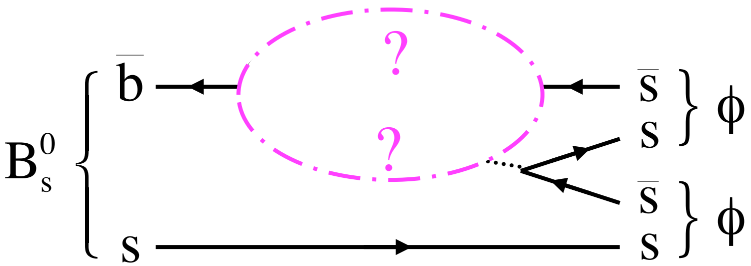
Strengths of indirect approach

- Can access higher scales and therefore see effect earlier:
  - Third quark family inferred by Kobayashi and Maskawa (1973) to explain small CP violation measured in kaon mixing (1964), but only directly observed in 1977 (b) and1995 (t)
  - Neutral currents ($\nu+N\rightarrow \nu+N$) discovered in 1973, but real Z discovered in 1983
- Can access the phases of the new couplings:
  - NP at TeV scale needs to have a "flavour structure" to provide the suppression mechanism for already observed FCNC processes → once NP is discovered, it is important to measure this structure (including new phases)

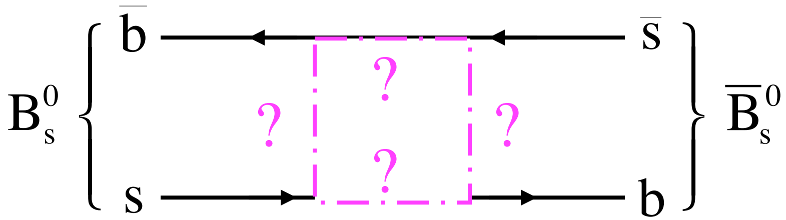
New Physics

$\Delta m_s \neq \Delta m_s^{SM} \propto |V_{ts}^2|$,

$\phi_s \neq \phi_s^{SM} = -\arg(V_{ts}^2) = 2\beta_s$



$B_s \rightarrow \phi\phi$ decay: "Penguin" diagram



B_s–$\bar{B}_s$ oscillations: "Box" diagram

Strategy for indirect NP search in B physics

- Measure FCNC transitions where New Physics is more likely to emerge, especially in b→s transitions which are less constrained by current data
  - Operator Product Expansion:

$$H_{\mathrm{eff}} = -\frac{4G_F}{\sqrt{2}} V_{tb} V_{ts}^* \sum_i \Big[\underbrace{C_i(\mu) O_i(\mu)}_{\text{left-handed part}} + \underbrace{C_i'(\mu) O_i'(\mu)}_{\substack{\text{right-handed part} \\ \text{suppressed in SM}}} \Big]$$

i = 1,2	Tree
i = 3 – 6,8	Gluon penguin
i = 7	Photon penguin
i = 9,10	Electroweak penguin
i = S	Higgs (scalar) penguin
i = P	Pseudoscalar penguin

  - New Physics may
    - modify $C_i^{(')}$ short-distance Wilson coefficients
    - add new long-distance operators $O_i^{(')}$
  - e.g. probe helicity structure in b→sγ and b→sμμ

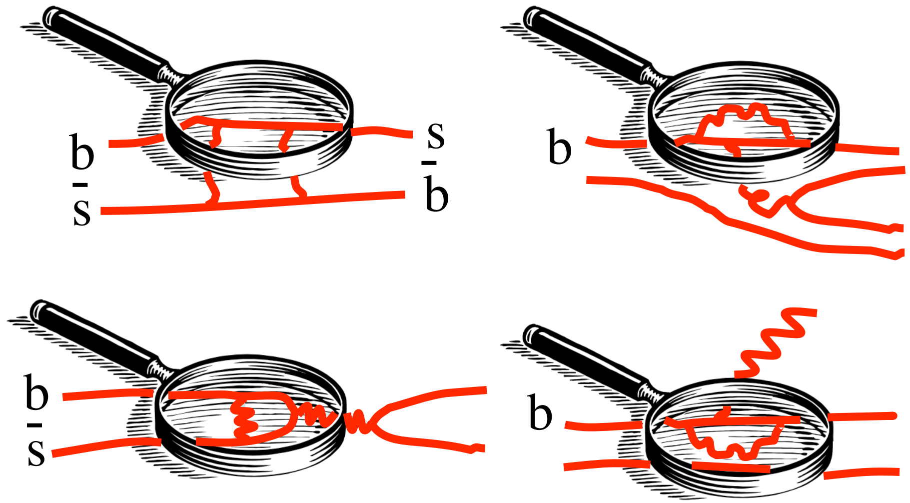
Single B decay measurements with NP discovery potential

- Improve measurement precision of CKM elements
  - Compare measurements of same quantity, which may or may not be sensitive to NP
  - Extract all CKM angles and sides in many different ways
    - any inconsistency will be a sign of New Physics

Precision CKM metrology, including NP-free determinations of CKM angle γ

LHCb “core” physics

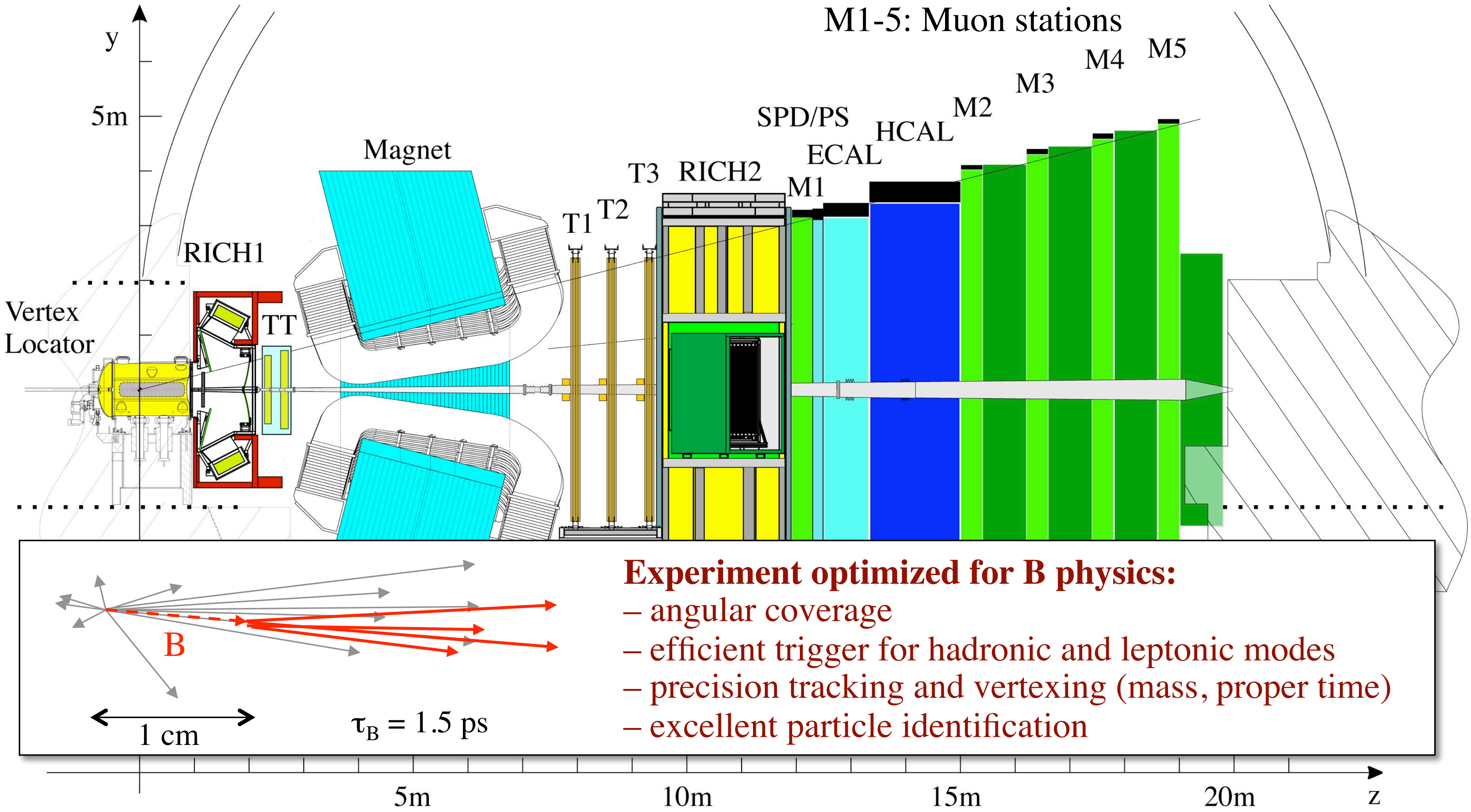
- **Selected key measurements:**
  - Search for $B_s \to \mu\mu$
  - Mixing-induced CP violation in $B_s \to J/\psi\phi$, $B_s \to \phi\phi$, ...
  - Charmless 2-body B decays
  - CKM angle γ from tree-level B decays
  - $B_s \to \phi\gamma$ and other radiative B decays
  - Asymmetries in $B^0 \to K^* l^+ l^-$ decays



- **Roadmap:**
  - LHCb-PUB-2009-029, arXiv:0912.4179v2 [hep-ex], Feb 2010
  - Main assumptions:
    - 2 fb^{-1} per year (=10^7 s), 25 ns bunch crossing
    - $\sqrt{s} = 14$ TeV, $\sigma_{bb} = 500$ μb

LHCb detector

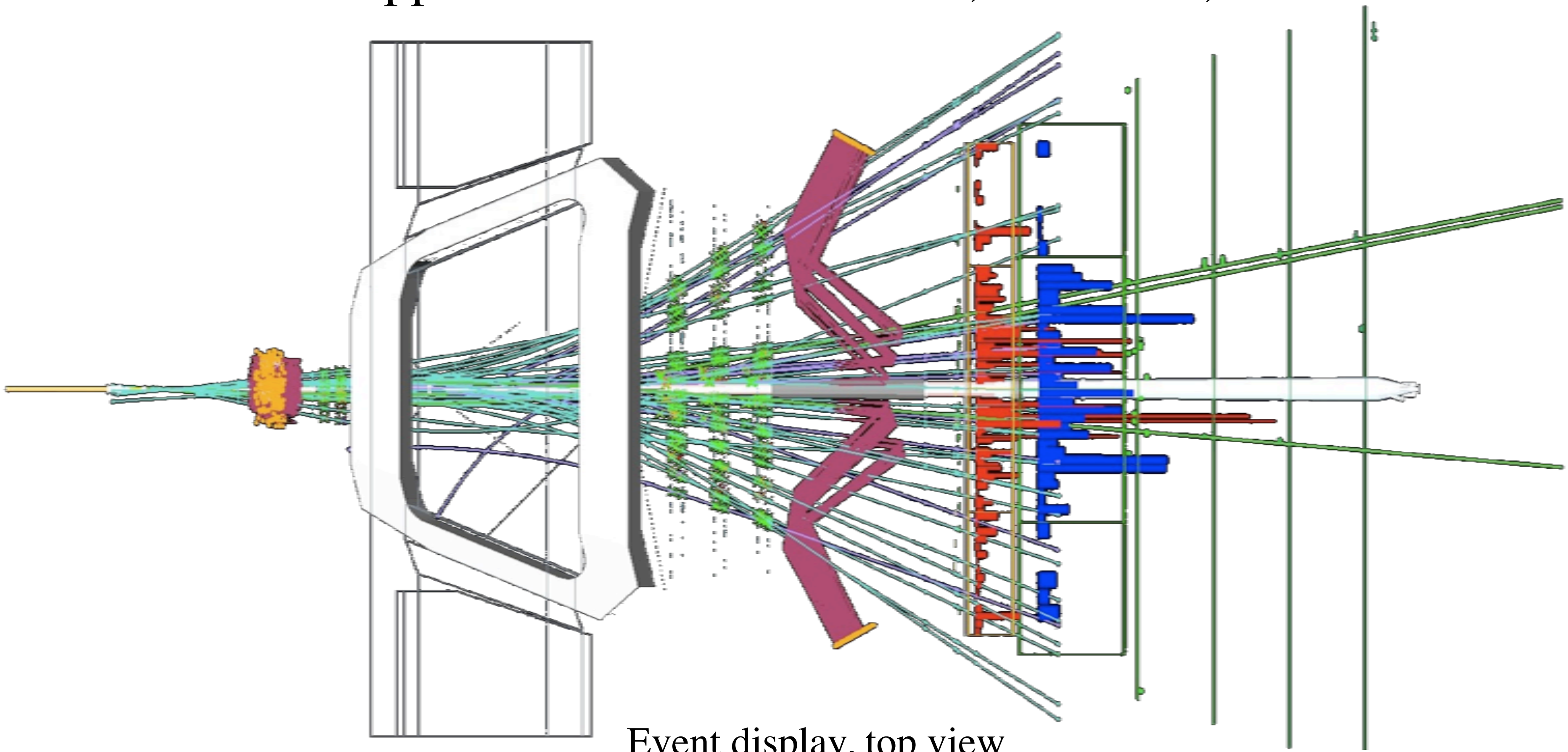
VELO: Vertex Locator
TT, T1-3: Tracking stations
RICH1-2: Ring Imaging Cherenkov detectors
ECAL, HCAL: Calorimeters
M1-5: Muon stations



Experiment optimized for B physics:
– angular coverage
– efficient trigger for hadronic and leptonic modes
– precision tracking and vertexing (mass, proper time)
– excellent particle identification

Day 1 at 7 TeV

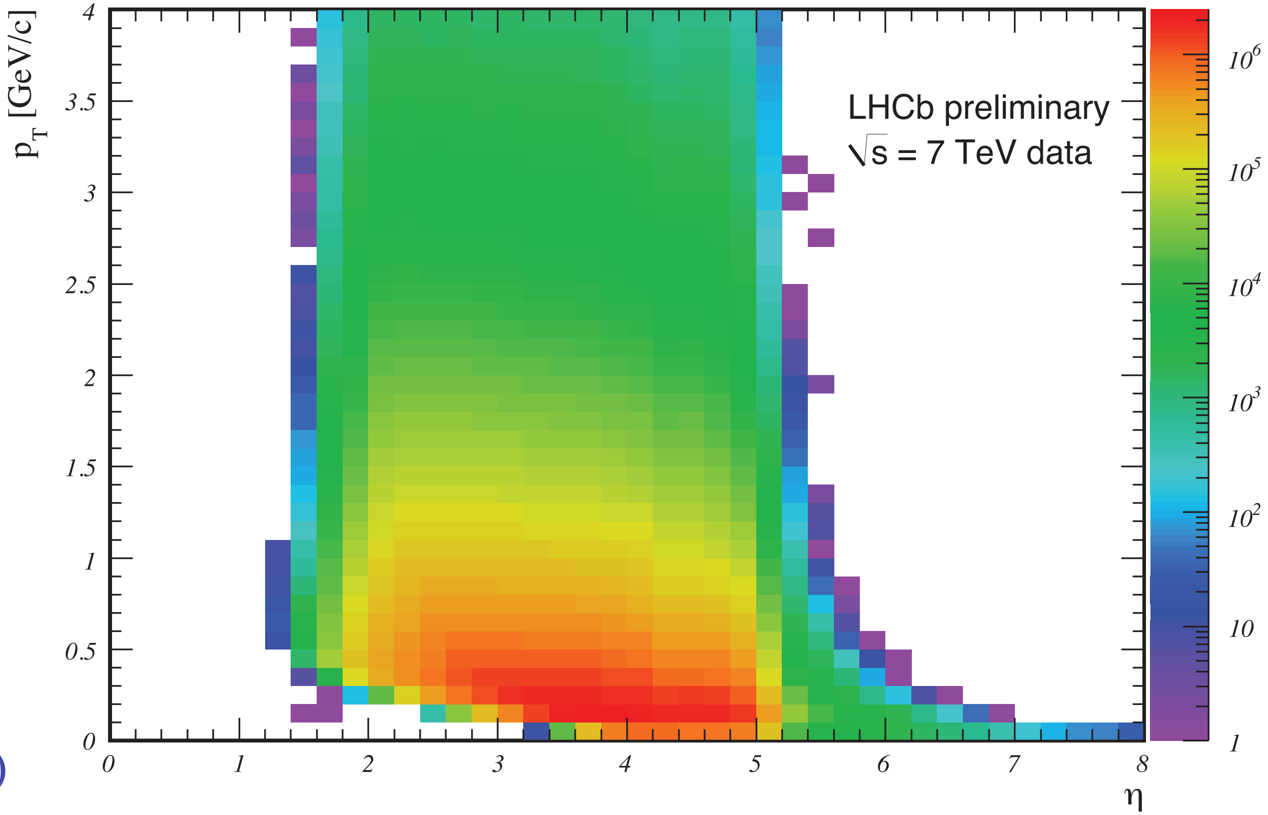
pp collision at 3.5+3.5 TeV, March 30, 2010



Event display, top view

Charged track acceptance

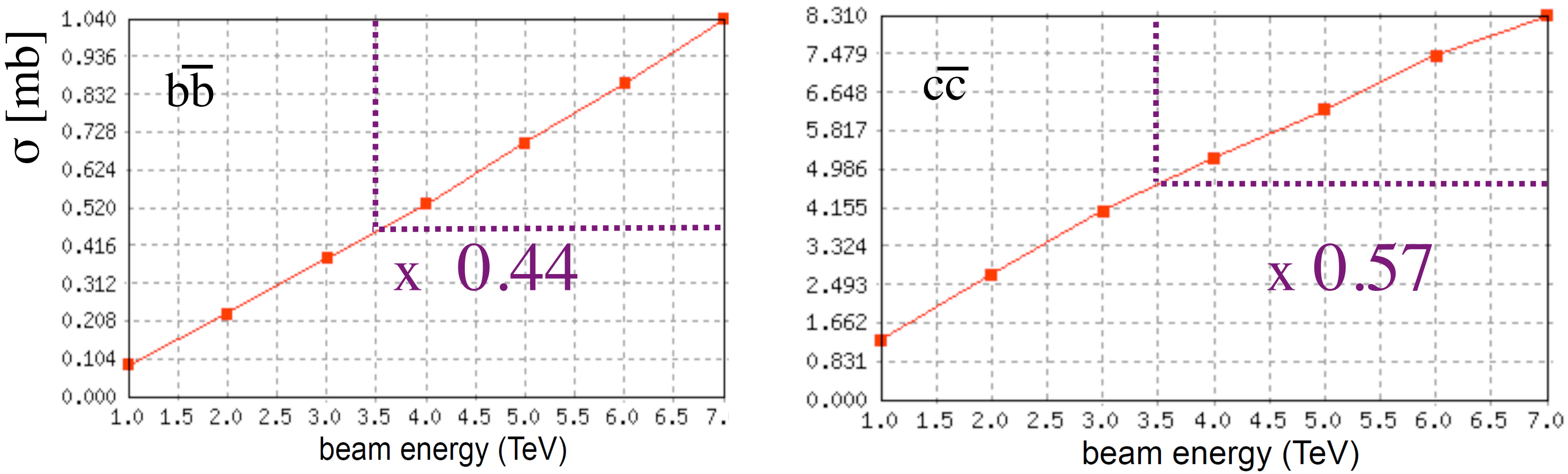
- 7 TeV data (~10M events):
  - use "micro-bias" trigger: at least one charged track seen in the detector
  - select events with one reconstructed primary vertex (PV)
  - look at raw distribution of charged tracks traversing VELO and tracking stations (i.e. with well measured p)
    - illustrative of LHCb acceptance



