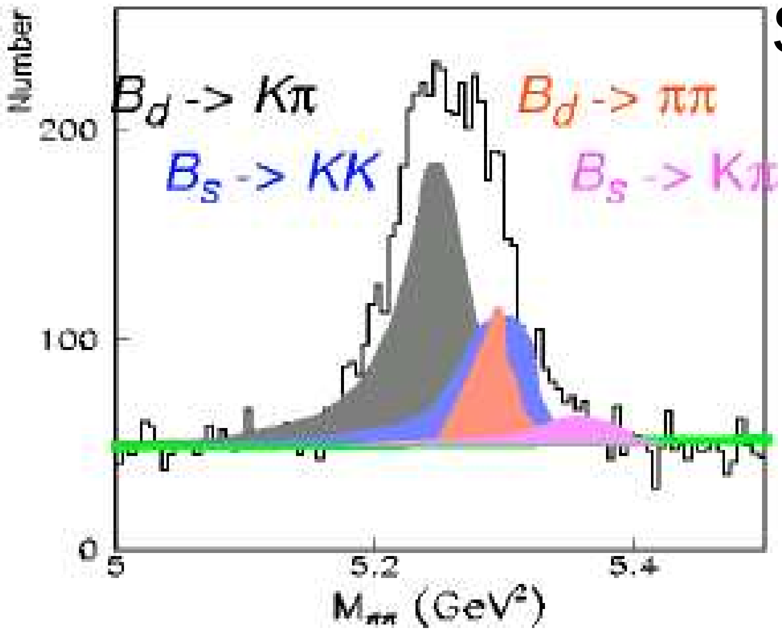
$B^0 \to h^+h^-$

Four decays compete:

- Tree dominant ($BR \sim 10^{-6}$)
  1. $B_d \to \pi^+\pi^-$ 2. $B_s \to K^+\pi^-$
- Penguin dominant($BR \sim 10^{-5}$)
  3. $B_s \to K^+K^-$ 4. $B_d \to K^+\pi^-$

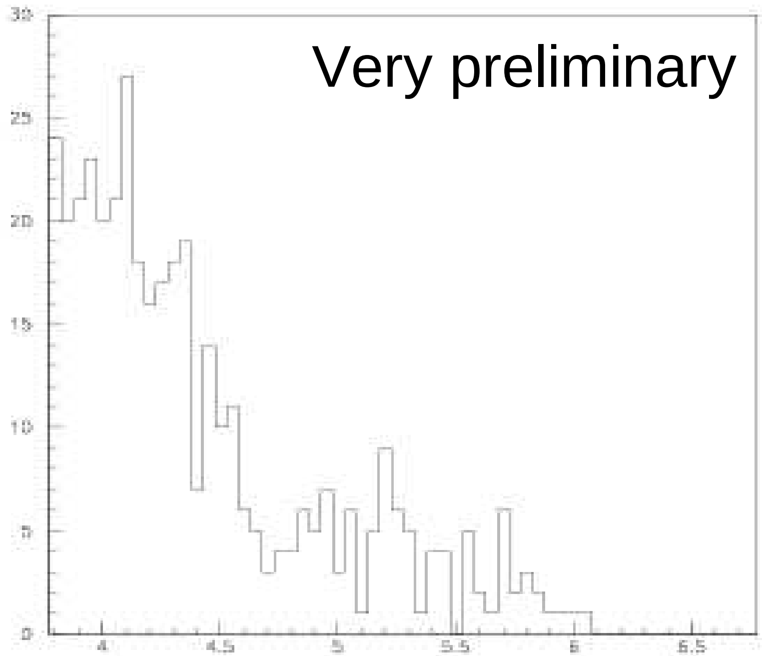
Two track trigger:

$B_d \to \pi^+\pi^-$	~5K	events
$B_s \to K^+K^-$	~10K	"
$B_s \to K^+\pi^-$	~2,5K	"
$B_d \to K^+\pi^-$	~20K	"



