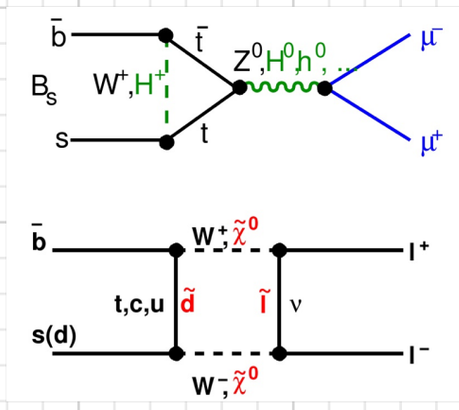
Bs to mu mu search with 1.14 fb-1 of 7 TeV pp collisions at CMS

Motivation

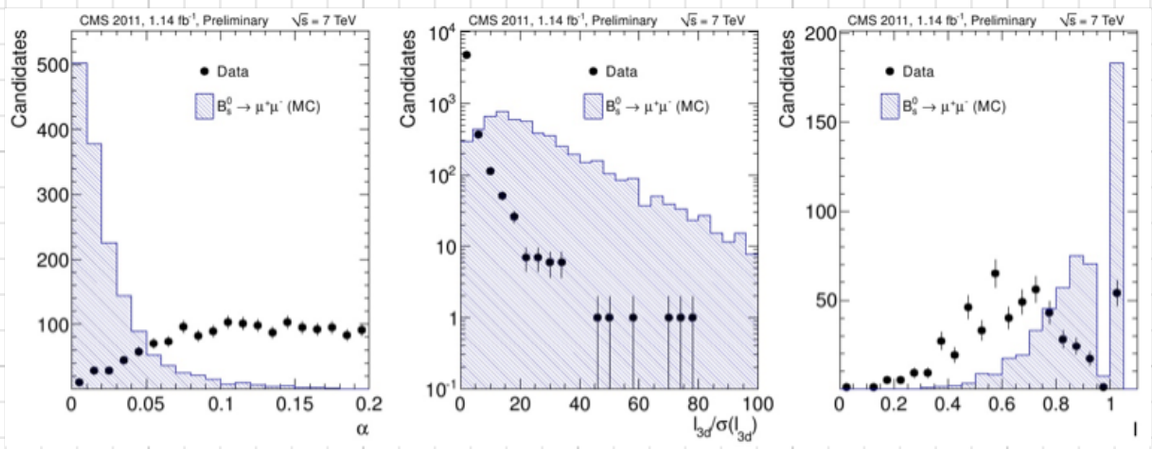


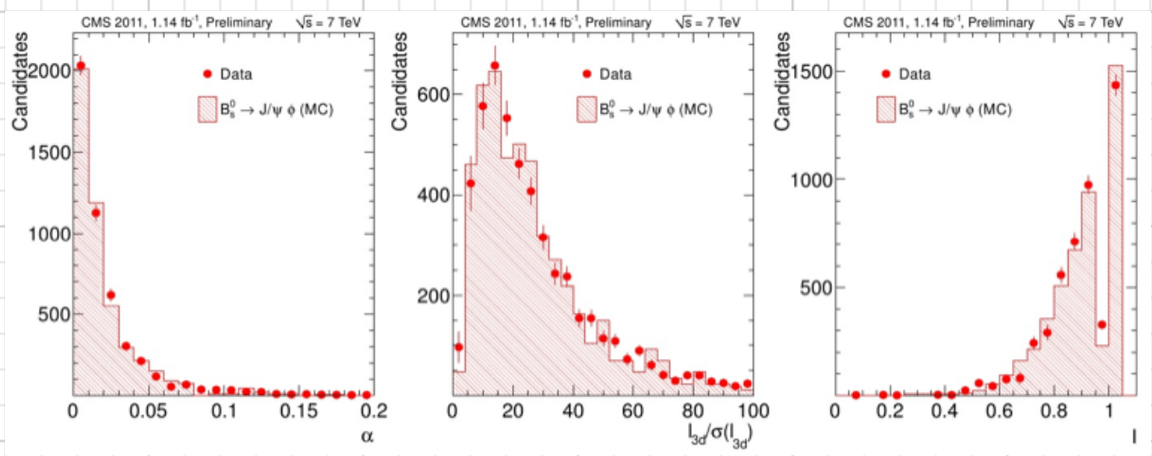
$$\mathcal{B}(B_s^0 \to \mu^+\mu^-) = (3.2 \pm 0.2) \times 10^{-9}$$
$$\mathcal{B}(B^0 \to \mu^+\mu^-) = (1.0 \pm 0.1) \times 10^{-10}$$

