



Estimation of the QCD background yield in the $1\tau 0L$ category

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	$t\bar{t}\bar{t}\bar{t}$	$t\bar{t}$	QCD	$t\bar{t}+X$
1τ 0L SR	10	6371	7461	192
1τ 0L CR	0	294	8087	8



- Inspired by [EXO-19-015](#)
- The **large QCD simulated yield** that we get **in CR** should come from **fake taus**
- Estimate the background completely from data by doing

$$N_{\text{fake-}\tau} = \sum_{p_T, \eta} N_{\text{fake-}\tau}(p_T, \eta) = \sum_{p_T, \eta} \left[N_{F, \bar{T}}(p_T, \eta) \times \frac{\text{FR}(p_T, \eta)}{1 - \text{FR}(p_T, \eta)} \right]$$

- Parametrize as a function of p_T, η of fakeable tau
- Binning in (p_T, η) inspired by EXO-19-015: $p_T \in [20, 30, 75, 150, 300, \text{Inf}]$;
 $\eta \in [0, 1.5, 2.3]$



- Compute FR in CR, **apply the method in** the same **CR**
- **Compare with number** of events in CR **you count from MC**
- This should close (at least approximately)

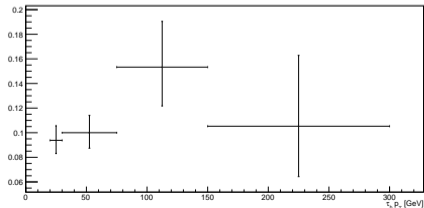
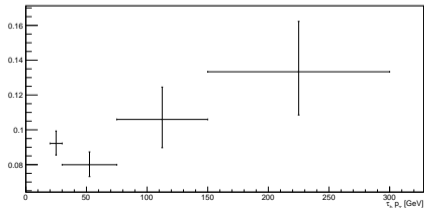
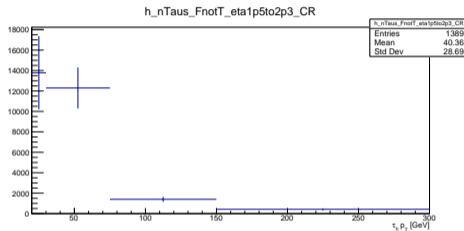
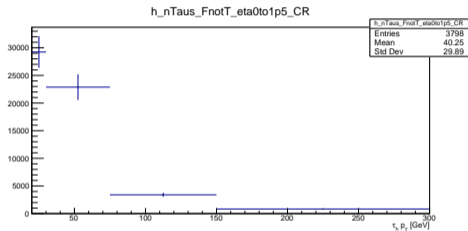
	Value	Raw entries
Counting	7979 ± 1350	547
Fake rate method	8636 ± 2321	–

- Values are in **agreement** within the uncertainties, **closure is not perfect**
 - Most likely due to approximations in weighting and summing $T_{\text{efficiency}}$ objects

Closure test on MC QCD: plots



- Upper row: number of fakeable-not-tight taus, lower row: fake rates





- Compute FR in CR, **apply the method in the application region** (same as signal region, but use fakeable-not-tight taus)
- **Compare with number of events in SR you count from MC**

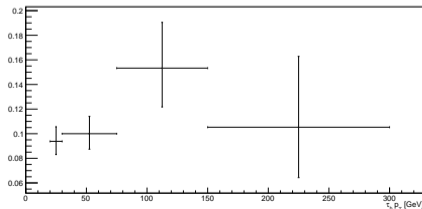
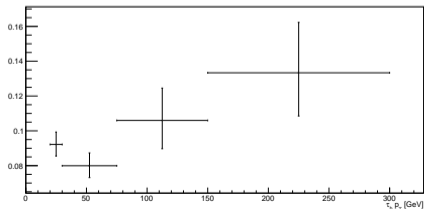
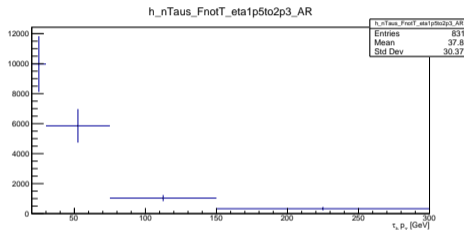
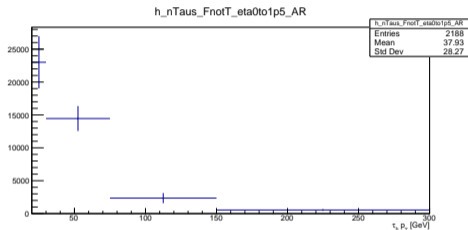
	Value	Raw entries
Counting	7461 ± 1681	315
Fake rate method	5887 ± 1782	–

- Values are in **agreement within the uncertainties**

Fake rate method in MC QCD: plots



- Upper row: number of fakeable-not-tight taus, lower row: fake rates



QCD yield estimation

F. Lemmi



- Compute FR in CR, **apply the method in** the same **CR**
- **Compare with number** of events in CR **you count from data**
- This should close (at least approximately)

