ATLAS Z' Search Result









Di-muon spectrum



The CKM-Matrix



CPLEAR detector





CPLEAR Detector - Leptonic decays



Mass difference measurement



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CP Violation



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The CKM-Matrix

$$V_{\text{CKM}} = \begin{pmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{pmatrix}$$
$$= \begin{pmatrix} 1 - \lambda^2/2 & \lambda & A\lambda^3(\rho - i\eta) \\ -\lambda & 1 - \lambda^2/2 & A\lambda^2 \\ A\lambda^3(1 - \rho - i\eta) & -A\lambda^2 & 1 \end{pmatrix} + \mathcal{O}(\lambda^4) .$$

$$V_{\text{Wolf}} = \begin{pmatrix} 1 - \frac{1}{2}\lambda^2 & \lambda & A\lambda^3(\rho - i\eta \\ +i\eta \frac{1}{2}\lambda^2) \\ -\lambda, & 1 - \frac{1}{2}\lambda^2 & A\lambda^2(1 + i\lambda^2\eta) \\ -i\eta A^2\lambda^4 & \\ A\lambda^3(1 - \rho - i\eta) & -A\lambda^2 & 1 \end{pmatrix}$$

V_{cb} Determination @ Belle



Beam energies:

$$\begin{array}{l} \mathsf{E}_{e^+} = 3.5 \; \text{GeV} \\ \mathsf{E}_{e^-} = 8 \; \text{GeV} \end{array}$$

CMS energy:

 $E_{\text{cms}} = M_{Y(4s)}$

Main Process:

 $e^+e^- \rightarrow Y \rightarrow B\overline{B}$

The Belle Detector at the KEK-B Accelerator

[BaBar: similar]

V_{cb} Determination @ Belle



B⁰_d Oscillation Measurement



B⁰_d Oscillation Measurement



B_d Oscillation Measurement

Consider:

$$B^{0}(\bar{b}d) \to D^{-}(\bar{c}d)\mu^{+}\nu_{\mu}$$
$$\bar{B}^{0}(b\bar{d}) \to D^{+}(c\bar{d})\mu^{-}\bar{\nu}_{\mu}$$



Measure:

$$A(\Delta t) = \frac{N_{\rm OF} - N_{\rm SF}}{N_{\rm OF} + N_{\rm SF}}$$

= $\frac{\left[P(B_{t=0}^0 \to B^0) + P(\bar{B}_{t=0}^0 \to \bar{B}^0)\right] - \left[P(B_{t=0}^0 \to \bar{B}^0) + P(\bar{B}_{t=0}^0 \to B^0)\right]}{\left[P(B_{t=0}^0 \to B^0) + P(\bar{B}_{t=0}^0 \to \bar{B}^0)\right] + \left[P(B_{t=0}^0 \to \bar{B}^0) + P(\bar{B}_{t=0}^0 \to B^0)\right]}$

$$A(\Delta t) = \cos^2\left(\frac{\Delta m_{\rm d} t}{2}\right) - \sin^2\left(\frac{\Delta m_{\rm d} t}{2}\right) = \cos(\Delta m_{\rm d} t)$$

B_d Oscillation Result



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Important: $|\xi| \neq 1$



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Unitarity Triangle and CP Violation



Determination of CP Violation



Determination of CP Violation



 $B^{0} \rightarrow J/\psi/K_{s}$: sin 2 β tan $\beta = \eta/(1-\rho)$

Kaon mixing: ε ε∝η (1-ρ+constant)

 $B^{0} mixing: \Delta m_{d}$ $\Delta m_{d} determines |V_{tb}|$



Unitarity Triangle from B Decays

Angles from CP violating observables [Rare decays; several 10⁹ B mesons necessary]



Constraints on ρ and η

