

*Alternative approach to top charge
determination*

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Preface

- Dilepton channel topQ – nominal analysis – cdfnotes 8638, 8713, 9620, 9680, QaA web page
http://www-cdf.fnal.gov/~chenyc/internal/TopCharge/topq_DIL_QandA_2
- Current analysis – cdfnote 9608
- Major difference – **shape of b-jet charge distribution is used and consequently measured top charge is continuous variable**
- Other assumptions are the same:
 - **Exclusive possibility of top charge 2/3 or 4/3**
 - **No kinematic difference between these two charge options**
- As in nominal analysis we implemented two sort of complementary approaches to pairing of leptons and b-jets from top decay:
 - Mlbsmax – **$\epsilon \simeq 40\%$, $P_{lb} = 95\%$**
 - KIN - **$\epsilon \simeq 98\%$, $P_{lb} = 72\%$**
- Analysis was inspired by original D0 paper (PRL 98 041801 (2007))

Universality of b-jet charge distribution

- ttop75 sample, standard DIL selection, reconstruction, selection of tracks associated with jets for jet charge calculation (tight secvtx tracks, $P_t > 1.5 \text{ GeV}/c^2, |D_0| < 0.15 \text{ cm}$)

- jet matching to $b(\bar{b})$

$$Q_{jet} = \frac{\sum |\vec{p}_i \cdot \vec{P}_{jet}|^{0.5} Q_i}{\sum |\vec{p}_i \cdot \vec{P}_{jet}|^{0.5}}$$

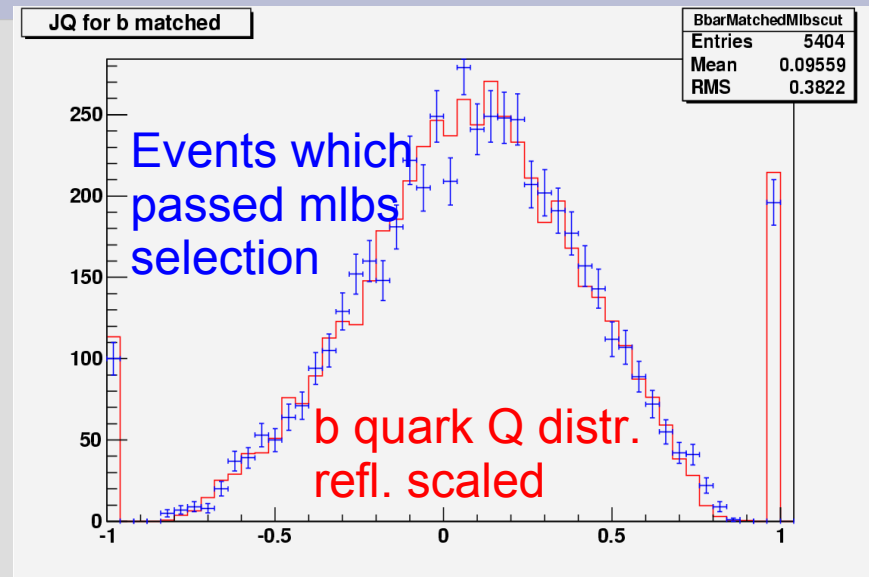
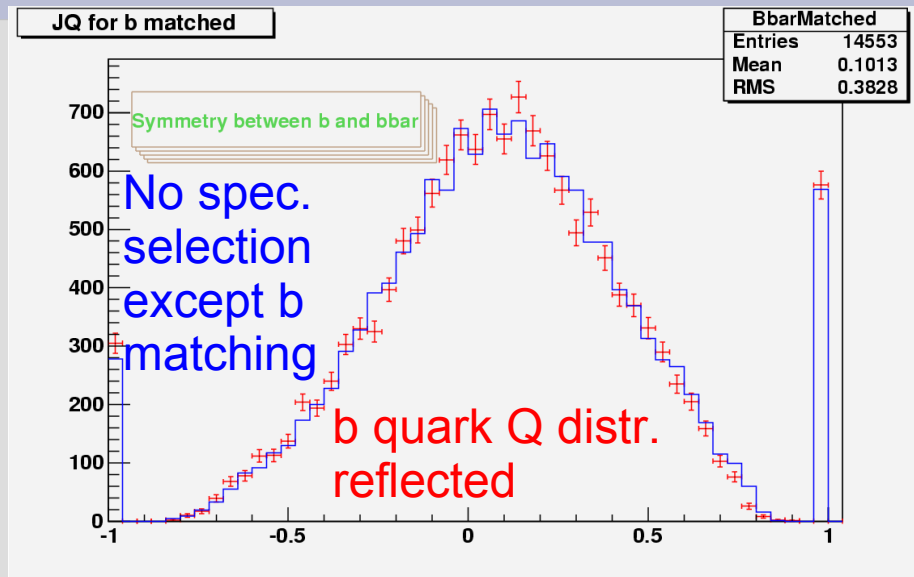
same as in nominal analysis

