t' (4^{th} Generation) Quark, Searches for

NODE=Q009

t'(2/3)-quark/hadron mass limits in $p\overline{p}$ and pp collisions

NODE=Q009TPP
NODE=Q009TPP;CHECK LIMITS

VALUE (GeV)	CL%	DOCUMENT ID		TECN	COMMENT	
>1530	95	[1] AAD	24BP	ATLS	B($t' \to Wq$) = 1 (q=d,s)	
>1700	95	[2] AAD	24N	ATLS	B($t' \to Wb$) = 1	
>1360	95	[3] AAD	24N	ATLS	B($t' \to Wb : Ht : Zt$) = 1/2 : 1/4 : 1/4	OCCUR=2
>1600	95	[4] AAD	23AV	ATLS	B($t' \to Zt$) = 1	
> 960	95	[5] TUMASYAN	23AX	CMS	EW production, $t' \to Ht$ ($H \to \gamma\gamma$)	
>1500	95	[6] TUMASYAN	23V	CMS	B($t' \to ht$) = 1	
> 980	95	[7] AABOUD	18CE	ATLS	$\geq 2\ell + \not{E}_T + \geq 1b$j	
>1030	95	[8,9] AABOUD	18CP	ATLS	2,3ℓ, singlet model	
>1210	95	[8,10] AABOUD	18CP	ATLS	2,3ℓ, doublet model	OCCUR=2
>1310	95	[11,12] AABOUD	18CR	ATLS	singlet t'. ATLAS combination	
>1370	95	[11,13] AABOUD	18CR	ATLS	t' in a weak isospin doublet (t',b'). ATLAS combination.	OCCUR=2
>1140	95	[14] SIRUNYAN	18BM	CMS	Wb, Zt, ht modes	
> 845	95	[15] SIRUNYAN	18Q	CMS	B($t' \to Wq$) = 1 (q=d,s)	
> 860	95	[16] SIRUNYAN	17AU	CMS		
> 735	95	[17] AAD	14AZ	ATLS	B($b' \to Wt$) = 1	
> 350	95	[18] AAD	12BC	ATLS	B($t' \to Wq$)=1 (q=d,s,b)	
> 420	95	[19] AAD	12C	ATLS	$t' \to Xt$ (m_X < 140 GeV)	
> 685	95	[20] CHATRCHYAN	12BH	CMS	$m_{b'} = m_{t'}$	
> 557	95	[21] CHATRCHYAN	12P	CMS	$t'\overline{t}' \to W^+ b W^- \overline{b} \to b\ell^+\nu\overline{b}\ell^-\overline{\nu}$	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
>1470	95	[22] AAD	23AG	ATLS	B($t' \to Zt$) = 1	
>1280	95	[23] SIRUNYAN	19AQ	CMS	B($t' \to Zt$) = 1	
>1370	95	[24] SIRUNYAN	19BW	CMS	B($t' \to ht$) = 1	
>1010	95	[25] AABOUD	18CL	ATLS	B($t' \to ht$) = 1	
>1295	95	[26] SIRUNYAN	18W	CMS	B($t' \to Wb$) = 1	
>1160	95	[27] AABOUD	17L	ATLS	B($t' \to Zt$) = 1	
> 770	95	[28] AAD	15AR	ATLS	B($t' \to Wb$) = 1	
> 590	95	[29] AAD	15BY	ATLS	Wb, Zt, ht modes	
> 745	95	[30] KHACHATRY...	15AI	CMS	B($t' \to ht$) = 1	
> 700	95	[31] CHATRCHYAN	14A	CMS	B($t' \to Wb$) = 1	
> 706	95	[31] CHATRCHYAN	14A	CMS	B($t' \to Zt$) = 1	OCCUR=2
> 782	95	[31] CHATRCHYAN	14A	CMS	B($t' \to ht$) = 1	OCCUR=3
> 656	95	[32] AAD	13F	ATLS	B($t' \to Wb$) = 1	
> 625	95	[33] CHATRCHYAN	13I	CMS	B($t' \to Zt$) = 1	
> 404	95	[34] AAD	12AR	ATLS	B($t' \to Wb$) = 1	
> 570	95	[35] CHATRCHYAN	12BC	CMS	$t'\overline{t}' \to W^+ b W^- \overline{b}$	
> 400	95	[36] AALTONEN	11AH	CDF	$t' \to Xt$ (m_X < 70 GeV)	
> 358	95	[37] AALTONEN	11AL	CDF	$t' \to Wb$	
> 340	95	[37] AALTONEN	11AL	CDF	$t' \to Wq$ (q=d,s,b)	OCCUR=2
> 360	95	[38] AALTONEN	11O	CDF	$t' \to Xt$ (m_X < 100 GeV)	
> 285	95	[39] ABAZOV	11Q	D0	$t' \to Wq$ (q=d,s,b)	
> 256	95	[40,41] AALTONEN	08H	CDF	$t' \to Wq$	

