CDF $\sin 2\beta$-$J/\psi K^0_S$ in Run II

Precision Measurements to constrain Unitary Triangle

- β to $\pm 2^\circ$, combining TeV, BaBar,Belle
- ΔM_s, constraining V_{td}, TeV
- V_{ub}- BaBar, Belle, CLEO

CDF: Scale Run I time dependent analysis

- N= 198 (Run I) $\Longrightarrow$ 10,000 (Nominal Run II)
- $\epsilon D^2 = 0.018$ (Run I) $\Longrightarrow 0.067 \Rightarrow 0.091$ with TOF
- $\sigma(\sin 2\beta)_{Stat} = 1.08 \Longrightarrow 0.078, \Rightarrow 0.067(+\mathrm{TOF})$

Systematics= Error on D

- Measured asymmetry= $D \times \sin 2\beta$
- $\sigma(\sin 2\beta) = \sigma(\sin 2\beta)_{Stat} + \sin 2\beta \times \frac{\sigma(D)}{D}$

Asymmetry and Dilution errors depend on ϵD^2 in same way
Dilution error depends on Calibration sample-$J/\psi K^+$, $J/\psi K^{*0}$

$$\frac{\sigma \mathcal{A}}{D} = \frac{K_1}{\sqrt{\epsilon D^2}} \ (J/\psi K^0_S \text{ Sample})$$

$$\frac{\sigma D}{D} = \frac{K_2}{\sqrt{\epsilon D^2}} \ (J/\psi K^+, K^{*0} \text{ Samples})$$

$$\sigma(\sin 2\beta) = \sigma(\sin 2\beta)_{Stat} \times 1.17 \text{ (SST)-}J/\psi K^{*0}$$
$$\times 1.05 \text{ (SLT,JETQ)-}J/\psi K^+$$

$$\sigma(\sin 2\beta) = 0.078 + 0.031 = 0.084$$
$$= 0.072(+\mathrm{TOF})$$

CDF J/ψ Triggers for Run II

- J/ψ Dimuons

  TWG Study using Monte Carlo + CMU-CMU-2.2 GeV CFT

  L1 stub gate, 100 $\rightarrow$ 200 nsec ($\times 1.36 J/\psi$)

  Remove Run I wedge cuts ($\times 1.10 J/\psi$)

  L2 M_T and $\Delta\phi$ Cuts ($\times 0.85 J/\psi$)

  $\Rightarrow$ 10 nb. in L2 (Wow!)

  Extend to include CMX and XFT= 1.5 GeV/c

  CMU, XFT=1.5 GeV/c, 384 ns ($\times 2.0 J/\psi$)

  CMX, XFT=2.0 GeV/c, 200 ns, add miniskirt, remove prescales

  CMU-CMU=69% J/ψ, L2=40 nb

  CMU-CMX=28% J/ψ, L2=22 nb

  CMX-CMX= 3% J/ψ, L2= 6 nb

  $\Rightarrow$ 70 nb in L2

  $\times 50 J/\psi$ yield, 20,000 $J/\psi K_S^0$

- J/ψ Dielectrons

  $\Rightarrow$ 100 nb in L2

  $\times 70 J/\psi$ yield, 28,000 $J/\psi K_S^0$

- Main issue is Level-2 Bandwidth, $<$ 3000nb at 1 10^{32}

  Appears Manageable- $<$ 200 nb combined

- 28000 $J/\psi K_S^0 \longrightarrow \sigma(\sin 2\beta) = 0.043$