- Eventually:
  - MC will need to be tuned to reproduce minimum bias data (but not crucial for core physics program)

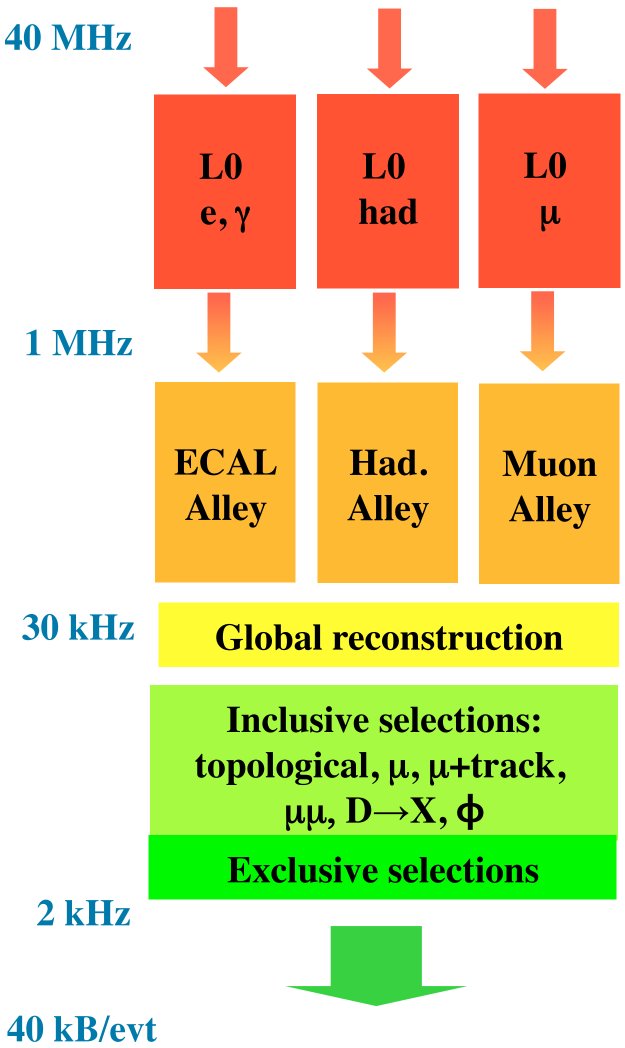
2010–2011 run at 7 TeV

- Beam energy at half of design value
  - — bottom and charm production cross sections (from PYTHIA 6.4) divided by ~2
    - no dramatic effect on physics reach
  - — Most previous MC predictions assumed $\sigma_{bb} = 0.5$ mb anyway



- Design luminosity for LHCb: 2×10^{32} cm^{-2} s^{-1} on average
  - — expected to be reached in 2011
  - — lower luminosities in 2010 allow for lower trigger thresholds

LHCb trigger scheme



Level-0

'High-pt' signals in calorimeter & muon systems

HLT1

Associate Level-0 signals with tracks, especially those in VELO displaced from PV

HLT2

Full detector information available for inclusive and exclusive selections

- At design luminosity:
  - trigger optimized for B physics
- At low luminosity in 2010 (up to few 10^{31} $cm^{-2}s^{-1}$):
  - trigger thresholds can be lowered significantly
  - large gain in D efficiency

  → **great window of opportunity for charm physics !**

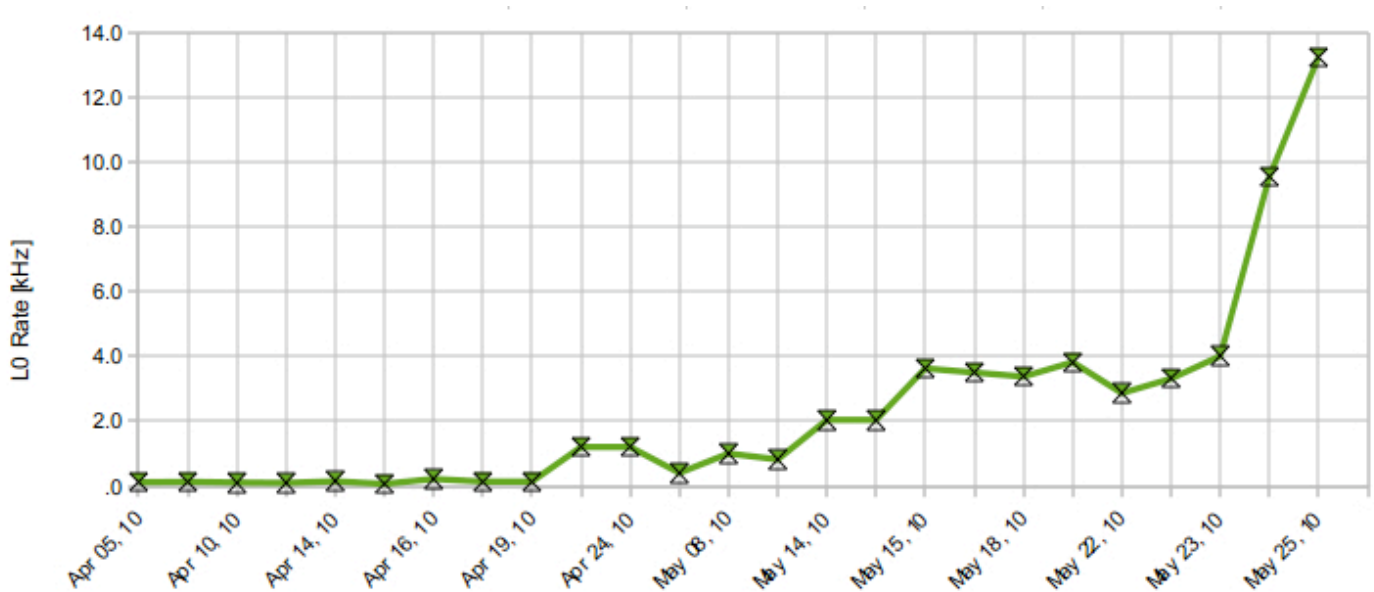
	charm	hadr. B	lept. B
nominal L	~ 10%	~ 40%	~ 90%
low L (2010)	40–50%	75–80%	> 90%

Trigger strategy for first data

Interaction rate	L0 output rate	HLT1 output rate	HLT2 output rate
< 2 kHz	< 2 kHz		
< 25 kHz	< 25 kHz	2 kHz	
< 300 kHz	< 300 kHz	10 kHz	2 kHz

— No real rate reduction at L0, so far (minimum bias trigger + random trigger)

— Running HLT1 in rejection mode since ~2 weeks



$L_{int} \sim 14\ nb^{-1}$ **recorded so far**

First physics and luminosity

- First physics results = production measurements !
  - strangeness, charm, bottom, …
- Luminosity determination is needed to turn results into cross sections
  - direct methods (measurements of the beam themselves):
    - e.g. beam imaging using beam-gas interactions
      - expect 5–10% precision by end 2010

    M. Ferro-Luzzi, NIM A 553 (2005) 388
  - indirect methods (measurements of physics process with known cross section)
    - e.g. quasi-elastic dimuon production via two-photon fusion ($pp \to pp\mu\mu$)
      - expect ~2% precision by end 2011
- Used 2009 pilot run data at $\sqrt{s} = 0.9$ TeV
  to demonstrate feasibility of absolute cross section measurement:
  - measurement of prompt K_S production cross section
    with luminosity obtained from beam-gas method

Luminosity with 2009 data

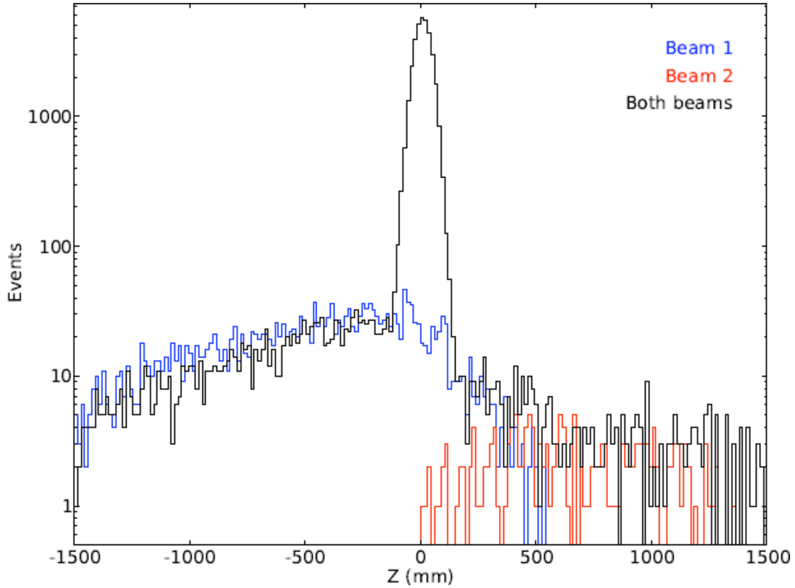
- Luminosity for N pairs of colliding bunches:

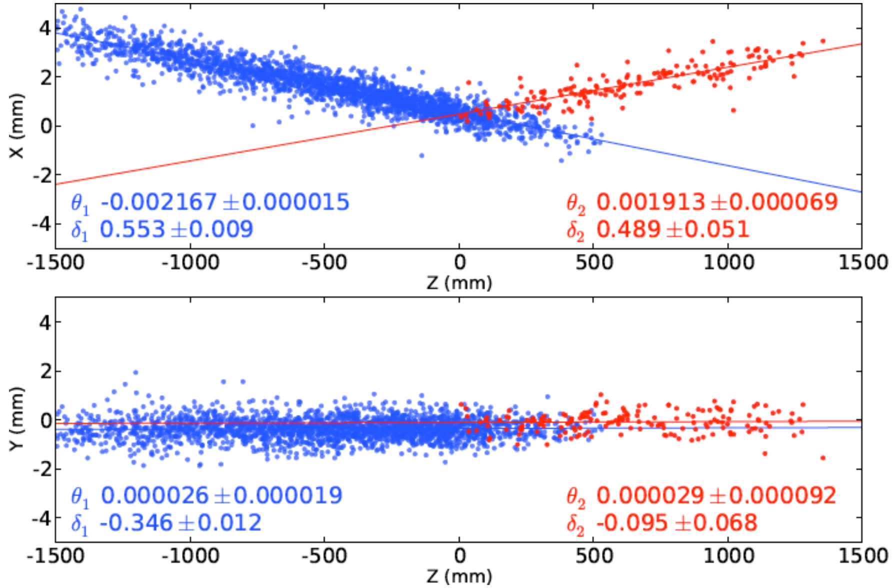
$$L = f \sum_{i=1}^{N} \frac{n_{1i}\, n_{2i}}{4\pi \sigma_{xi}\, \sigma_{yi}}$$

$f = 11.246$ kHz = revolution frequ.
n_{1i}, n_{2i} = number of protons in bunch 1, 2
σ_{xi}, σ_{yi} = transverse bunch sizes (Gaussian)

  - some refinement needed to above formula because colliding bunches:
    - may differ in transverse sizes, may collide with an offset, and cross at a small angle (2 mrad, due to LHCb dipole field)

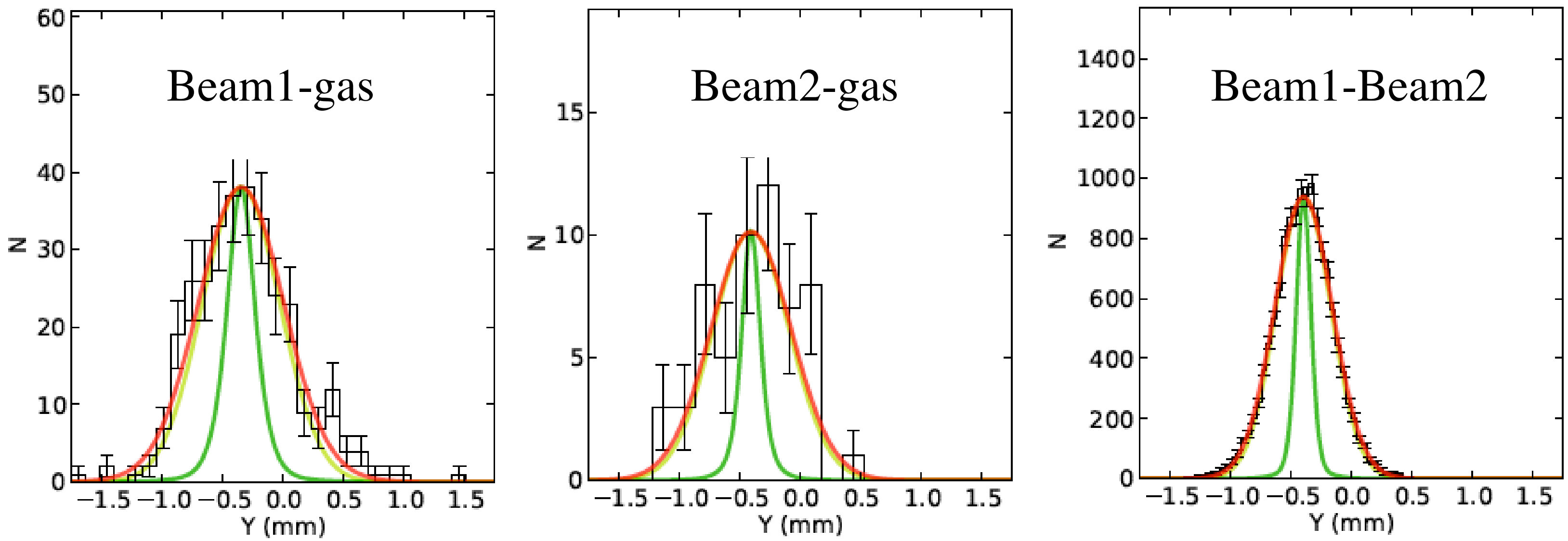
- Idea:
  - get the bunch currents from machine measurements (BCT)
  - measure (with VELO) beam sizes, positions and angles using beam-gas interactions:





Luminosity with 2009 data

- Vertex resolution significant, need to deconvolute
  - example: transverse profiles measured in y for one pair of bunches (red = observed, green = resolution, yellow = after deconvolution)



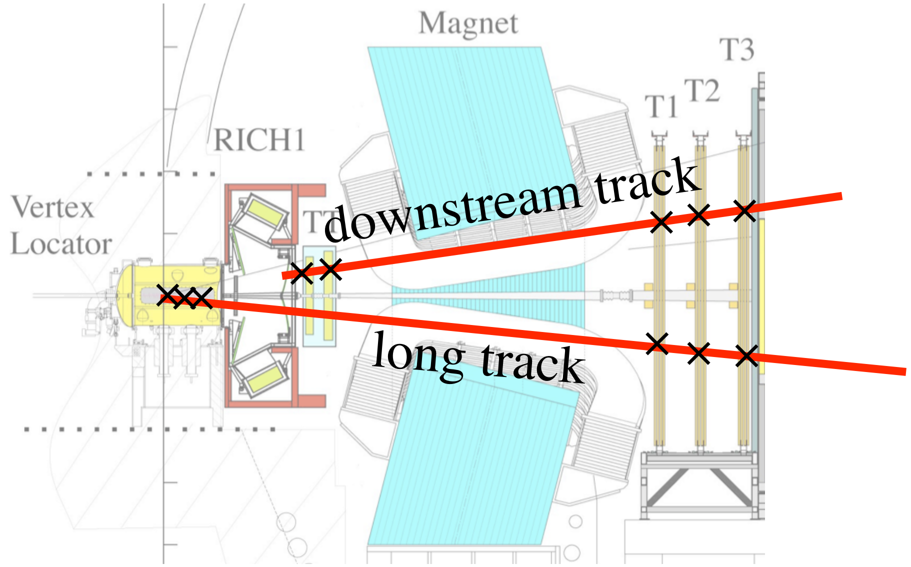
- Measured luminosity for good runs used in K_S analysis:

$$L_{int}\,(2009) = 6.8 \pm 1.0\ \mu b^{-1}$$

Dominated by systematic uncertainties:

Currents	Widths	Positions	Angles
12%	5%	3%	1%

Prompt K_S production (2009)



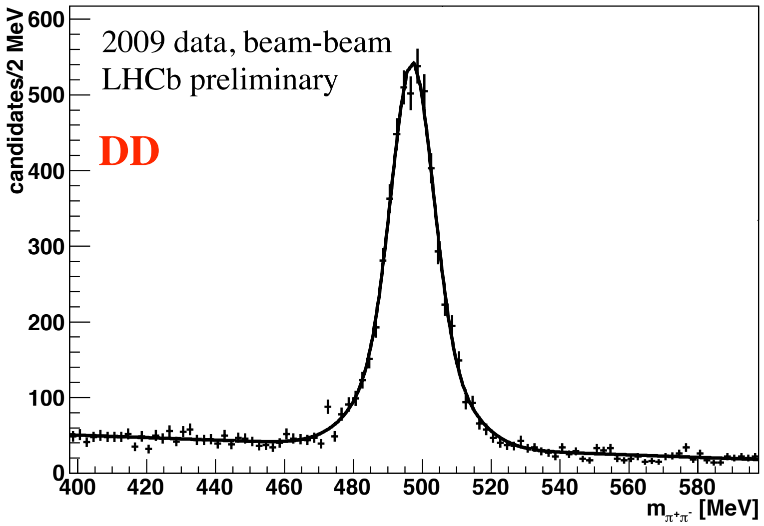
- Reconstruct $K_S \to \pi^+\pi^-$ pointing back to primary vertex (PV), in bins of p_T and rapidity y:
  - beam-gas substracted,
  - background-subtracted
  - efficiency corrected using MC tuned/reweighted to the data
- DD analysis:
  - use only downstream (D) tracks with hits in TT and T, ignore VELO info
  - pseudo-PV determined from K_S direction and beam axis

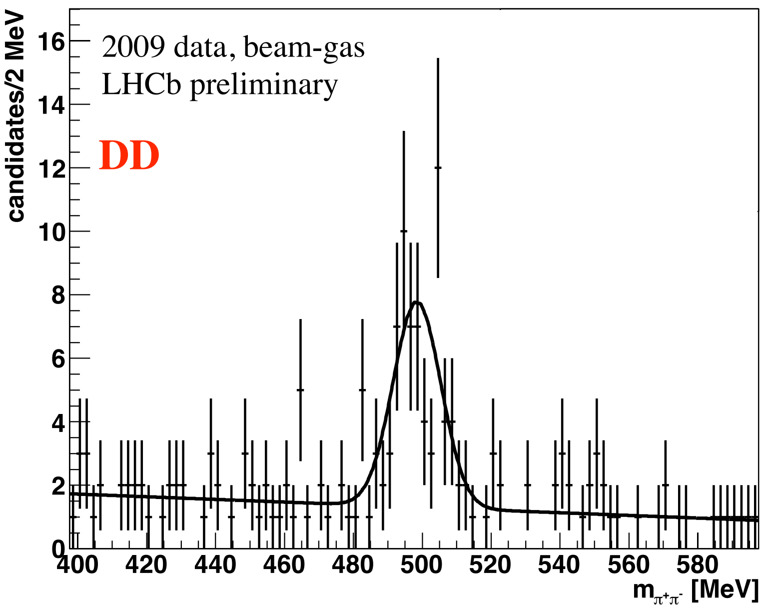
Statistically most precise analysis:
– K_S long-lived
– VELO retracted by 15 mm from its nominal closed position
(large beam sizes and crossing angle)

