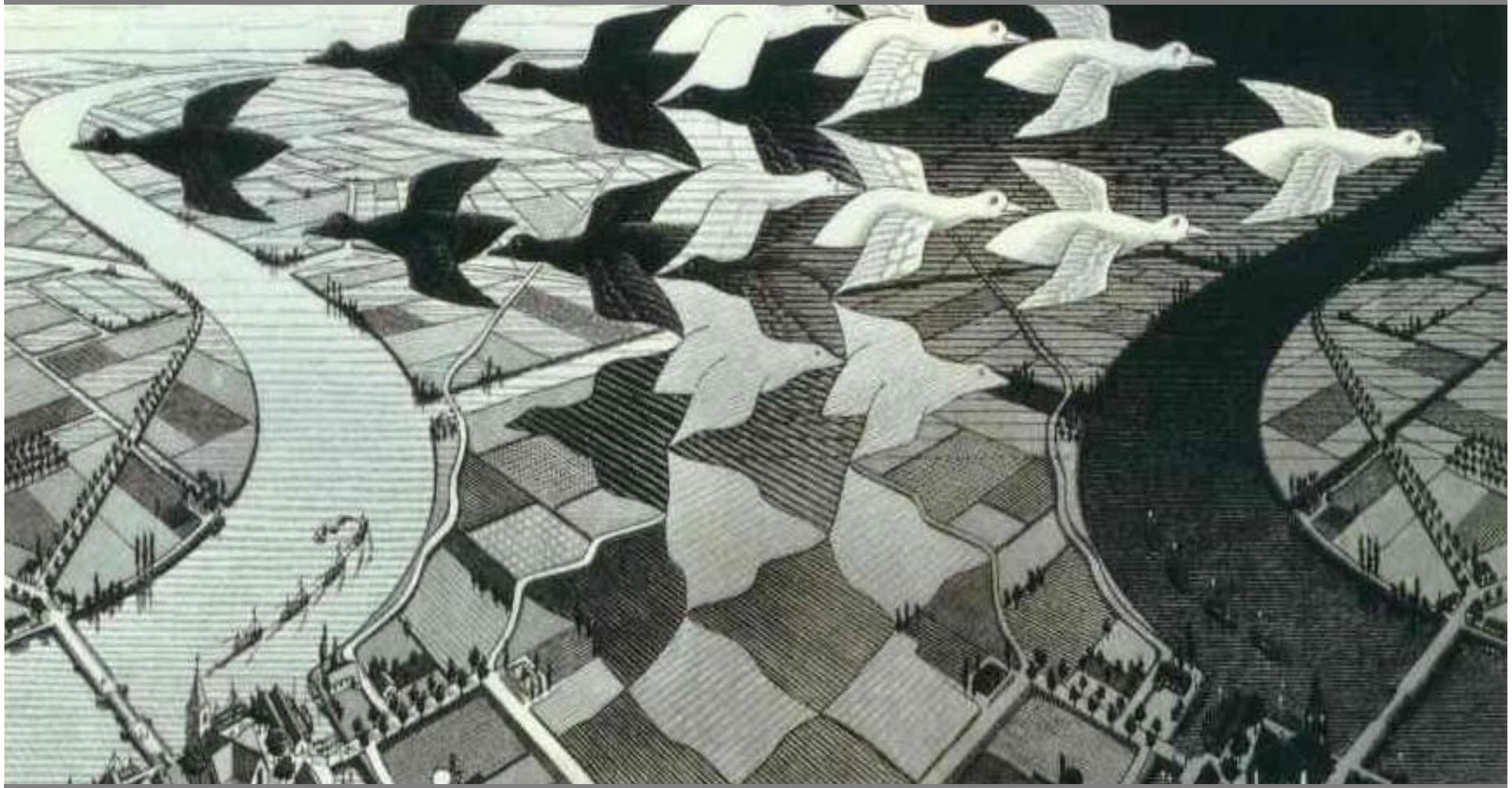
Analysis plan for CDF B physics