(Buras 2010)

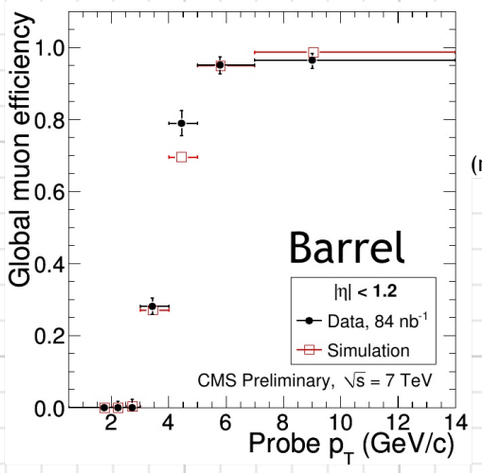
Analysis

$$\mathcal{B}(B_s^0 \to \mu^+\mu^-; 95\%\text{C.L.}) = \frac{N(n_{obs}, n_B, n_S; 95\%\text{C.L.})}{\varepsilon_{B_s^0} N_{B_s^0}} = \frac{N(n_{obs}, n_B, n_S)}{\varepsilon_{B_s^0} \mathcal{L}\, \sigma(pp \to B_s^0)}$$
$$= \frac{N(n_{obs}, n_B, n_S)}{N(B^\pm \to J/\psi\, K^\pm)} \frac{A_{B^+}}{A_{B_s^0}} \frac{\varepsilon_{B^+}^{ana}}{\varepsilon_{B_s^0}^{ana}} \frac{\varepsilon_{B^+}^{\mu}}{\varepsilon_{B_s^0}^{\mu}} \frac{\varepsilon_{B^+}^{trig}}{\varepsilon_{B_s^0}^{trig}} \frac{f_u}{f_s} \mathcal{B}(B^+ \to J/\psi\,[\mu^+\mu^-]K)$$





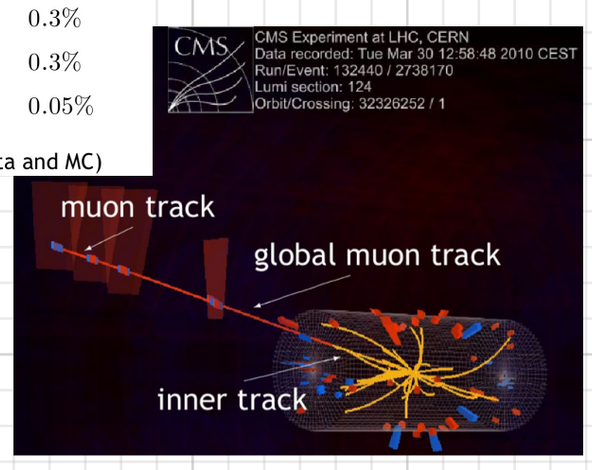
Muon Reconstruction



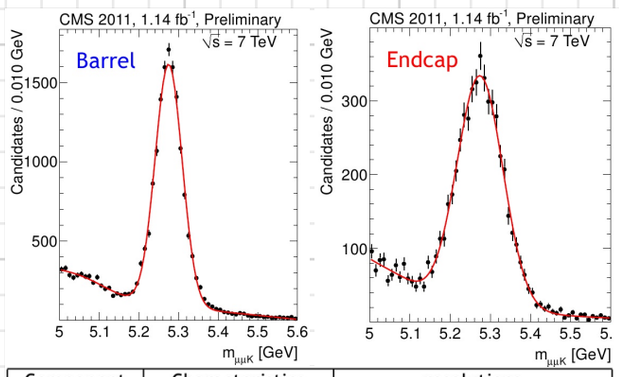
Muon misidentification

$$\varepsilon(\mu|\pi) \leq 0.3\%$$
$$\varepsilon(\mu|K) \leq 0.3\%$$
$$\varepsilon(\mu|p) \leq 0.05\%$$