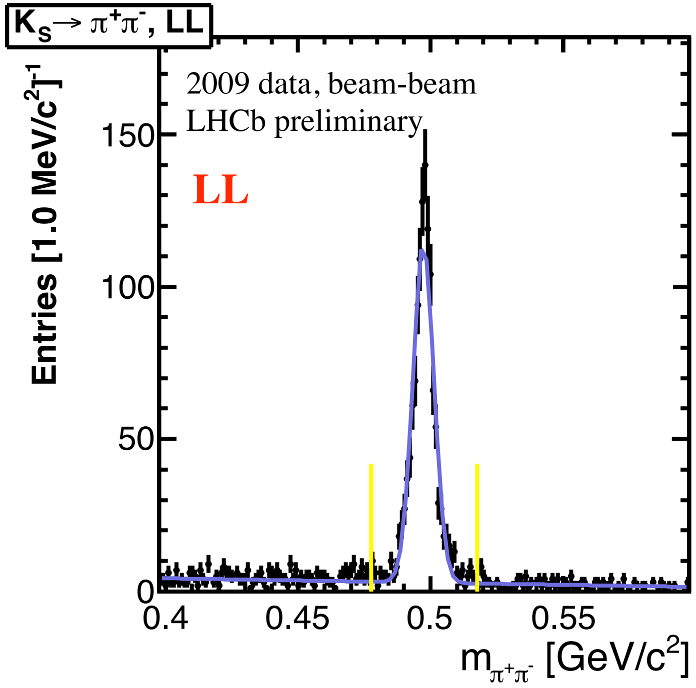
- LL analysis:
  - use only long (L) tracks with VELO hits
  - PV determined from reconstructed tracks

Clean and high-resolution signal
+ extend reach at low p_T and y

Prompt K_S production (2009)





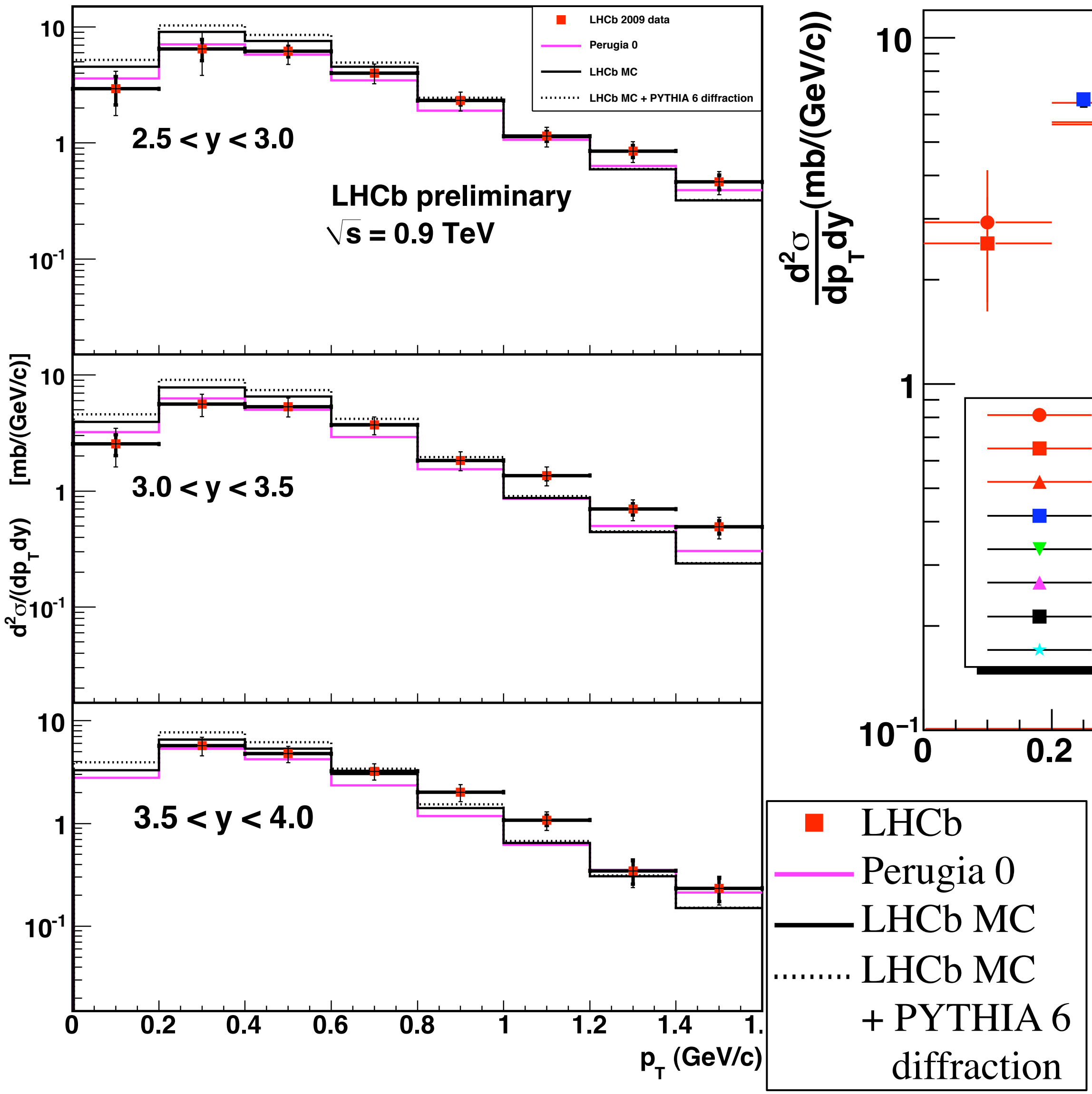


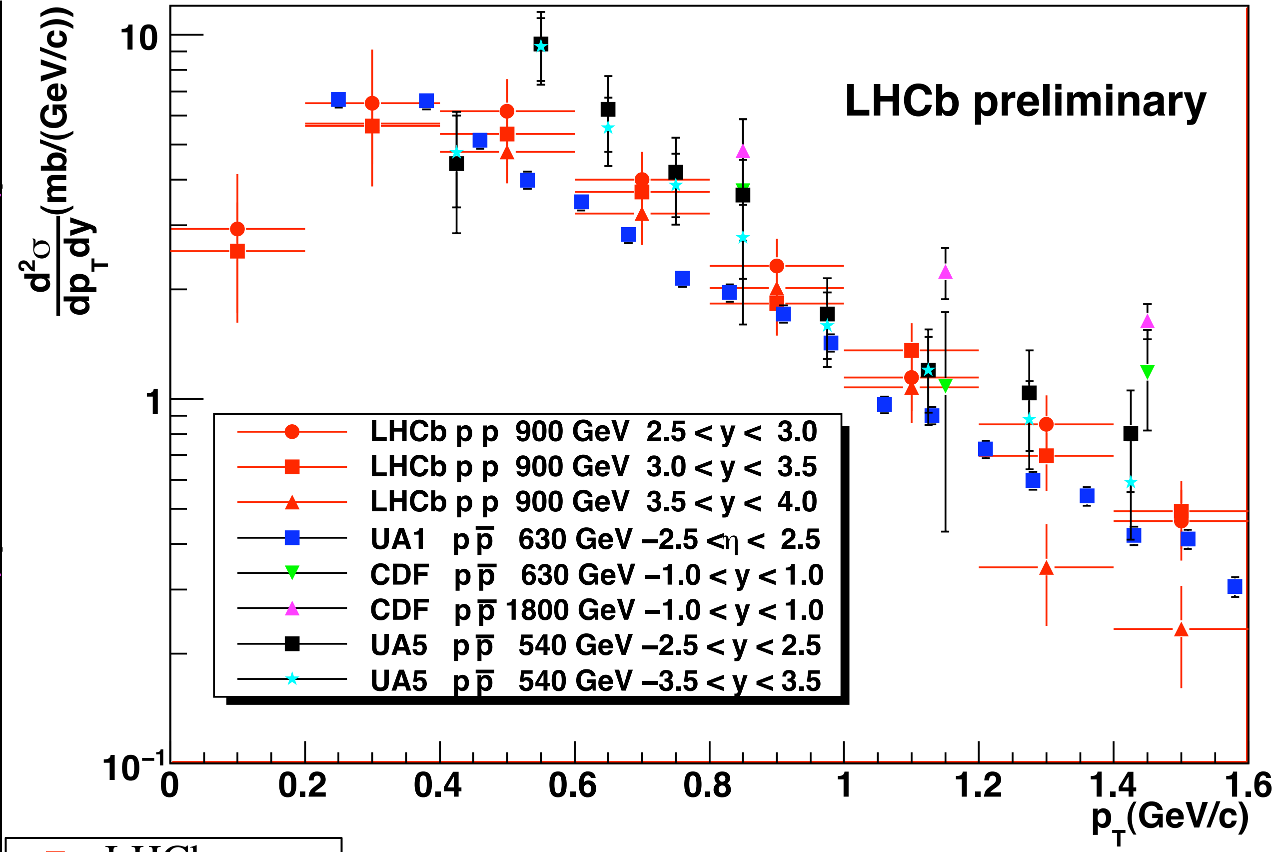
Main systematics:
- signal extraction
- tracking efficiency
- selection efficiency
- efficiency variation within phase-space bin
- luminosity

	DD	LL
Mass resolution (MeV/c^2)	~ 9.3	~ 4.0
Total yield in beam-beam	4864 ± 84	1196 ± 36
Total yield in beam-gas	56 ± 10	15 ± 6

Results of both analyses in agreement
→ take most precise result in each bin

Prompt K_S production cross section

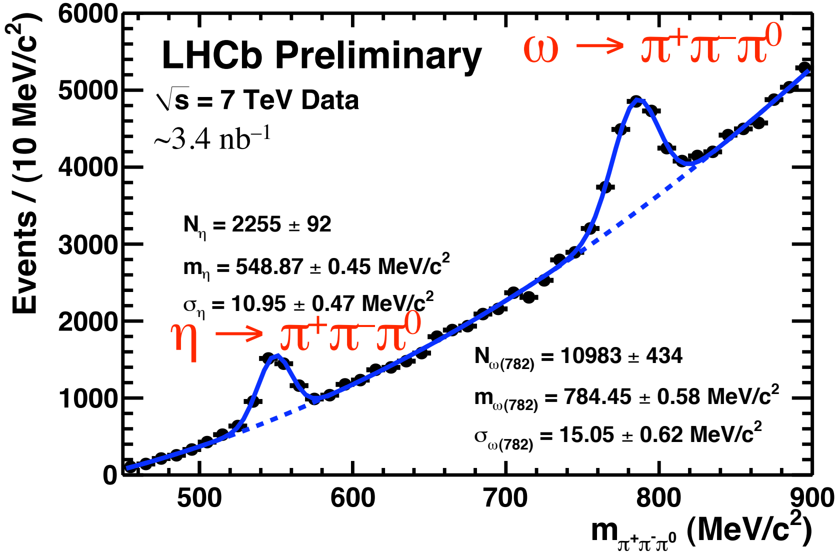




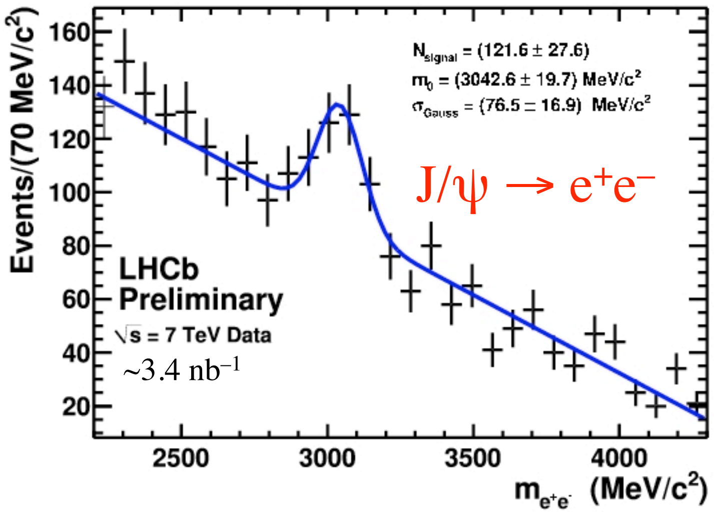
- Compare with:
  - PYTHIA 6 tunings
  - earlier measurements

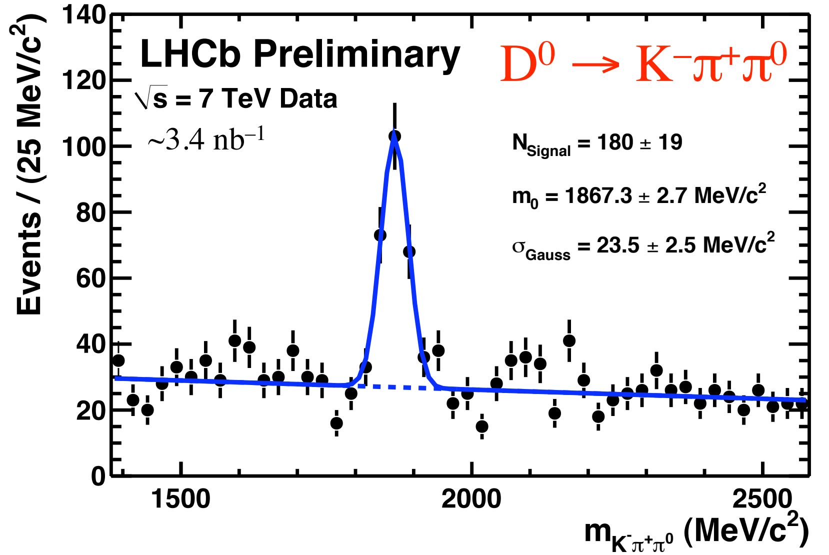
2010 data: zoo expanding rapidly

- Many fully reconstructed mass peaks:
  - $\pi^0 \to \gamma\gamma$
  - $\eta \to \gamma\gamma, \pi^+\pi^-\pi^0$
  - $\omega \to \pi^+\pi^-\pi^0$
  - $\eta' \to \pi^+\pi^-\gamma$
  - $K_S \to \pi^+\pi^-$
  - $K^{*0} \to K^-\pi^+$
  - $\Lambda \to p\pi^-$
  - $\Xi^- \to \Lambda\pi^-$
  - $\Omega^- \to \Lambda K^-$
  - $\phi \to K^+K^-$
  - $D^0 \to K^-\pi^+, K^-K^+, \pi^-\pi^+$
  - $D^0 \to K^-\pi^+\pi^0, K^-\rho^+$
  - $D^0 \to K^-\pi^+\pi^+\pi^-$
  - $D^+ \to K^-\pi^+\pi^+, K^-K^+\pi^+, K_S\pi^+$
  - $D^{*+} \to D^0\pi^+$
  - $D_s \to K^-K^+\pi^+$
  - $\Lambda_c \to pK^-\pi^+$
  - $J/\psi \to \mu^+\mu^-, e^+e^-$
  - $\psi(2S) \to \mu^+\mu^-$
  - $B^{0/+} \to D^{+/0}\pi^{-/+}$



- Important for calibration:
  - detector
  - trigger
  - physics

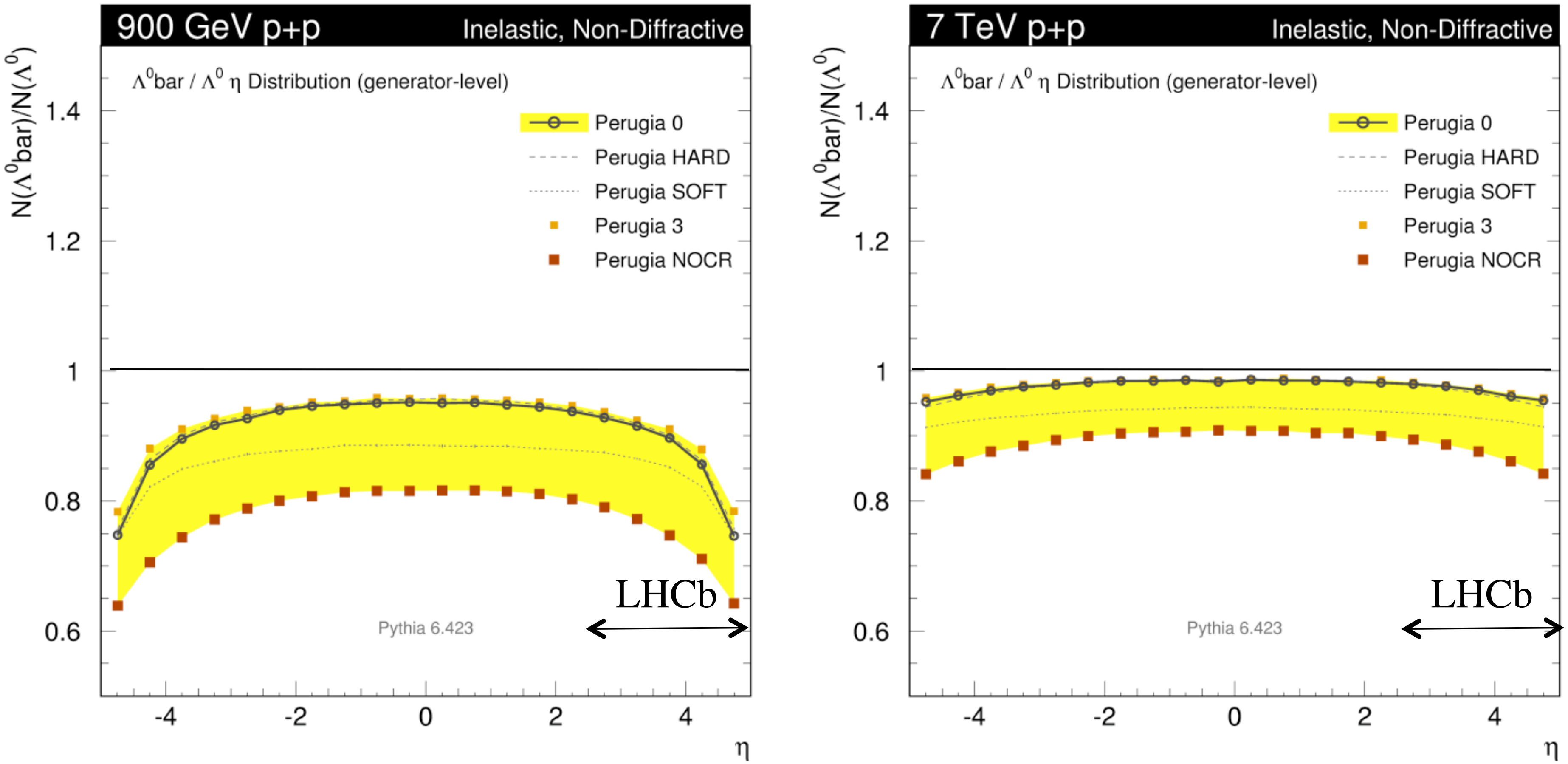




Prompt $\bar{\Lambda}$ and Λ production

P. Skands, http://home.fnal.gov/~skands/leshouches-plots/

- Production ratio interesting to study baryon transport:
  - models disagree, but predict dependence vs η and vs √s

