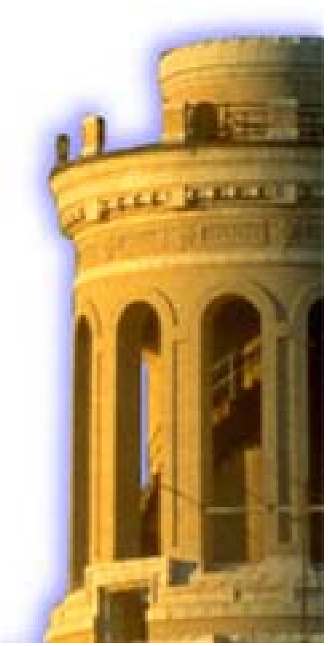
ATLAS B Physics Performance Update

- Detector and trigger
- Precision measurements
- Rare decays
- B production
- Summary

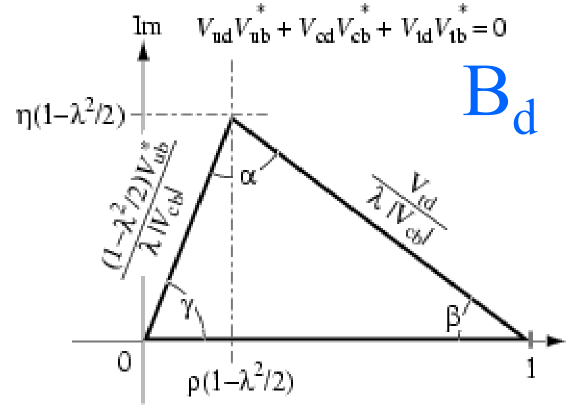


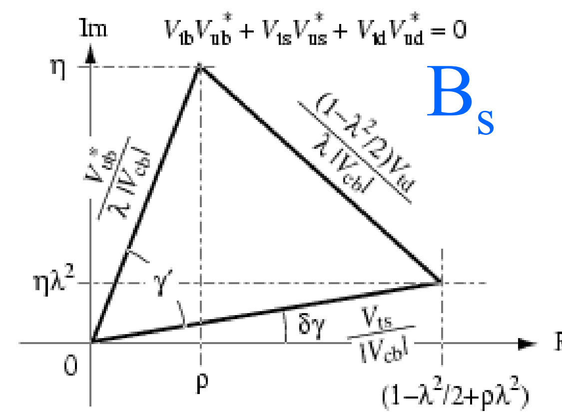
Paula Eerola for the ATLAS Collaboration
Beauty 2003, Carnegie Mellon 14-18 Oct 2003

LUND UNIVERSITY

B decays at LHC

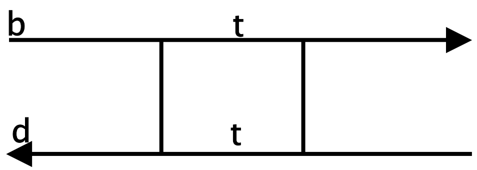
- Unlike BaBar, Belle, access to B_s and Λ_b decays
  ($B_s \to KK$, $B_s \to D_sK$, $B_s \to J/\psi\phi$ (η), $\Lambda_b \to J/\psi\Lambda$. . .)
  Mixing measurements
- Much higher statistics than at the Tevatron
  - Access to rare b-decays
    ($B_d \to K^*\gamma$, $B_d \to K^*\mu\mu$, $B_s \to \mu\mu$ . . .)
- Precision CPV measurements
  ($B_d \to J/\psi\ K^0_S$. . .)

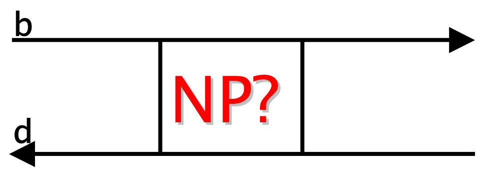




- Overconstrain the unitarity triangles
- Search for New Physics beyond SM

New particles may show up in loop diagrams, overconstrain will allow to disentangle SM components from the new-physics ones



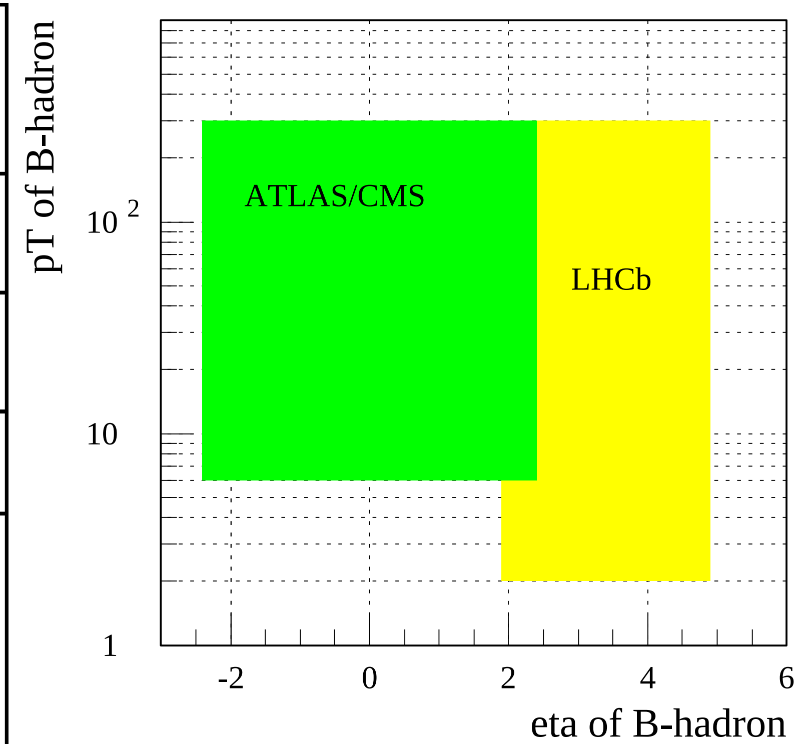


High statistics is a requirement

B production at LHC

ATLAS/CMS and LHCb are complementary

LHC σ total = 100 mb, σ inelastic = 80 mb σ bb = 500 μb	
ATLAS **Central detector**	**LHCb** **Forward detector**
one b in $\|\eta\|<2.5$, $p_T>10$GeV → $\sigma = 100\ \mu b$	one b in $1.9<\eta<4.9$, $p_T>2$GeV → $\sigma = 230 \mu b$
$L = 1\text{-}2 \times 10^{33}\ cm^{-2}\ s^{-1}$ Rare decays $L = 10^{34}\ cm^{-2}\ s^{-1}$	$L = 2 \times 10^{32}\ cm^{-2}\ s^{-1}$
1 y@$10^{33}\ cm^{-2}\ s^{-1}$: Total number of reconstructed "physics" events 2.6×10^6 • dominated by bb → J/ψ • hadronic $<10^5$ (all μ-tag)	1 y@$2\times10^{32}\ cm^{-2}\ s^{-1}$: Total number of reconstructed "physics" events 3.4×10^6 • 1.7×10^6 bb → J/ψ • 1.7×10^6 hadronic



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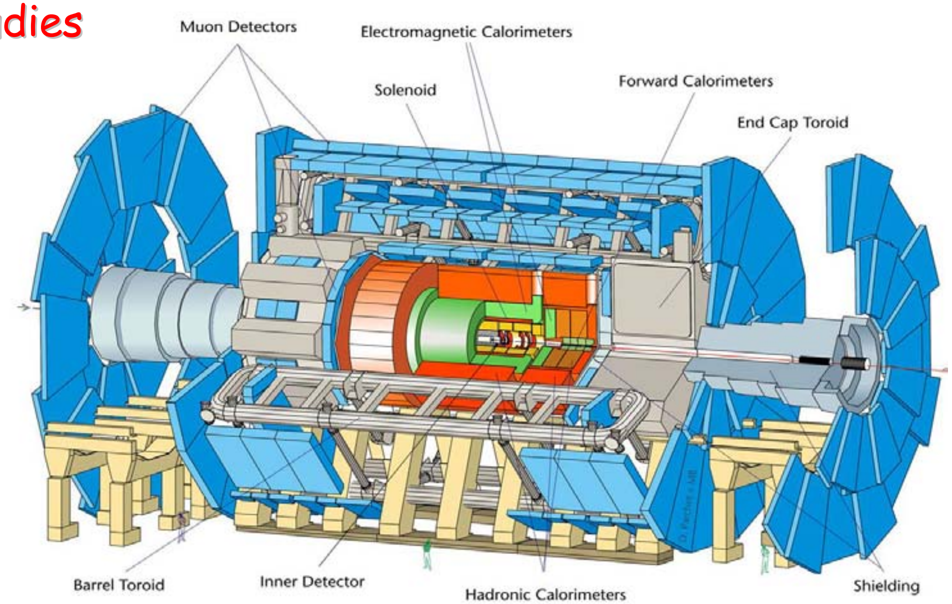
The ATLAS Detector

The Inner Detector (ID): pixels, silicon detectors and the transition radiation tracker inside a solenoidal 2T field (see H. G. Moser)
+ Good tracking – complementary systematics to the LHCb case
+ e/π separation in TRT
- marginal π/K identification

ID, calorimeters and muon system cover $|\eta|<2.5$
+ Access to central region good for production studies



Muon trigger and reconstruction down to p_T=5 (3) GeV in muon chambers, tile calorimeter, ID.

