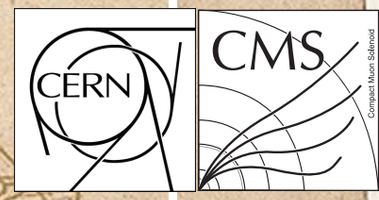
國立臺灣大學
National Taiwan University



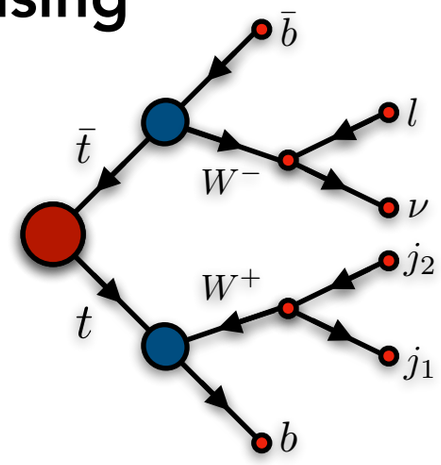
Search for CP violation in $t\bar{t}$+ jets production and decay at $\sqrt{s}$ = 13 TeV

National Taiwan University

Pu-Sheng Chen, Chen-Yu Chuang, Kai-Feng Chen

Motivation

- CP violation initially observed in kaon decays by James Cronin and Val Fitch
- CPV in the SM is not enough to explain the matter-dominant universe
- Search for CP asymmetries in top pair production and decay using lepton+jets final state
  - SM predicts very small asymmetries in $t\bar{t}$ production and decay
  - Develop a generic method to find CPV in $t\bar{t}$ decay



Introduction

T-odd observables

$$O_3 = Q_\ell \epsilon(p_{\mathrm{b}}, p_{\bar{\mathrm{b}}}, p_\ell, p_{j_1}) \xrightarrow{\mathrm{b\bar{b}\ CM}} \propto Q_\ell \vec{p}_{\mathrm{b}} \cdot (\vec{p}_\ell \times \vec{p}_{j_1})$$

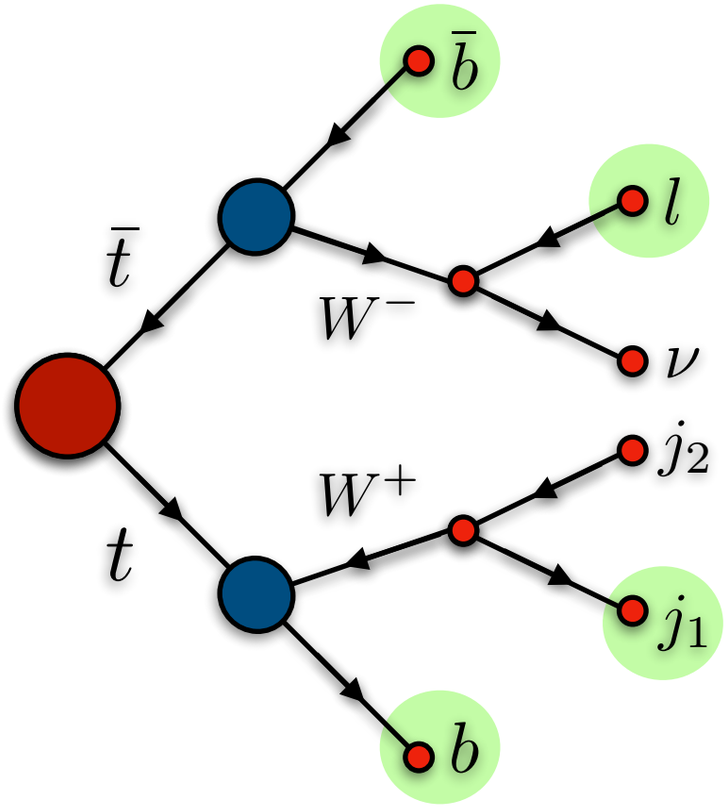
$$O_6 = Q_\ell \epsilon(P, p_{\mathrm{b}} - p_{\bar{\mathrm{b}}}, p_\ell, p_{j_1}) \xrightarrow{\mathrm{lab}} \propto Q_\ell (\vec{p}_{\mathrm{b}} - \vec{p}_{\bar{\mathrm{b}}}) \cdot (\vec{p}_\ell \times \vec{p}_{j_1})$$