Separated using

1. dE/dx (K−π 1.3σ P_t>2)
2. kinematics



Donatella Lucchesi

$B^0 \to h^+h^-$

R. Fleisher (PLB459, 306 (1999) suggest to use:

1. $B_d \to \pi^+\pi^-$ and 3. $B_s \to K^+K^-$

$$a_{CP}(B_d(t)\to f) \equiv \frac{\Gamma(B_d^0(t)\to f) - \Gamma(\overline{B_d^0}(t)\to f)}{\Gamma(B_d^0(t)\to f) + \Gamma(\overline{B_d^0}(t)\to f)}$$

$$= \mathcal{A}_{CP}^{dir}(B_d\to f)\cos(\Delta M_d t) + \mathcal{A}_{CP}^{mix}(B_d\to f)\sin(\Delta M_d t)$$

$$\mathcal{A}_{CP}^{dir}(B_d\to f) = -\left[\frac{2\, d\sin\theta\sin\gamma}{1-2\, d\cos\theta\cos\gamma + d^2}\right]$$

$$\mathcal{A}_{CP}^{mix}(B_d\to f) = \eta\left[\frac{\sin(\phi_d+2\gamma) - 2\, d\cos\theta\,\sin(\phi_d+\gamma) + d^2\sin\phi_d}{1-2\, d\cos\theta\cos\gamma + d^2}\right]$$

$$a_{CP}(B_s(t)\to f) \equiv \frac{\Gamma(B_s^0(t)\to f) - \Gamma(\overline{B_s^0}(t)\to f)}{\Gamma(B_s^0(t)\to f) + \Gamma(\overline{B_s^0}(t)\to f)}$$

$$= 2\, e^{-\Gamma_s t}\left[\frac{\mathcal{A}_{CP}^{dir}(B_s\to f)\cos(\Delta M_s t) + \mathcal{A}_{CP}^{mix}(B_s\to f)\sin(\Delta M_s t)}{e^{-\Gamma_H^{(s)}t} + e^{-\Gamma_L^{(s)}t} + \mathcal{A}_{\Delta\Gamma}(B_s\to f)(e^{-\Gamma_H^{(s)}t} - e^{-\Gamma_L^{(s)}t})}\right]$$

$$\mathcal{A}_{CP}^{dir}(B_s\to f) = +\left[\frac{2\,\tilde{d}'\sin\theta'\sin\gamma}{1+2\,\tilde{d}'\cos\theta'\cos\gamma + \tilde{d}'^2}\right]$$

$$\mathcal{A}_{CP}^{mix}(B_s\to f) = +\eta\left[\frac{\sin(\phi_s+2\gamma) + 2\,\tilde{d}'\cos\theta'\,\sin(\phi_s+\gamma) + \tilde{d}'^2\sin\phi_s}{1+2\,\tilde{d}'\cos\theta'\cos\gamma + \tilde{d}'^2}\right]$$

$$\mathcal{A}_{\Delta\Gamma}(B_s\to f) = -\eta\left[\frac{\cos(\phi_s+2\gamma) + 2\,\tilde{d}'\cos\theta'\cos(\phi_s+\gamma) + \tilde{d}'^2\cos\phi_s}{1+2\,\tilde{d}'\cos\theta'\cos\gamma + \tilde{d}'^2}\right].$$