[1] AAD 24BP based on 140 fb^{-1} of pp data at $\sqrt{s}$ = 13 TeV. Limit on pair-production of heavy vectorlike quarks where each decays into a W boson and a light quark. Used events with $\ell + \not{E}_T$ + multiple jets + 1 boosted-W-jet.

NODE=Q009TPP;LINKAGE=DA

[2] AAD 24N based on 140 fb^{-1} of pp data at $\sqrt{s}$ = 13 TeV. Pair production of vector-like t' is searched for in the lepton+jets mode. The limit is for t' in a weak isospin doublet. The data are consistent with the SM background predictions and limits are obtained for different branching ratios. The same limits also apply to t' of charge $-4/3$.

NODE=Q009TPP;LINKAGE=Z

[3] AAD 24N based on 140 fb^{-1} of pp data at $\sqrt{s}$ = 13 TeV. Pair production of vector-like t' is searched for in the lepton+jets mode. The limit is for a singlet model. The data are consistent with the SM background predictions and limits are obtained for different branching ratios.

NODE=Q009TPP;LINKAGE=BA

[4] AAD 23AV based on 139 fb^{-1} of pp data at $\sqrt{s}$ = 13 TeV. Pair production of vector-like t' is searched for in the mode $\ell^\pm\ell^\mp + \geq 2$j ($\geq$ 1b-tagged) + $\not{E}_T$ or with 3ℓ. The data

NODE=Q009TPP;LINKAGE=X

are consistent with the SM background predictions and limits are obtained for different branching ratios.

[5] TUMASYAN 23AX based on 138 fb^{-1} of pp data at $\sqrt{s}=13$ TeV. A vector-like t' is seached for in the $t+\ H$ ($H \to \gamma\gamma$) decay channel. EW production via a coupling to third-generation quarks of $\kappa_T=0.25$ is assumed. The branching fractions are assumed to be 50, 25, and 25%, respectively, for bW, tZ, and tH decays. NODE=Q009TPP;LINKAGE=Y

[6] TUMASYAN 23V based on 138 fb^{-1} of pp data at $\sqrt{s}=13$ TeV. Pair production of vector-like t' is seached for in the single-lepton, same-sign charge dilepton and multi-lepton channels. The data are consistent with the SM background predictions and limits are obtained for different branching ratios. Masses below 1.48 TeV are excluded for all decays to third generation quarks. NODE=Q009TPP;LINKAGE=V

[7] AABOUD 18CE based on 36.1 fb^{-1} of proton-proton data taken at $\sqrt{s}=13$ TeV. Events including a same-sign lepton pair are used. The limit is for a singlet model, assuming the branching ratios of t' into Zt, Wb and Ht as predicted by the model. NODE=Q009TPP;LINKAGE=S

[8] AABOUD 18CP based on 36.1 fb^{-1} of pp data at $\sqrt{s}=13$ TeV. Pair and single production of vector-like t' are seached for with at least one t' decaying into Zt. In the case of B($t' \to\ Zt$) = 1, the limit is $m_{t'}\ >$ 1340 GeV. NODE=Q009TPP;LINKAGE=M

[9] The limit is for the singlet model, assuming that the branching ratios into Zt, Wb, and Ht add up to one. NODE=Q009TPP;LINKAGE=O

[10] The limit is for the doublet model, assuming that the branching ratios into Zt, Wb, and Ht add up to one. NODE=Q009TPP;LINKAGE=N

[11] AABOUD 18CR based on 36.1 fb^{-1} of pp data at $\sqrt{s}=13$ TeV. A combination of searches for the pair-produced vector-like t' in various decay channels ($t' \to\ Wb$, Zt, ht). Also a model-independent limit is obtained as $m_{t'}\ >$ 1.31 TeV, assuming that the branching ratios into Zt, Wb and ht add up to one. NODE=Q009TPP;LINKAGE=P