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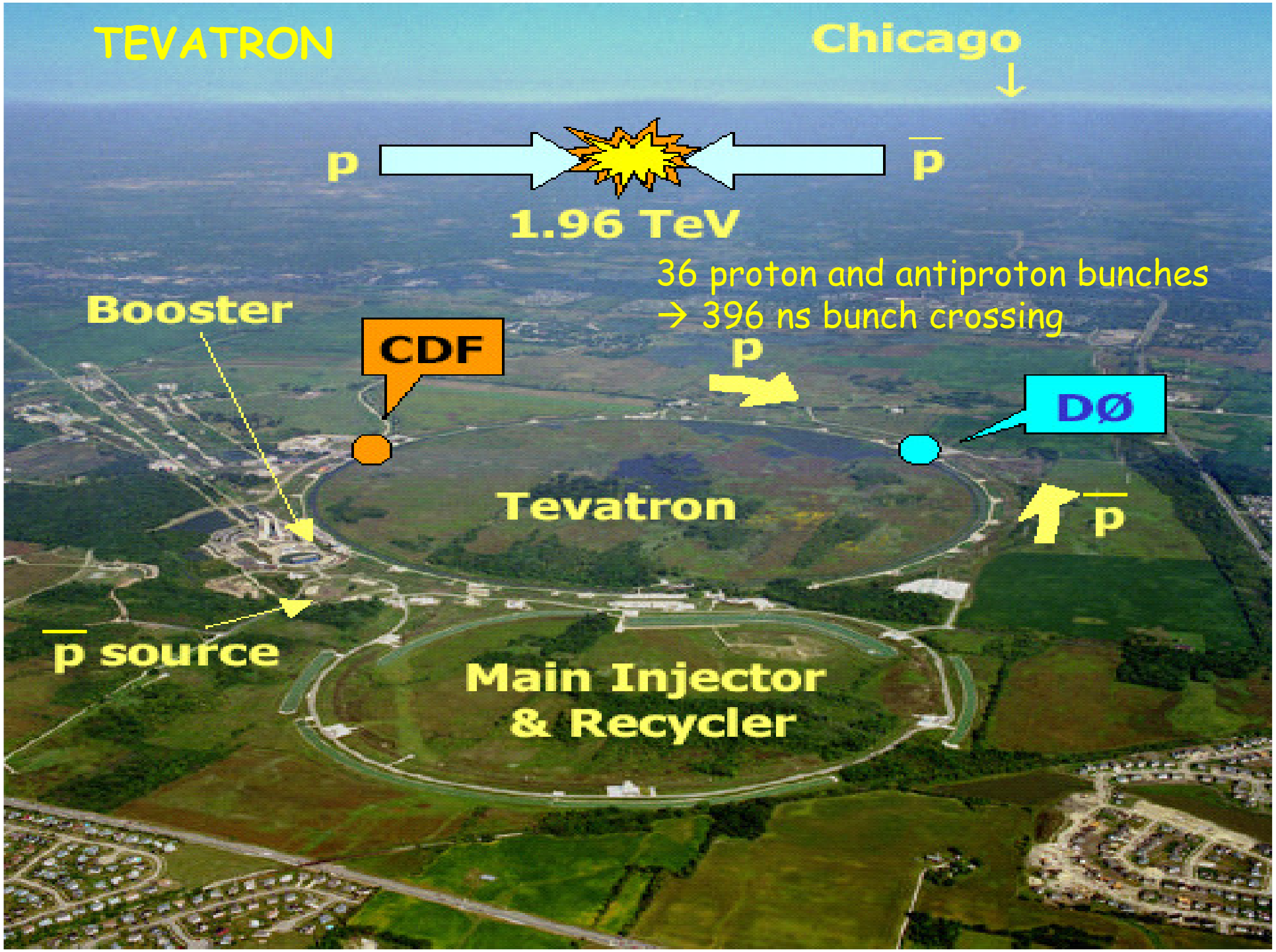