$$O_{12} = q \cdot (p_{\mathrm{b}} - p_{\bar{\mathrm{b}}}) \epsilon(P, q, p_{\mathrm{b}}, p_{\bar{\mathrm{b}}}) \xrightarrow{\mathrm{lab}} \propto (\vec{p}_{\mathrm{b}} - \vec{p}_{\bar{\mathrm{b}}})_z (\vec{p}_{\mathrm{b}} \times \vec{p}_{\bar{\mathrm{b}}})_z$$

$$O_{14} = \epsilon(P, p_{\mathrm{b}} + p_{\bar{\mathrm{b}}}, p_\ell, p_{j_1}) \xrightarrow{\mathrm{lab}} \propto (\vec{p}_{\mathrm{b}} + \vec{p}_{\bar{\mathrm{b}}}) \cdot (\vec{p}_\ell \times \vec{p}_{j_1}).$$

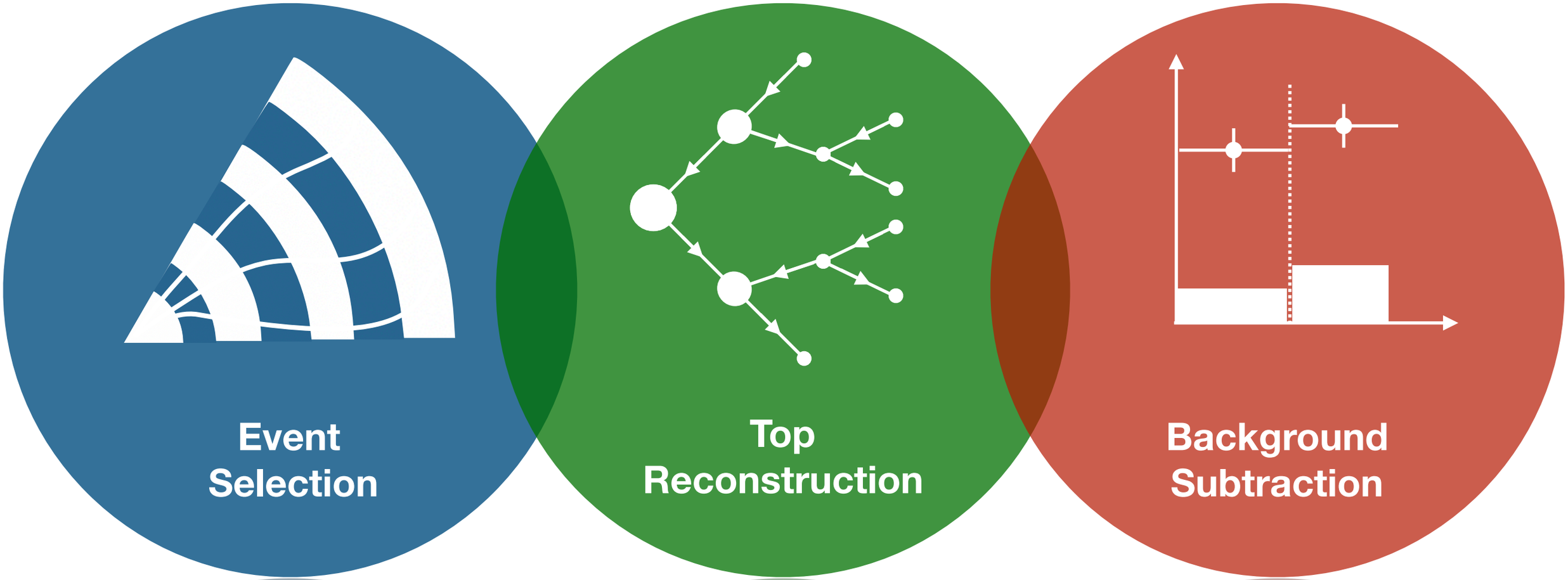
Counting-event method

$$A_{CP}(O_i) = \frac{N_{\mathrm{events}}(O_i > 0) - N_{\mathrm{events}}(O_i < 0)}{N_{events}(O_i > 0) + N_{events}(O_i < 0)}, i = 3, 6, 12, 14.$$



- **Measure CPV through T-odd triple product observables**
  - CPV can be observed by the kinematics of final states objects
- **Results are presented by the value of A'_{CP}**
  - Asymmetry is measured by counting-event method
  - SM predicts zero value

Analysis flow



Event Selection

Use Run-2 dataset

Exactly one lepton and at least four jets (2 b-tagged)