[12] The limit is for the singlet t'. NODE=Q009TPP;LINKAGE=R

[13] The limit is for t' in a weak isospin doublet (t',b') and $|V_{t'b}| \ll |V_{tb'}|$. NODE=Q009TPP;LINKAGE=Q

[14] SIRUNYAN 18BM based on 35.9 fb^{-1} of pp data at $\sqrt{s}=13$ TeV. The limit is for the pair-produced vector-like t'. Three channels (single lepton, same-charge 2 leptons, or at least 3 leptons) are considered for various branching fraction combinations. Assuming B(tH) = 1, the limit is 1270 GeV and for B(tZ) = 1 it is 1300 GeV. NODE=Q009TPP;LINKAGE=I

[15] SIRUNYAN 18Q based on 19.7 fb^{-1} of pp data at $\sqrt{s}=8$ TeV. The limit is for the pair-produced vector-like t' that couple only to light quarks. Constraints for other decay channels (Zq and Hq) are also given in the paper. NODE=Q009TPP;LINKAGE=J

[16] SIRUNYAN 17AU based on 2.3-2.6 fb^{-1} of pp data at $\sqrt{s}=13$ TeV. Limit on pair-produced singlet vector-like t' using one lepton and several jets. The mass bound is given for a t' transforming as a singlet under the electroweak symmetry group, assumed to decay through W, Z or Higgs boson (which decays to jets) and to a third generation quark. For a doublet, the limit is >830 GeV. Other limits are also given in the paper. NODE=Q009TPP;LINKAGE=G

[17] Based on 20.3 fb^{-1} of pp data at $\sqrt{s}=8$ TeV. No significant excess over SM expectation is found in the search for pair production or single production of t' in the events with dilepton from a high p_T Z and additional jets ($\geq$ 1 b-tag). If instead of B($b' \to\ Wt$) = 1 an electroweak singlet with B($b' \to\ Wt$) $\sim$ 0.45 is assumed, the limit reduces to 685 GeV. NODE=Q009TPP;LINKAGE=B

[18] Based on 1.04 fb^{-1} of pp data at $\sqrt{s}=7$ TeV. No signal is found for the search of heavy quark pair production that decay into W and a quark in the events with dileptons, large $\not{E}_T$, and ≥ 2 jets. NODE=Q009TPP;LINKAGE=GA

[19] Based on 1.04 fb^{-1} of data in pp collisions at 7 TeV. AAD 12C looked for $t'\overline{t}'$ production followed by t' decaying into a top quark and X, an invisible particle, in a final state with an isolated high-P$_T$ lepton, four or more jets, and a large missing transverse energy. No excess over the SM $t\overline{t}$ production gives the upper limit on $t'\overline{t}'$ production cross section as a function of $m_{t'}$ and m_X. The result is obtained for B($t' \to\ Wt$) = 1. NODE=Q009TPP;LINKAGE=AD

[20] Based on 5 fb^{-1} of pp data at $\sqrt{s}=7$ TeV. CHATRCHYAN 12BH searched for QCD and EW production of single and pair of degenerate 4'th generation quarks that decay to Wb or Wt. Absence of signal in events with one lepton, same-sign dileptons or tri-leptons gives the bound. With a mass difference of 25 GeV/c^2 between $m_{t'}$ and $m_{b'}$, the corresponding limit shifts by about $\pm$20 GeV/c^2. NODE=Q009TPP;LINKAGE=CT

[21] Based on 5.0 fb^{-1} of pp data at $\sqrt{s}=7$ TeV. CHATRCHYAN 12P looked for $t'\overline{t}'$ production events with two isolated high p_T leptons, large $\not{E}_T$, and 2 high p_T jets with b-tag. The absence of signal above the SM background gives the limit for B($t' \to\ Wb$) = 1. NODE=Q009TPP;LINKAGE=CH

[22] AAD 23AG based on 139 fb^{-1} of pp data at $\sqrt{s}=13$ TeV. Pair production of vector-like top or bs is searched for in the mode $1\ell +\ \geq 4$j($\geq$ 1b-tagged) + $\not{E}_T$. The data are consistent with the SM background predictions and limits are obtained for different branching ratios. Masses below 1.59 TeV are excluded assuming a mass-degenerate vector-like doublet (t',b') model. NODE=Q009TPP;LINKAGE=W