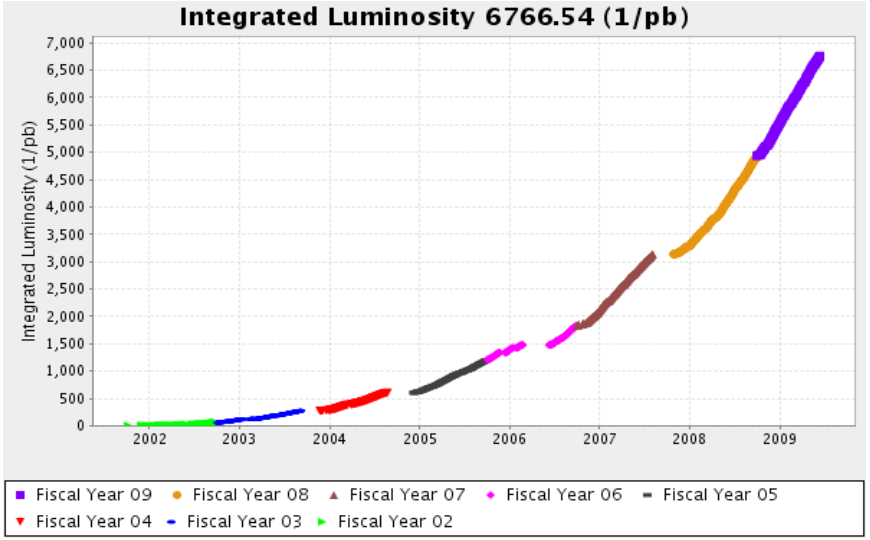
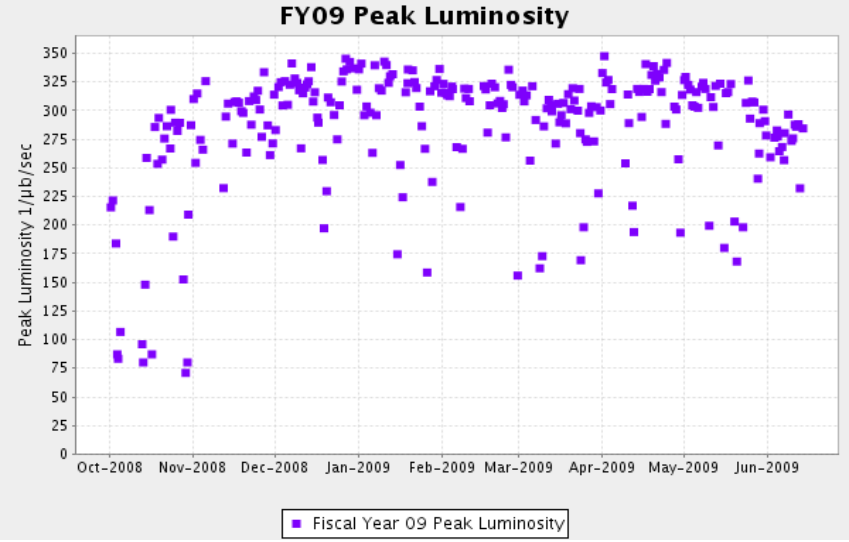