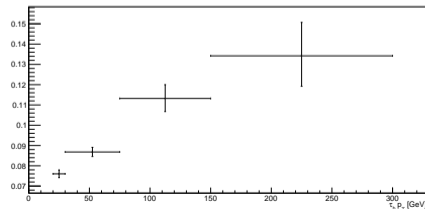
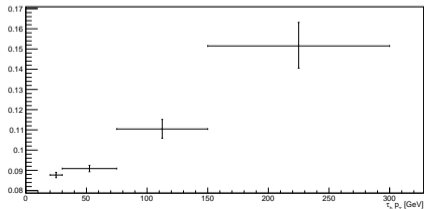
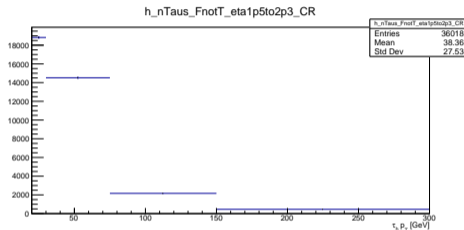
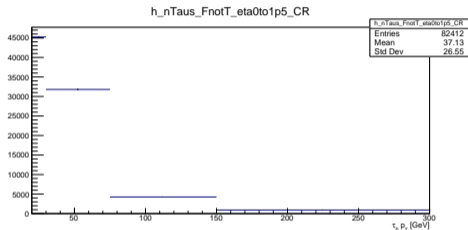
	Value	Raw entries
Counting	11561 ± 108	11561
Fake rate method	11561 ± 384	–

- Values are in **agreement** within the uncertainties, **perfect closure**
 - No weighting of any kind of objects is needed for data

Closure test in DATA: plots



- Upper row: number of fakeable-not-tight taus, lower row: fake rates





- Compute FR in CR, **apply the method in the application region** (same as signal region, but use fakeable-not-tight taus)
- **Do not compare with number** of events in SR **you count from data: we are blinded**

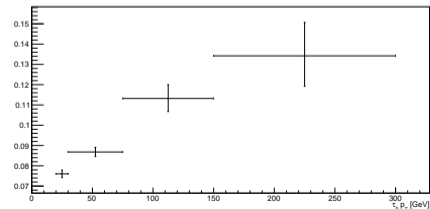
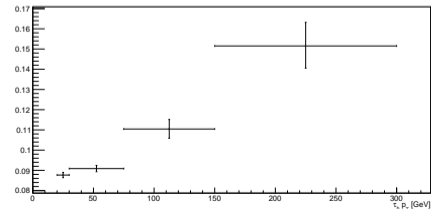
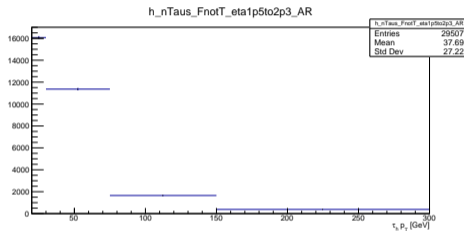
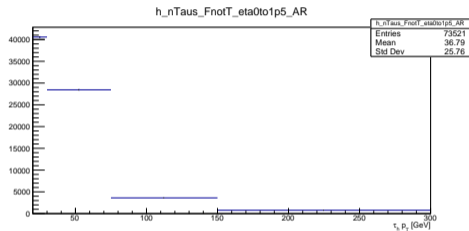
	Value	Raw entries
Counting	–	–
Fake rate method	10042 ± 331	–

- **WRONG!:** need to subtract $t\bar{t}$ and single top from $N_{F,\bar{T}}(p_T, \eta)$

Fake rate method in DATA: plots



- Upper row: number of fakeable-not-tight taus, lower row: fake rates



Some tests: computing fake rates with SF



QCD yield
estimation

F. Lemmi

- Previous results on MC QCD were obtained without the application of scale factors
- Repeat the study with SF applied
 - Prefiring weight
 - Pileup SF
 - Trigger SF
 - b tagging SF



- Compute FR in CR, **apply the method in** the same **CR**
- **Compare with number** of events in CR **you count from MC**
- This should close (at least approximately)

	Value	Raw entries
Counting	5979 ± 1002	547
Fake rate method	6366 ± 1648	–

- Values are in **agreement** within the uncertainties, **closure is not perfect**
 - Closure is slightly better when SFs are applied (discrepancy goes from 8.2% to 6.4%)



- Compute FR in CR, **apply the method in the application region** (same as signal region, but use fakeable-not-tight taus)
- **Compare with number of events in SR you count from MC**

	Value	Raw entries
Counting	6563 ± 1596	315
Fake rate method	5053 ± 1690	–

- Values are in **agreement within the uncertainties**
 - Discrepancy is slightly higher when SFs are applied (it goes from 21% to 23%)