[23] SIRUNYAN 19AQ based on 35.9 fb^{-1} of pp data at $\sqrt{s}=13$ TeV. Pair production of vector-like t' is seached for with one t' decaying into Zt and the other t' decaying into Wb, Zt, ht. Events with an opposite-sign lepton pair consistent with coming from Z and jets are used. Mass limits are obtained for a variety of branching ratios of t'. NODE=Q009TPP;LINKAGE=T

[24] SIRUNYAN 19BW based on 35.9 fb^{-1} of pp data at $\sqrt{s}$ = 13 TeV. The limit is for the pair-produced vector-like t' using all-hadronic final state. The analysis is made for the Wb, Zt, ht modes and mass limits are obtained for a variety of branching ratios. NODE=Q009TPP;LINKAGE=U

[25] AABOUD 18CL based on 36.1 fb^{-1} of pp data at $\sqrt{s}$ = 13 TeV. The limit is for the pair-produced vector-like t' using all-hadronic final state. The analysis is also made for the Wb, Zt, ht modes and mass limits are obtained for a variety of branching ratios. NODE=Q009TPP;LINKAGE=L

[26] SIRUNYAN 18W based on 35.8 fb^{-1} of pp data at $\sqrt{s}$ = 13 TeV. The limit is for the vector-like t' pair-produced by strong interaction using lepton-plus-jets mode and assuming that B($t' \rightarrow Wb$) is 100%. Generally the measurement sets upper limits on the product of the production cross section and branching faction to Wb for any new pair-produced heavy quark decaying to this channel as a narrow resonance. NODE=Q009TPP;LINKAGE=H

[27] AABOUD 17L based on 36.1 fb^{-1} of pp data at $\sqrt{s}$ = 13 TeV. No signal is found in the search for heavy quark pair production that decay into Zt followed by $Z \rightarrow \nu\nu$ in the events with one lepton, large $\not{E}_T$, and $\geq$ 4 jets. The lower mass limit 0.87 (1.05) TeV is obtained for the singlet (doublet) model with other possible decay modes. NODE=Q009TPP;LINKAGE=F

[28] AAD 15AR based on 20.3 fb^{-1} of pp data at $\sqrt{s}$ = 8 TeV. Used lepton-plus-jets final state. See Fig. 20 for mass limits in the plane of B($t' \rightarrow Ht$) vs. B($t' \rightarrow Wb$) from a combination of $t'\overline{t}' \rightarrow Wb + X$ and $t'\overline{t}' \rightarrow Ht + X$ searches. Any branching ratio scenario is excluded for mass below 715 GeV. NODE=Q009TPP;LINKAGE=C

[29] AAD 15BY based on 20.3 fb^{-1} of pp data at $\sqrt{s}$ = 8 TeV. Limit on pair-produced vector-like t' assuming the branching fractions to W, Z, and h modes of the singlet model. Used events containing $\geq 2\ell + \not{E}_T + \geq$ 2j ($\geq$ 1 b) and including a same-sign lepton pair. NODE=Q009TPP;LINKAGE=D

[30] KHACHATRYAN 15AI based on 19.7 fb^{-1} of pp data at $\sqrt{s}$ = 8 TeV. The search exploits all-hadronic final states by tagging boosted Higgs boson using jet substructure and b-tagging. NODE=Q009TPP;LINKAGE=E

[31] Based on 19.5 fb^{-1} of pp data at $\sqrt{s}$ = 8TeV. The t' quark is pair produced and is assumed to decay into three different final states of bW, tZ, and th. The search is carried out using events with at least one isolated lepton. NODE=Q009TPP;LINKAGE=HA

[32] Based on 4.7 fb^{-1} of pp data at $\sqrt{s}$ = 7 TeV. No signal is found for the search of heavy quark pair production that decay into W and a b quark in the events with a high p_T isolated lepton, large $\not{E}_T$ and at least 3 jets ($\geq$ 1 b-tag). Vector-like quark of charge 2/3 with 400 < $m_{t'}$ < 550 GeV and B($t' \rightarrow Wb$) > 0.63 is excluded at 95% CL. NODE=Q009TPP;LINKAGE=AG

[33] Based on 5.0 fb^{-1} of pp data at $\sqrt{s}$ = 7 TeV. CHATRCHYAN 13I looked for events with one isolated electron or muon, large $\not{E}_T$, and at least four jets with large transverse momenta, where one jet is likely to originate from the decay of a bottom quark. NODE=Q009TPP;LINKAGE=A