TEVATRON
Chicago
p
p̄
1.96 TeV
36 proton and antiproton bunches
→ 396 ns bunch crossing
Booster
CDF
p
DØ
Tevatron
p̄
p̄ source
Main Injector
& Recycler

Accelerator performance

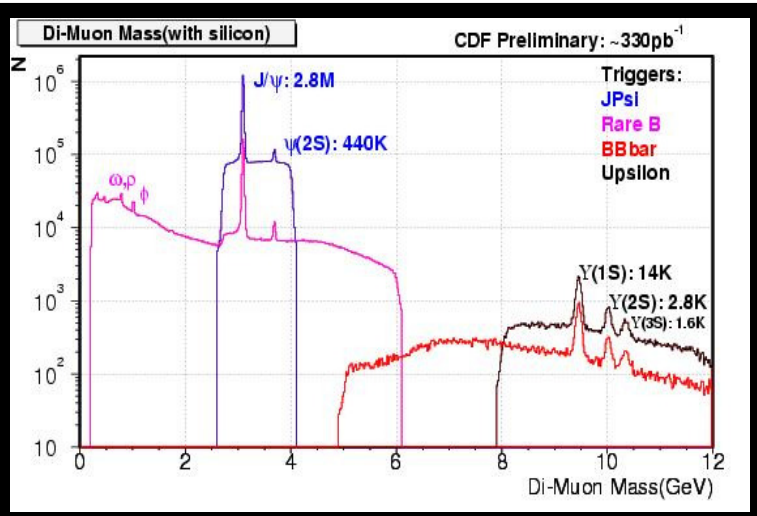




$J/\psi \rightarrow \mu^+\mu^-$

CDF dimuon trigger

1st track : Track+Muon
2nd track :Track+Muon
opposite charge
Invariant mass

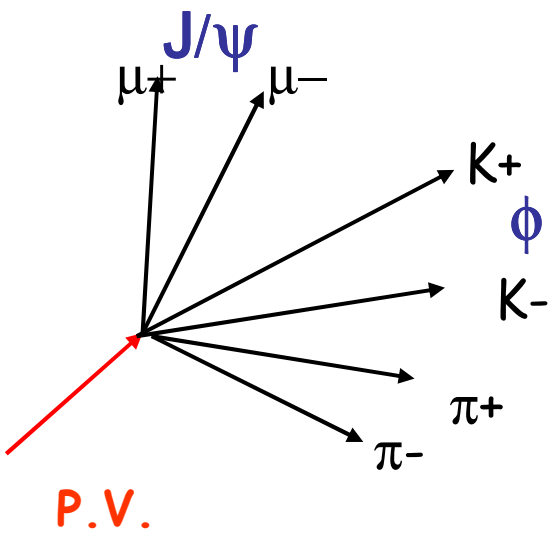


B Physics Plan @ KISTI

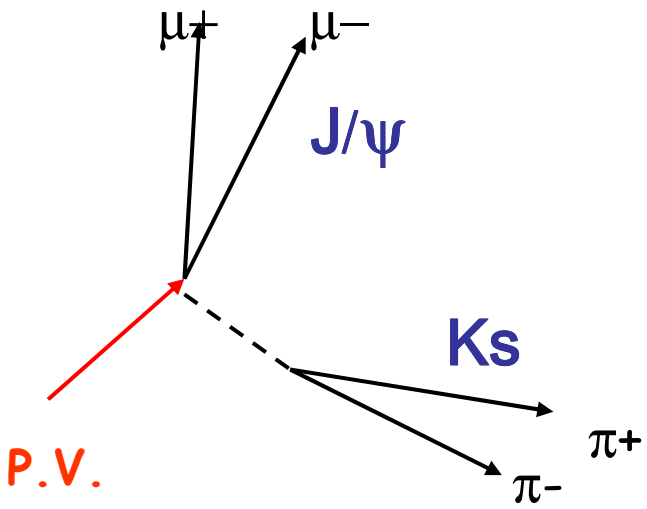
- ✓ Search for $B_s \rightarrow J/\psi\phi\pi^+\pi^-$
- ✓ Search for $B_s \rightarrow J/\psi K_S^0$
- ✓ Study for $J/\psi\pi^+\pi^-$ Production Mechanism

Event topology

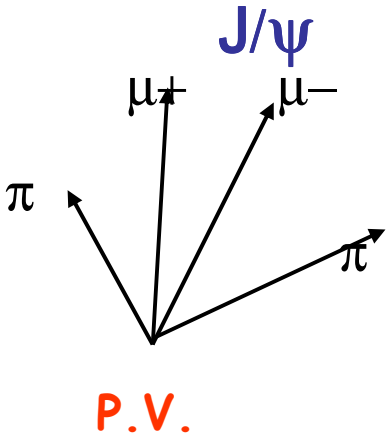
$B_s \to J/\psi\phi\pi^+\pi^-$



$B_s \to J/\psi K_s^0$



$J/\psi\pi^+\pi^-$



Search for $B_s \rightarrow J/\psi \pi^+ \pi^- \phi$

Could be a good method to separate production mechanism

- Internal pop up vs. Higher resonance state ?
- X(3872) or $\psi(2s) \rightarrow J/\psi\, \pi^+\pi^-$?