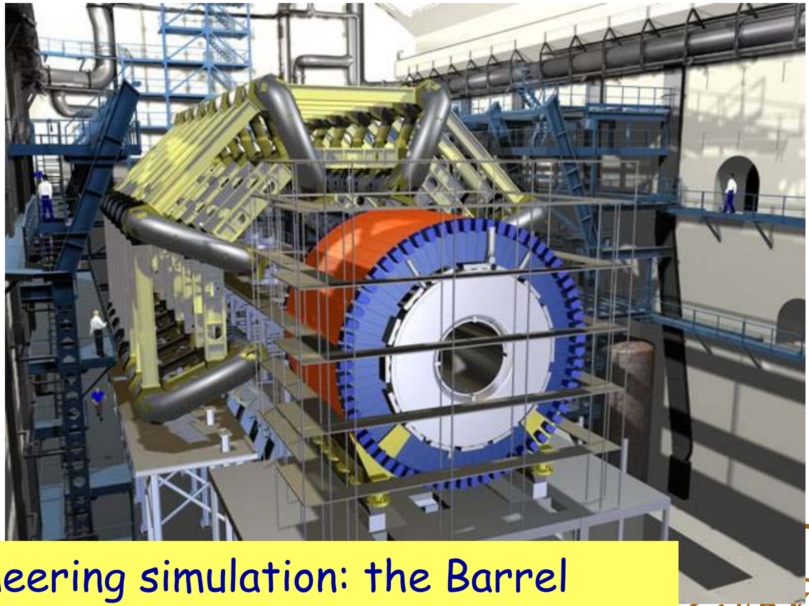
Electron trigger and reconstruction down to p_T=2 GeV in LAr calorimeter, TRT (see S. George)

+ Better statistics than LHCb in all leptonic channels
+ Very good for leptonic rare decays (high luminosity running)
- Must share trigger bandwidth with other physics → hadronic channels suffer

ATLAS construction

- Installation status: installation activities at LHC Point 1 have started. April 2003: part of the underground experimental area (UX15) has been delivered to ATLAS. Nov 2003: start installing feet and rails.
- All subdetectors are under construction, some already completed (tile calorimeter). Jan 2004→ first detector parts in the cavern: barrel calorimeter, tile calorimeter first, then LAr. Mar 2004→ barrel toroid coils.
- The "initial" detector ready for global commissioning and cosmics summer 2006, ready for beam in April 2007. Some components will be staged for later installation.

Shielding installation in the underground cavern, status 2003.

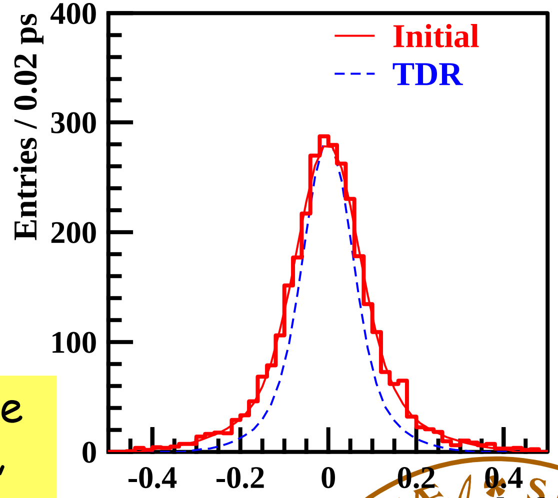


Engineering simulation: the Barrel Toroid and the Barrel Calorimeter installed in position (October 2004).

ATLAS initial detector

Detector layouts	Complete	Initial	Physics TDR 1999
Radius of B-layer	5 cm	5 cm	4.3 cm
B-layer pixel length in z	400 μm	400 μm	300 μm
Middle pixel layer	yes	missing	yes
Pixel disk #2, TRT C-wheels	yes	missing	yes

Channel	Mass resolution, single Gaussian fit		
	Complete	Initial	TDR
$B_s \to D_s(\phi\ \pi)\ \pi$	46 MeV	46 MeV	42 MeV
$B_d \to J/\psi(\mu_6\mu_3)K^0$	21 MeV	21 MeV	19 MeV



Decay time resolution $B_s \to D_s(\phi\ \pi)\ \pi$

- Proper time resolution for B_s decays (TDR layout): core resolution 52 fs. Initial layout: core resolution > 60 ps, cuts to be optimized in view of Δm_s measurement (N(events) vs resolution).
- Initial and complete layouts have appr. the same τ–resolution (fewer detector layers $\propto$ less material).

B-Physics Trigger

- The ATLAS Trigger will consist of three levels
  - 40 MHz $\rightarrow$ Level-1 $\rightarrow$ O(20 kHz) $\rightarrow$ Level-2 $\rightarrow$ O(1-5 kHz) $\rightarrow$ Event Filter $\rightarrow$ O(200 Hz).
  - B-physics 'classical' scenario: LVL1 muon with $p_T > 6$ GeV, $|\eta| < 2.4$, LVL2 muon confirmation, ID full scan.
- The B-physics trigger strategy had to be revised
  - changed LHC luminosity target ($1 \rightarrow 2 \times 10^{33}$ cm^{-2}s^{-1})
  - changes in detector geometry, possibly reduced detector at start-up
  - tight funding constraints
- Alternatives to reduce resource requirements
  - require at LVL1, in addition to single-muon trigger, a second muon, a Jet or EM RoI; reconstruct tracks at LVL2 and EF within RoI
  - flexible trigger strategy: start with a di-muon trigger for higher luminosities, add further triggers (hadronic final states, final states with electrons and muons) and/or lower the thresholds later in the beam-coast/for low-luminosity fills.

B-Physics Trigger II

New Scenario:

- B-physics trigger types (always single muon at LVL1)
  - di-muon trigger: additional muon at LVL1. Effective selection of channels with $J/\psi(\mu^+\mu^-)$, rare decays like $B \to \mu^+\mu^-(X)$, etc.
  - hadronic final states trigger : RoI-guided reconstruction in ID at LVL2, RoI from LVL1 Jet trigger. Selection of hadronic modes e.g. $B_s \to D_s\,\pi$
  - electron-muon final states trigger: RoI-guided reconstruction in TRT at LVL2, RoI from LVL1 EM trigger. Selection of electrons, e.g. $J/\psi \to e^+e^-$
  - 'classical' scenario as fall-back
- Results are promising
  - Strong reduction in processing requirements compared to previous strategy that involved full scan of Inner Detector at level-2.
  - Further studies needed.

Precision measurements: sin2β, α

sin2β measurement with $B_d \to J/\psi K^0_S$. Maximum likelihood fit with simulated inputs: proper time resolution, tag probability, wrong tag fraction, background composition. Direct CP violation term neglected here. TDR layout.

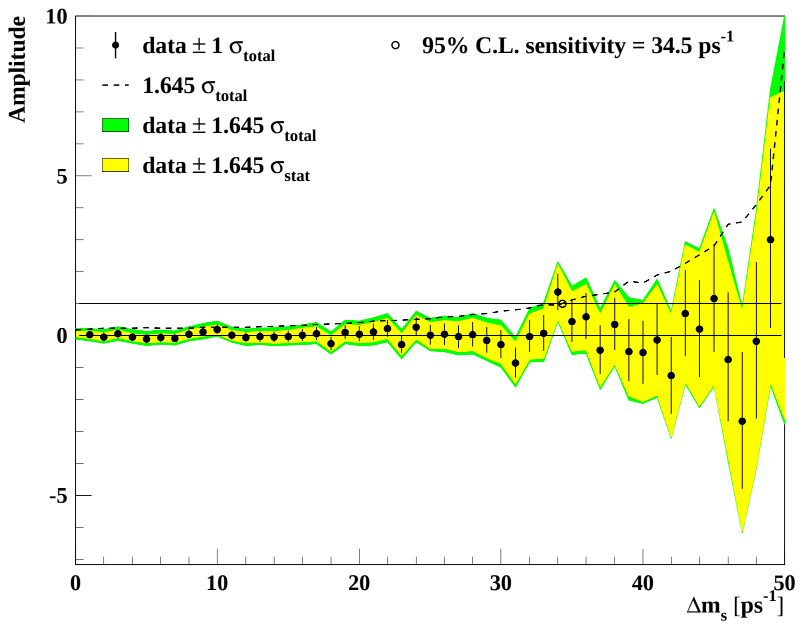
3 years@$10^{33}cm^{-2}\ s^{-1}$	$J/\psi(\mu6\mu3)$	$J/\psi(\mu6\mu5)$	$J/\psi(ee) + B\to\mu6$
N(all reconstructed evts) S/B	490k 28	250k 32	15k 16
Δsin2β statistical Lepton tag Jet/charge tag Total	 0.023 0.015 0.0126	 0.030 0.019 0.016	 0.018 - 0.018
Total $J/\psi(\mu6\mu3)$ + $J/\psi(ee)$, $B\to\mu6$	0.010	Total $J/\psi(\mu6\mu5)$ + $J/\psi(ee)$, $B\to\mu6$	0.012
Δsin2β systematics prod. asymmetry, tagging, background	0.005		

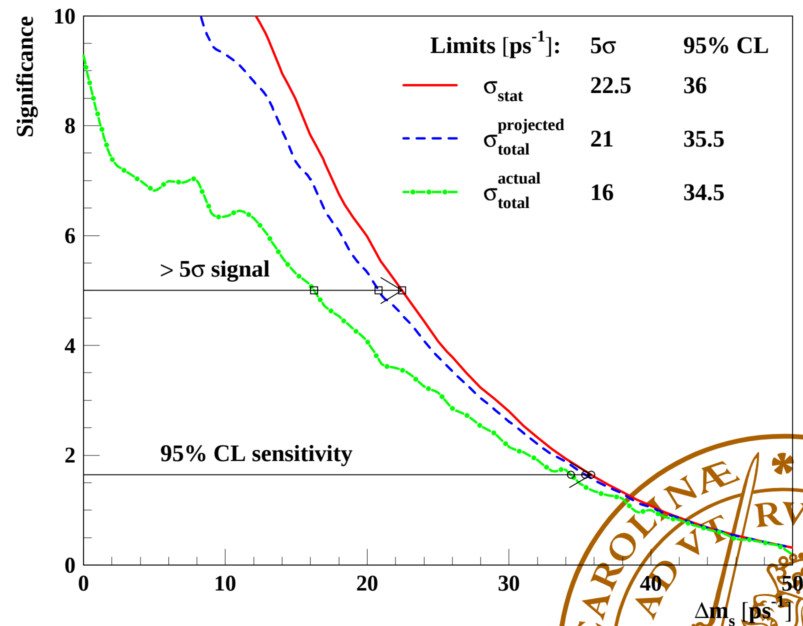
Sensitivity to angle α: fit ($A_{dir}\cos(\Delta m\ t) + A_{mix}\sin(\Delta m\ t)$) in $B\to hh$.
A_{dir}, A_{mix} in SM depend on α, δ (or α_{eff}), $O(|P/T|^2)$.
ATLAS alone: $\sigma(A_{dir})=0.16$, $\sigma(A_{mix})=0.21$ → combined LHC measurement.