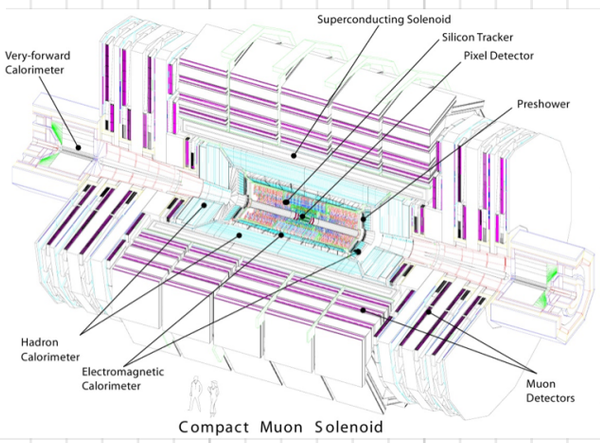
(measured in data and MC)



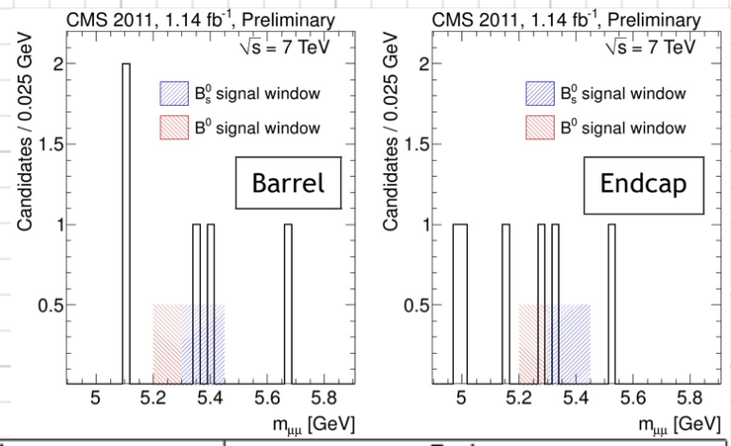
Detector Resolution



Component	Characteristics	resolutions
Pixel	3/2 Si layers	$\delta_z \approx 20\,\mu$m, $\delta_\phi \approx 10\,\mu$m
Tracker	10/12 Si strips	$\delta(p_\perp)/p_\perp \approx 1\%$
ECAL	$PbWO_4$	$\delta E/E \approx 3\%/\sqrt{E} \oplus 0.5\%$
HCAL (B)	Brass/Sc, $> 7.2\lambda$	$\delta E/E \approx 100\sqrt{E}\%$
HCAL (F)	Fe/Quartz	$\delta(\not{E}_T) \approx 0.98\sqrt{\sum E_T}$
Magnet	3.8 T solenoid	
Muons	DT/CSC + RPC	$\delta(p_\perp)/p_\perp \approx 10\%$ (STA)