$Br(B^0 \rightarrow J/\psi\, \pi^+ \pi^- K^{*0}) \;/\; Br(B^0 \rightarrow \psi(2s)(\rightarrow J/\psi\, \pi^+ \pi^-)\, K^{*0})$

$Br(B^+ \rightarrow J/\psi\, \pi^+ \pi^- K^+) \;/\; Br(B^+ \rightarrow \psi(2s)(\rightarrow J/\psi\, \pi^+ \pi^-)\, K^+)$

$Br(B_S \rightarrow J/\psi\, \pi^+ \pi^- \phi) \;/\; Br(B_S \rightarrow \psi(2s)(\rightarrow J/\psi\, \pi^+ \pi^-)\, \phi)$

	$B=B^+$, $K=K^+$	$B=B^0$, $K=K^{*0}$	$B=B_S$, $K=\phi$
$B \rightarrow J/\psi\, K$	$(1.007 \pm 0.035)*10^{-3}$	$(1.33 \pm 0.06)*10^{-3}$	$(1.3 \pm 0.4)*10^{-3}$
$B \rightarrow J/\psi\, K\pi^+\pi^-$	$(1.07 \pm 0.19)*10^{-3}$	$(6.6 \pm 2.2)*10^{-4}$	
$B \rightarrow \psi(2s)K$	$(6.48 \pm 0.35)*10^{-4}$	$(7.2 \pm 0.8)*10^{-4}$	$(6.8 \pm 3.0)*10^{-4}$
$B \rightarrow \psi(2s)K\pi^+\pi^-$	$(1.9 \pm 1.2)*10^{-3}$		

Event Selection, $B_s \rightarrow J/\psi\pi^+\pi^-\Phi$

Selection	Cut application
Bs → J/ψΦπ+π- Bs → ψ(2S)Φπ+π-	$P_T\ (B_s) > 6.5$ GeV/c CTVMFT fit converge prob(B_s vertex fit) > 0.1 % $L_{xy}(B) > 100\ \mu$m
$\phi \rightarrow K^+K^-$	$P_T(\phi) > 2.0$ GeV/c $\lvert M(K^+K^-) - M_{\phi}^{PDG}\rvert \leq 10$MeV/$c^2$
$J/\psi \rightarrow \mu^+\mu^-$	$\lvert M(\mu^+\mu^-) - M_{J/\psi}^{PDG}\rvert \leq 80$MeV/$c^2$
$\psi(2S) \rightarrow \mu^+\mu^-$	$\lvert M(\mu^+\mu^-) - M_{\psi(2S)}^{PDG}\rvert \leq 80$MeV/$c^2$
$\psi(2S) \rightarrow J/\psi\pi\pi$	$\lvert M(\mu^+\mu^-\pi^+\pi^-) - M_{\psi(2S)}^{PDG}\rvert \leq 20$MeV/$c^2$ 0.31GeV/$c^2 \leq M(\pi\pi) \leq 0.61$GeV/$c^2$ $P_T(\pi) > 0.4$ GeV/c