Precision measurements: B^0_s

Precise measurements of B^0_s - anti-B^0_s system parameters : $\Delta\Gamma_s$, Δm_s.
Probe B_s mixing phase $\phi_s = -2\lambda^2\eta$ to investigate new physics.

- Δm_s measured from flavour specific final states $B_s \rightarrow D_s\,\pi$ and $B_s \rightarrow D_s\,a_1$. Already after 1 year (10 fb^{-1}) sensitivity to Δm_s up to 36 ps^{-1} → SM allowed range Δm_s (14.3 - 26) ps^{-1} fully explored.





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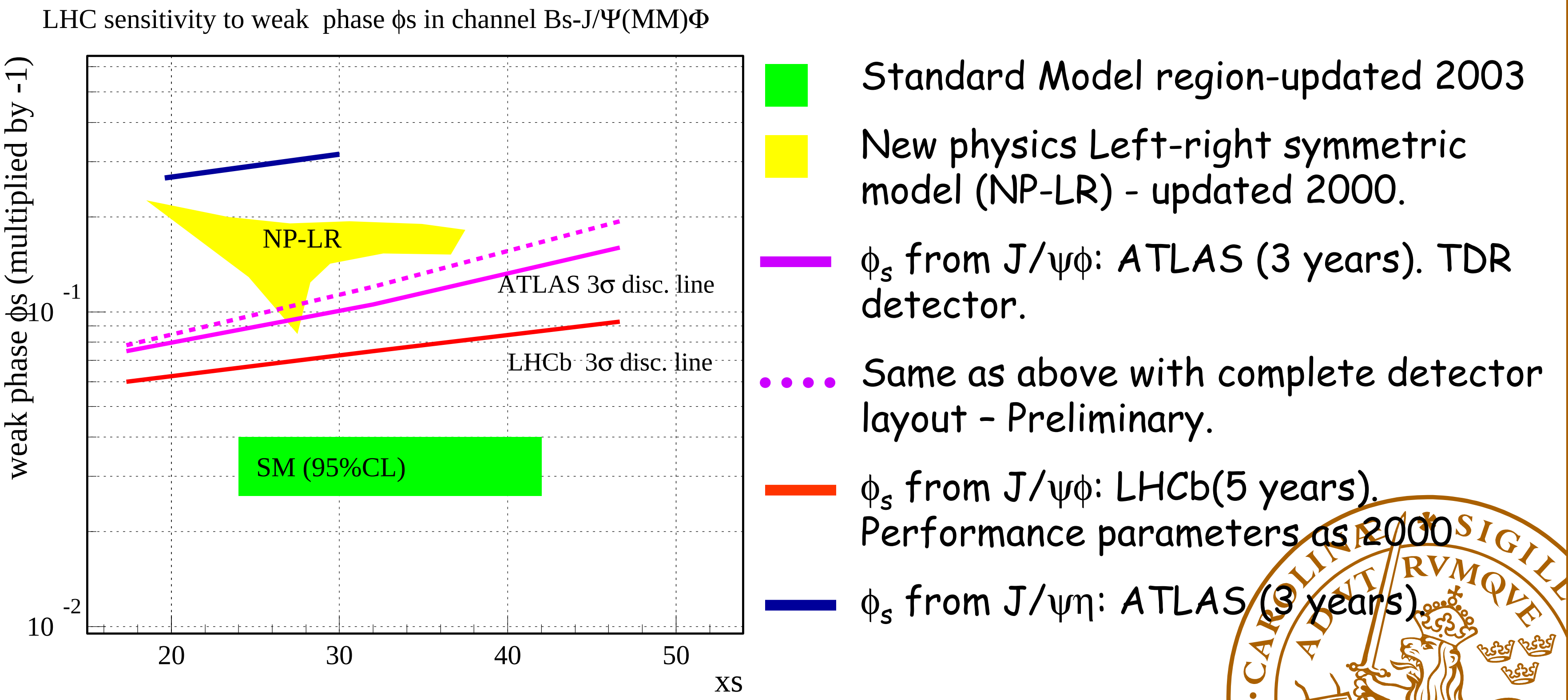
$\Delta\Gamma_s$ and ϕ_s from $B^0_s \to J/\psi\phi$ (η)

- $\Delta\Gamma_s$, Γ_s and ϕ_s determined from angular analyses of $B_s \to J/\psi\ (\mu\mu)\phi(KK)$.
- $\Delta\Gamma_s$ can be determined with a relative error of 12% (stat) with 30 fb^{-1}.
- Measurement precision of ϕ_s depends on x_s: for $B_s \to J/\psi\phi$, sensitivity in the range 0.08-0.15 for x_s=20-40 (SM) (Δm_s = 13.7-27.3 ps^{-1})
- $B_s \to J/\psi\eta$: sensitivity for ϕ_s in the range 0.27-0.31 for x_s=20-30 (Δm_s = 13.7-20.5 ps^{-1})



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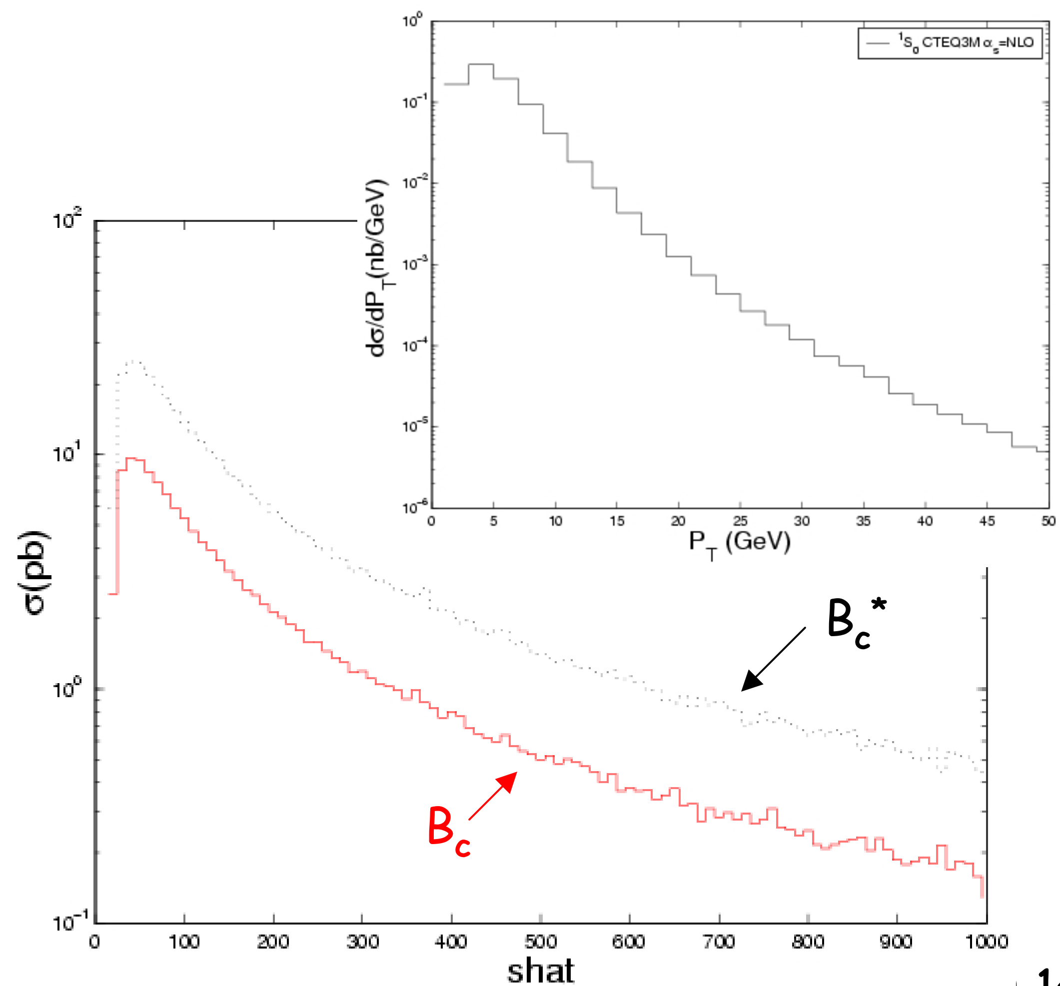
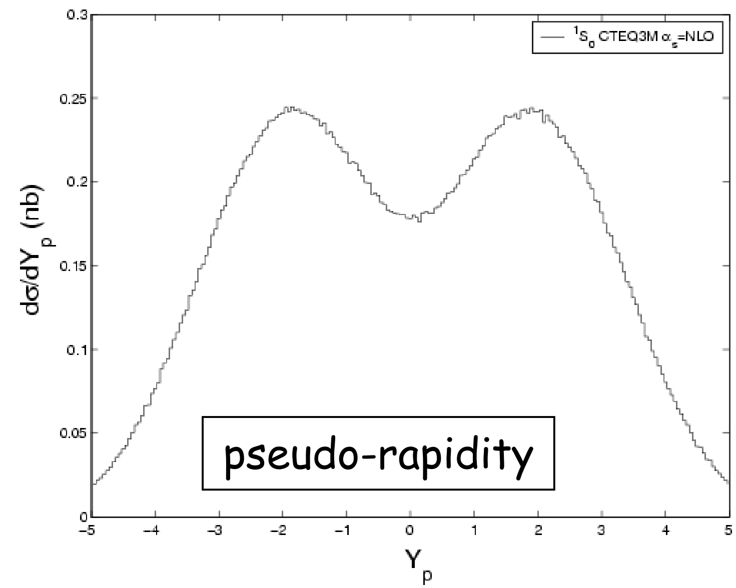
B_c Studies in ATLAS