$de^{i\theta}$:function of peng/tree $\phi_d=2\beta$

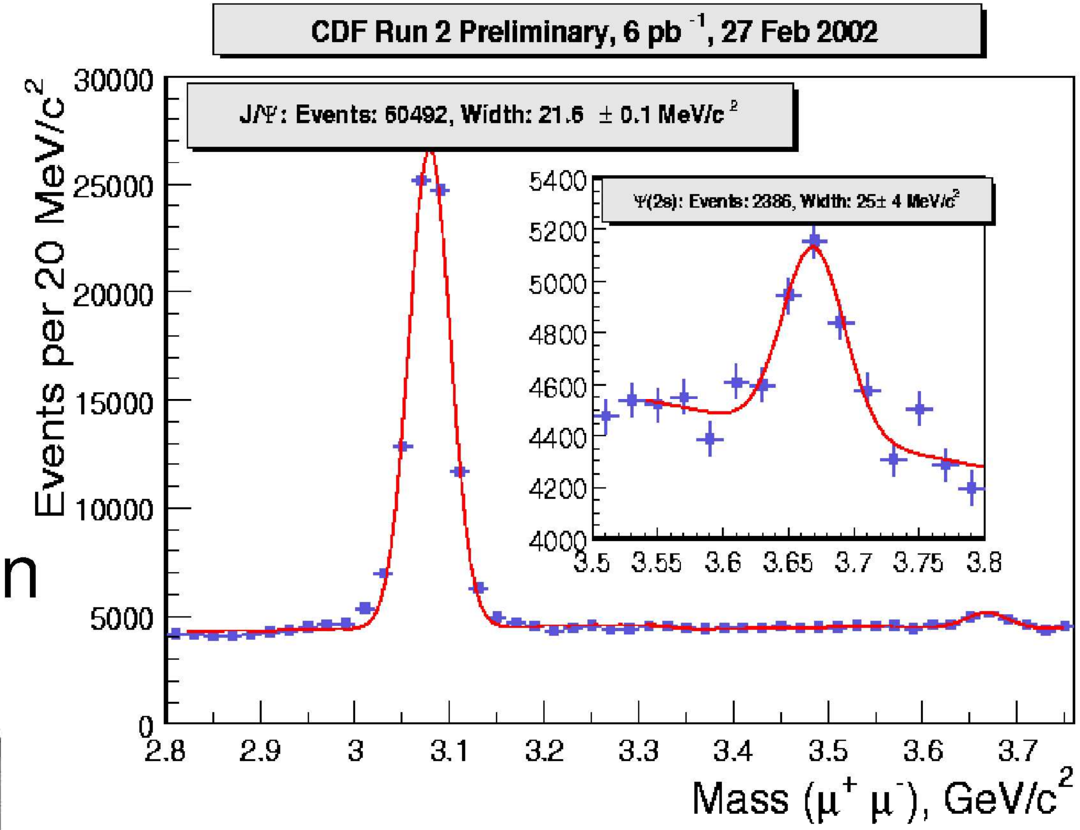
$\phi_s=-2\delta\gamma$ Assuming SU(3) symmetry: $d'=d$ $\theta'=\theta$

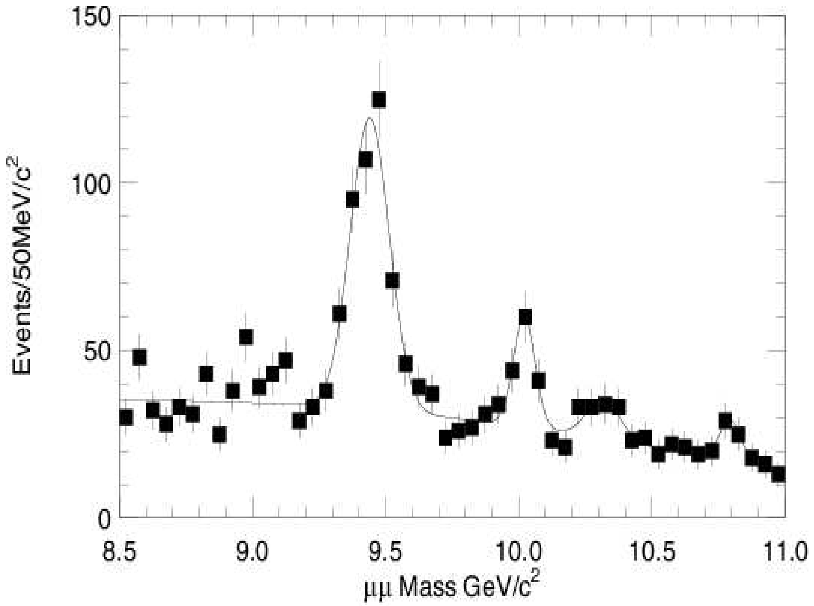
	$\gamma=60^o$		$\gamma=(60^{+5.4}_{-6.8})^o$
Input	$d=0.3$, $\theta=0$	Output	$d=0.3^{+0.11}_{-0.07}$, $\theta=0\pm10.8$
	$\beta=22.2^0\pm2.0^0$		$\beta=22.2^0\pm2.0^0$