$$P_b(x) = P_{\bar{b}}(-x)$$

if CP violation is neglected

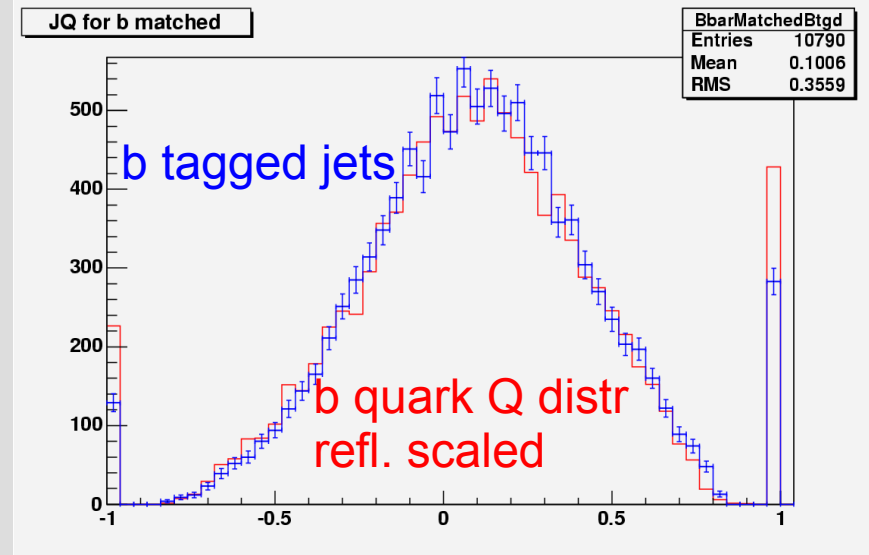
Demonstration of universality of b-jet charge distribution (for selection we are interested in)

