

QCD CR in 1τ 0L F. lemmi

QCD control region in the $1\tau\, 0L$ category

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General idea



QCD CR in 1τ 0L

• QCD simulations are not reliable, especially at high jet multiplicity

- Large uncertainties on the theoretical cross sections
- $\, \circ \,$ You usually have low selection efficiency $\, \Longrightarrow \,$ few events to use in the analysis
- Find a QCD-enriched region (control region, CR) in data
- Important properties for a good CR:
 - It should be verified that it's indeed QCD-enriched
 - It should be depleted from signal and other backgrounds
 - It should be as kinematically close as possible to the signal region (SR)
 - It should be orthogonal to the SR

General idea

- QCD is only dominant in 1τ 0L category
 - pprox 50% of the background yield in 1 au 0L
- All the remaning major backgrounds (tt and tt+X) and signal involve top quarks, i.e., bottom quarks in the final state
- First try: revert the request on the number of b tagged jets in the event

	$ N_{\tau_h}$	N_ℓ	N_{jets}	N_{bjets}
1 au 0L	1	0	\geq 8	≥ 2
1 au 0L ctl	1	0	\geq 8	0

- $\bullet~N_{bjets}=0$ is meant to reject all the top-related processes
- Since setup is ready, check this for each VSjet DeepTau WP
 - Maybe a looser WP can help?





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Yields



Signal region

	VVT	VT	Т	М	L	VL	VVL	VVVL
tttt	4	6	7	10	13	20	27	23
tt	2146	3074	4384	6371	9861	17860	29339	25721
QCD	368	2378	4842	7461	15443	32927	61744	57889
tt + X	74	102	140	192	279	460	725	653

Control region

	VVT	VT	Т	М	L	VL	VVL	VVVL
tttt	0	0	0	0	0	0	0	0
tt	96	143	202	294	468	901	1550	1347
QCD	958	2411	4581	8087	15054	46772	89186	81403
tt+X	4	5	6	8	12	25	46	41

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 $\begin{array}{c} \mathsf{QCD} \; \mathsf{CR} \; \mathsf{in} \\ 1\tau \; \mathsf{0L} \end{array}$

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Conclusions

- For Medium WP, the QCD **purity** is $\frac{8087}{294+8087+8} \approx 96\%$
- Purity increases with looser WPs
- Medium WP purity seems satisfying
- More things should be checked, especially if this region is kinematically close to SR
 - Need more inputs for this: BDT to check the shapes in SR and CR

• Want to do sth like this: compare shapes in SR and CR, see if they are close enough



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