μμ Sample

Usefull for

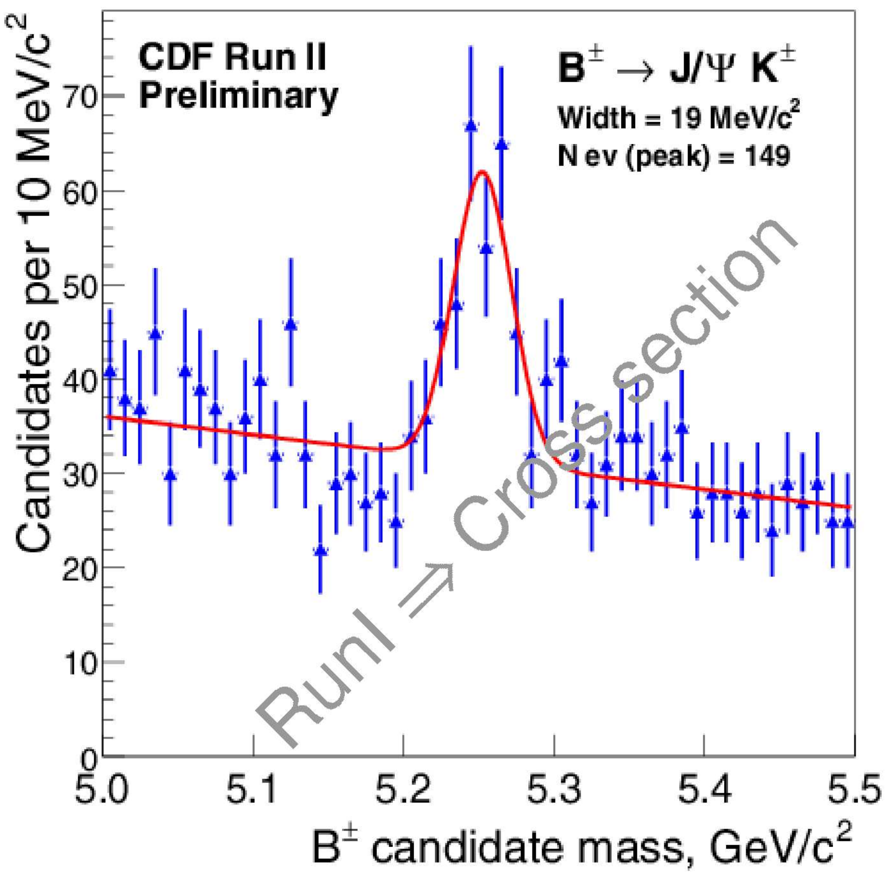
- ✔ Tracking
  - ➔ optimization
  - ➔ efficiency
  - ➔ magnetic field correction
- ✔ Trigger efficiency (SVT)