b-jet charge distribution

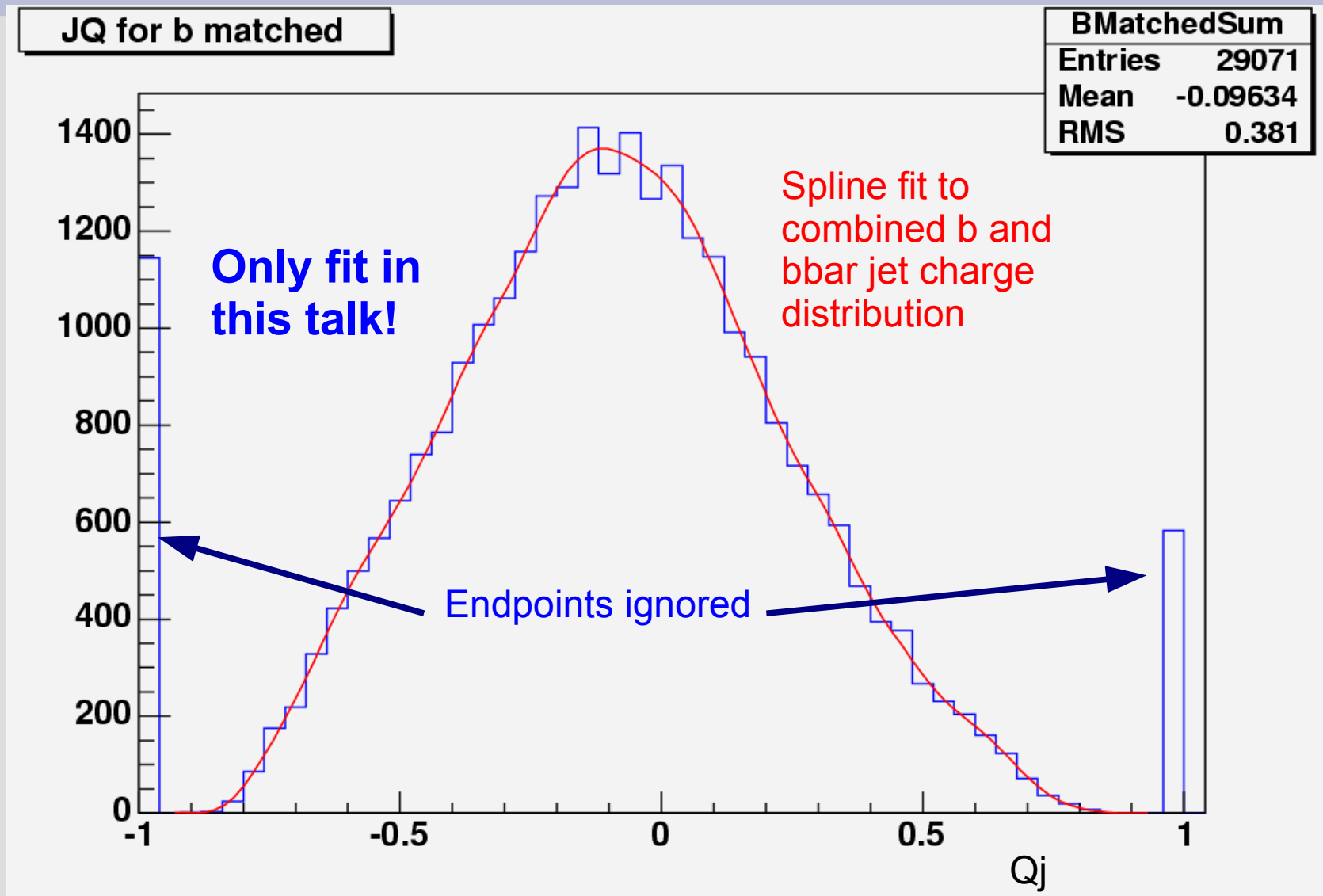


$$Q_{jet} = \frac{\sum |\vec{p}_i \cdot \vec{P}_{jet}|^{0.5} Q_i}{\sum |\vec{p}_i \cdot \vec{P}_{jet}|^{0.5}}$$

$$P_b(x) = P_{\bar{b}}(-x)$$

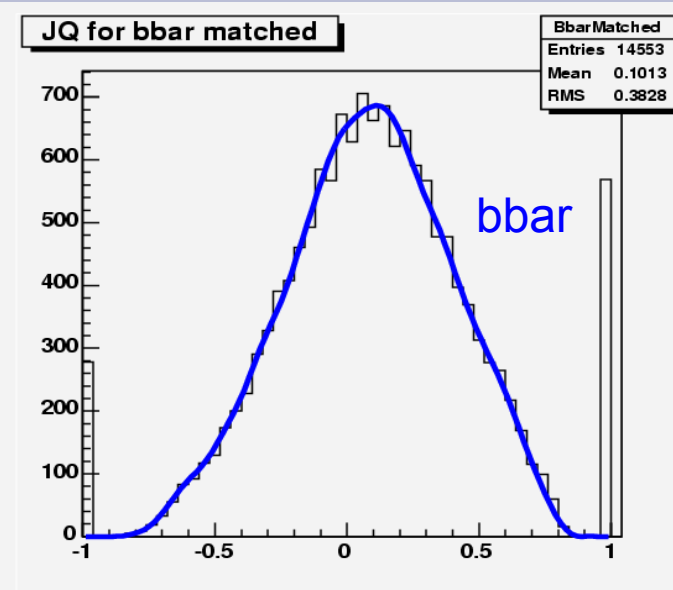
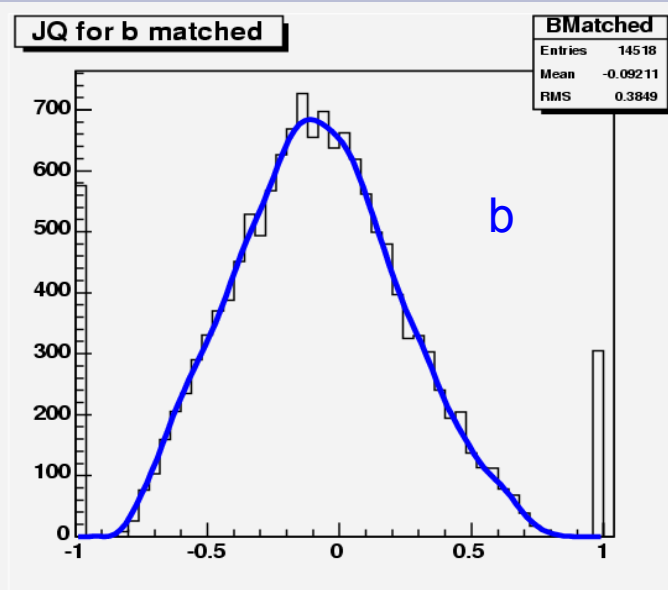