Top Reconstruction

Chi square minimum study

Optimization cut

Background Subtraction

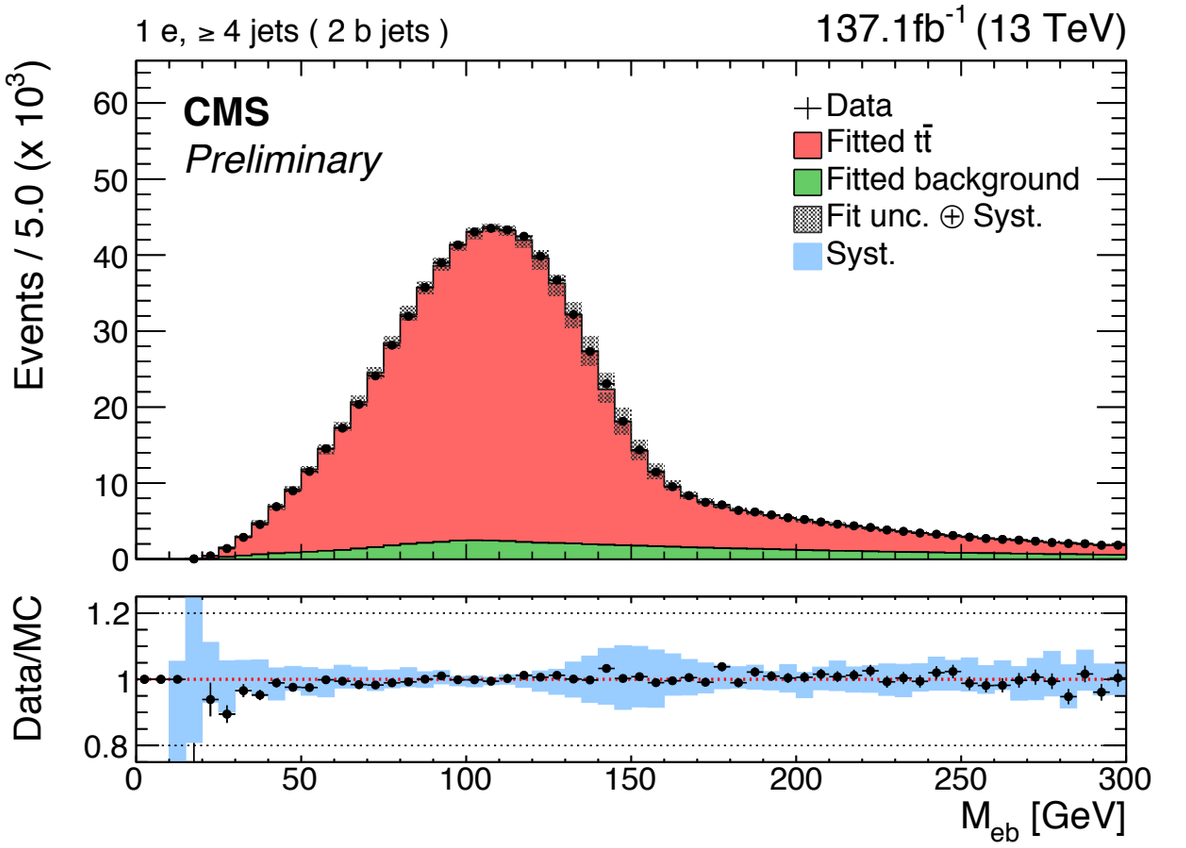
Template fit method

Pseudo-data experiment

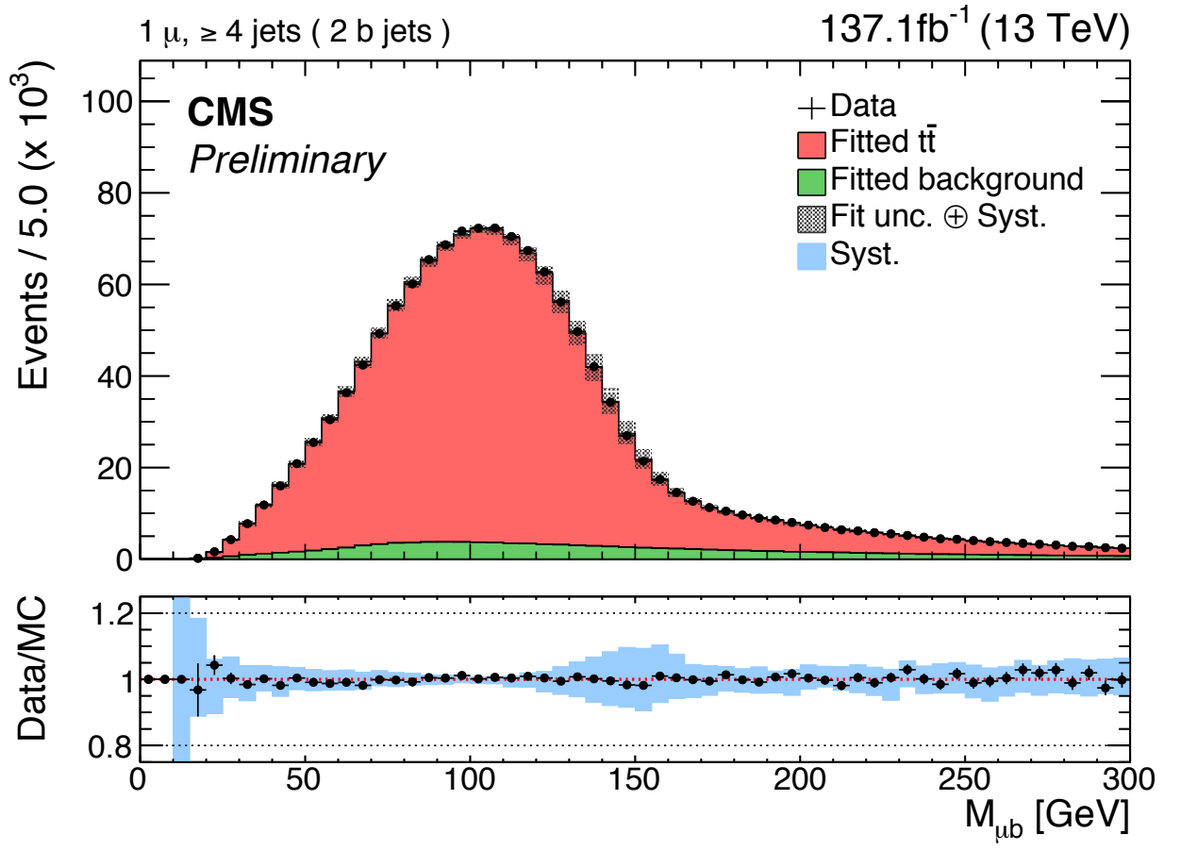
Detector bias

Fitting results

Electron channel



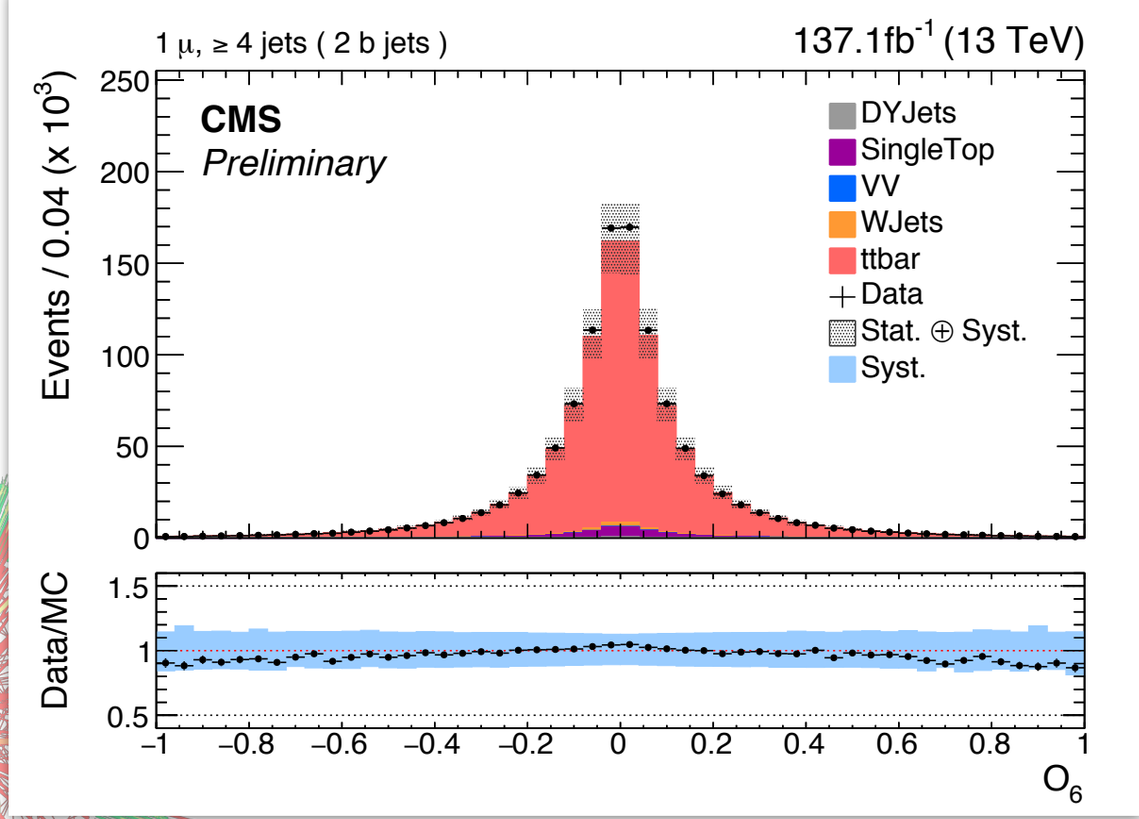