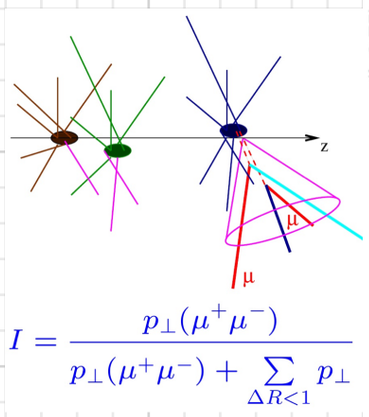


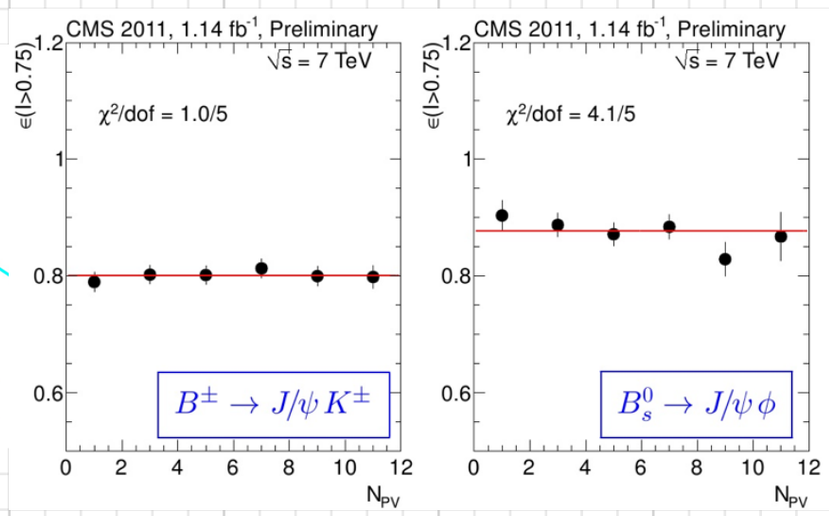
Results



	Barrel		Endcap	
	$B^0 \to \mu^+\mu^-$	$B_s^0 \to \mu^+\mu^-$	$B^0 \to \mu^+\mu^-$	$B_s^0 \to \mu^+\mu^-$
Acceptance	$(24.62 \pm 0.99) \times 10^{-2}$	$(24.72 \pm 0.99) \times 10^{-2}$	$(22.61 \pm 0.91) \times 10^{-2}$	$(23.14 \pm 0.93) \times 10^{-2}$
$\varepsilon_{\text{analysis}}$	$(2.23 \pm 0.19) \times 10^{-2}$	$(2.22 \pm 0.19) \times 10^{-2}$	$(1.16 \pm 0.10) \times 10^{-2}$	$(1.24 \pm 0.11) \times 10^{-2}$
ε_{tot}	$(0.36 \pm 0.04) \times 10^{-2}$	$(0.36 \pm 0.04) \times 10^{-2}$	$(0.21 \pm 0.02) \times 10^{-2}$	$(0.21 \pm 0.02) \times 10^{-2}$
$N_{\text{signal}}^{\text{exp}}$	0.065 ± 0.011	0.80 ± 0.16	0.025 ± 0.004	0.36 ± 0.07
$N_{\text{bg}}^{\text{exp}}$	0.40 ± 0.23	0.60 ± 0.35	0.53 ± 0.27	0.80 ± 0.40
$N_{\text{peak}}^{\text{exp}}$	0.25 ± 0.06	0.07 ± 0.02	0.16 ± 0.04	0.04 ± 0.01
N_{obs}	0	2	1	1

(Lack of) Dependence on Pile-Up





$$\mathcal{B}(B_s^0 \to \mu^+\mu^-) < 1.9 \times 10^{-8} \quad (95\%\,\text{C.L.})$$
$$\mathcal{B}(B_s^0 \to \mu^+\mu^-) < 1.6 \times 10^{-8} \quad (90\%\,\text{C.L.})$$
$$\mathcal{B}(B^0 \to \mu^+\mu^-) < 4.6 \times 10^{-9} \quad (95\%\,\text{C.L.})$$
$$\mathcal{B}(B^0 \to \mu^+\mu^-) < 3.7 \times 10^{-9} \quad (90\%\,\text{C.L.})$$

p values for background-only hypothesis

$B_s^0 \to \mu^+\mu^-$: 0.11

$B^0 \to \mu^+\mu^-$: 0.40

p value for $5.6 \times \text{SM}$ (cf. arXiv:1107.2304)

$B_s^0 \to \mu^+\mu^-$: 0.053