Many B→J/ψ +X Decays

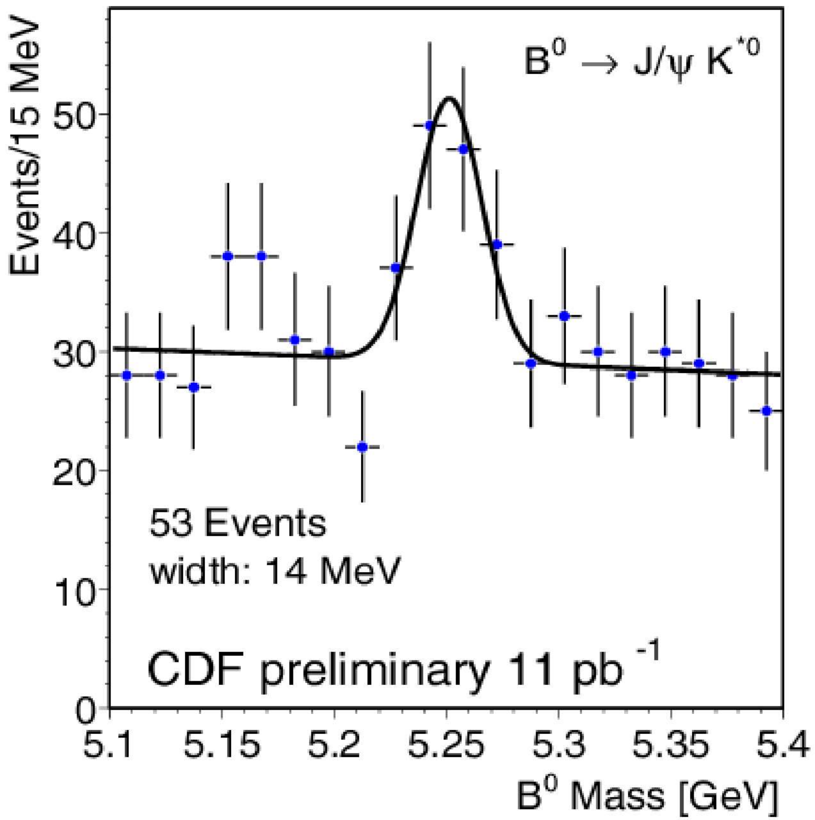
$B_u \to J/\psi K$



$P_t(k)$>2 GeV

$P_t(B)$>6 GeV

$B_d \to J/\psi K^*$



$P_t(k)$>3 GeV $P_t(\pi)$>0.5 GeV

$P_t(B)$>4.5 GeV L_{xy}>0

810<m(K*)<970 MeV

$B \to J/\psi\, K_s$ Decays

Run I: $\sin(2\beta) = 0.79^{+0.41}_{-0.44}$ stat ⊕ sys.

Scale the error for RunII: $\sigma(\sin 2\beta) = \frac{\sigma(A)}{D} \oplus \sin 2\beta \bullet \frac{\sigma(D)}{D}$

Statistical error:

RunI: 198±17 events

RunII: 10,000 events

x50 luminosity +
detector improvements

$\frac{\sigma(A)}{D}$ =0.067

Systematic error:

RunI: $\varepsilon D^2 = (6.3 \pm 1.7)\%$

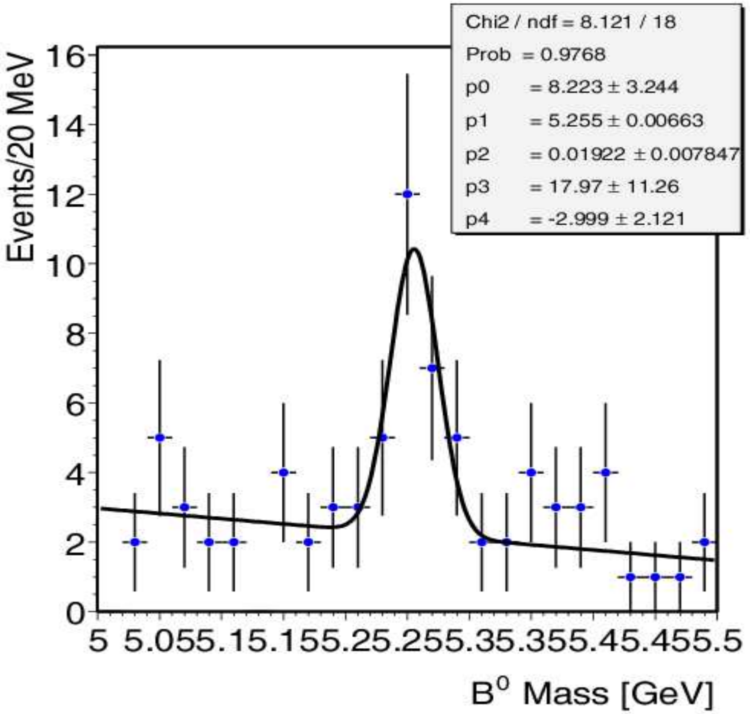
RunII:9.1% $\frac{\sigma(D)}{D}$ =0.027

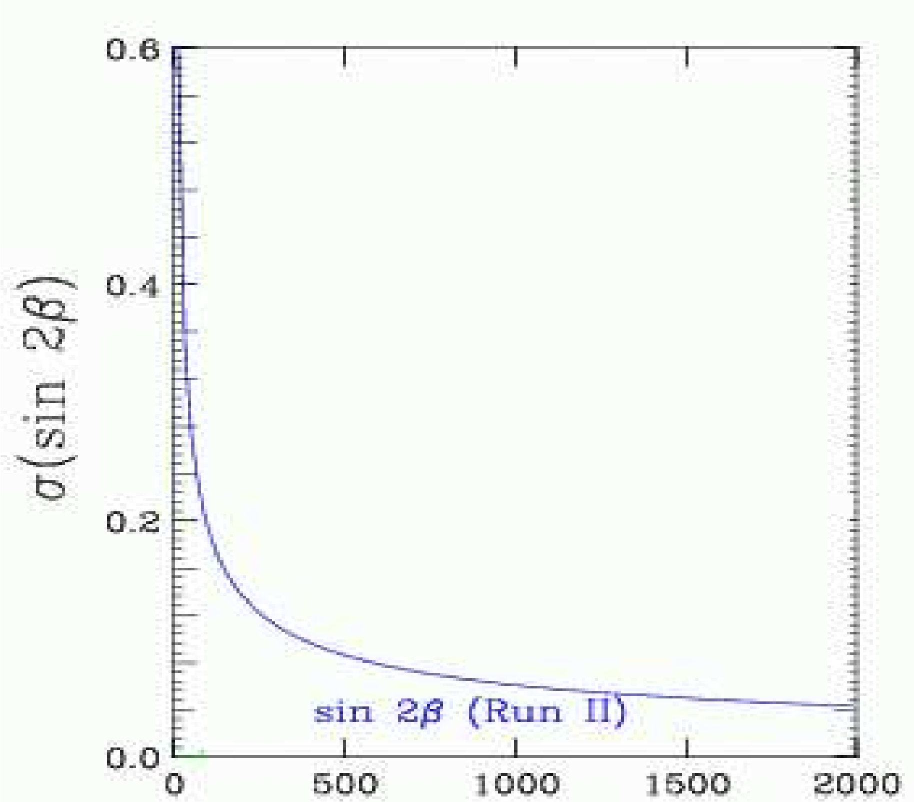
If $\sin(2\beta)=1 \Rightarrow \sigma(\sin(2\beta))=0.072$

If N~28,000 $\sigma(\sin(2\beta))=0.043$

BaBar latest results: 0.75 ± 0.09(stat.) ± 0.04(syst.)