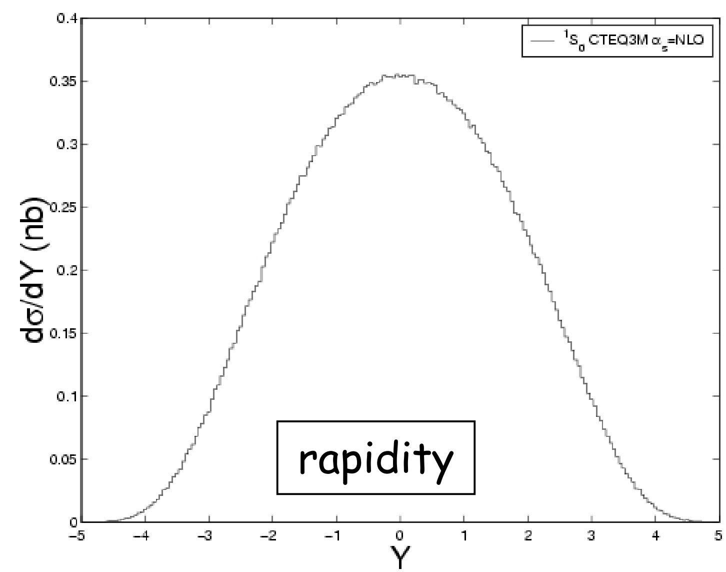
- The expected large production rates at the LHC will allow for precision measurements of B_c properties
  - recent estimates for ATLAS (assuming $f(b \to B_c) \sim 10^{-3}$, 20 fb^{-1}, LVL1 muon with $p_T > 6$ GeV, $|\eta| < 2.4$)
    - ~5600 $B_c \to J/\psi\ \pi$ produced events
    - ~100 $B_c \to B_s\ \pi$ produced events
- Channels studied so far: $B_c \to J/\psi\ \pi$ (mass measurement), $B_c \to J/\psi\ \mu\nu$ (clean signature, ingredient for $|V_{cb}|$ determ.)
- MC generation of B_c events using standard tools is CPU intensive.
- Implementation of two MC generators in PYTHIA 6.2
  - Fragmentation Approximation Model MC
  - Full Matrix Element MC (C. Driouichi et al., hep-ph/0309120): based on the "extended helicity" approach (grouping of Feynman diagrams into gauge-invariant sub-groups to simplify calculations, never done for $gg \to QQ$ before). pQCD to $O(\alpha_s^4)$, 36 diagrams contributing.

B_c Studies in ATLAS II

Results from FME generator
(BCVEGPY 1.0)



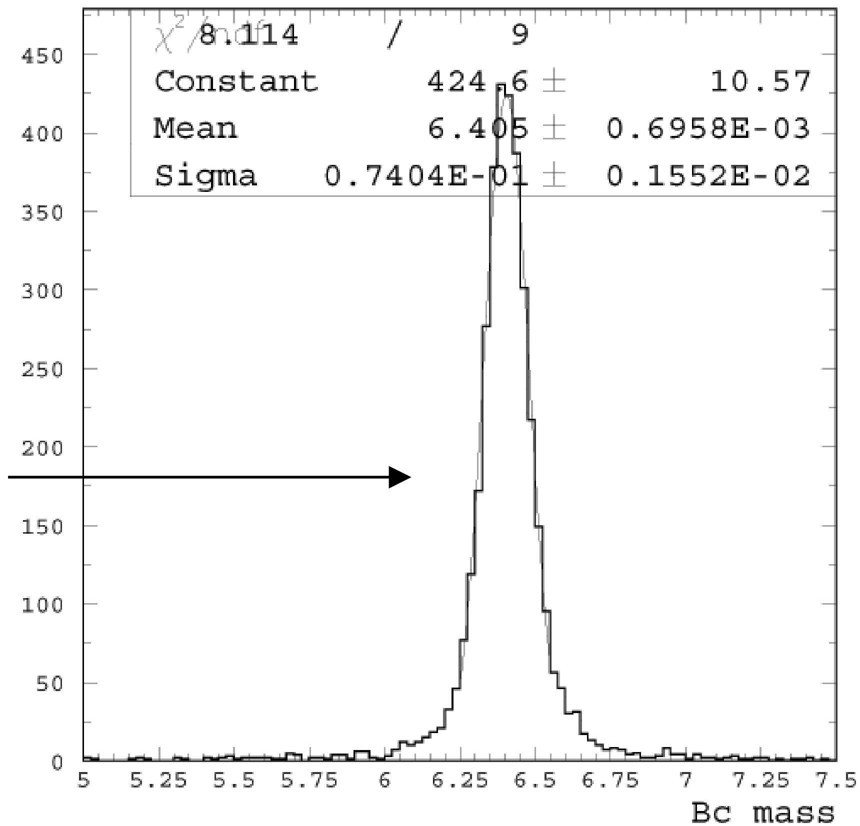


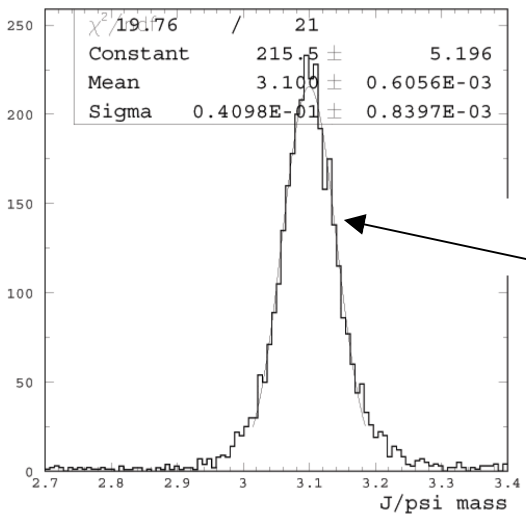


B_c Studies in ATLAS III

First preliminary results from full detector simulation (Geant3) and reconstruction

- 'initial layout'
- channel $B_c \to J/\psi\ \pi$
- mass resolution σ_{B_c} = 74 MeV

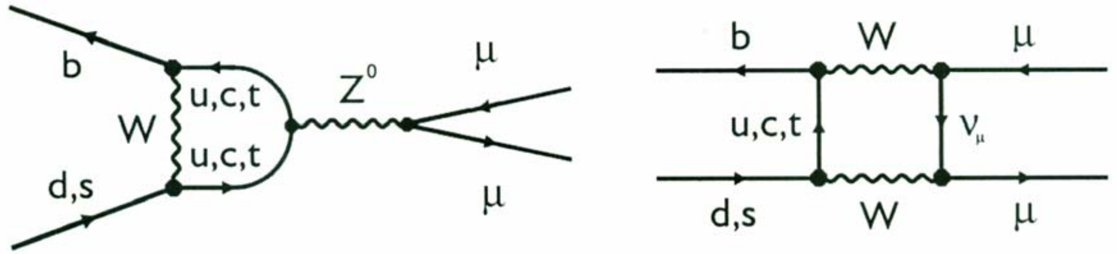




mass resolution $\sigma_{J/\psi}$ = 41 MeV

Rare decays $B^0_{s,d} \to \mu^+\mu^-$

FCNC B decays with b→s or b→d occur only at loop level in SM
BR < 10^{-5} → probe of new physics



- $B_{s,d} \to \mu\mu$: BR=3.5×10^{-9} (B_s) and 1.5×10^{-10} (B_d) (SM, "optimistic")
- clear signature, tiny BR → ideal for new physics observation.
- Di-muon trigger allows high-luminosity data-taking. After 1 year at high luminosity (100 fb^{-1}) – **4.3σ signal**

After 1 year $10^{34} cm^{-2} s^{-1}$

	Signal Bs->μμ	Signal Bd->μμ	BG
ATLAS	92	14	660
CMS	26	-	<6.4

- The difference with CMS can be attributed to better vertex reconstruction precision and secondary vertex selection.
- There is an indication of possible improvement of background conditions with another vertex fit procedure.

Rare decays $B^0_{s,d} \rightarrow \mu^+\mu^- X$

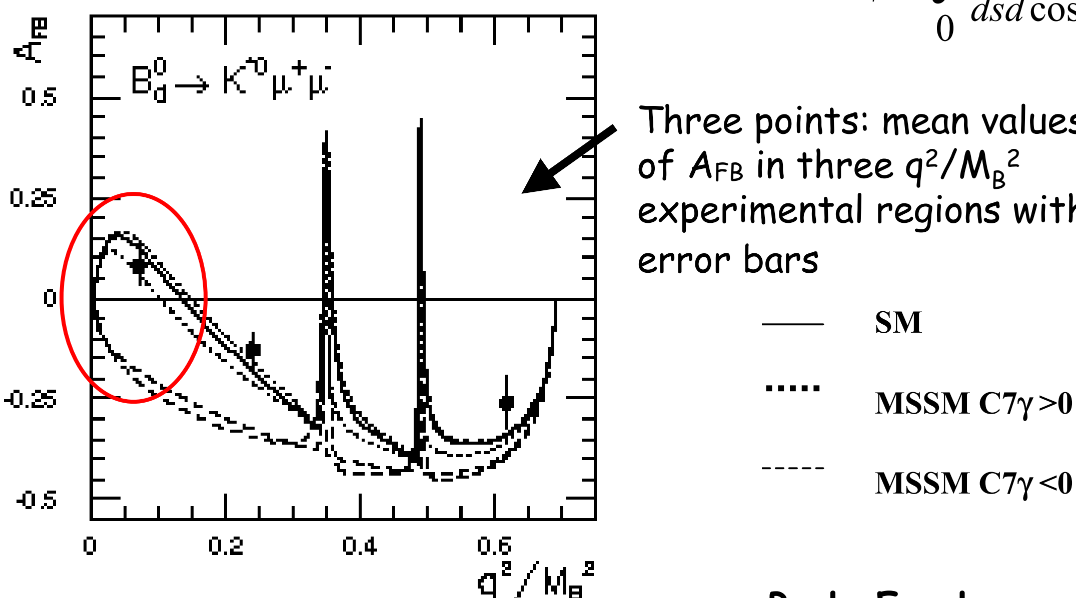
- $B_d \rightarrow K^*\mu\mu$: sensitive to $|V_{ts}|$. The shape of F-B asymmetry is sensitive to new physics (MSSM)
- $N(B_d \rightarrow \rho\mu\mu)/N(B_d \rightarrow K^*\mu\mu) \sim |V_{td}|^2/|V_{ts}|^2$ useful also for $\Delta m_s/\Delta m_d$ estimation – complementary to oscill.meas.

