Model Independent Determination of Unitary Triangle

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Effects of new physics in $B_d - \bar{B}_d$ mixing:

$$\frac{\langle B_d^0 | \mathcal{H}^{full} | \bar{B}_d^0 \rangle}{\langle B_d^0 | \mathcal{H}^{SM} | \bar{B}_d^0 \rangle} = (r_d e^{i\theta_d})^2$$

4 Measured Quantities:

i) $a_{J/\psi K_S} = \sin(2\beta + 2\theta_d)$

ii) $a_{\pi\pi} = \sin(2\alpha - 2\theta_d)$

iii) $\frac{\Gamma(b \to u \ell \nu)}{\Gamma(b \to c \ell \nu)} = \frac{1}{F_{ps}} \left|\frac{V_{cd}}{V_{ud}}\right|^2 R_u^2$, $R_u = \left|\frac{V_{ub}^* V_{ud}}{V_{cb}^* V_{cd}}\right| = \frac{\sin\beta}{\sin\alpha}$

iv) $x_d = C_t R_t^2 r_d^2$, $R_t = \left|\frac{V_{tb}^* V_{td}}{V_{cb}^* V_{cd}}\right| = \frac{\sin\gamma}{\sin\alpha}$

And, $\alpha + \beta + \gamma = \pi \pmod{2\pi}$

Solve (i) - (iii) for α, β, θ_d

→ gives $\gamma \Rightarrow r_d$ from (iv)

Limiting Factors:

- Experimental + Theoretical Uncertainties
- 8-fold discrete ambiguity