Universal b -jet charge distribution

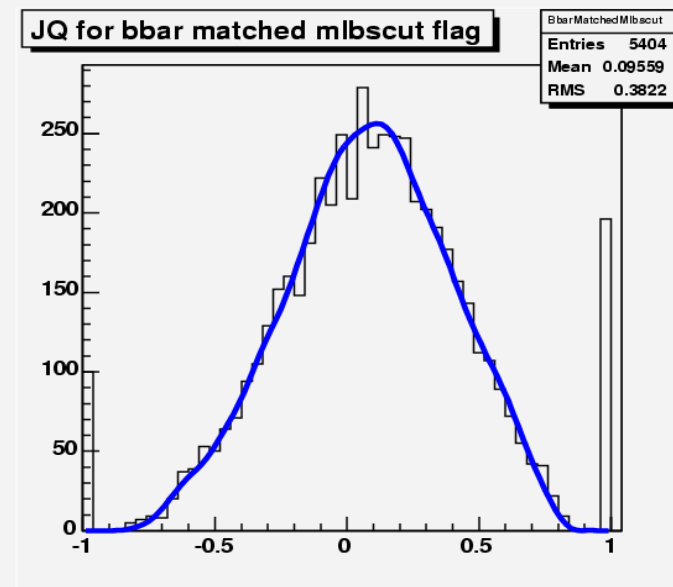
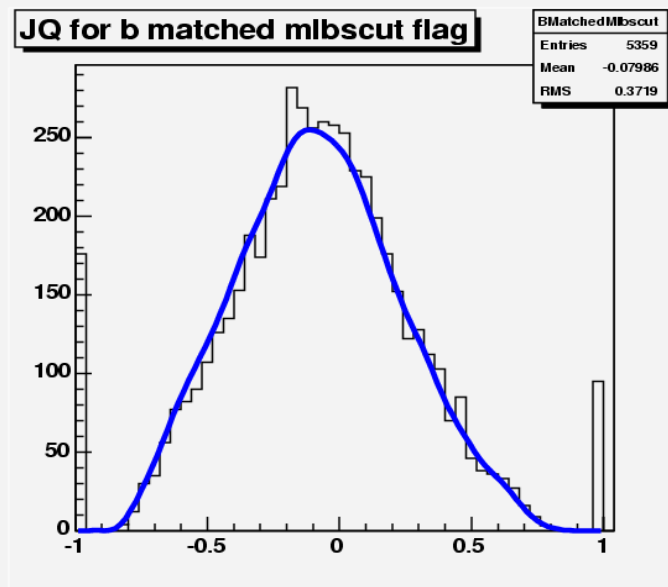