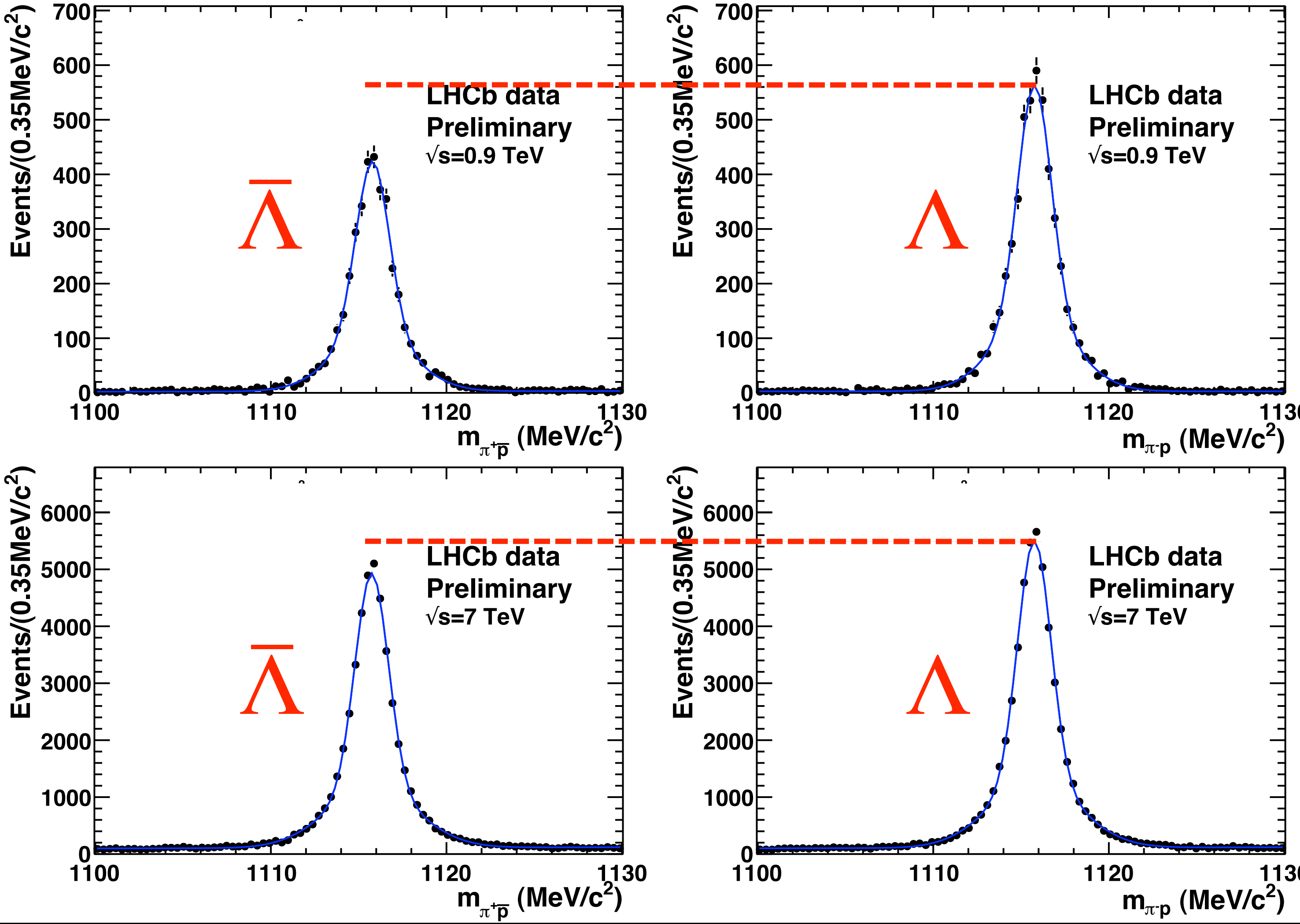


Prompt $\bar{\Lambda}$ and Λ production

- Use only long tracks in 2010 data recorded with "microbias" trigger

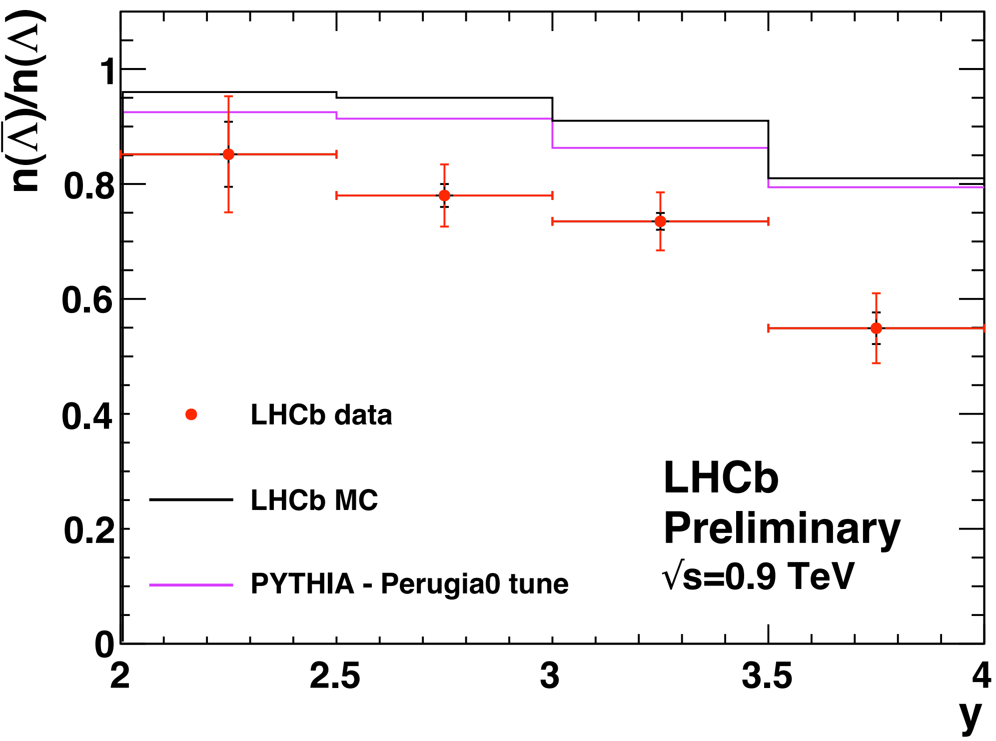
- $\sqrt{s}$ = 0.9 TeV
  - VELO "half closed" (10mm)

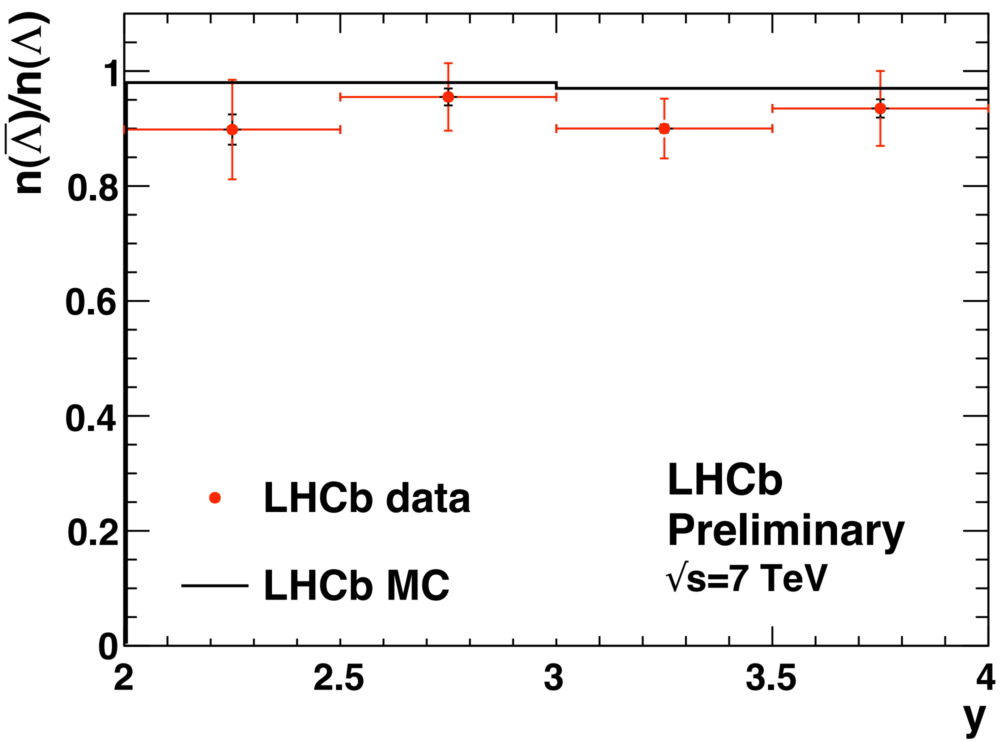
- $\sqrt{s}$ = 7 TeV
  - VELO closed



$\bar{\Lambda}/\Lambda$ production ratio

- Efficiency corrected ratio, in rapidity bins:

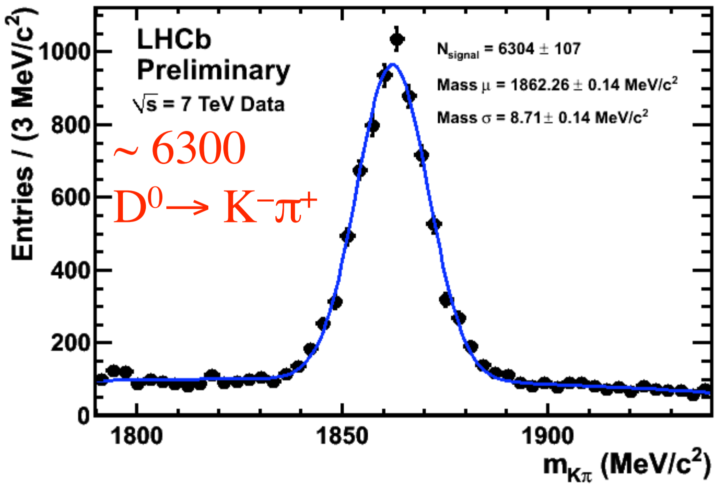


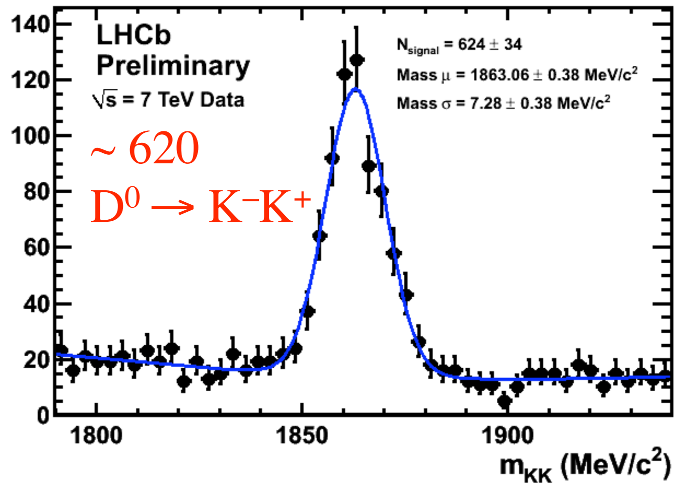


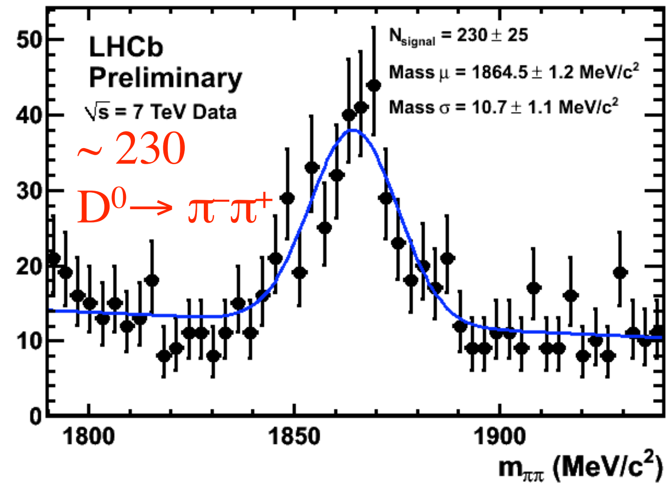
- At 0.9 TeV:
  - ratio low, dropping with y
  - not reproduced by PYTHIA reference tunes
- At 7 TeV:
  - ratio larger, ~ flat in y
  - prediction in fair agreement

Untagged 2-body D^0 signal

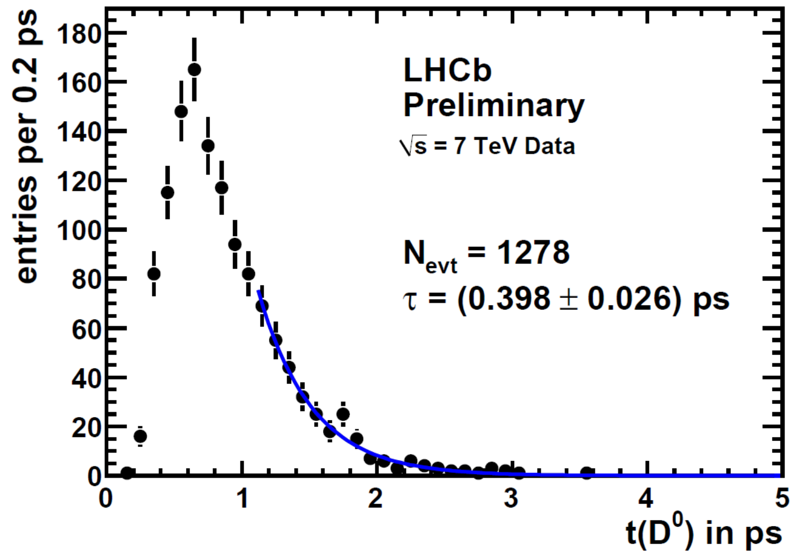
in ~ 2.7 nb^{-1}







- Check: measurement of D^0 lifetime
  - make very pure $D^0 \to K^-\pi^+$ selection (S/B ~ 22)
  - proper-time distribution with simple exponential
  - use only tail, where efficiency is constant
    - $\tau(D^0) = 0.398 \pm 0.026$ ps (6.5% stat. precision)
    - result does not depend on where the fit starts and agrees with the known D^0 lifetime of 0.4101 ± 0.0015 ps



D^0 mixing measurements

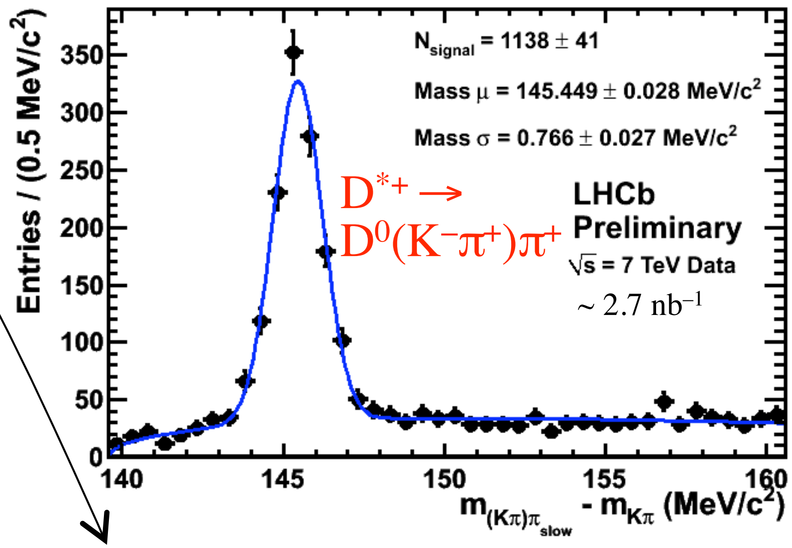
- Often need flavour-tagged D^0 decays:
  - reconstruct $D^{*+} \to D^0\pi^+$ decay, cut on reconstructed $\Delta m = m(D^*) - m(D^0)$
  - **expect > 10 × BABAR statistics in 0.1 fb^{-1}**
- Mixing through lifetime difference:

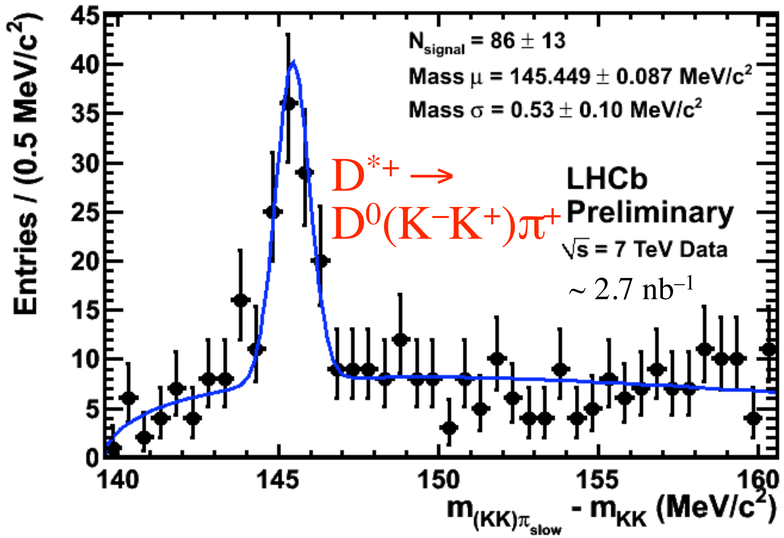
$$y_{CP} = \frac{\tau(D^0 \to K^-\pi^+)}{\tau(D^0 \to K^-K^+)} - 1$$

- CP-violating observable A_Γ:

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

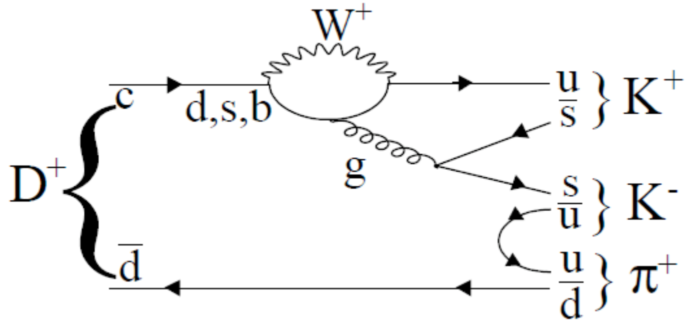
- Time-dependent analysis of wrong-sign tagged $D^0 \to K\pi$ decays:
  - interference between DCS decays and mixing+ CF decays (mixing parameters y'and x'^{2})



