Measurement of the B_s^0 - $\bar{B}_s^0$ Oscillation Frequency

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Abstract

- first precise measurement of the B_s^0 - $\bar{B}_s^0$ oscillation frequency Δm_s
- $1 fb^{-1}$ of data from $p\bar{p}$ collisions at $\sqrt{s} = 1.96$ TeV
- 3600 fully reconstructed B_s decays and 37000 partially reconstructed semileptonic B_s decays
- $\Delta m_s = 17.31^{+0.33}_{-0.18}(stat) \pm 0.07(syst) ps^{-1}$
- $V_{td}/V_{ts} = 0.208^{+0.001}_{-0.002}(expt)^{+0.008}_{-0.006}(theor)$

Theory

- probability for a $\bar{B}^0_q$ produced at time $t = 0$ to decay as a B^0_q at time t

$$P_{\pm}(t) = \frac{\Gamma_q}{2} e^{-\Gamma_q t} \left[1 \pm \cos(\Delta m_q t)\right]$$

- Δm_q = mass difference between $B^0_{q,H}$ and $B^0_{q,L}$
- Γ_q is the decay width

Theory

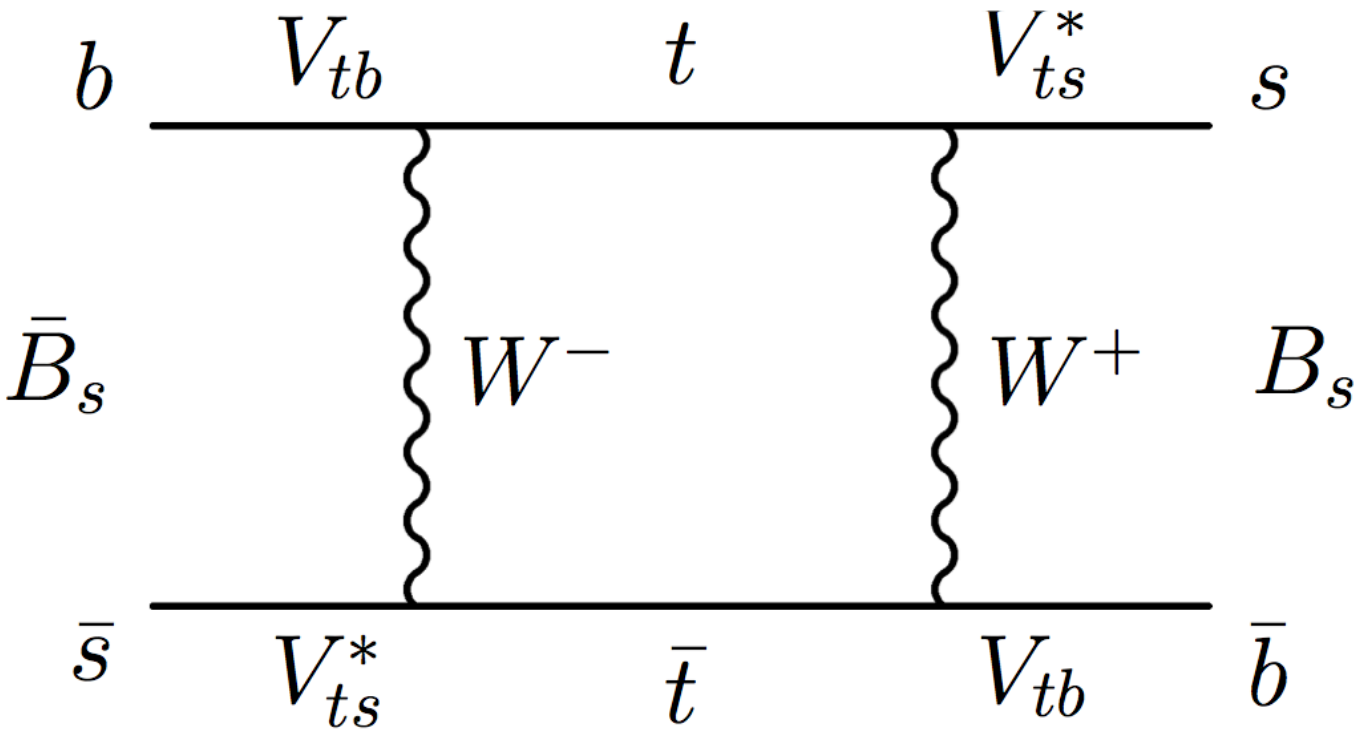

Figure: Feynman Diagram of B^0 - $\bar{B}^0$ oscillation

Measurment method

- 2 decay modes reconstructed:
- $\bar{B}_s^0 \to D_s^+ \pi^-, D_s^+ \pi^- \pi^+ \pi^-$
- $\bar{B}_s^0 \to D_s^+ \ell^- \bar{\nu}_\ell, \ell = e$ or μ
- using charged particles only
- calculating decay time from distance and momentum measurment between production and decay
- flavor at decay determined by charge of decay products

Tagging initial B

- 2 techniques to identify flavor of the B at production
- same-side tag: uses secondary meson K^- for $\bar{B}_s^0$ and K^+ for B_s^0
- high sensitivity at large values of Δm
- opposite-side tag: uses charge of the lepton from the semileptonic decay
- high sensitivity at low values of Δm

checking for unitarity of the CKM matrix

- the measured oscillation frequency can be used to derive:

$$\frac{V_{td}}{V_{ts}} = \epsilon \sqrt{\frac{\Delta m_d}{\Delta m_s} \frac{m_{B_s^0}}{m_{B^0}}} \sim 0.208$$

- which is consistent with standart model expectations
- can be used to improve constrains on the unitarity of the CKM matrix or on new physics
- it is still a topic in state of the art research in the LHCb experiment

Questions?