Tau ID for W$\to \tau\nu$ background estimation

D.Colling, P. Dunne, A. Magnan, A. Nikitenko, J. Pela

$W \to \tau$ Background Estimation

$W \to \tau$ Method:

- Select subsample of signal region (without CJV to increase stat.) with 1 $\tau_{hadronic}$ candidate with $p_T > 20 GeV$, $|\eta| < 2.3$:
  - Main tau discriminant "byTightCombinedIsolationDeltaBetaCorr3Hits"
  - Cross-check with "byMediumIsolationMVA2"
  - There is also a choice of loose or tight antilepton discriminators
- Subtract events from other backgrounds
- Correct with tau ID efficiency from MC
- Correct with CJV efficiency from MC

Equations

$$N_{Data}^{W\rightarrow\tau\nu} = (N_{Data}^{\tau subsample} - N_{MC}^{Background})X\frac{\epsilon_{CJV}}{\epsilon_{\tau_{ID}}},$$

Background = Top,Z+Jets and VV

Efficiency definitions

$$\epsilon_{\tau_{ID}} = \frac{N_{W\rightarrow\tau\nu}^{tausubregion}}{N_{W\rightarrow\tau\nu}^{SignalregionwithoutCJV}}$$

$$\epsilon_{CJV} = \frac{N_{W\rightarrow\tau\nu}^{SignalregionwithCJV}}{N_{W\rightarrow\tau\nu}^{SignalregionwithoutCJV}}$$

Yield Tables

Discriminant	$W \rightarrow e\nu$	$W \rightarrow \mu\nu$	$W \rightarrow \tau\nu$	Bkg	Data
3Hits & againsteμloose	2 ± 1	0 ± 0	26 ± 4	16.4 ± 3.2	47 ± 7
3Hits & againsteμtight	0.4 ± 0.4	0 ± 0	20 ± 4	12.4 ± 2.2	32 ± 6
MVA2 & againsteμloose	6 ± 2	0.7 ± 0.5	40 ± 5	22.5 ± 3.6	75 ± 9
MVA2 & againsteμtight	6 ± 2	0.7 ± 0.5	40 ± 5	20.5 ± 3.6	70 ± 8

Efficiencies

Discriminant	$\epsilon_{\tau_{ID}}$
3Hits & againsteμloose discriminant	0.14 ± 0.03
3Hits & againsteμtight discriminant	0.11 ± 0.02
MVA2 & againsteμloose discriminant	0.22 ± 0.03
MVA2 & againsteμtight discriminant	0.22 ± 0.03

- ϵ_{CJV} is independent of discriminant choice and is 0.43 ± 0.03.

Remaining $W \to e\nu$ events

- With loose(tight) antilepton discrimant $W \to e\nu$ from MC is:
  - 8(2)% of expected $W \to \tau\nu$ events for 3hit discriminant
  - 15(15)% for the MVA2 discriminant
  - this is 12(3)% of the expected background for 3hit and 27(30)% for MVA2 .
- Two approaches will be compared:
  1) subtract MC prediction of $W \to e\nu$ from N^{C}_{Data} and update stat. error accordingly
  2) add number of $W \to e\nu$ from MC as an additional systematic

Option 1

- Subtracting MC estimation of $W \to e\nu$ contamination gives a final $W \to \tau\nu$ estimate of:

- 3Hits againsteμloose: $86 \pm 29 \pm 19$
- 3Hits againsteμtight: $75 \pm 30 \pm 18$
- MVA2 againsteμloose: $91 \pm 25 \pm 17$
- MVA2 againsteμtight: $85 \pm 23 \pm 15$

Option 2

- Adding MC prediction of $W \to e\nu$ contribution as a systematic gives a final $W \to \tau\nu$ estimate of:

- 3Hits againsteμloose: $92 \pm 29 \pm 20$
- 3Hits againsteμtight: $76 \pm 31 \pm 18$
- MVA2 againsteμloose: $102 \pm 26 \pm 20$
- MVA2 againsteμtight: $97 \pm 24 \pm 19$

Summary

- Behaviour agrees with what is seen in tau tau
- Best purity comes from tight antilepton discrimination
- For the main discriminant with tight antilepton discrimination the $W \to e\nu$ contamination is small 2% so systematic approach apropriate.
- For the cross-check discriminant $W \to e\nu$ contamination is large so subtraction may be the better option.
- Should we be doing anything else to reduce $W \to e\nu$ contribution?