B→J/ψ K_s Decays





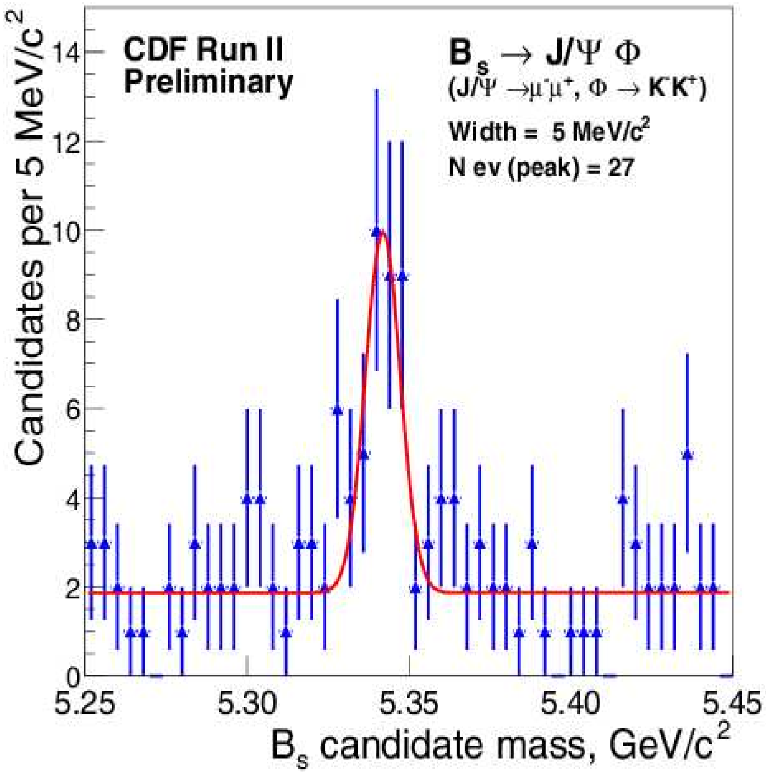
K_S: $P_t(\pi)$>0.4GeV

479<m(ππ)<512 MeV

J/ψ: 3.0<m(μμ)<3.16 GeV

B: Angular cut

B→J/ψ φ: CP beyond S.M.

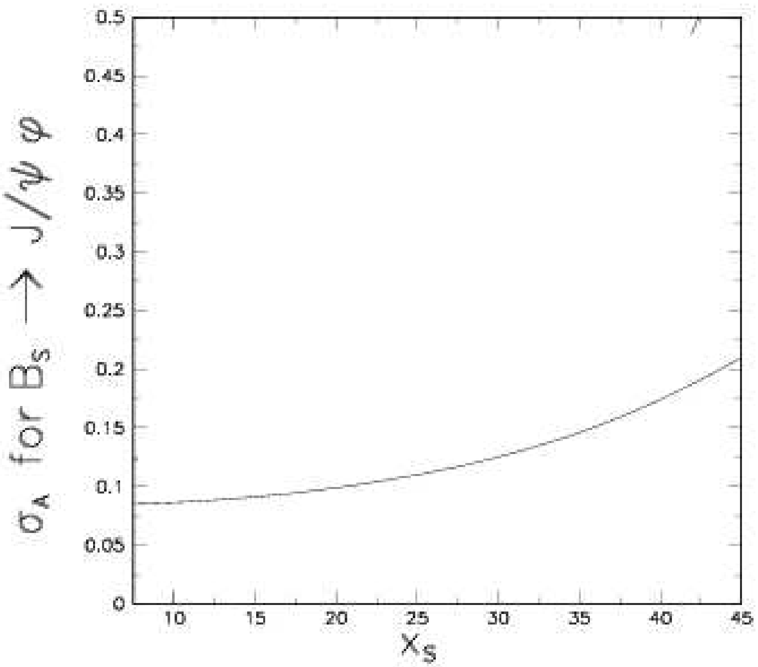


CP asymmetry

- CP asymmetry ~few %
- if larger ⇒ new physics
- measure CP asymmetry ⇒phase β_s

RunII: ~4,000 events 2fb^{-1}

$\varepsilon D^2 = 9.7\%$



$P_t(B)>5$ GeV

$1.00964<m(\varphi)<1.02964$ MeV

$P_t(\varphi)>2$ GeV

New B_s lifetime hopefully in summer

$B \to J/\psi\ \varphi$: $\Delta\Gamma/\Gamma$

$\Delta\Gamma/\Gamma = 1/2(\Gamma_h - \Gamma_l)/(\Gamma_h + \Gamma_l)$

$\Delta\Gamma/\Gamma$ = 0.05 − 0.20 in the Standard Model

Run I: $\Delta\Gamma/\Gamma = 0.36^{+50}_{-42}$

RunII:

S/N & mass resolution=RunI $\sigma(c\tau)$=18μm

CP_{even} =0.77±0.19 $\Rightarrow$ $\sigma(\Delta\Gamma/\Gamma)$=0.05

CP_{even} =0.5(1) $\Rightarrow$ $\sigma(\Delta\Gamma/\Gamma)$=0.08 (0.035)