Universal b -jet charge distribution

Scaled or
(and)
reflected
universal
function



Mlbs
max cut
selected
events



Toward top charge sensitive variable, distribution

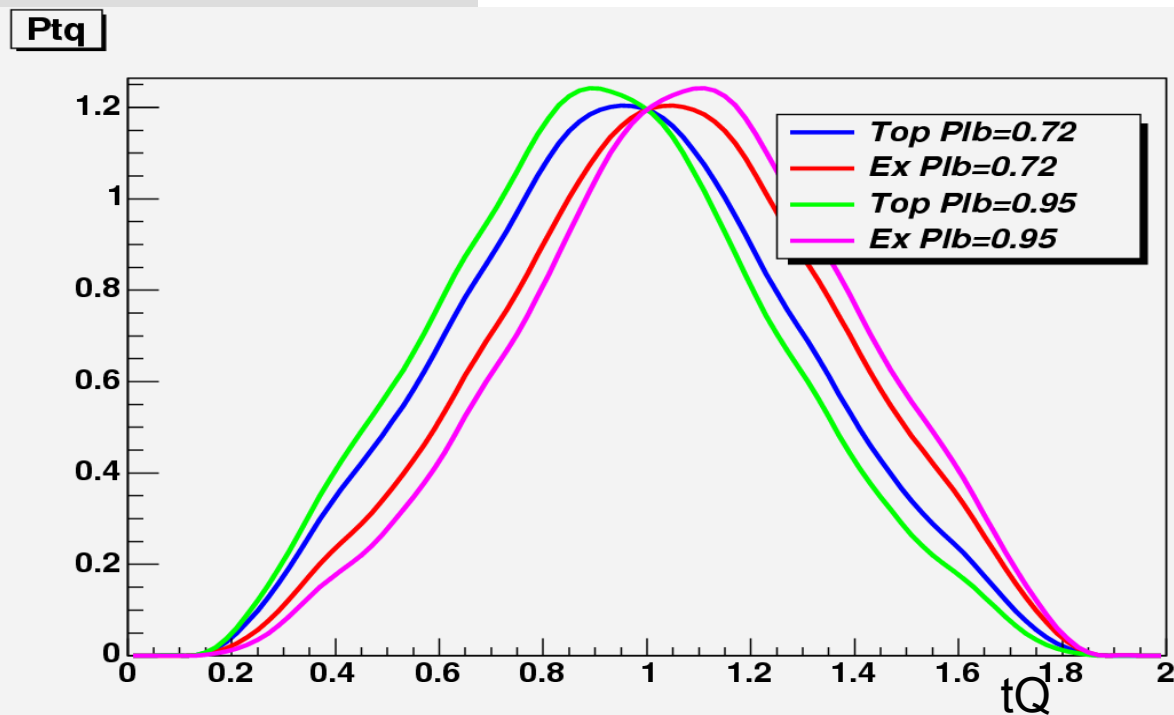
- Variable should combine b-jet charge and lepton charge (lepton paired to b-jet from top decay)
- Distribution in this variable should be expressed in universal b-jet charge distribution $P_b(x)$ and probability for correct pairing of leptons and b-jets (P_{lb})
- Reminder – KIN – $P_{lb} = 0.72$
MlbsMax Cut - $P_{lb} = 0.95$