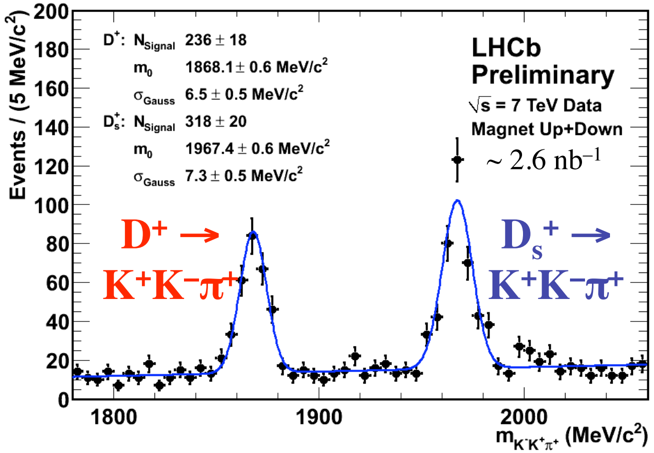


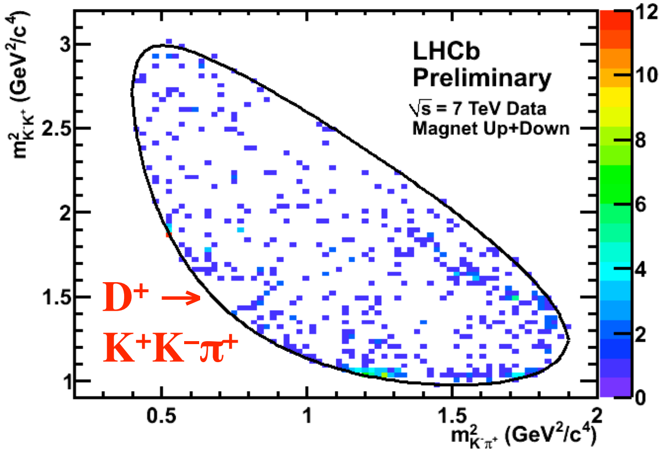
Search for direct CPV in charm

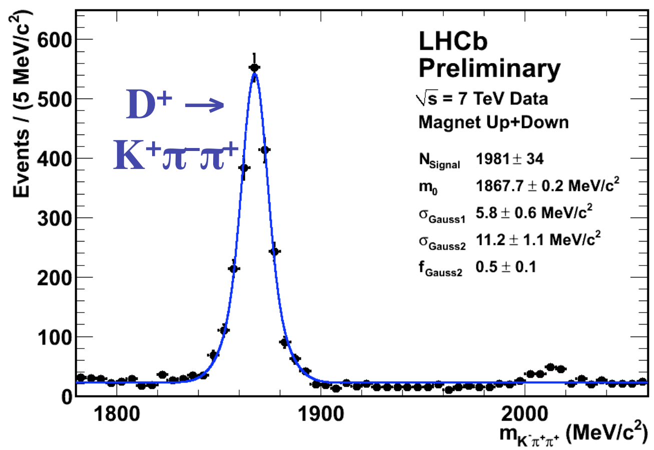
- Interesting modes are:
  - — singly Cabibbo-suppressed decays, where NP may enter in gluonic Penguin
  - — 3-body decays, where Dalitz plot analysis allows for many local CP asymmetries to be probed



- $D^+ \to K^+K^-\pi^+$ is an excellent candidate:
  - — use Cabibbo-favoured $D_s^+ \to K^+K^-\pi^+$ and $D^+ \to K^+\pi^-\pi^+$ decays as control channels



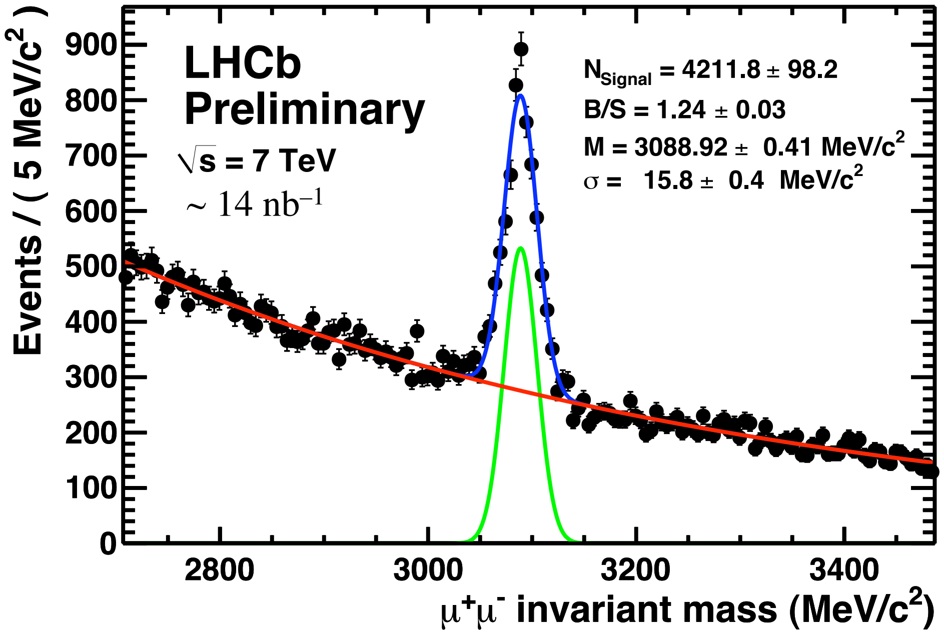




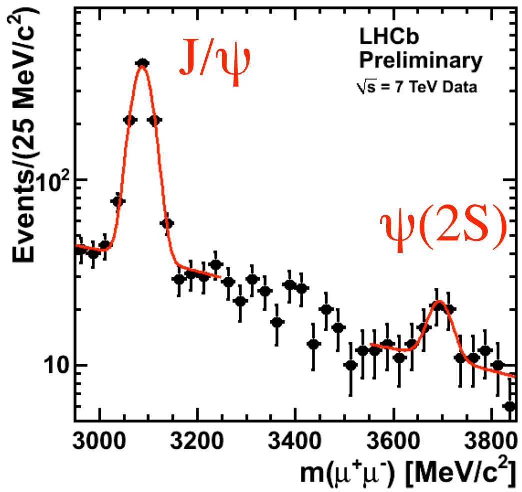
  - — expect several million events in $0.1\ \mathrm{fb}^{-1}$ (an order of magnitude more than B-factory samples)

Studies with J/ψ → $\mu^+\mu^-$

- **Abundant J/ψ signal = gold mine:**
  - data-MC and data-PDG differences (in bins of many variables) provide many crucial calibration handles, to be exploited to improve performance:
    - alignment, tracking studies
    - material effects (dE/dx)
    - B-field systematic effects
    - momentum resolution, mass scale
    - lepton identification

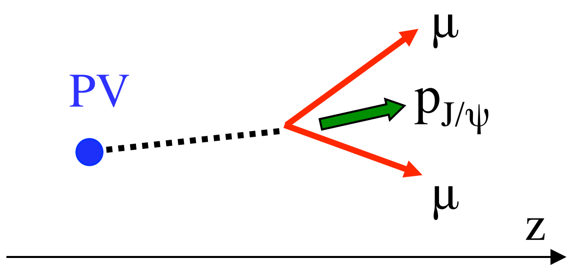


- **J/ψ, ψ(2S), … signals open large parts of the physics program:**
  - quarkonium production, polarization, spectroscopy, …
  - bottom physics with both incl. and excl. b → J/ψ modes



J/ψ production measurement

- In each bin of J/ψ phase space (p_T and y):
  - combined fit to mass and pseudo proper-time t_z allows separation of prompt J/ψ and b → J/ψ components



$$t_z = \left(z_{J/\psi} - z_{PV}\right) \frac{m_{J/\psi}}{p_{z,J/\psi}}$$

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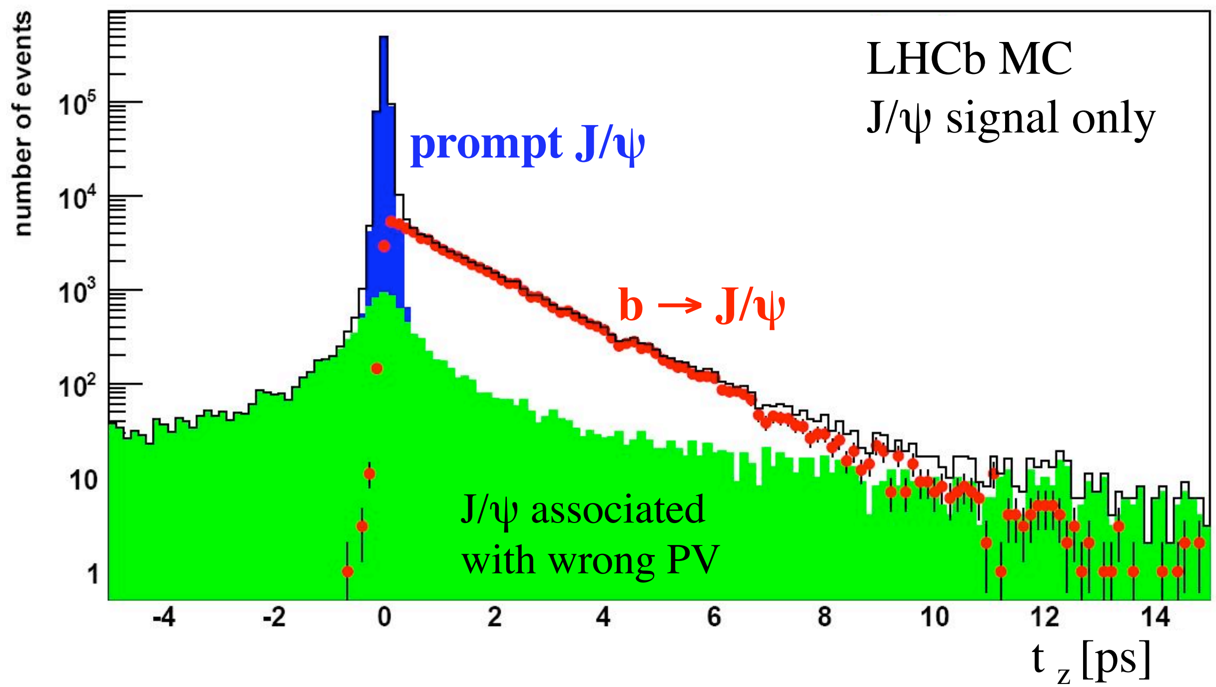
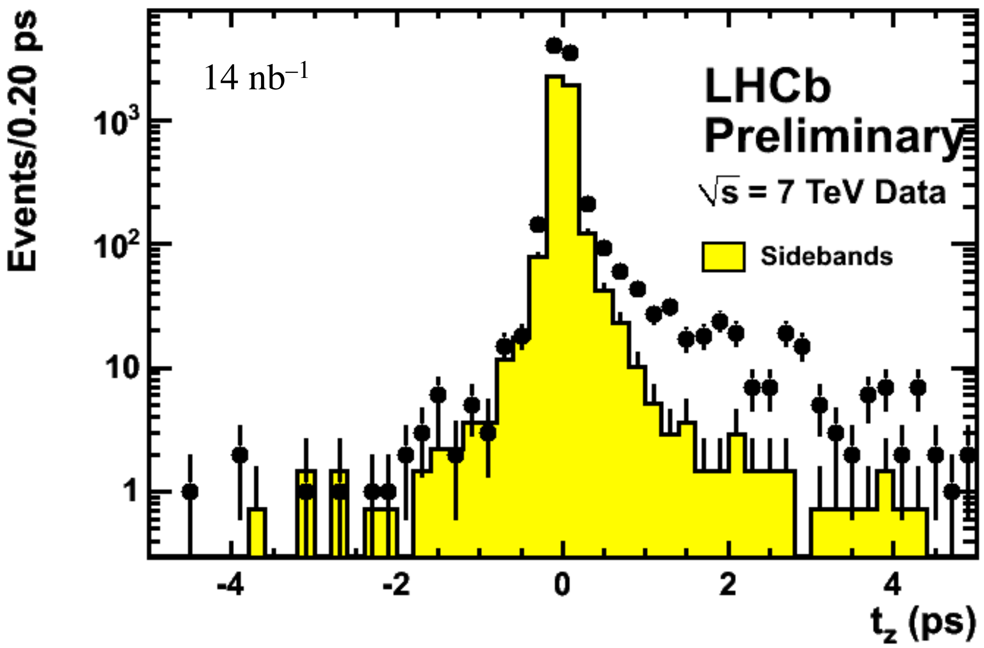


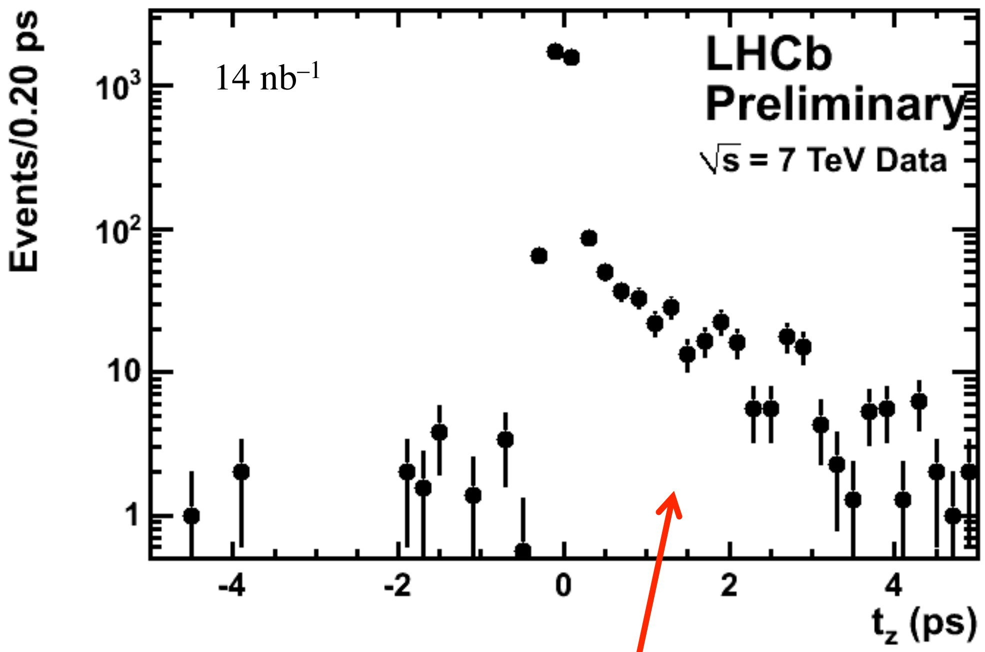
- Extract differential production cross sections:
  - prompt J/ψ very interesting in its own right:
    - colour-octet model predicts well cross sections seen at Tevatron, but not polarisation
  - make first measurement of b→ J/ψ production:
    - important for initial tuning of b spectrum in LHCb Monte Carlo

J/ψ pseudo proper time (t_z)

Signal window & normalized sideband



Sideband-subtracted distribution (pure signal)

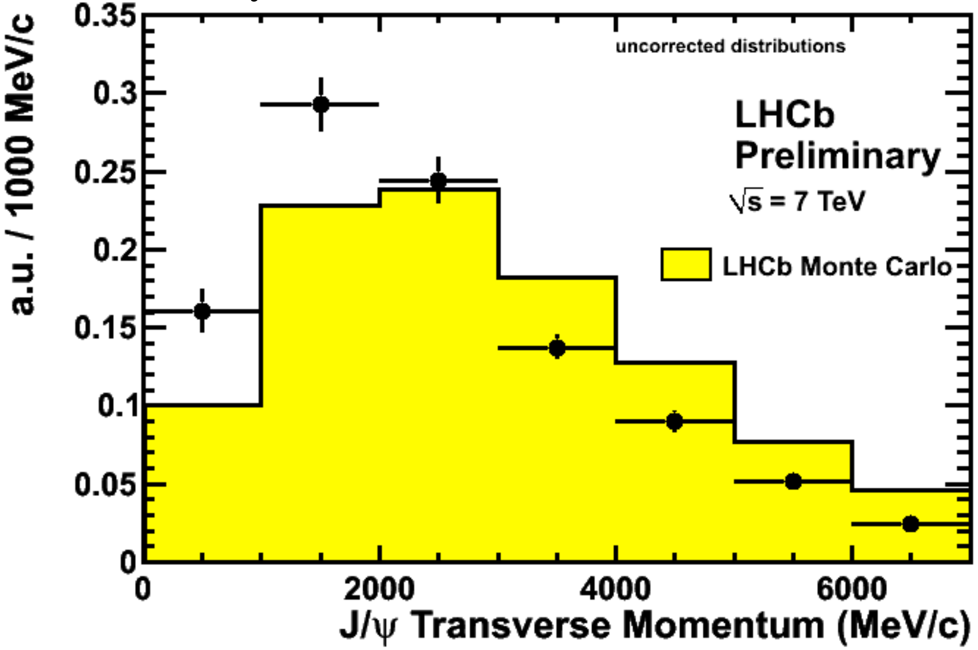


- Asymmetric distribution with clear long-lived signal from b-hadron decays

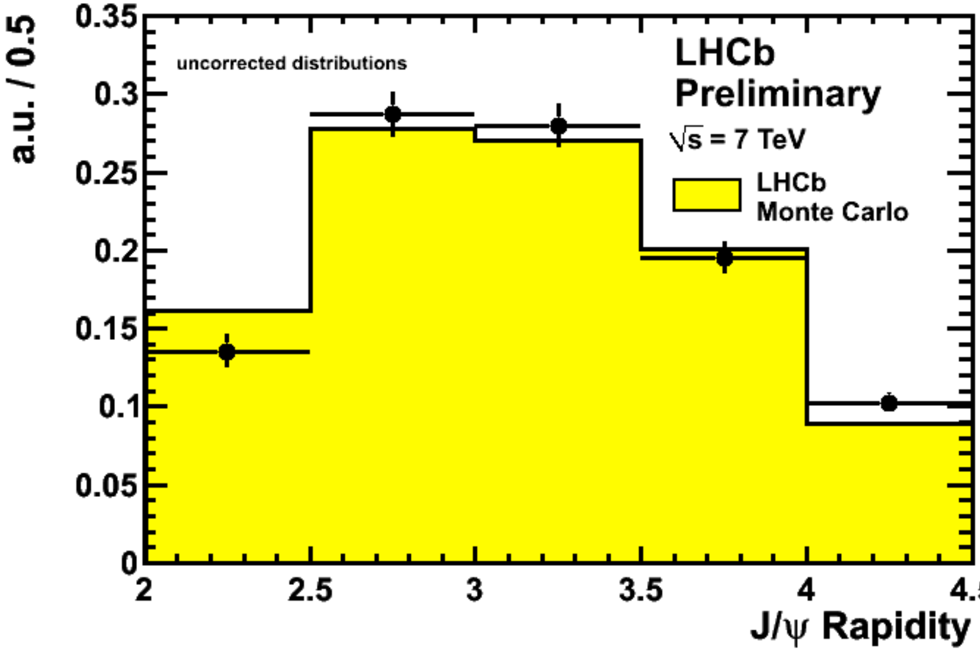
Raw J/ψ p_T and y spectra

- In each p_T or y bin, J/ψ yield extracted from mass distribution
  - shown before any correction (e.g. efficiency correction)
  - spectrum contains prompt J/ψ and b → J/ψ