Statistics with 30 fb^{-1}

channel	BR	signal	BG
$B_d^0 \Rightarrow \rho^0\mu\mu$	10^{-7}	222	950
$B_d^0 \Rightarrow K^*\mu\mu$	1.5×10^{-6}	1995	290
$B_d^0 \Rightarrow \phi^0\mu\mu$	10^{-6}	411	140

$B_d -> K^{0*}\mu^+\mu^-$

$$A_{FB}(S) = \frac{1}{d\Gamma/ds}\int_0^1 \frac{d^2\Gamma}{ds\,d\cos(\theta)} d\cos(\theta) - \int_{-1}^0 \frac{d^2\Gamma}{ds\,d\cos(\theta)} d\cos(\theta)$$

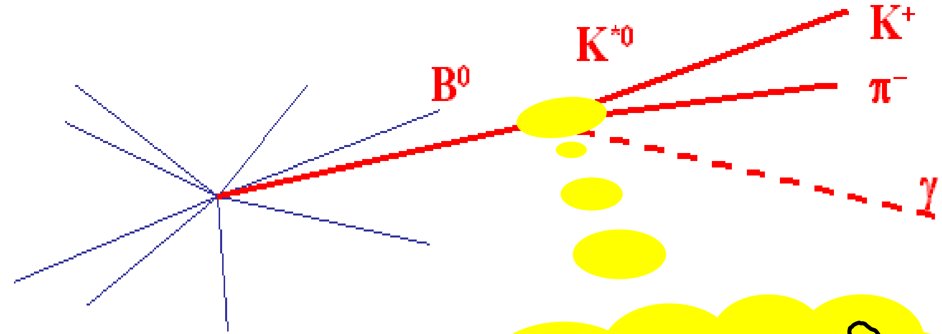


Three points: mean values of A_{FB} in three q^2/M_B^2 experimental regions with error bars

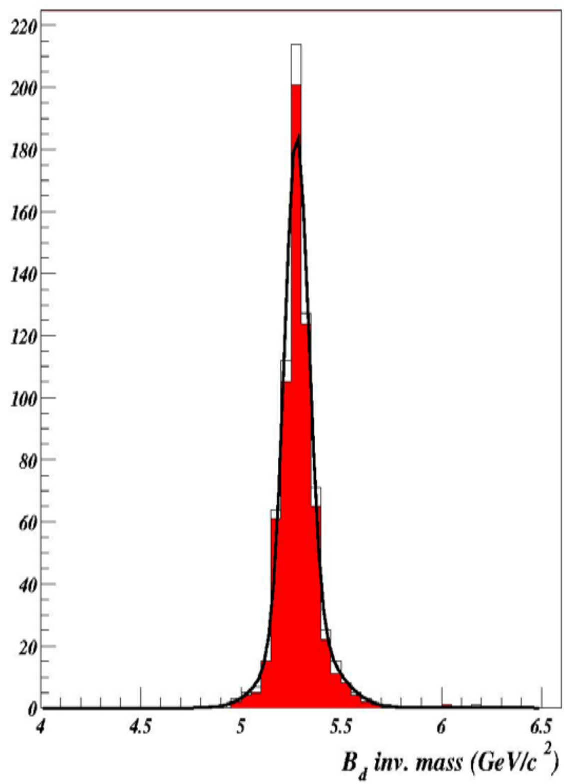
Lowest mass region: sufficient accuracy to separate SM and MSSM if Wilson coefficient $C_{7\gamma}$ <0

Rare decays $B^0 \to K^{0*} \gamma$

- BR($B^0 \to K^{0*} \gamma$) = $(4.2 \pm 0.4)\ 10^{-5}$
- Sensitive to New Physics effects through the loop diagram

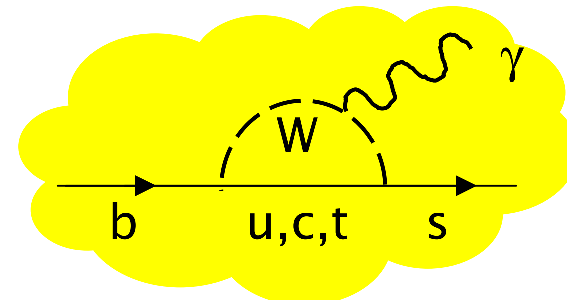


57 MeV mass resolution



$$\frac{S}{B} > 0.3\%$$

$$\frac{S}{\sqrt{B}} \sim 5.7$$

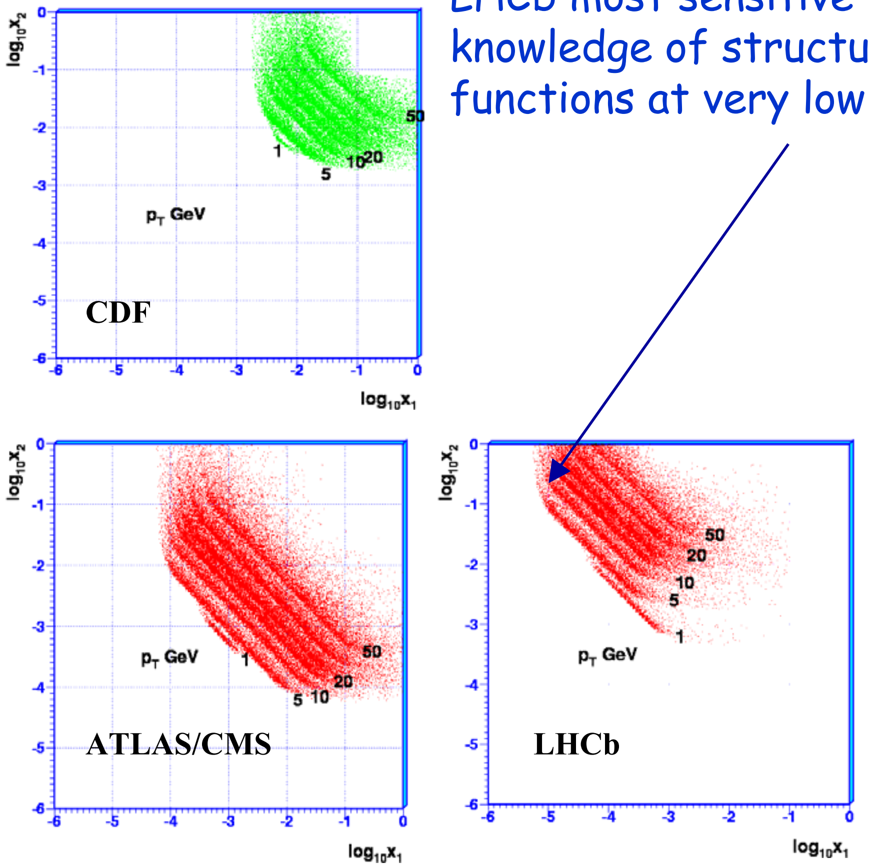


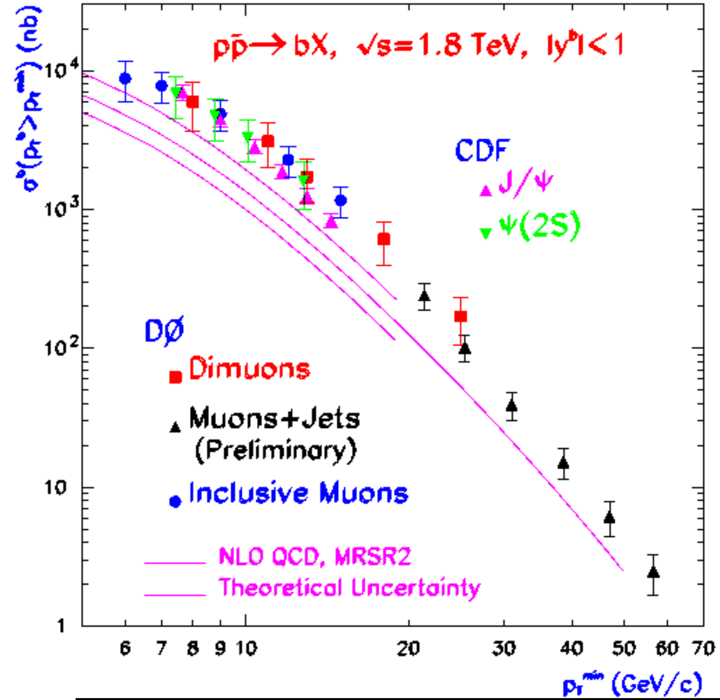
2.8% rec. efficiency (incl. muon efficiency) → statistics 10 500 events per 30 fb^{-1}.

Combinatorial background from $bb \to \mu(6)X$ was considered. Specific background from $B^0 \to K^* \pi^0$ is under investigation.

B production at LHC

Bjorken x region: one of B's in detector volume: LHCb most sensitive to knowledge of structure functions at very low x



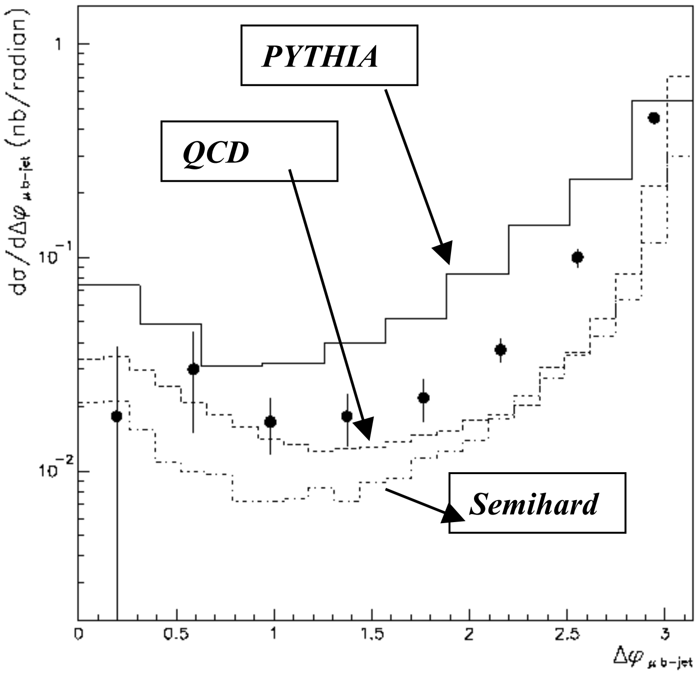


CDF and D0 beauty cross section in central region underestimated by NLO QCD by ~2.4