Event Selection of Bs→J/ψπ+π-Φ ≈ Bs→J/ψΦ

Search for Bs → J/Ψ Ks

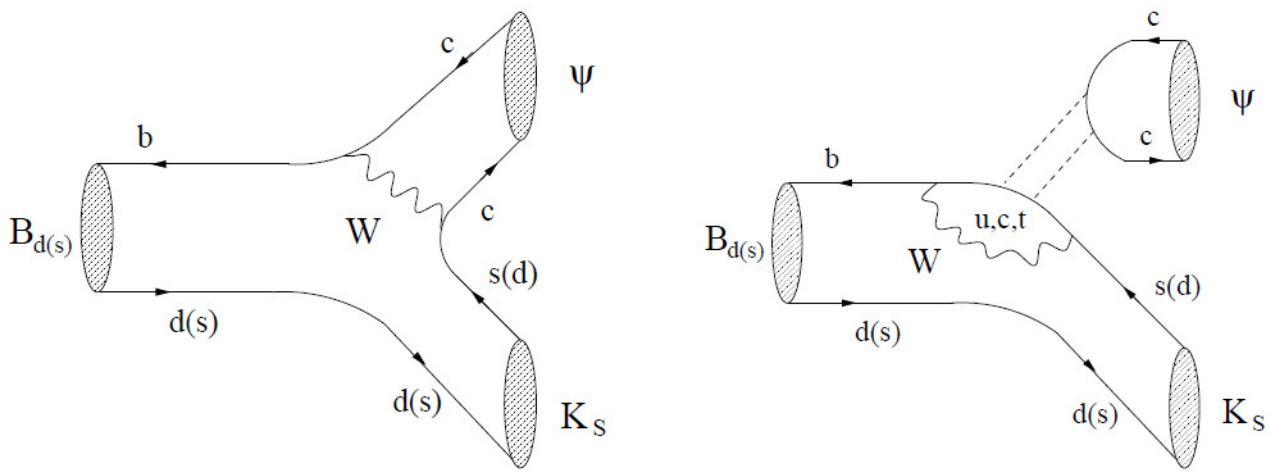


Figure 1: Feynman diagrams contributing to $B_{d(s)} \to J/\psi K_S$. The dashed lines in the penguin topology represent a colour-singlet exchange.

- Nobody measured ratio of B_s → J/psi Ks
- Color & Cabibbo Suppressed Mode
- Decay Mechanism
- Extracting CKM γ angle (Ref : Eur. Phys. J. C10, 299-306(1999))
- Etc ..

Event Selection Bs → J/ΨKs

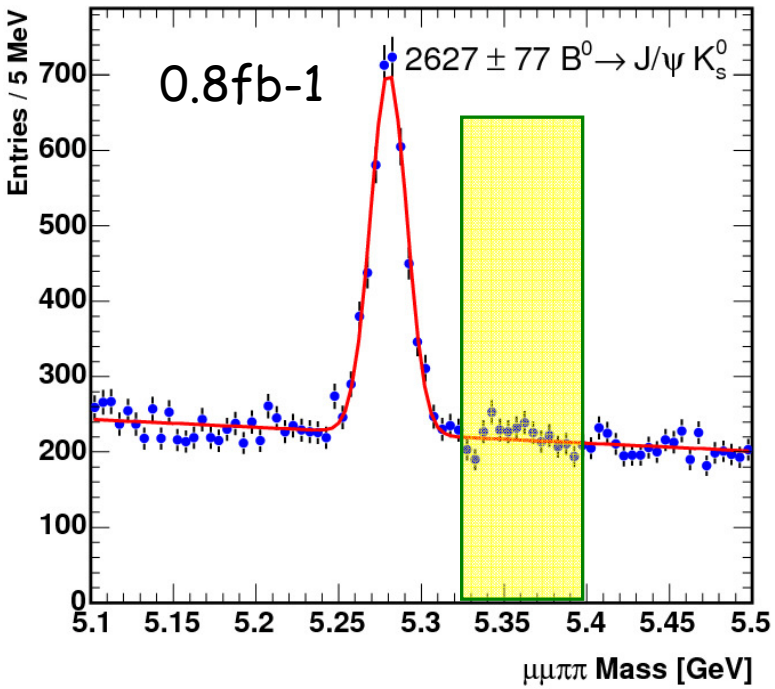
	Cut Quantity	Value	
Muon Tracks	N($r-\phi$) SVX hits	≥ 3	
	$p_T(\mu)$(GeV)	≥ 1.5	
Non-Muon Tracks	N(COT-axial)*	≥ 2	
	N(COT-stereo)*	≥ 2	
Muons	Muon Type	CMU,CMP,CMUP,CMX (type ≤ 7)	
	χ^2_x for CMU, CMX	≤ 9	
J/ψ	mass (GeV)	$3.014 \leq m(\mu\mu) \leq 3.174$	
	2 track fit $P(\chi^2)$	> 0.001	
		for $B^0 \to J/\psi K^0_s$	for $\Lambda^0_b \to J/\psi \Lambda^0$
K^0_s, Λ	L_{xy}(cm)	≥ 0.1	≥ 0.1
	2 track fit $P(\chi^2)$	>0.001	>0.001
	mass(GeV)	$0.472 \leq m(\pi\pi) \leq 0.523$	$1.107 \leq m(p\pi) \leq 1.125$
	p_T(GeV)	≥ 1.5	≥ 2.6
	$L_{xy}/\sigma_{L_{xy}}$	≥ 6.0	≥ 4.0
	Λ/K^0_s veto (GeV)	$1.1085 \leq m(p\pi) \leq 1.1235$	$0.482 \leq m(\pi\pi) \leq 0.511$
B^0, Λ^0_b	4 track fit $P(\chi^2)$	> 0.0001	> 0.0001
	p_T(GeV)	≥ 4.0	≥ 4.0

