Anomalous top quark couplings

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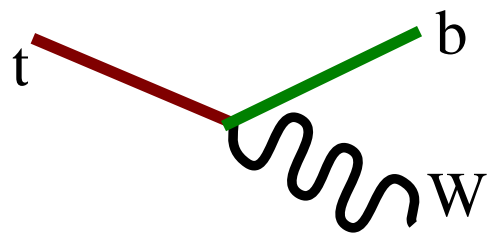
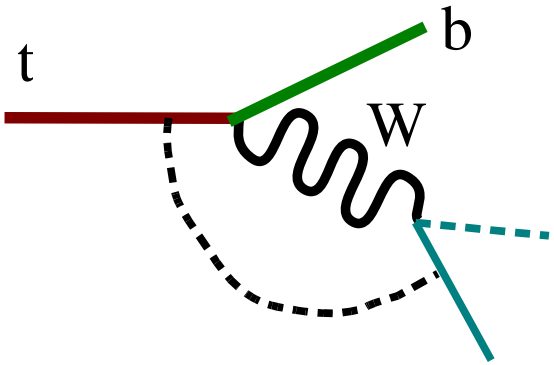
Introduction

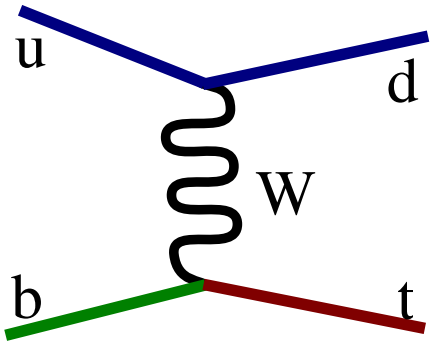
- General top quark coupling to b quark and W boson
- Allowed coupling terms are left-vector, right-vector, left-tensor, right-tensor

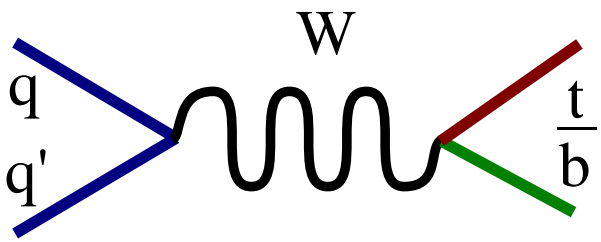


$$\mathcal{L} = -\frac{g}{\sqrt{2}}\bar{b}\gamma^{\mu}V_{tb}(f_1^L P_L + f_1^R P_R)tW_{\mu}^{-}$$
$$- \frac{g}{\sqrt{2}}\bar{b}\frac{i\sigma^{\mu\nu}q_{\nu}}{M_W}(f_2^L P_L + f_2^R P_R)tW_{\mu}^{-} + h.c.$$

Wtb coupling in top quark events







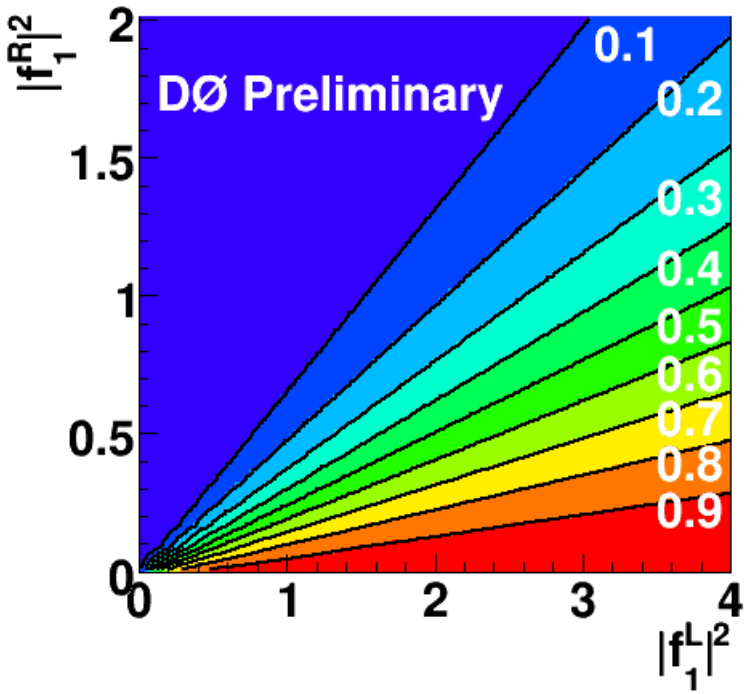
- Top quark final states are sensitive to nature of the top quark couplings:
  - W boson helicity in top quark decay
    - Angular correlation
  - Single top production
    - Production cross section
    - Angular correlations of final state products
  - General Analysis of Single Top Production and W Helicity in Top Decay (Ren, Larios, and Yuan, PLB 631, 126 (2005))