Top Q variable

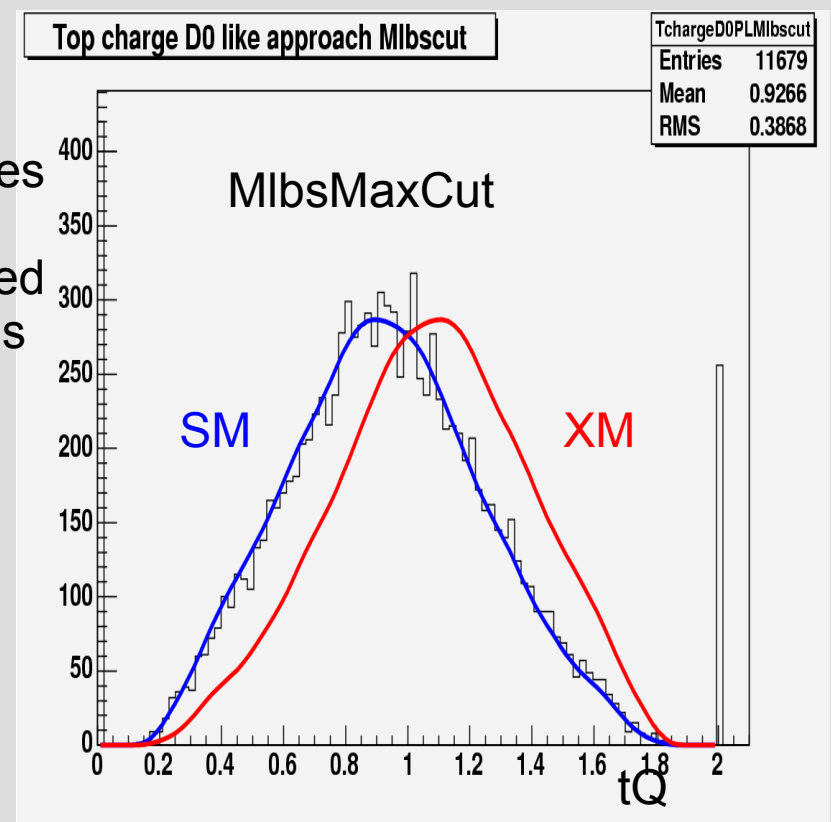
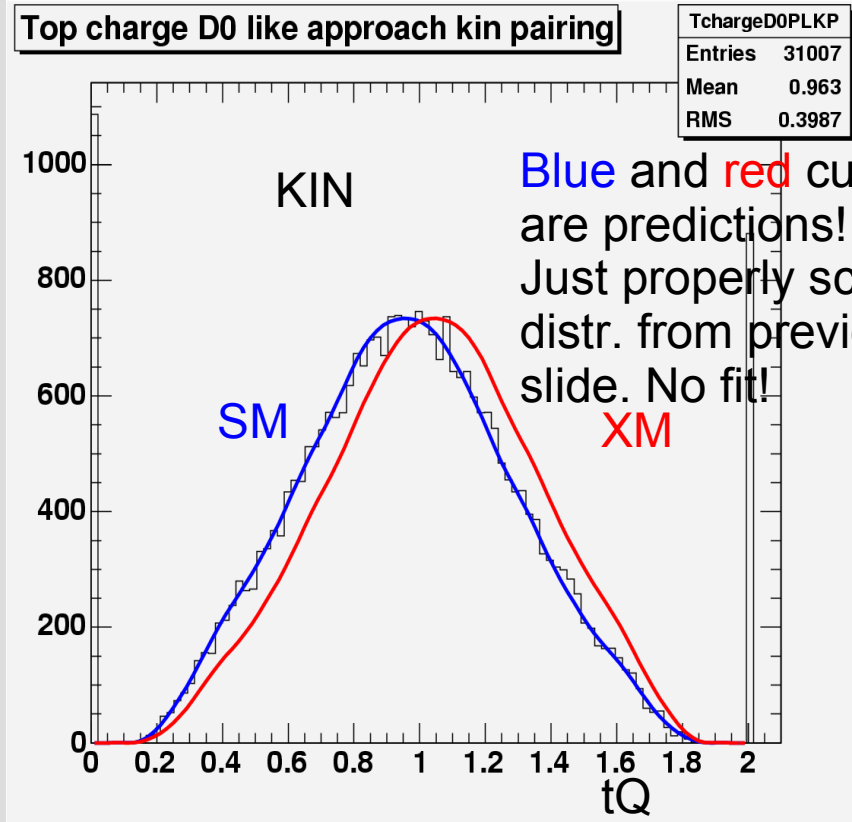
$$t_Q = |Q_j + l_Q|$$