2.5 < y < 4.0



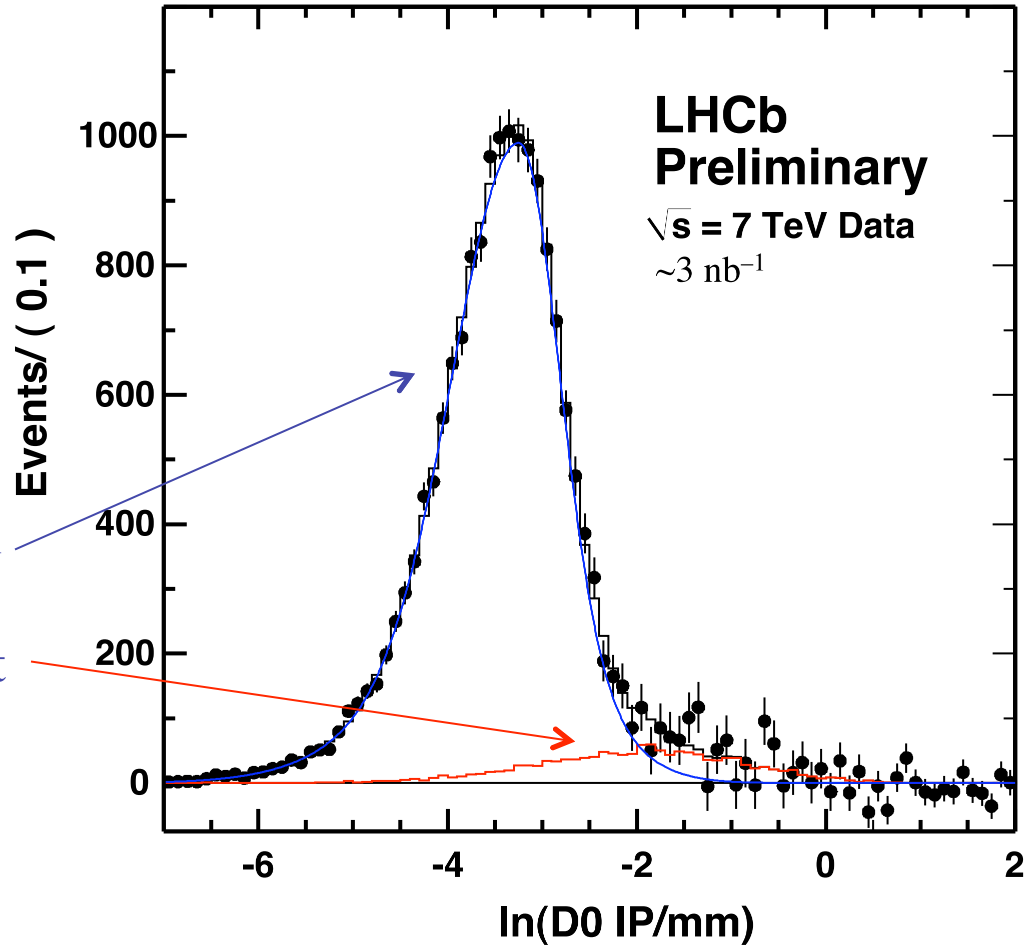
p_T < 12 GeV/c



- above is illustrative of the capability, measurement expected soon

Looking for b hadrons: D^0 IP

- Select $D^0 \to K^-\pi^+$
  - minimum bias sample
  - two PIDed tracks with min. IP forming good vertex
- Fit sideband-subtracted D^0 IP distribution:
  - free double bifurcated Gaussian for prompt component
  - MC shape for $B \to D$ component
- Yields:
  - 15'827 ± 262 prompt D^0
  - 1'331 ± 354 secondary D^0

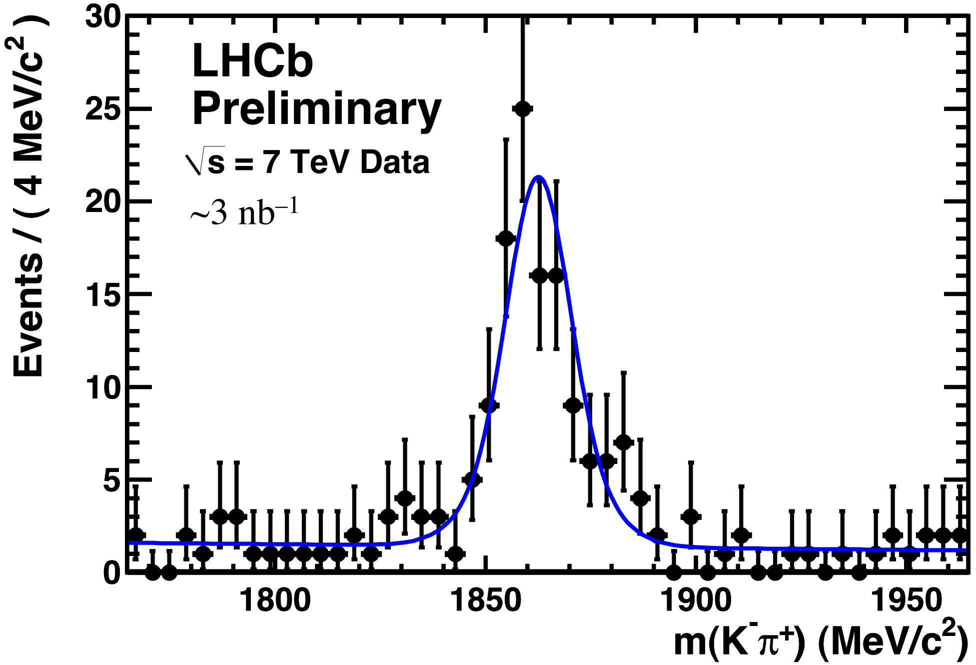


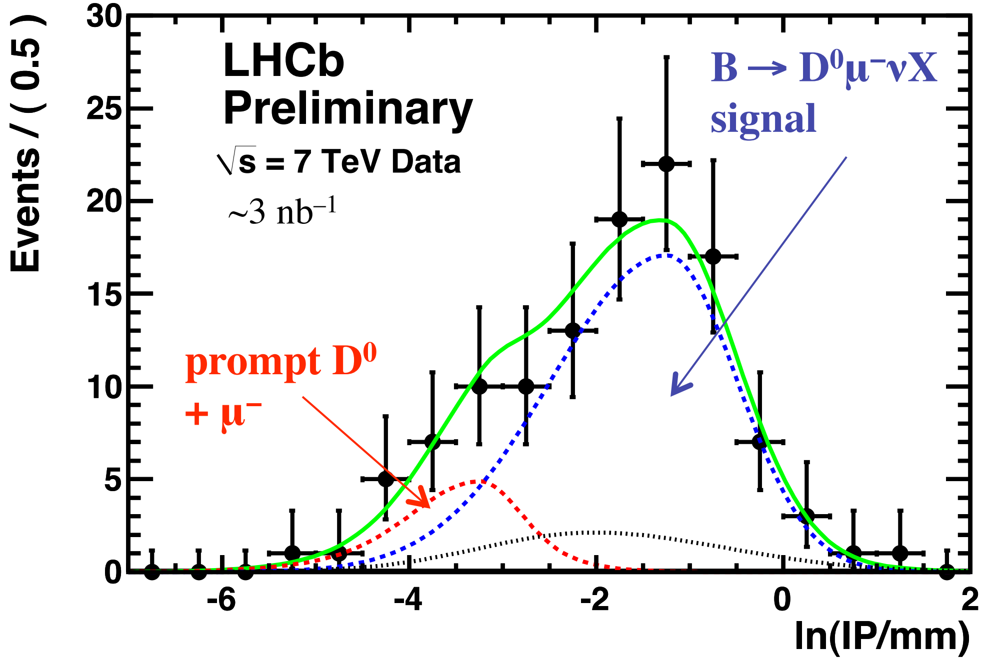
Largest b-hadron signal so far !

$B \to D^0\mu^-\nu X$

- Form right-sign $D^0\mu^-$ combinations:
  - fit D^0 IP distribution:
    - 14.0 ± 1.9 non D^0 background (shape from D^0 mass sideband)
    - 16.2 ± 5.7 prompt D^0 (shape from data)
    - **85.3 ± 10.6 $B \to D^0\mu^-\nu X$** (shape from MC)

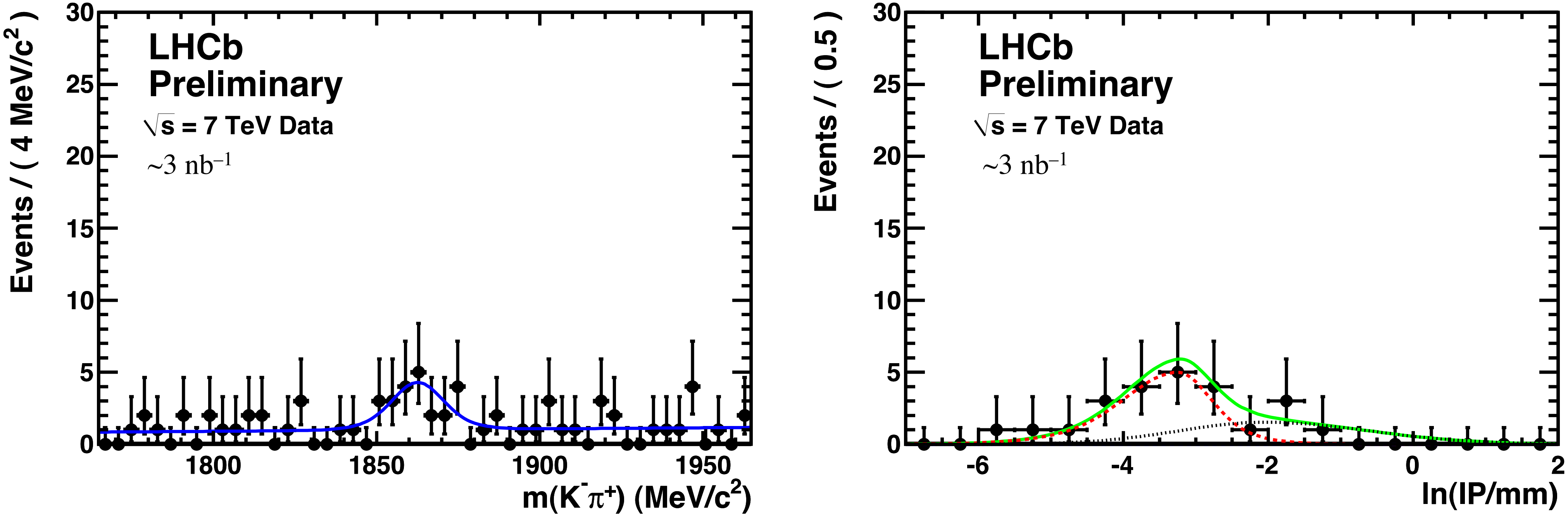
Clean 8σ signal





wrong-sign $D^0\mu^+$

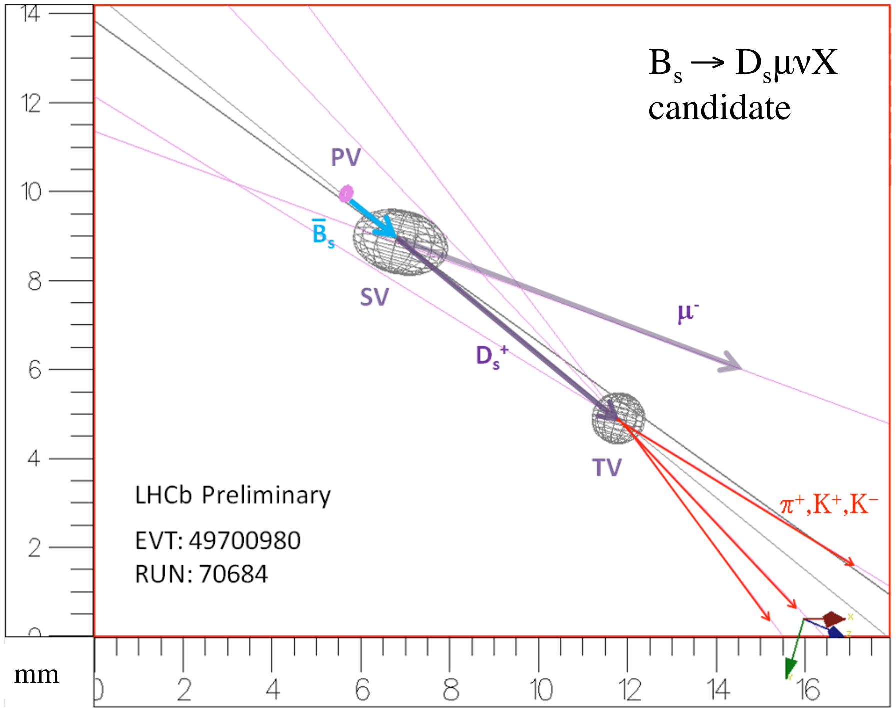
- Form wrong-sign $D^0\mu^+$ combinations:
  - fit D^0 IP distribution:
    - 10.2 ± 1.5 non D^0 background (from D^0 mass sideband)
    - 16.7 ± 4.9 prompt D^0 (shape from data)
    - **0 ± 1.1 non prompt D^0** (shape from MC) **No signal**



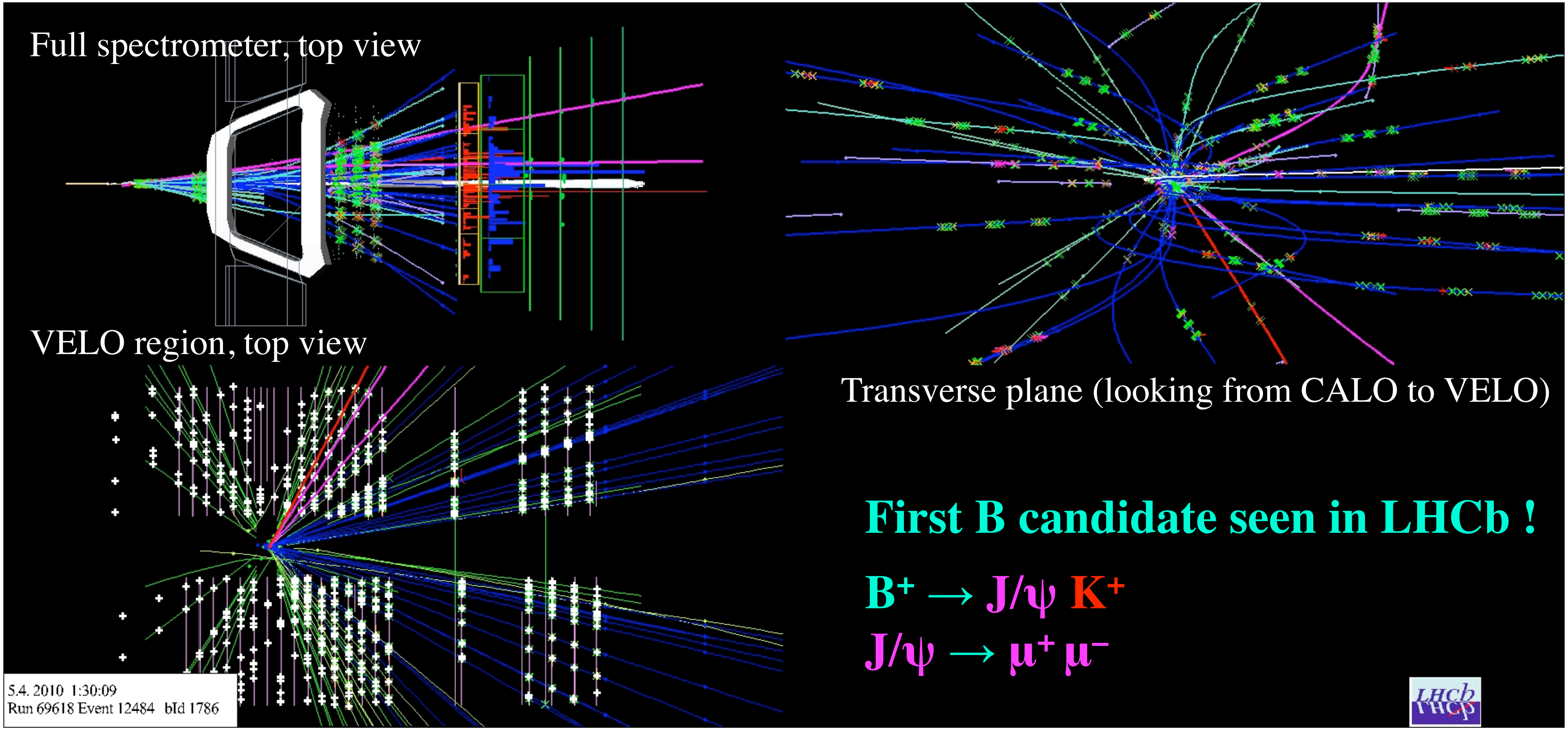
Semileptonic B decays

- Large branching fraction, suitable for early cross section measurement:
  - with 100 nb^{-1}, expect 2.8k $B \to D^0\mu^-\nu X$ signal events with good purity
  - measurement complementary to $b \to J/\psi$ result

- $B_d \to D^-\mu^+\nu$ and $B_s \to D_s^-\mu^+\nu$ decays useful for:
  - B_d and B_s oscillations (Δm_d and Δm_s), flavour tagging studies and calibration
  - CP violation in B_d and B_s mixing:
    - measurement of $\Delta A_{fs} = (a_{fs}(B_s) - a_{fs}(B_d))/2$ where detector asymmetry will be drop out if D^- and D_s^- to same $K^+K^-\pi^-$ final state
    - will provide constraint "orthogonal" to recent D0 measurement of $A_{sl}^b \sim (a_{fs}(B_s)+a_{fs}(B_d))/2$
    - expect statistical precision on ΔA_{fs} of 2×10^{-3} (similar to that of D0 on A_{sl}^b) from MC study assuming 0.1 fb^{-1} and $\sigma_{bb} = 500$ μb