* N(COT-axial/stereo) refers the the number of axial/stereo superlayers with ≥ 5 hits.

Table 1: All cuts used in reconstruction of $B^0 \to J/\psi K^0_s$ and $\Lambda^0_b \to J/\psi \Lambda^0$

Event Selection of Bs → J/ΨKs ≈ B^0 → J/ΨKs

Search for Bs → J/ψKs @ CDF II



Measured Br(B^0 → J/ψ Ks) = $4.45*10^{-4}$
Theory exp. Br(B_s → J/ψ Ks) ~ $2.0*10^{-5}$

Yield (B0 → J/ψKs) ~ 2630 ($0.8fb^{-1}$) : measur
Yield (B0 → J/ψKs) ~ 16400 ($5.0fb^{-1}$) : expect

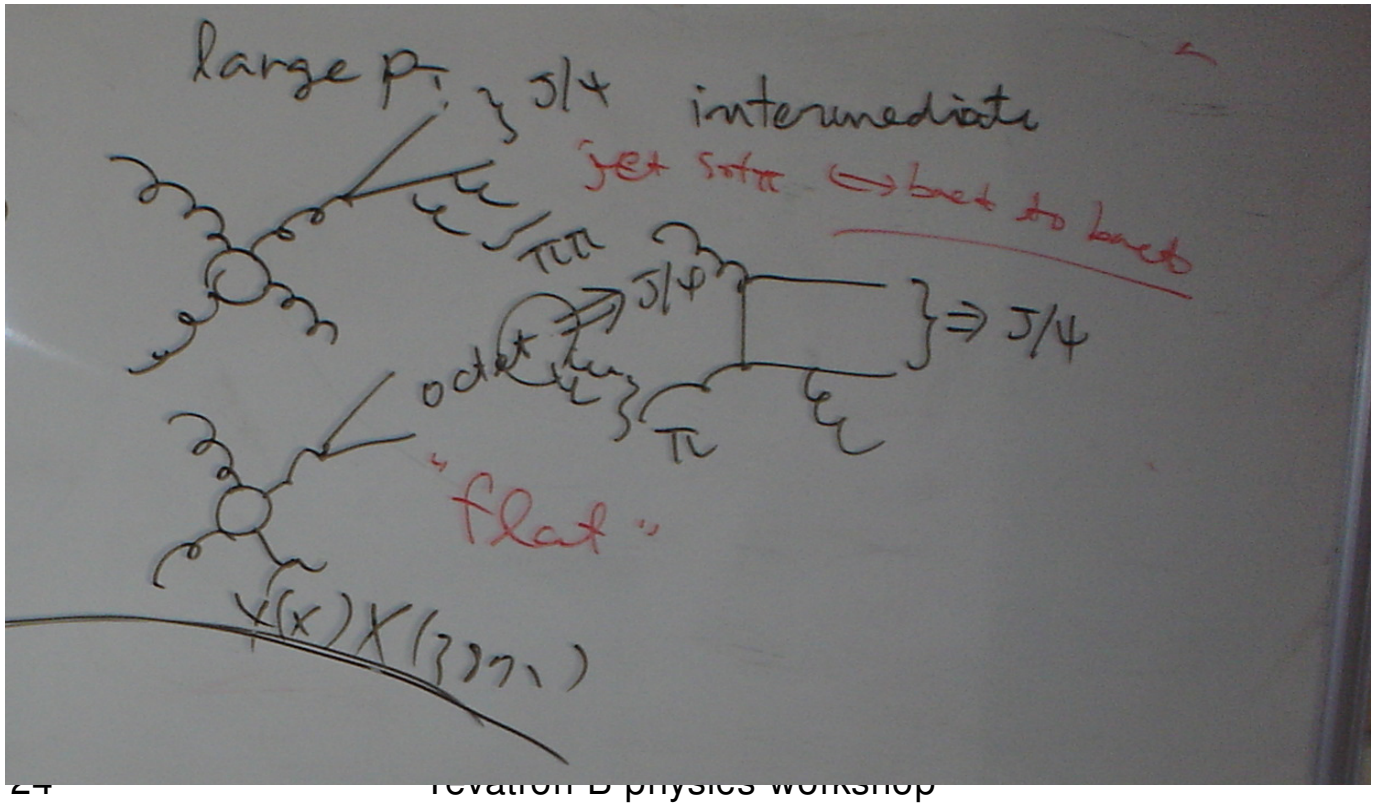
Expected Yield (Bs → J/ψ Ks) @ $5.0fb^{-1}$
~ 16400 * 0.3(f_s/f_b) * $2/4.45*10^{-1}$
~ 200