Anomalous single top couplings

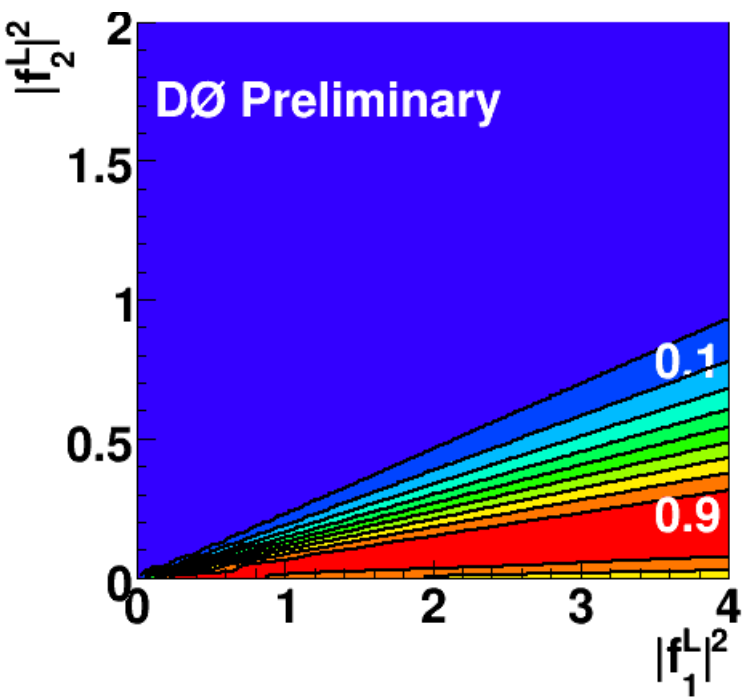
- Anomalous couplings modify event kinematics and angular correlations
- Boosted decision trees to separate single top from backgrounds

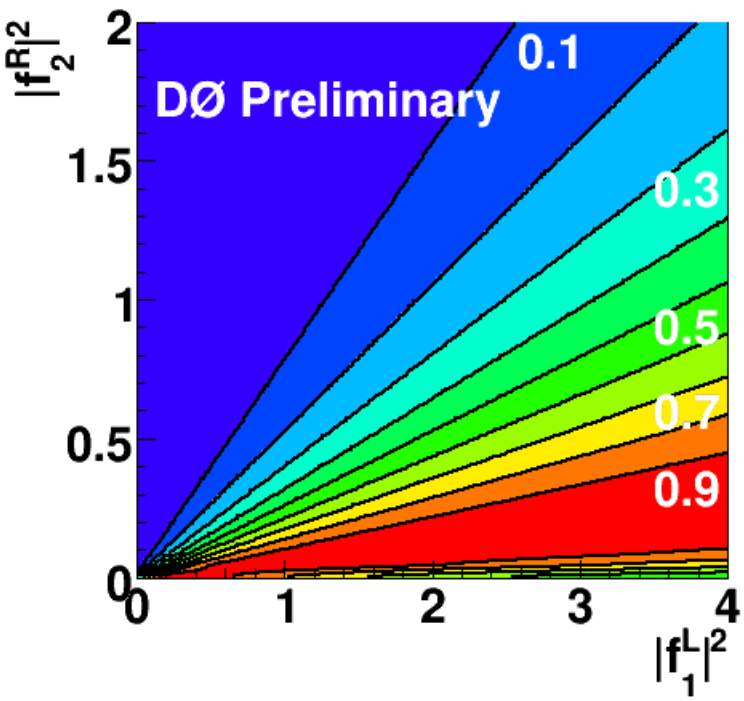
W helicity analysis

Anomalous couplings in W helicity



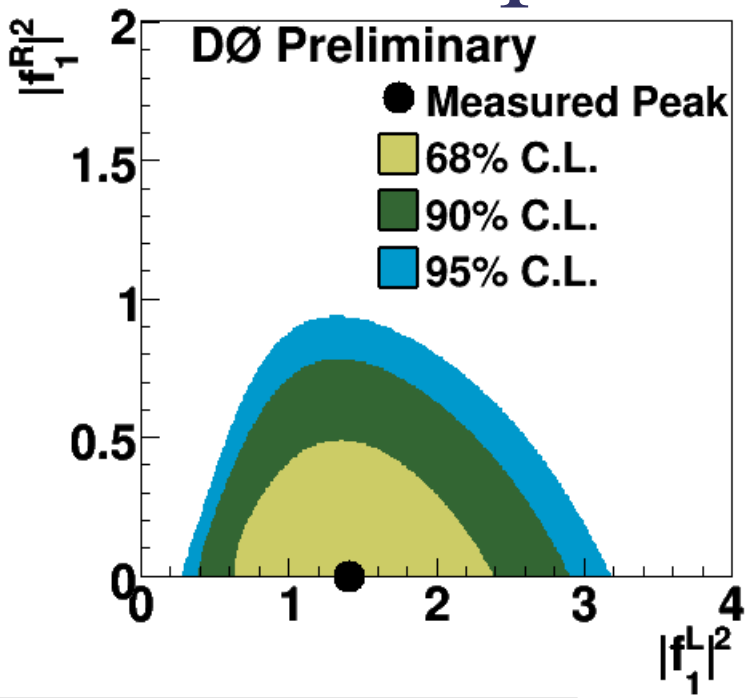
- 10 contours, evenly spaced from 0 to max. Each color corresponds to 10% of the total height
- Red is the highest contour
- All systematic uncertainties included