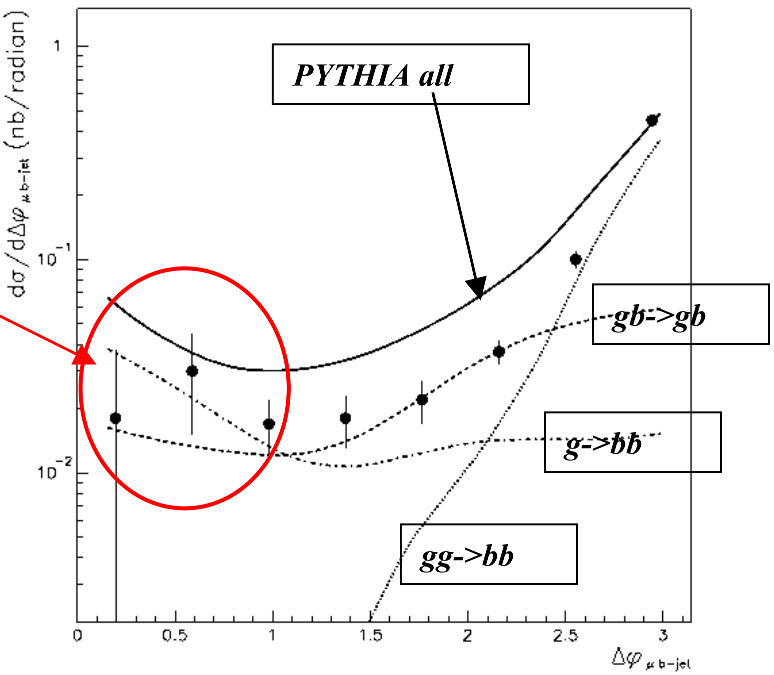
Better agreement at higher p_T (D0 measurement with b-jets)

B production at LHC II

CDF measurement of b-b correlations using μ + jet data



3 points where the model dependent acceptance correction was used to correct for isolation cut between μ and b-jet



Pythia is above the data

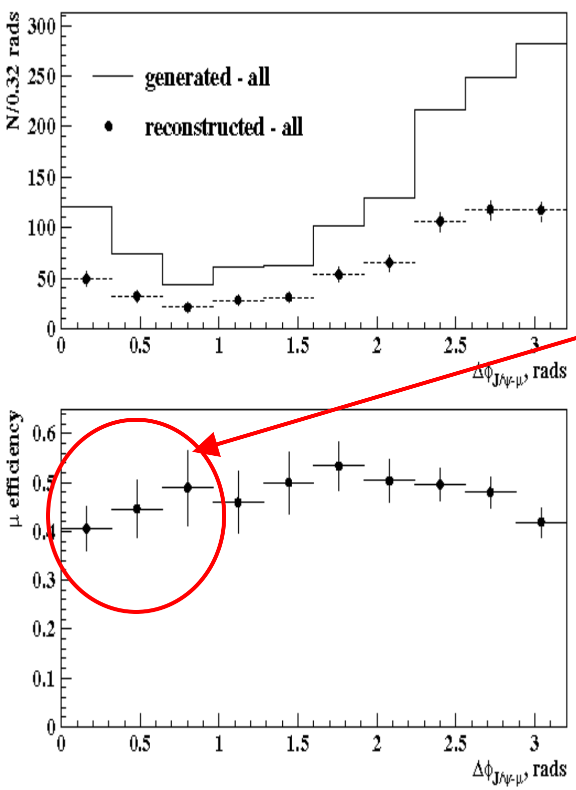
NLO QCD is below the data

LHC statistics will allow using exclusive channels instead of b-jets

B production at LHC III

ATLAS - proposal for measuring b-b production correlations using exclusive B-decays and semileptonic decays to muons

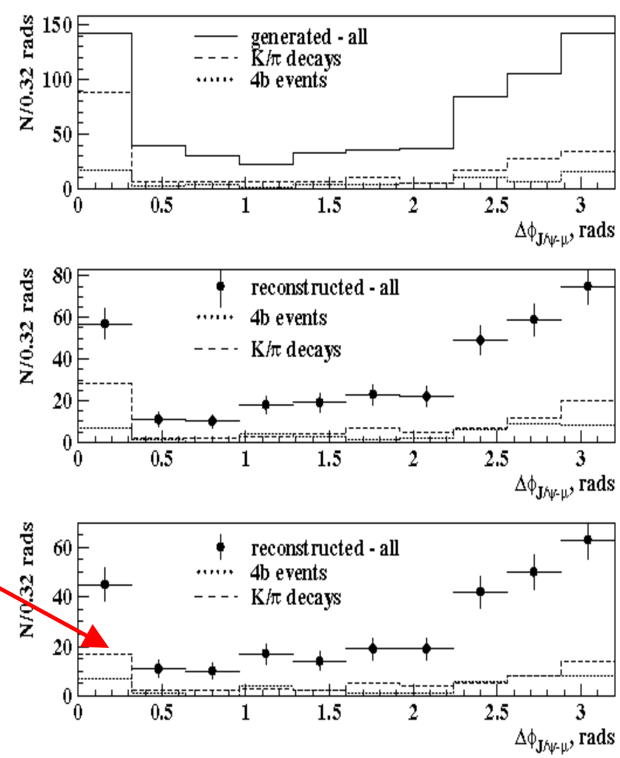
$B \to \mu \; B_d \to J/\psi K_s^0$



$$\Delta\phi = \phi_{J/\psi} - \phi_\mu$$

No degradation of efficiency as b-b close in space.

$B \to \mu \; B_s \to J/\psi \phi$



In B_s case – interesting specific background

$K \to \mu$ originating from s-quark associated with Bs production. Need

$B \to e \; B_s \to J/\psi \phi$

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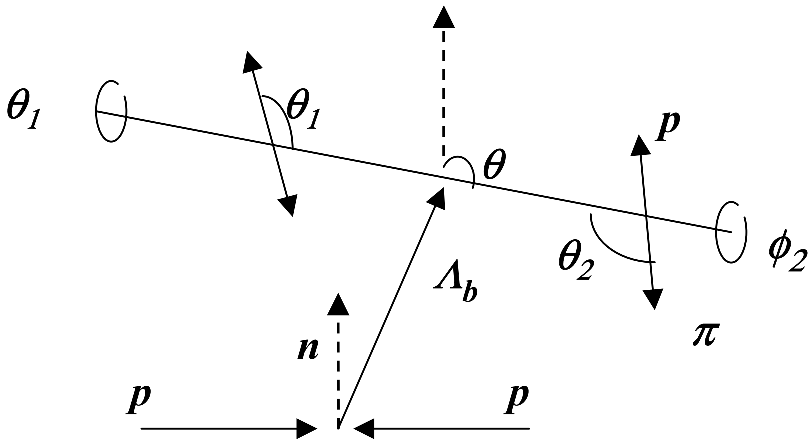
Λ_b production polarization

In p-p collisions Λ_b baryon will be polarized perpendicularly to production plane. The polarization vanishes as $\eta \to 0$ because of p-p symmetry. At LHCb polarization higher than ATLAS/CMS.

Angular distribution $\Lambda_b \to J/\psi(\mu\mu)\Lambda(p\pi)$ depends on 5 angles (fig) + 6 parameters of 4 helicity amplitudes and polarization P_b . Helicity amplitudes and P_b – simultaneously determined.



75000 $\Lambda_b \to J/\psi(\mu\mu)\Lambda(p\pi)$ in 3 years will allow precision $\delta P_b = 0.016$.

Also studied

- Properties of beauty baryons.

Conclusions

- **ATLAS is preparing a multithematic B-physics program.**
  - Includes B-decays and B-production.
- **ATLAS B-physics trigger strategy revised** to maximize physics potential within tight funding constraints:
  - Rely on dimuon trigger for initial luminosity 2×10^{33} $cm^{-2}s^{-1}$, extending the selection when the luminosity falls.
- **The main emphasis will be on underlying mechanisms of CP violation and evidence of New physics.**
  - ATLAS is especially precise in measurement of angle β.
  - In $B_s \to J/\psi\ \phi(\eta)$ large CP violation would indicate new physics.
  - There is sensitivity to Δm_s beyond SM expectations.
- **The expected large production rates** at the LHC will allow for **precision measurements of B_c properties**:
  - e.g. ~5600 $B_c \to J/\psi\ \pi$ produced events, ~100 $B_c \to B_s\ \pi$ prod. events
- **Rare decays $B \to \mu\mu(X)$** have a favourable experimental signature, allowing measurements also at the nominal LHC luminosity 10^{34} $cm^{-2}s^{-1}$.
  - Will measure branching ratio of $Bs \to \mu\mu$ which is in SM of order $Br<(10^{-9})$
  - Precision measurements will be done for $B \to K^*\mu\mu$.
- **Large sample of $B \to K^*\gamma$** allows for **probing New physics effects.**
- **Beauty production and bb correlations** in central LHC collisions will be measured for QCD tests.
  - Complementary phase space region to LHCb.

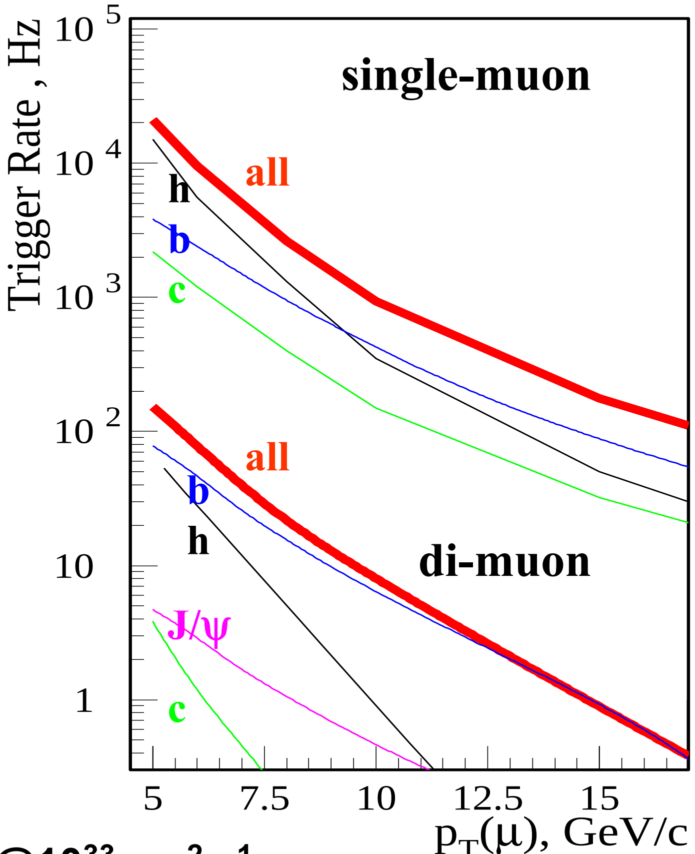
Backup slides

Reconstruction of masses

Mass resolution single Gauss fit $\sigma[MeV/c^2]$	TDR	Complete	Initial
$B_s \to D_s(\phi\ \pi)\ \pi$	42	46	46
$B \to \mu_6\mu_6$	69	79	80
$B_s \to J/\psi(\mu_6\mu_3)\phi$	15	17	17
$B_d \to J/\psi(\mu_6\mu_3)K^0$	19	21	21
$\Lambda_b \to J/\psi(\mu\mu)\ \Lambda(p\pi)$	22	25	26