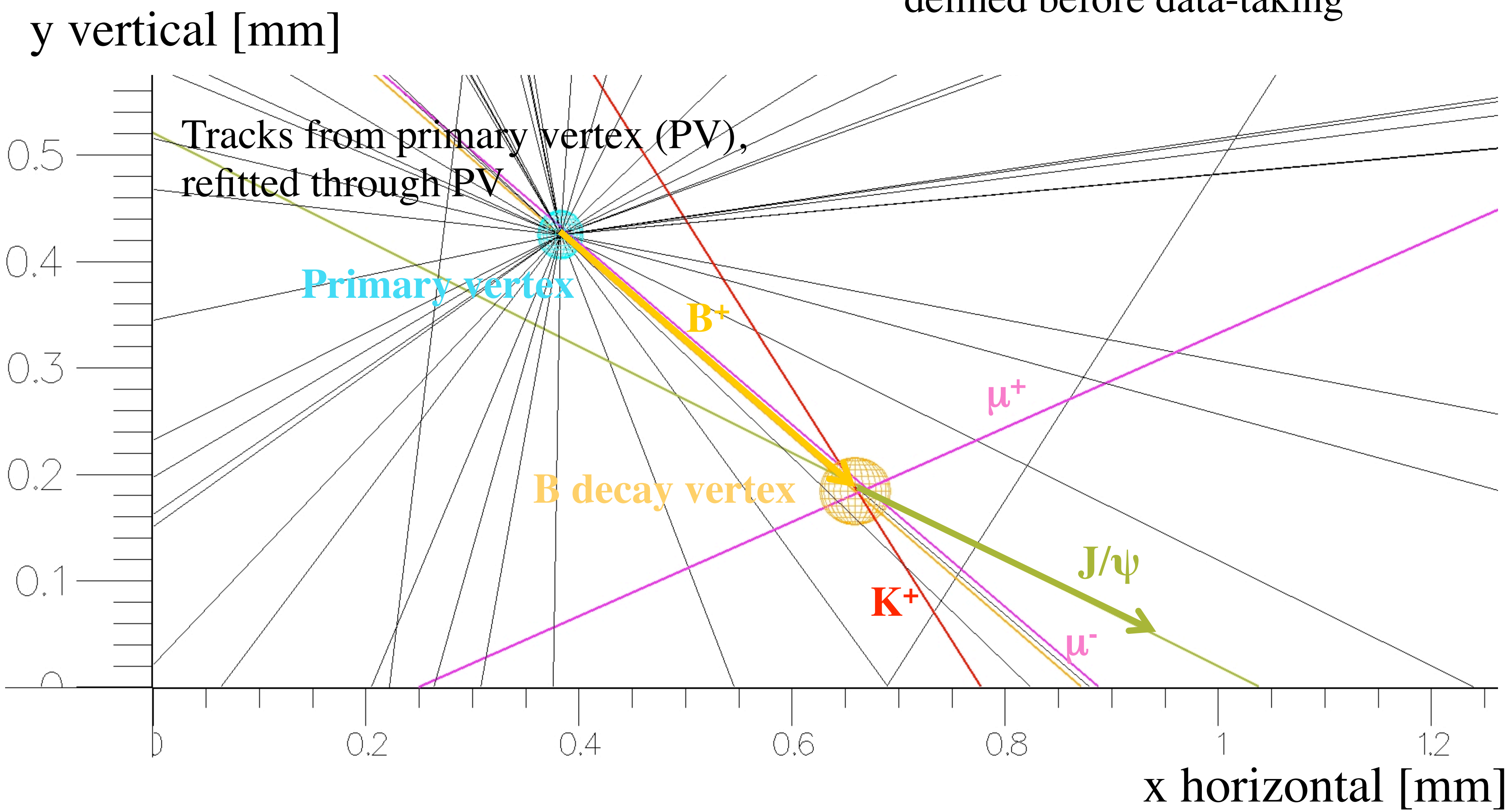


Fully reconstructed B



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

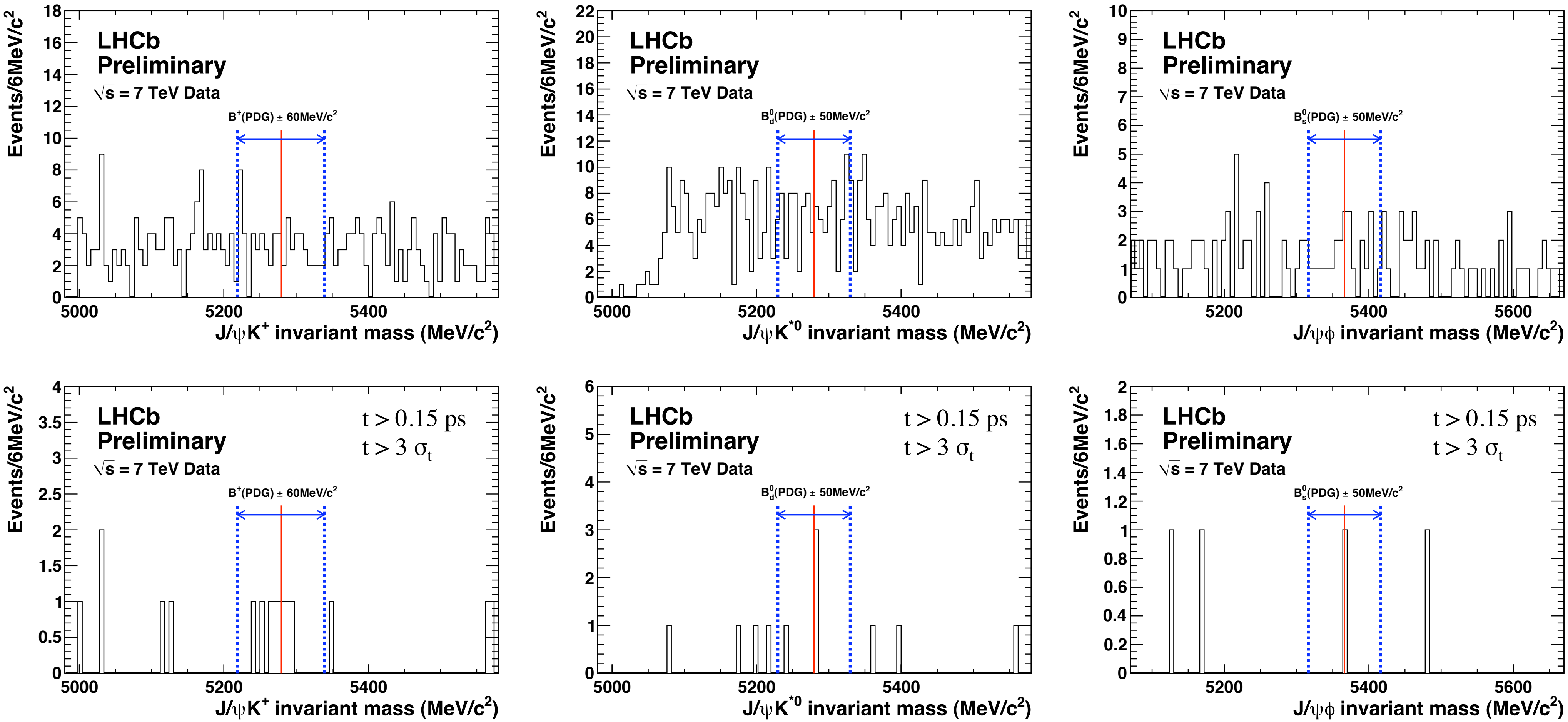
All observables far from cut values defined before data-taking



Exclusive B→ J/ψX selections

~ 13 nb^{-1}

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



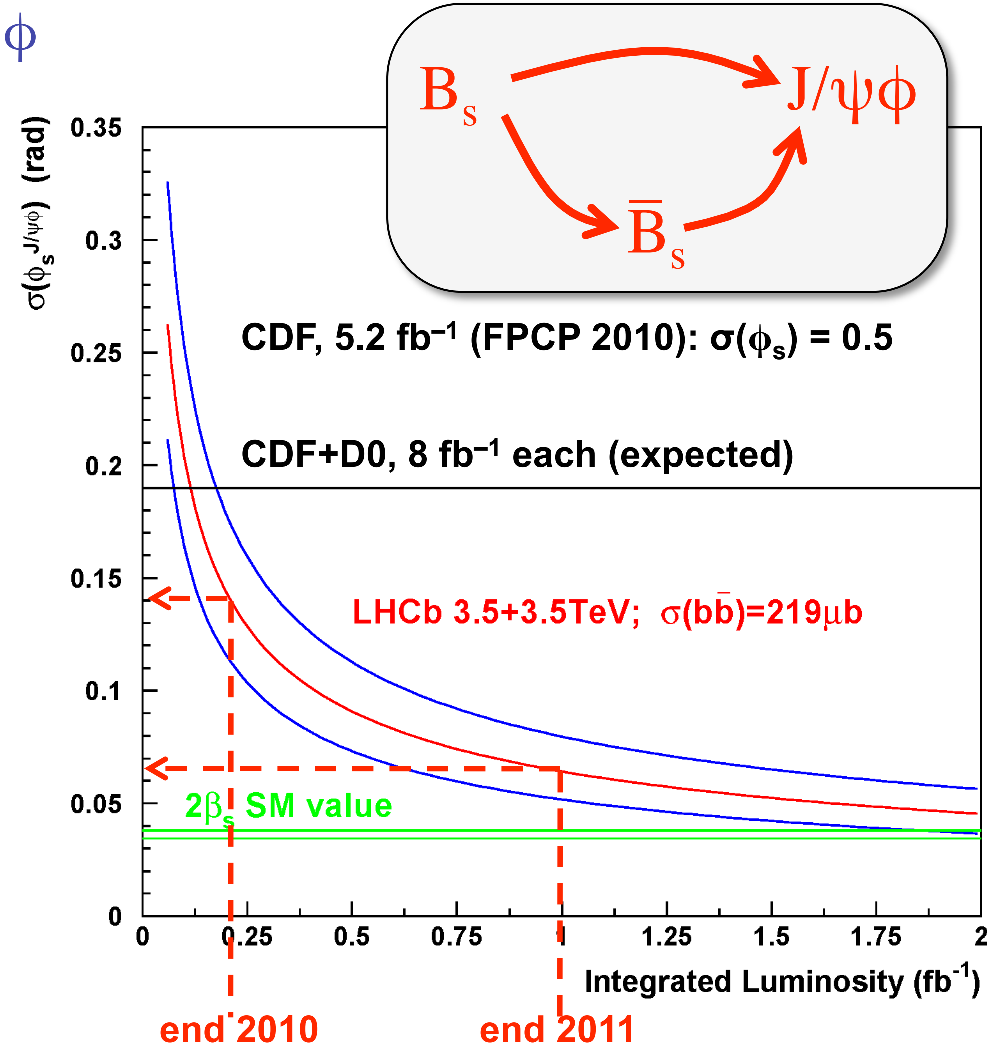
(J/ψ mass constraint applied)

Mixing-induced CPV in $B_s \to J/\psi\phi$

- Golden mode $B_s \to J/\psi\phi$ is strange counterpart of $B^0 \to J/\psi K^0$
  - phase $2\beta_s$ can be accessed with $B_s \to J/\psi\phi$ in the same way as 2β with $B^0 \to J/\psi K^0$
- Phase $2\beta_s$ small in SM, hence very sensitive to NP contributions:
  - $2\beta_s = 0.036 \pm 0.002$ rad (SM)
  - Some NP models predict large phase $\phi_s(J/\psi\phi) \neq -2\beta_s$
- LHCb expectation:
  - With 1 fb^{-1} and full time and angular analysis of flavour-tagged $B_s \to J/\psi\phi$ decays:

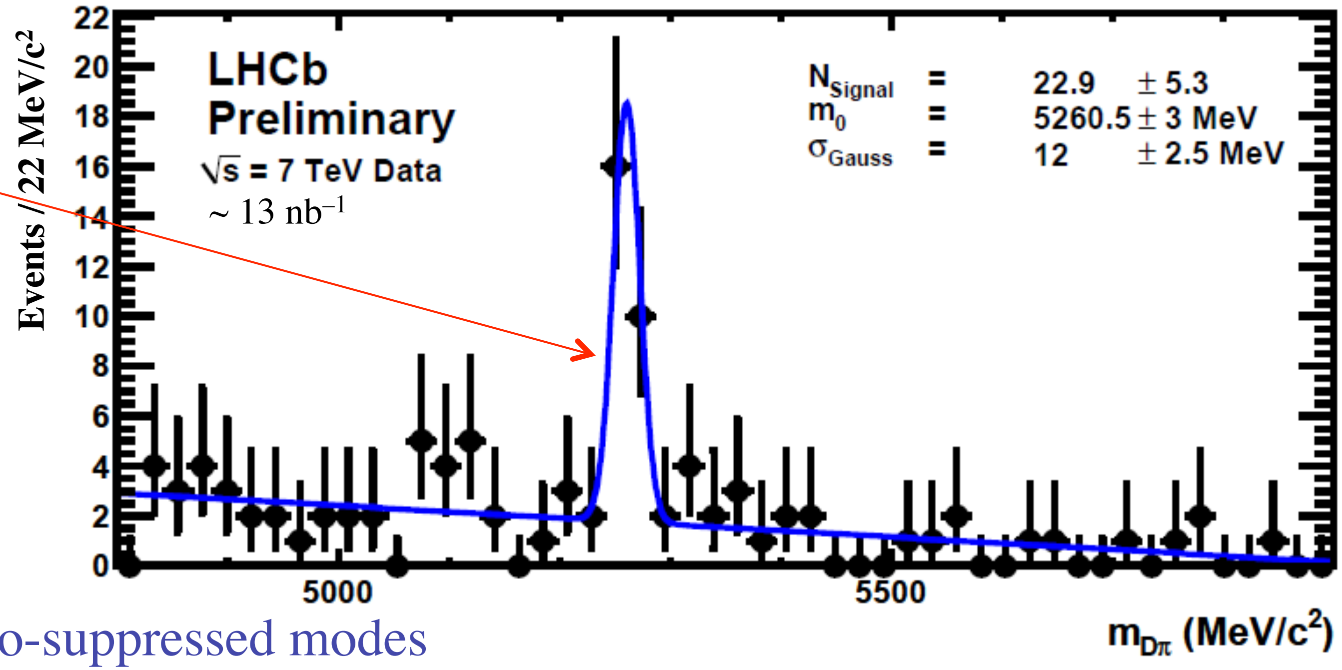
$$\boxed{\sigma(\phi_s(J/\psi\phi)) \sim 0.07}$$

  - Pure CP modes can be added, e.g. $B_s \to J/\psi f_0(980)$, $f_0(980) \to \pi^+\pi^-$



Exclusive hadronic B decays

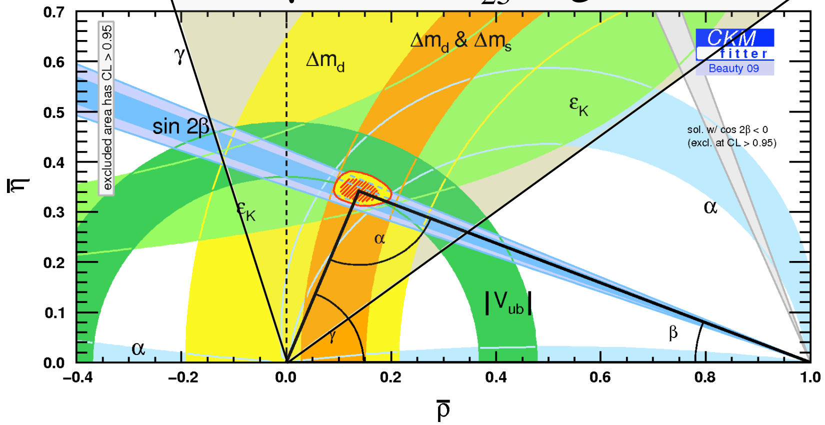
- First signal combining two modes:
  - $B^0 \rightarrow D^+\pi^-$
  - $B^+ \rightarrow D^0\pi^+$



- Expect soon:
  - $B_s \rightarrow D_s\pi^-$
  - $B \rightarrow DK$ Cabibbo-suppressed modes
- Main physics goal:
  - « New Physics free » determination of CKM angle γ using interference between $b \rightarrow c$ and $b \rightarrow u$ tree-level diagrams in $B_{(s)} \rightarrow D_{(s)}K$
  - combined precision expected with 1 fb^{-1}:

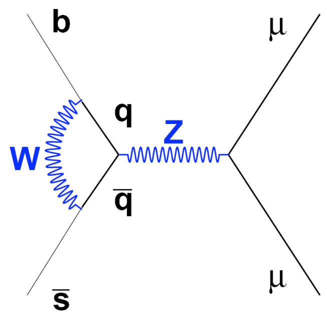
$\sigma(\gamma) \sim 7$ degrees

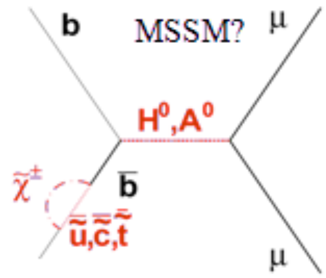
$\gamma = 73\,^{+22}_{-25}$ degrees



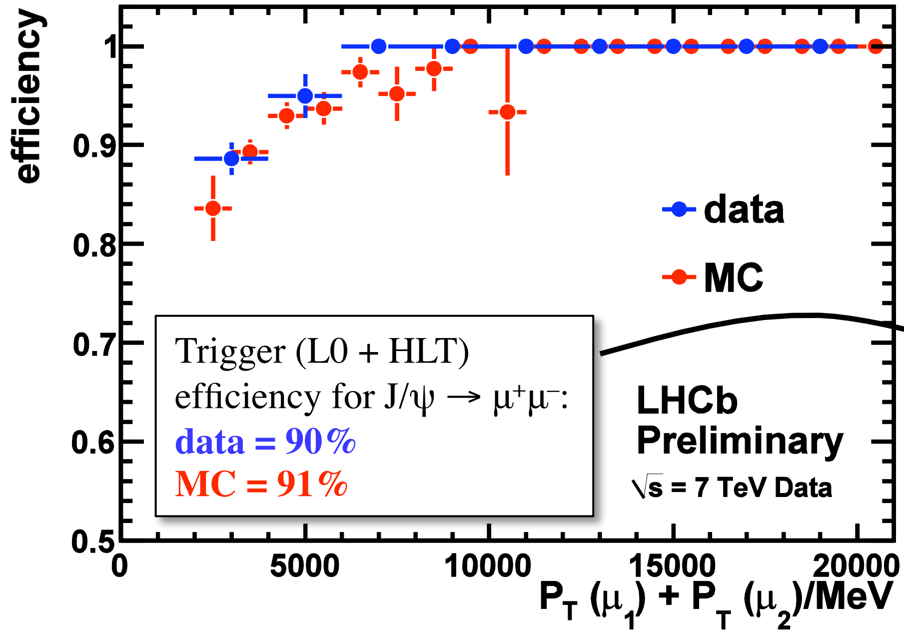
$B_s \to \mu\mu$

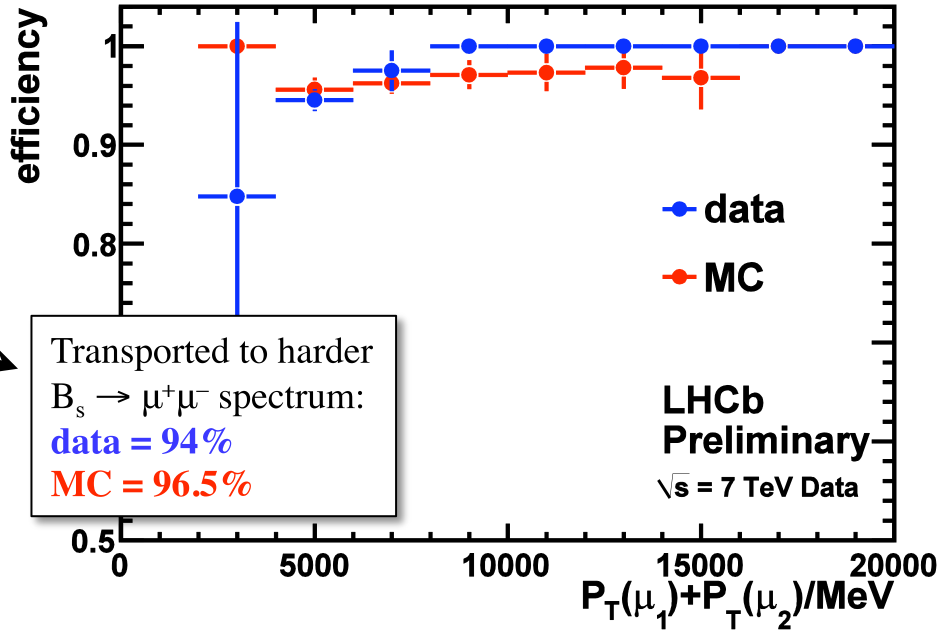
- Very rare loop decays, helicity suppressed
  - Standard Model BR = $(3.35\pm0.32)\times10^{-9}$
  - Can be strongly enhanced in many NP models, e.g. MSSM with large tanβ