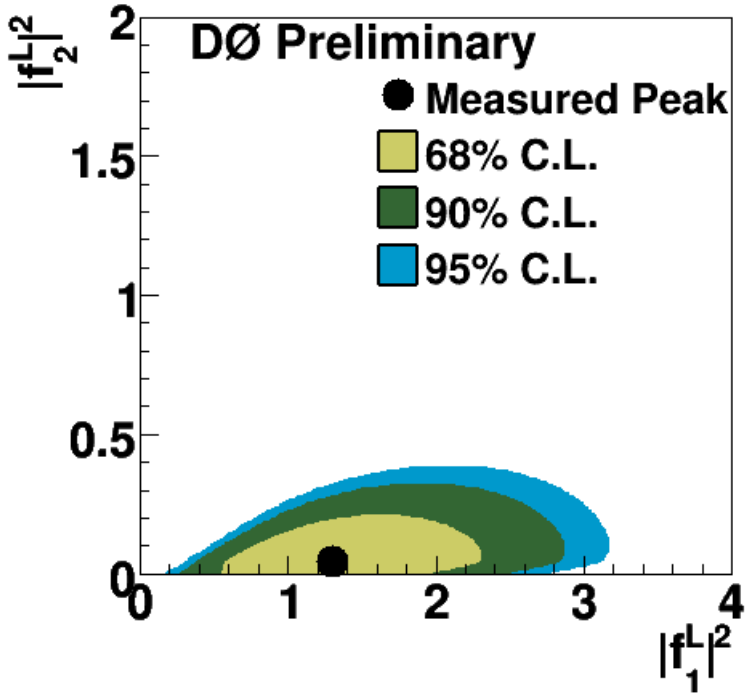


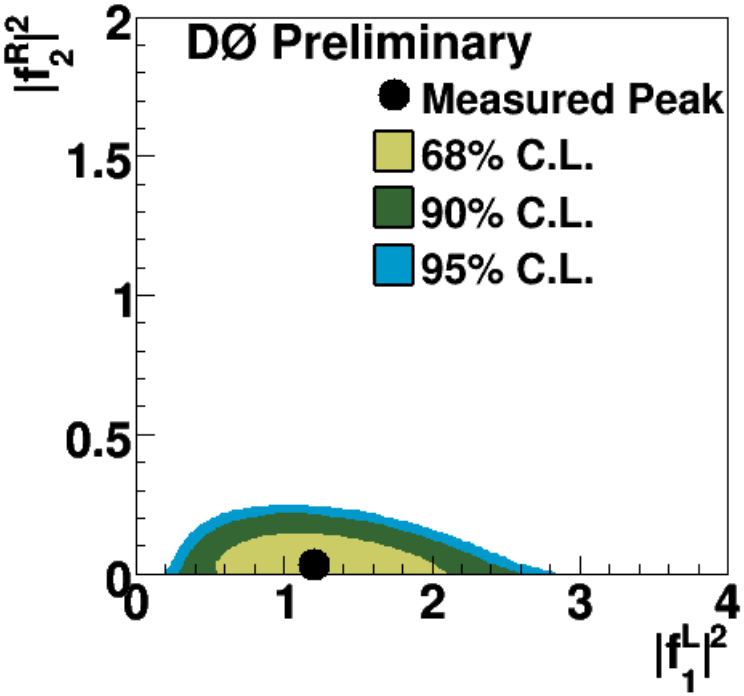


Combined analysis

Combined top couplings posteriors







Anomalous coupling limits

- Observe SM-like coupling
- Set 95% CL limits on non-SM couplings
  - $|f_1^R|^2 < 0.72$ (was 0.95 in PRL)
  - $|f_2^L|^2 < 0.30$ (was 0.32 in PRL)
  - $|f_2^R|^2 < 0.19$ (was 0.23 in PRL)

Summary

- Set limits on anomalous Wtb couplings using all applicable top quark information
  - Combining W helicity and single top analyses
  - Updated analysis using latest W helicity result
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