$$P^T(t_Q, P_{lb}) = P_{lb}P_b(t_Q - 1) + (1 - P_{lb})P_b(1 - t_Q)$$

$$P^{Ex}(t_Q, P_{lb}) = P_{lb}P_b(1 - t_Q) + (1 - P_{lb})P_b(t_Q - 1)$$



tQ comparison in MC



Statistical treatment

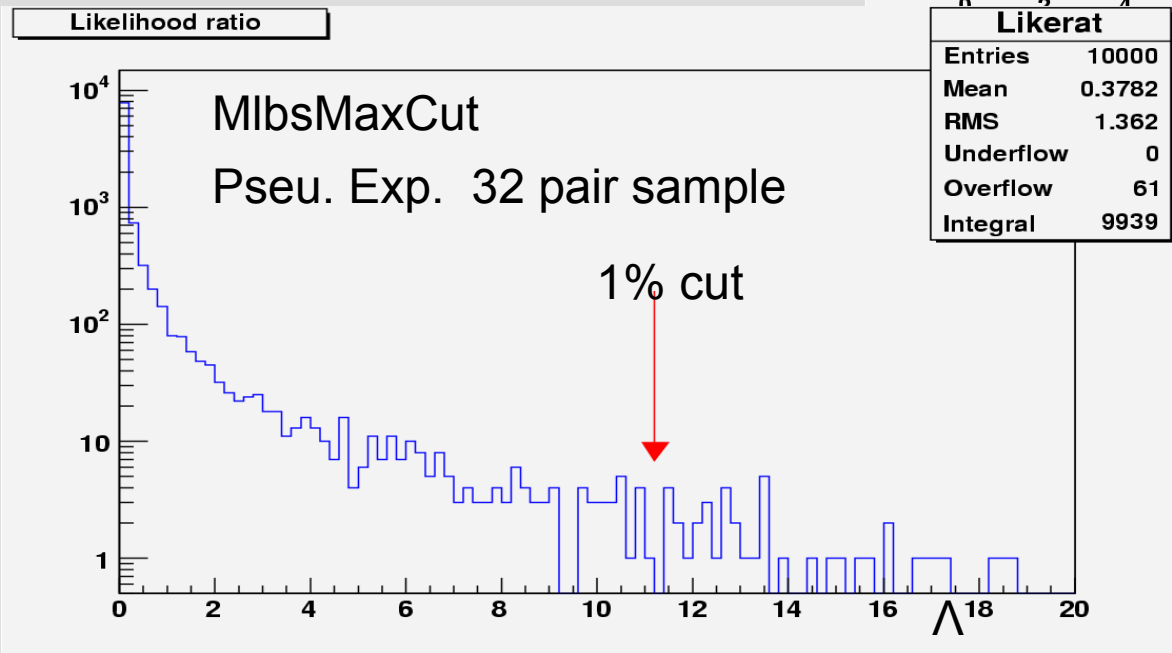
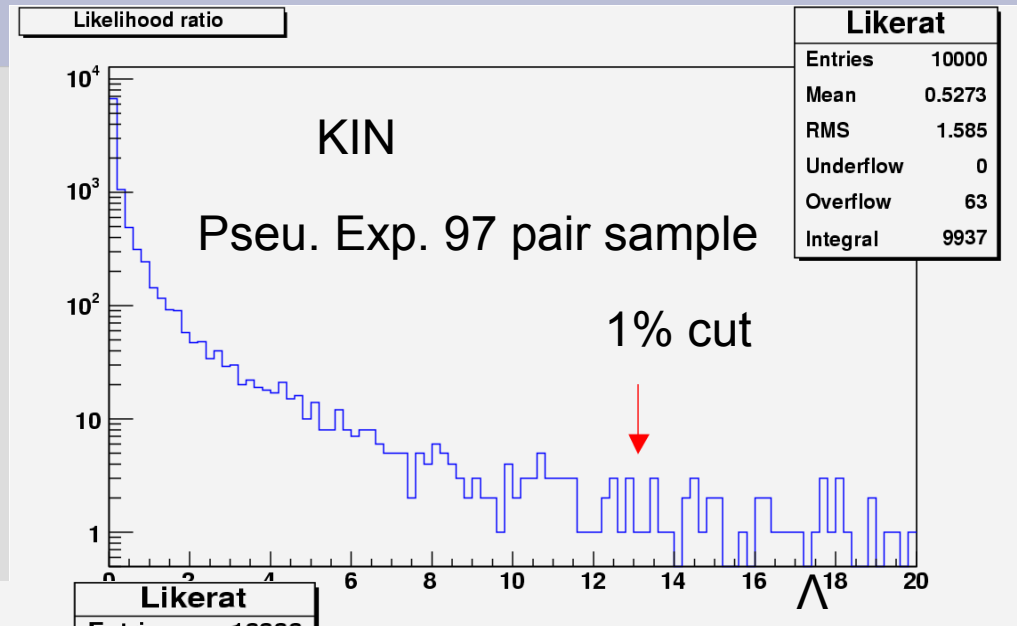
- We want to have procedure to decide acceptance or rejection of SM hypothesis
- Solution – Likelihood ratio test (as in case of D0)

$$\Lambda = \frac{\prod_i P_{final}^{Ex}(t_{Q_i}, P_{lb})}{\prod_i P_{final}^t(t_{Q_i}, P_{lb})}$$

- Pseudoexperiments to determine cut passed by e.g. less than 1% cases if SM is true

Statistical treatment

$$\Lambda = \frac{\prod_i P_{final}^{Ex}(t_{Q_i}, P_{lb})}{\prod_i P_{final}^t(t_{Q_i}, P_{lb})}$$



Conclusion

Methodology for using b-jet charge shape for top charge study was developed and tested on MC