Other decays:

$B_s \to D_s \pi \Rightarrow$ measure $1/\Gamma$

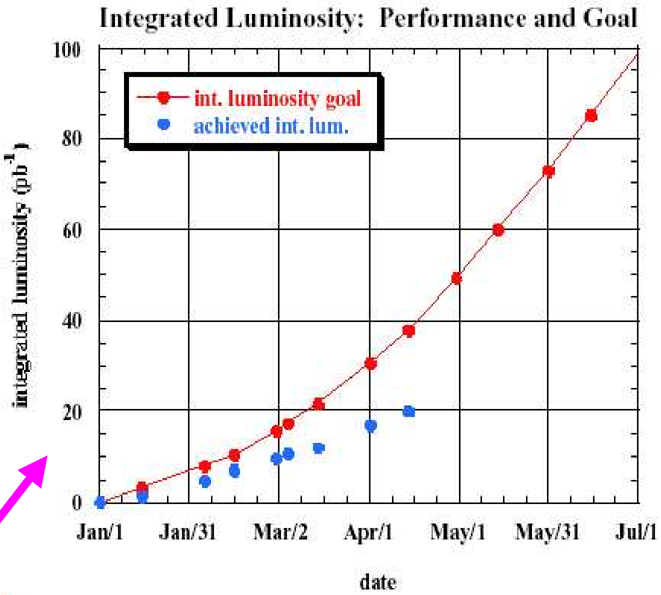
$B_s \to D_s D_s$ (CP even) $\Rightarrow$ $\sigma(\Delta\Gamma/\Gamma)$=0.06

I did not say anything about:

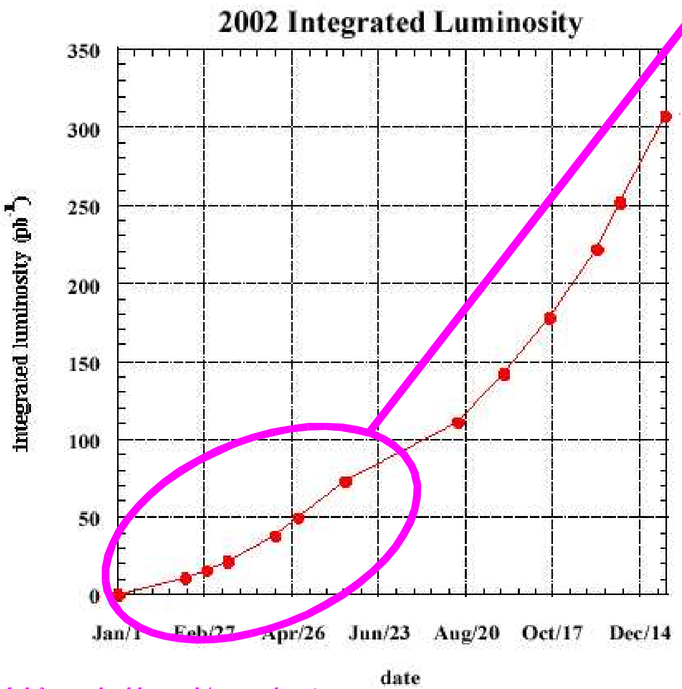
- ✔ Cross sections (B,b, D,c)
- ✔ $B_{d,s}$ Lifetimes (exclusive, inclusive)
- ✔ B_c
- ✔ Λ_b lifetime and polarizzazion
- ✔ spectroscopy
- ✔ Quarkonia production and polarization
- ✔ Rare decays: $B_{d,s} \rightarrow K^*\gamma$ $\Lambda_b \rightarrow \Lambda\gamma$ $B_d \rightarrow K^*\mu\mu$ $B \rightarrow \mu\mu$
- ✔ β_s through $B_s \rightarrow J/\psi\ \eta(\eta')$ (~1,000 events/2fb^{-1})

Conclusions

Even with very few pb^{-1} of data CDF can do a lot of B & D physics



Concerns about luminosity:
~60% "Church plan"



but the new adventure already started