- Easy to trigger and reconstruct:
  - checks performed with $J/\psi \to \mu^+\mu^-$ signal



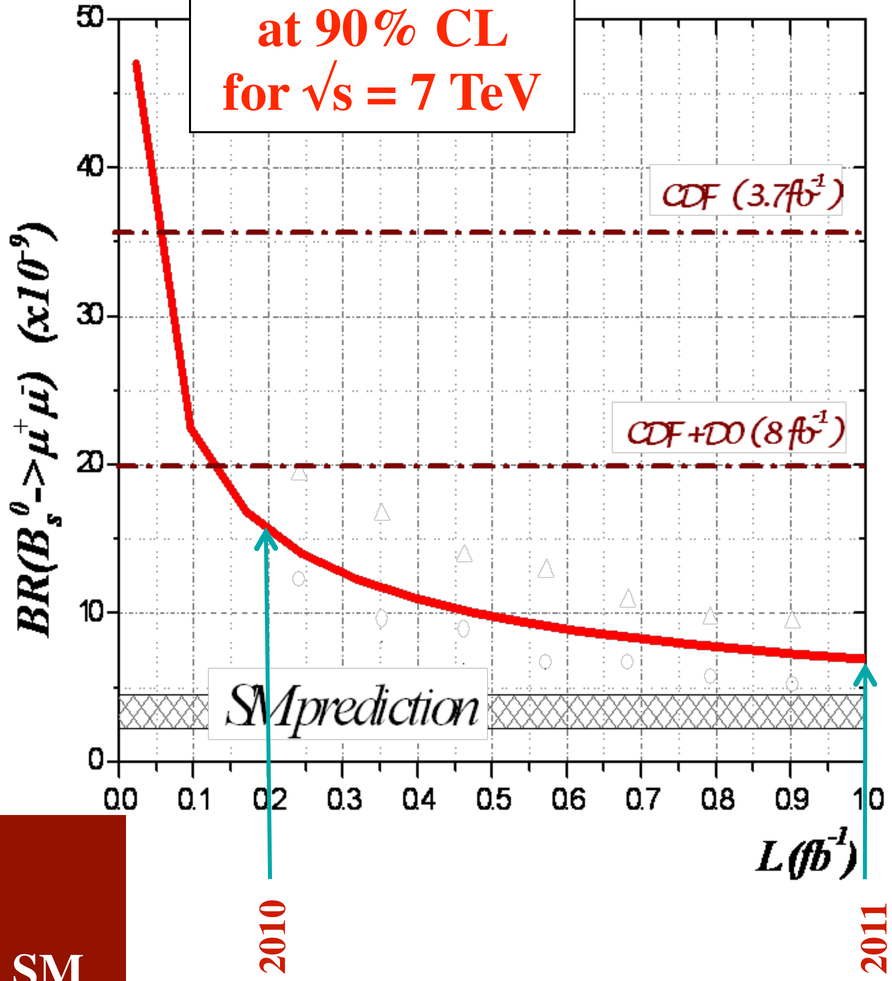


- But main issue is background rejection ...

$B_s \to \mu\mu$

- Quoted sensitivity relies on MC
  - MC compared with data where possible:
    - muon misID checked with true pions and protons from K_S and Λ
    - dimuon combinatorial checked with background in $J/\psi \to \mu^+\mu^-$ selection
    - mass resolutions studied with available mass peaks
    - separation power of geometrical variables (e.g IP signficance) checked with 2-body K_S and D^0 decays
  - All checks performed so far indicate that sensitivity obtained from MC is realistic

Exclusion limit at 90% CL for $\sqrt{s}$ = 7 TeV

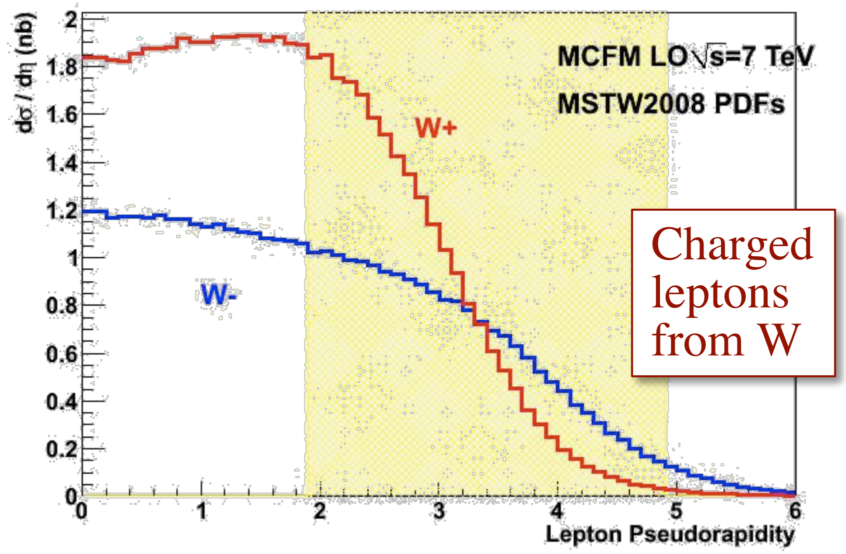


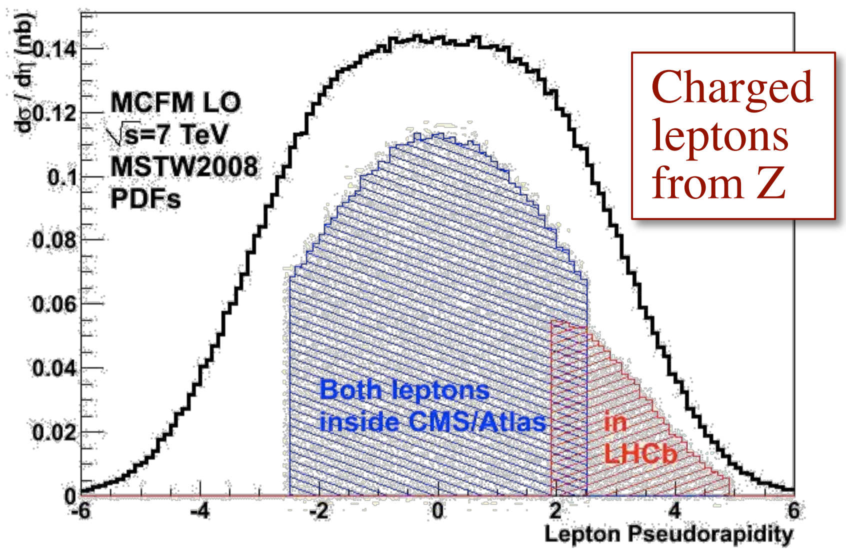
0.1 fb^{-1} ⇒ improve on current Tevatron limit
1 fb^{-1} ⇒ exclude BR values down to 7×10^{-9} or observe 5σ signal with BR = 3.5 × SM

(Need 10 fb^{-1} at 14 TeV for 5σ observation of SM signal)

Electroweak boson production

- ❑ LHCb coverage:
  - — interesting pseudo-rapidity region where W^+/W^- ratio varies rapidly
  - — small y overlap with ATLAS/CMS
  - — unique area of (Q^2, x) plane
- ❑ Measurements of interest:
  - — $Z^0/W^\pm$ ratio
    - precisely predicted (< 1%)
    - should aim at 1% measurement with 0.1 fb^{-1} → test SM
  - — W^+/W^- ratio
    - sensitive to u/d ratio
  - — W, Z production cross sections
    - can constrain PDFs, down to ~6×10^{-4} at $\sqrt{s}$= 7 TeV



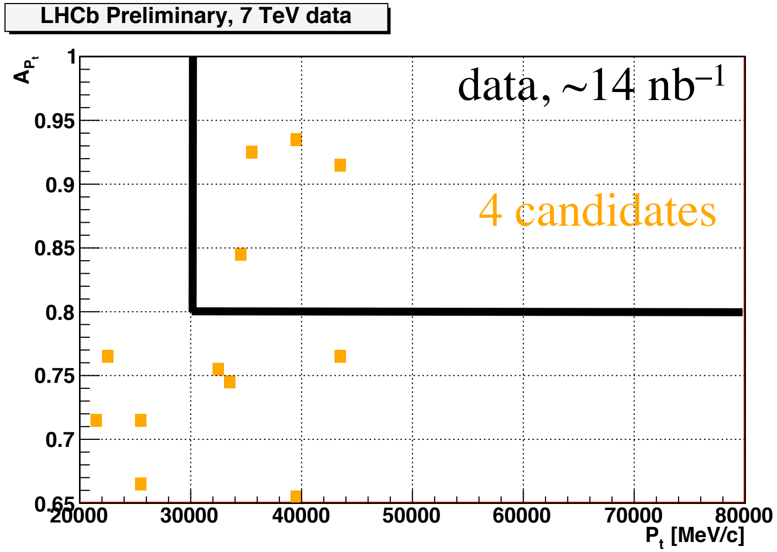


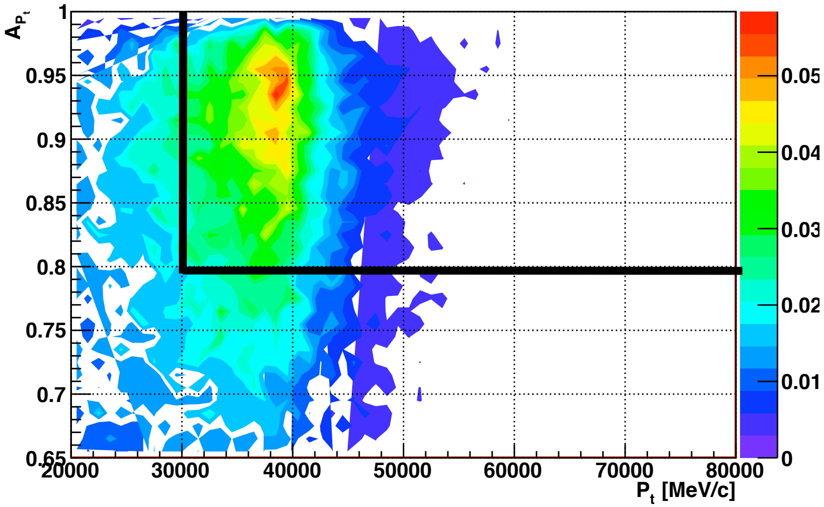
$W \to \mu\nu$ selection

- **Selection:**
  - good track (χ^2, $\sigma_p/_p$, …) identified as muon
  - $p_T > 30$ GeV/c and $A_{pT} > 0.8$

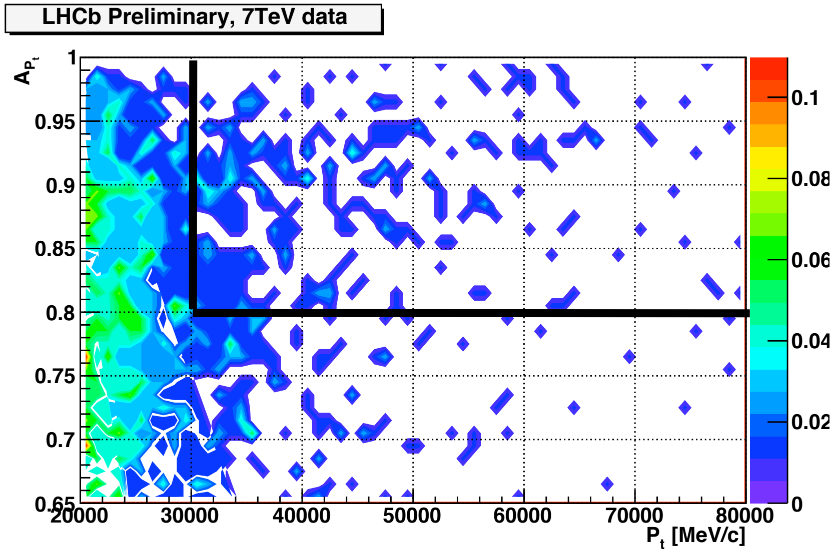
$$A_{pT} = \frac{p_T - p_T^{rest}}{p_T + p_T^{rest}}$$

p_T^{rest} = transverse momentum of vector sum of all charged tracks, excluding the selected track



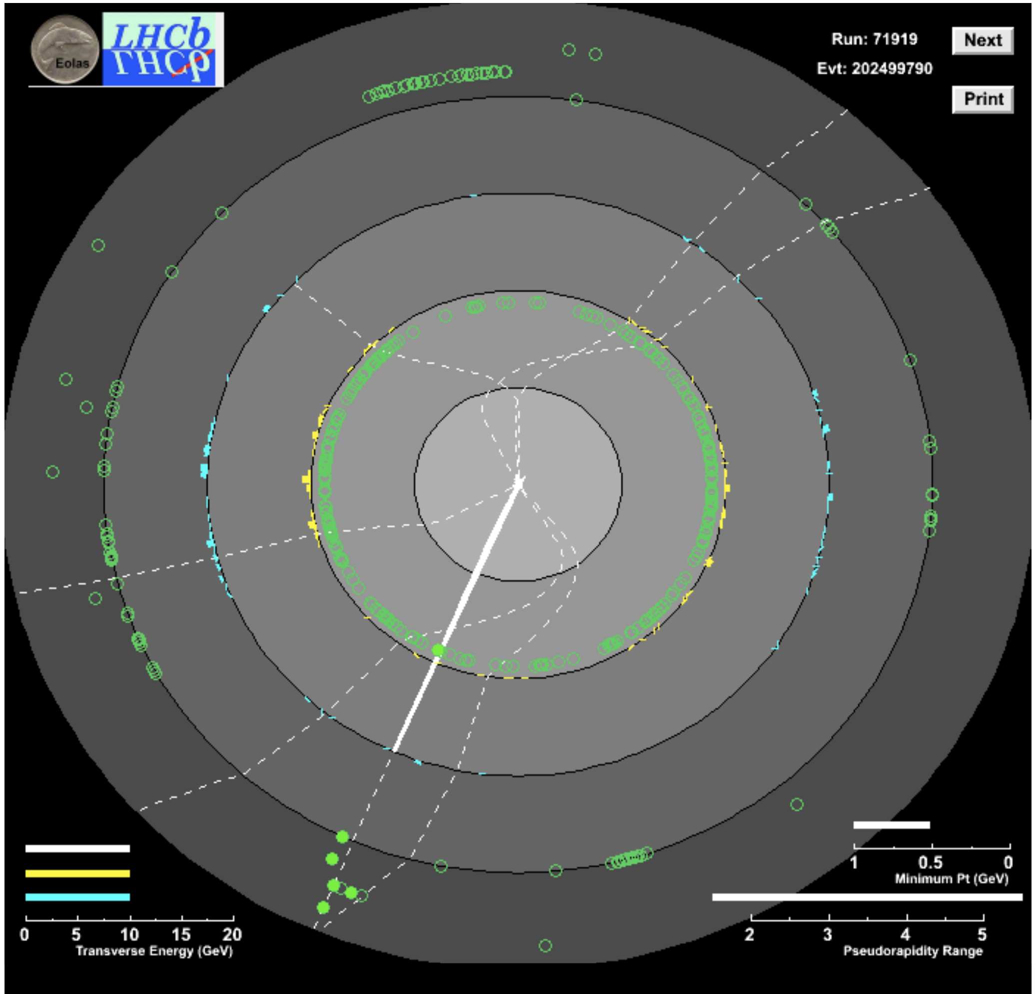


MC, W→ μν signal



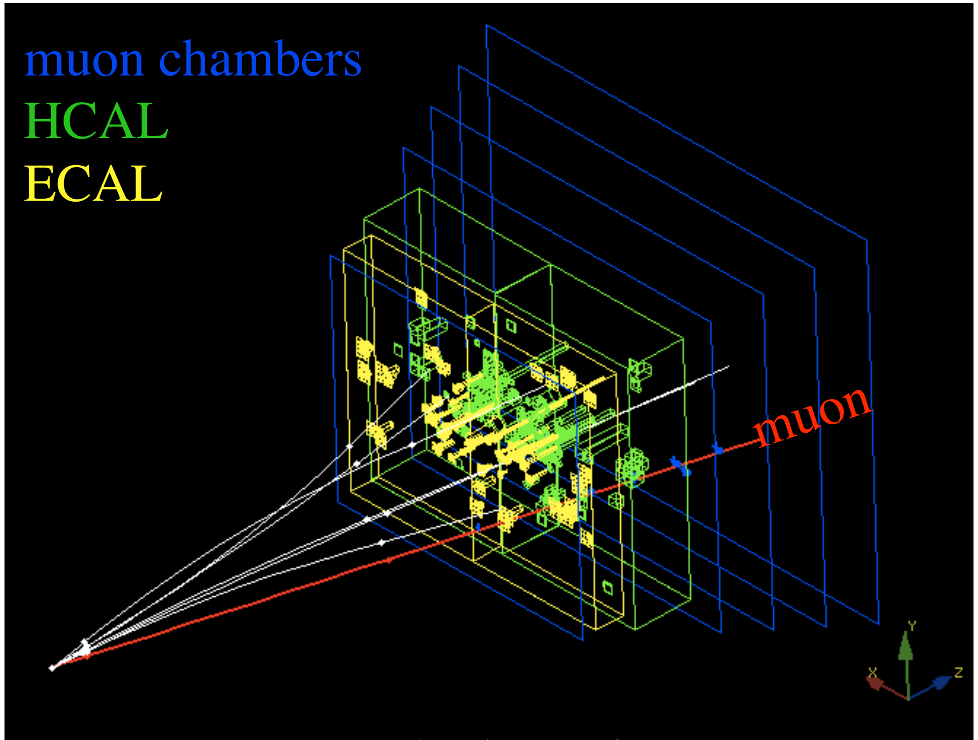
data, ~8 nb⁻¹, without muID cut

$W^+ \to \mu^+\nu$ candidate



z–φ view

$\eta = 2.51$
$p_T = 35.4$ GeV/c
$A_{pT} = 0.92$



standard 3D view

Summary

- LHCb will deploy its core physics within next year with the first fb^{-1}:
  - Lower $\sqrt{s}$ for 2010–2011 run not a big penalty
  - At low luminosity, take opportunity to give more trigger bandwidth to charm
- Initial production measurements:
  - Absolute K_S production cross section at 0.9 TeV
  - $\bar{\Lambda}/\Lambda$ production ratio at 0.9 and 7 TeV
  - very soon:
    - prompt J/ψ, $b \to J/\psi$, $B \to D^0\mu X$
    - charm and bottom hadrons in fully reconstructed modes
- Indirect New Physics searches at LHCb:
  - several highly-sensitive physics observables in B and D sectors, accessible with data from 2010–2011 run
  - active preparation using existing calibration/control signals while looking forward to more statistics !