- B^0 contamination,
- BG reduction

$J/\Psi\pi^+\pi^-$ Production Mechanism

Could be a good method to separate production mechanism

- By study of soft $\pi^+\pi^-$, singlet production or octet production?
- M(J/psi pi+pi-) distributions after large P_T of J/psi cut
  - Flat => Octet
  - Jet => Singlet



$J/\psi\pi^+\pi^-$ Production Mechanism

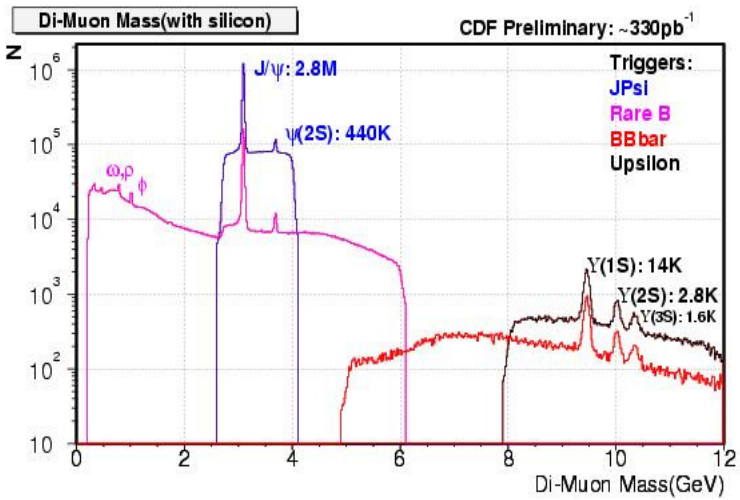
- Working together with theory group at Korea University. (Prof. J.Lee)
- J/psi pi pi is same final state of Bs-> J/psi pi pi
- Same stream and ntuple

Summary

- High Energy Physics Team @ KISTI is working on e-Science paradigm of experiment-computing-theory in B physics
- We are planning to work on CDF B physics program.

  - ✓ **Search for** $B_s \rightarrow J/\psi\phi\pi^+\pi^-$
  - ✓ **Search for** $B_s \rightarrow J/\psi K_s^0$
  - ✓ **Study for** $J/\psi\pi^+\pi^-$ **Production Mechanism**

Di-muon triggered DataSet @ CDF



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