B-Physics Trigger III

- Di-muon trigger
  - effective selection of channels with $J/\psi(\mu^+\mu^-)$, rare decays like $B \to \mu^+\mu^-(X)$, etc.
  - minimum possible thresholds:
    $p_T > 5$ GeV (Muon Barrel)
    $p_T > 3$ GeV (Muon End-Cap)
  - actual thresholds determined by LVL1 rate
  - at LVL2 and EF: confirmation of muons using the ID and Muon Precision Chambers
    - at EF mass and decay-length cuts, after vertex reconstruction
  - trigger rates (2×10^{33} cm^{-2}s^{-1}): ~200 Hz after LVL2, ~10 Hz after EF



@10^{33}cm^{-2}s^{-1}

ATLAS initial detector

Detector layouts	Complete	Initial	Physics TDR 1999
Radius of B-layer	5 cm	5 cm	4.3 cm
B-layer pixel length in z	400 μm	400 μm	300 μm
Middle pixel layer	yes	missing	yes
Pixel disk #2, TRT C-wheels	yes	missing	yes

Channel	Mass resolution, single Gaussian fit		
	Complete	Initial	TDR
$B_s \to D_s(\phi\ \pi)\ \pi$	46 MeV	46 MeV	42 MeV
$B \to \mu_6\mu_6$	79 MeV	80 MeV	69 MeV
$B_s \to J/\psi(\mu_6\mu_3)\phi$	17 MeV	17 MeV	15 MeV
$B_d \to J/\psi(\mu_6\mu_3)K^0$	21 MeV	21 MeV	19 MeV
$\Lambda_b \to J/\psi(\mu\mu)\ \Lambda(p\pi)$	25 MeV	26 MeV	22 MeV

Software & physics channels

Physics channels
$B_s \to D_s(\phi\,\pi)\,\pi$
$B \to \mu_6\mu_6$
$B_s \to J/\psi(\mu_6\mu_3)\phi$
$B_d \to J/\psi(\mu_6\mu_3)K^0$
$\Lambda_b \to J/\psi(\mu_6\mu_3)\,\Lambda^0$

Detector layouts	TDR	Complete	Initial
Radius of b-layer	4.3 cm	5 cm	5 cm
Longitudinal pixel size of b-layer	300 m	400 m	400 m
Middle pixel layer	yes	yes	missing
Pixel disk #2 and forward TRT wheels	yes	yes	missing

Software	Complete	Initial
Detector simulation	atsim 6.0.2	atlsim 6.0.2
Reconstruction	atrecon6.5.0 (xKalman)	atrecon6.5.0 (xKalman)
Analyses	CBNT, CTVMFT vertexing	

B-hadrons — proper time resolution

Single Gauss fit	TDR
$B_s \to Ds\ \pi$	67 fs
$B \to \mu\mu$	69 fs
$B_s \to J/\psi(\mu\mu)\phi$	63 fs
$B_d \to J/\psi(\mu_6\mu_3)K^0$	69 fs
$\Lambda_b \to J/\psi(\mu\mu)\ \Lambda(p\pi)$	73 fs

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B-Physics Trigger

- The ATLAS Trigger will consist of three levels
  - Level-1 (40 MHz $\rightarrow$ O(20 kHz))
    - muons, Regions-of-Interest (RoI's) in the Calorimeters
    - B-physics ('classical' scenario): muon with $p_T > 6$ GeV, $|\eta| < 2.4$
  - Level-2 (O(20 kHz) $\rightarrow$ O(1-5 kHz))
    - RoI-guided, running dedicated on-line algorithms
    - B-physics ('classical' scenario): muon confirmation, ID full scan
  - Event Filter (O(1-5 kHz) $\rightarrow$ O(200 Hz))
    - offline algorithms, alignment and calibration data available
- The B-physics trigger strategy had to be revised
  - changed LHC luminosity target ($1 \rightarrow 2\times10^{33}$ $cm^{-2}s^{-1}$)
  - changes in detector geometry, possibly reduced detector at start-up
  - tight funding constraints

B-Physics Trigger II

- Alternatives to reduce resource requirements
  - require at LVL1, in addition to single-muon trigger, a second muon, a Jet or EM RoI, reconstruct at LVL2 and EF within RoI
  - re-analyse thresholds and use flexible trigger strategy
    - start with a di-muon trigger for higher luminosities
    - add further triggers (hadronic final states, final states with electrons and muons) later in the beam-coast/for low-luminosity fills
- B-physics trigger types (always single muon at LVL1)
  - di-muon trigger: additional muon at LVL1. Effective selection of channels with $J/\psi(\mu^+\mu^-)$, rare decays like $B \to \mu^+\mu^-(X)$, etc.
  - hadronic final states trigger : RoI-guided reconstruction in ID at LVL2, RoI from LVL1 Jet trigger. Selection of hadronic modes e.g. $B_s \to D_s \pi$
  - electron-muon final states trigger: RoI-guided reconstruction in TRT at LVL2, RoI from LVL1 EM trigger. Selection of electrons, e.g. $J/\psi \to e^+e^-$
  - 'classical' scenario as fall-back
- Results are promising
  - Strong reduction in processing requirements compared to previous strategy that involved full scan of Inner Detector at level-2.
  - Further studies needed.

Sensitivity to angle α

Signal yields 3y @$10^{33}cm^2s^{-1}$	Atlas	LHCb 5y
Offline 2-body select.	**2.3k**	**4.9k**
Mass resol [MeV]	**70**	**17**
Signal/2-body bck	**0.19**	**15**
Signal/other bck	**1.6**	**>1**
σAdir	**0.16**	**0.09**
σAmix	**0.21**	**0.07**
correlation	**0.25**	**0.47**

Max.likelihood computed from: *Proper time *Invariant mass *Flavour at production *Specific ionisation.	**Simulateous fit of 6 contributing decays parametrized by 9 coefficients, constrained by current experimental limits.**

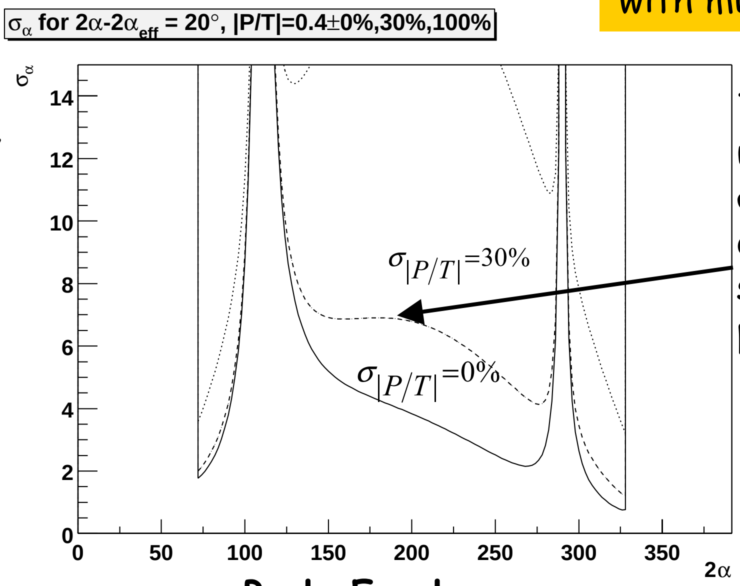
Signal decay parametrized in terms of A_{dir}, A_{mix}:

$$A_{dir} \cos(\Delta m\, t) + A_{mix} \sin(\Delta m\, t)$$

A_{dir}, A_{mix} in SM depend on α, δ (or α_{eff}), $O(|P/T|^2)$ were used to derive sensitivity to α

ATLAS compensate large backgrounds with multi-channel fits.

α-sensitivity as a function of α and theoretical uncertainty of |P/T| using full LHC potential

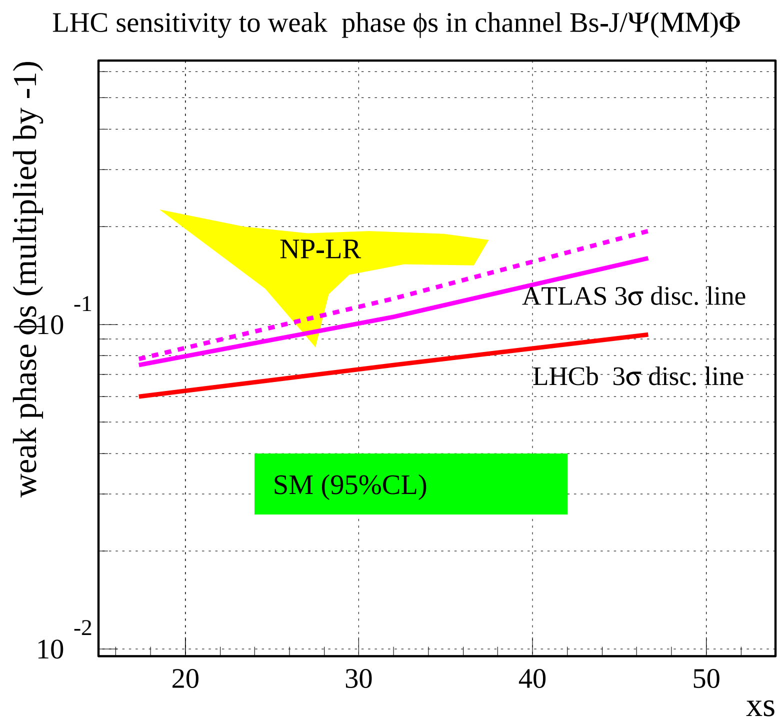


The current theoretical uncertainty on |P/T|, σ|P/T|~30%, dominates other systematical and statistical errors of full LHC potential.