Muon channel



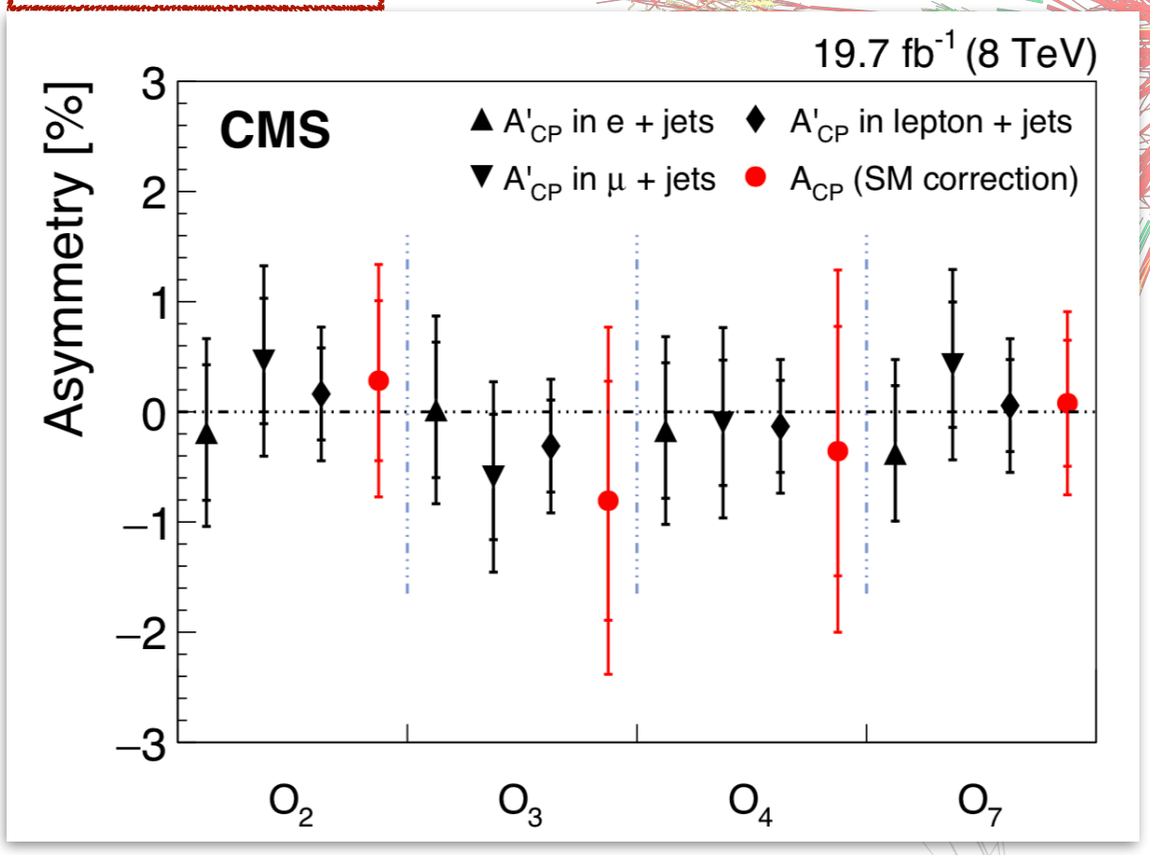
- **Template fit results with systematic and statistic uncertainties**
  - — Data and the fitted distribution show reasonable agreement
  - — Purity of estimated $t\bar{t}$ events is around **93.5%** after applying upper bound on M_{lb}

Conclusion

- The previous published 8TeV studies has been fully deployed
- High purity (93.5%) in signal region



TOP-16-001



- Dominant systematics have been improved by a factor of **2.5-3**

國立臺灣大學
National Taiwan University

Thank you for your attention