$\Delta\Gamma_s$ and ϕ_s from $B^0_s \to J/\psi\phi$ (η)

- $\Delta\Gamma_s$ and ϕ_s measured from $B_s \to J/\psi\phi$, indep. measurement of ϕ_s from $B_s \to J/\psi\eta$.
- $\Delta\Gamma_s$, Γ_s and ϕ_s are determined simultaneously with helicity amplitudes $A_{||}(t=0)$, $A_T(t=0)$, $A_0(t=0)$, δ_1, δ_2 from angular analyses of $B_s \to J/\psi\ (\mu\mu)\phi(KK)$.
- $\Delta\Gamma s$ can be determined with a relative error of 12% (stat) with 30 fb-1.
- ϕ_s depends on x_s: for $B_s \to J/\psi\phi$, sensitivity in the range 8-15% for x_s=20-40 (SM range)
- $B_s \to J/\psi\eta$, sensitivity for ϕ_s in the range 27-31% for x_s=20-30

DGs and fs from B0s→J/yf (h)



- Standard Model region-updated 2003
- New physics Left-right symmetric model (NP-LR) - updated 2000.
- ATLAS (3 years): LVL1 1μ trigger only. TDR Detector.
- ATLAS - same as above with Final Detector Layout – Preliminary
- LHCb(5 years): full 1st Level trigger, performance parameters as given in 2000

Background,Signal (new cuts)

- CMS vertex cuts gives rejection better than **2.3×10^{-4}**
  Try to apply similar cuts for ATLAS data
- compare two vertex fit procedures – CTVMFT (CDF) and dedicated fit procedure from xKalman (private)

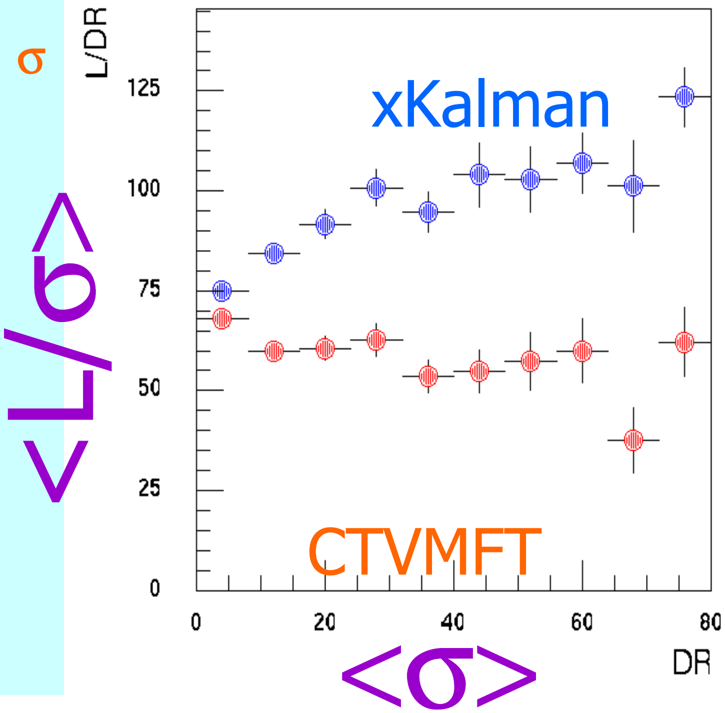
Efficiencies of vertex selection cuts (10^{4} pb^{-1})

(cuts chosen to give the same signal efficiency)

Cuts (CTVMFT and xKalman)	CTVMFT	xKalman
Error on the decay length *L* $\sigma<60\mu m$; $\sigma<70\mu m$	**0.55**	0.41
$L/\sigma > 12$; $L/\sigma > 10$	0.37	0.33
Both cuts together + Cos(θ)>0.99987 (1°)	$(0.9\pm0.2)\times10^{-2}$	$(4.4\pm1.6)\times10^{-3}$
Number of BG events (with mass and isolation cuts)	54±15	24±9

Discussion

- xKalman vertex fit gives a better rejection than CTVMFT one
- The quantities used for cuts can correlate
- The plot shows the profile histogram of decay length L vs. error on this value σ for the background events.
  For xKalman it is correlated – i.e. larger decay length has larger errors (as it should be for BG)
  This explain the better rejection of this algorithm – events survived L > L_cut will be removed by cut σ> σ_cut



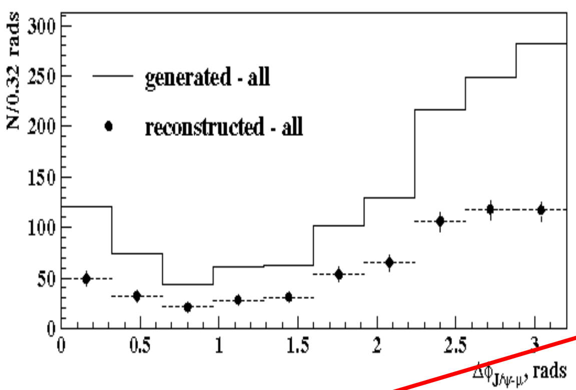
Paula Eerola

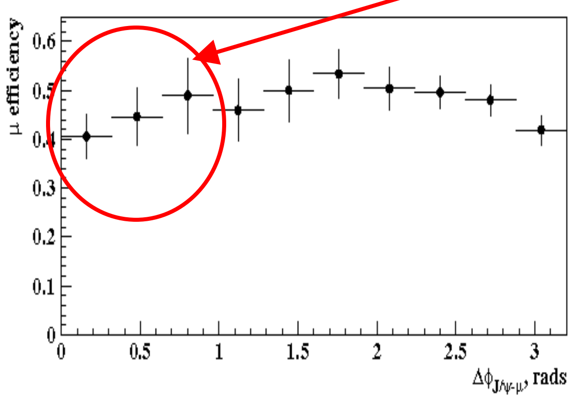
Beauty 2003, Carnegie Mellon 14-18 Oct 2003

B production at LHC (III)

ATLAS - proposal for measuring b-b production correlations using exclusive B-decays and semileptonic decays to muons

$B \to \mu \; B_d \to J/\psi K_s^0$

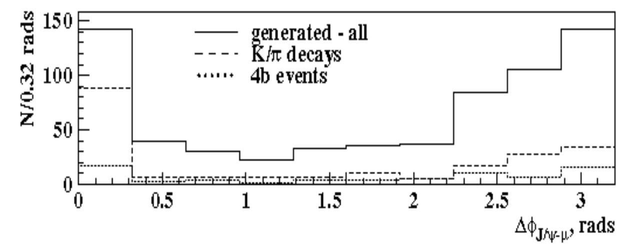


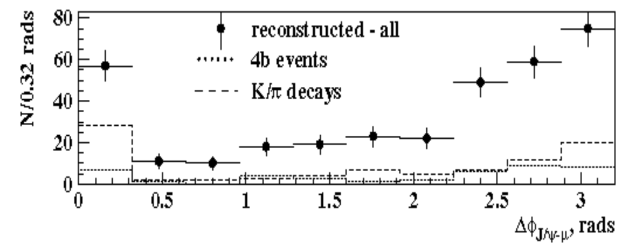


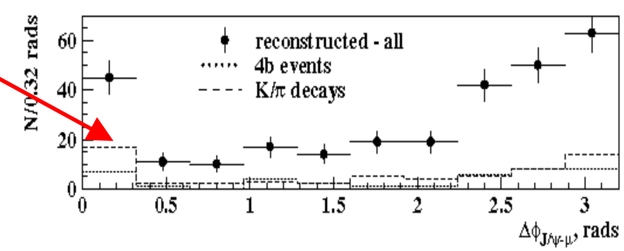
$$\Delta\phi = \phi_{J/\psi} - \phi_{\mu}$$

No degradation of efficiency as b-b close in space.

$B \to \mu \; B_s \to J/\psi\phi$







In B_s case – interesting specific background

$K \to \mu$ originating from s-quark associated with Bs production. Need

$B \to e \; B_s \to J/\psi\phi$

$B_d \to K^* \gamma$ for 2 fb^{-1} with Initial Layout

2.8% rec. efficiency, 57 MeV mass resolution

Level 1: μ6

Level 2:

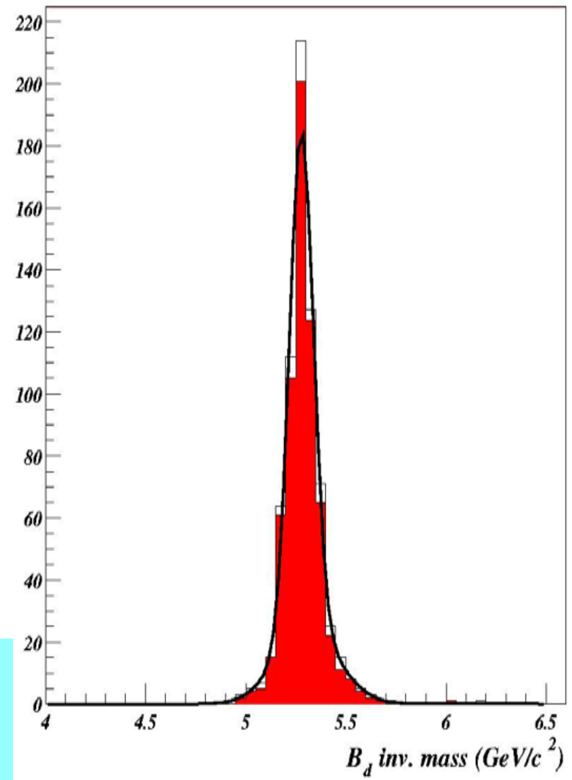
γ: cluster E_T cut, shower shape cuts, γ/π^0 rejection

K*: 2 charged (opposite-sign) tracks, p_T cuts

Event Filter:

γ: level-2 confirmation

K*: vertexing, impact-parameter cuts



Combinatorial background from $b\bar{b} \to \mu(6)X$ was considered.
Background from $B^0 \to K^* \pi^0$ is under investigation.

Installation schedule

- The schedule consists of 6 major phases which are partially overlapping + 50 days for global commissioning and 40 days for cosmic tests.