[34] Based on 1.04 fb^{-1} of pp data at $\sqrt{s}$ = 7 TeV. No signal is found in the search for pair produced heavy quarks that decay into W boson and a b quark in the events with a high p_T isolated lepton, large $\not{E}_T$ and at least 3 jets ($\geq$ 1 b-tag). NODE=Q009TPP;LINKAGE=GD

[35] Based on 5.0 fb^{-1} of pp data at $\sqrt{s}$ = 7 TeV. CHATRCHYAN 12BC looked for $t'\overline{t}'$ production events with a single isolated high p_T lepton, large $\not{E}_T$ and at least 4 high p_T jets with a b-tag. The absence of signal above the SM background gives the limit for B($t' \rightarrow Wb$) = 1. NODE=Q009TPP;LINKAGE=CA

[36] Based on 5.7 fb^{-1} of data in $p\overline{p}$ collisions at 1.96 TeV. AALTONEN 11AH looked for $t'\overline{t}'$ production followed by t' decaying into a top quark and X, an invisible particle, in the all hadronic decay mode of $t\overline{t}$. No excess over the SM $t\overline{t}$ production gives the upper limit on $t'\overline{t}'$ production cross section as a function of $m_{t'}$ and m_X. The result is obtained for B($t' \rightarrow Xt$) = 1. NODE=Q009TPP;LINKAGE=TN

[37] Based on 5.6 fb^{-1} of data in ppbar collisions at 1.96 TeV. AALTONEN 11AL looked for $\ell + \geq$ 4j events and set upper limits on $\sigma(t'\overline{t}')$ as functions of $m_{t'}$. NODE=Q009TPP;LINKAGE=ON

[38] Based on 4.8 fb^{-1} of data in $p\overline{p}$ collisions at 1.96 TeV. AALTONEN 11O looked for $t'\overline{t}'$ production signal when t' decays into a top quark and X, an invisible particle, in $\ell + \not{E}_T$ + jets channel. No excess over the SM $t\overline{t}$ production gives the upper limit on $t'\overline{t}'$ production cross section as a function of $m_{t'}$ and m_X. The result is obtained for B($t' \rightarrow Xt$) = 1. NODE=Q009TPP;LINKAGE=LT

[39] Based on 5.3 fb^{-1} of data in $p\overline{p}$ collisions at 1.96 TeV. ABAZOV 11Q looked for $\ell + \not{E}_T + \geq$ 4j events and set upper limits on $\sigma(t'\overline{t}')$ as functions of $m_{t'}$. NODE=Q009TPP;LINKAGE=AB

[40] Searches for pair production of a new heavy top-like quark t' decaying to a W boson and another quark by fitting the observed spectrum of total transverse energy and reconstructed t' mass in the lepton + jets events. NODE=Q009TPP;LINKAGE=AA

[41] HUANG 08 reexamined the t' mass lower bound of 256 GeV obtained in AALTONEN 08H that assumes B($b' \rightarrow qZ$) = 1 for $q = u$, c which does not hold when $m_{b'} < m_{t'} - m_W$ or the mixing $\sin^2(\theta_{bt'})$ is so tiny that the decay occurs outside of the vertex detector. Fig. 1 gives that lower bound on $m_{t'}$ in the plane of $\sin^2(\theta_{bt'})$ and $m_{b'}$. NODE=Q009TPP;LINKAGE=HU

$t'(5/3)$-quark/hadron mass limits in $p\overline{p}$ and pp collisions

NODE=Q009TP5
NODE=Q009TP5

VALUE (GeV)	CL%	DOCUMENT ID		TECN	COMMENT	
>1460	95	[1] AAD	23AG	ATLS	$t'(5/3) \to tW^+$	
>1330	95	[2] SIRUNYAN	19T	CMS	$t'_R(5/3) \to tW^+$	
>1300	95	[2] SIRUNYAN	19T	CMS	$t'_L(5/3) \to tW^+$	OCCUR=2
>1190	95	[3] AABOUD	18CE	ATLS	$\geq 2\ell + \not{E}_T + \geq 1b$j	
>1020	95	[4] SIRUNYAN	17J	CMS	$t'_R(5/3) \to tW^+$	
> 990	95	[4] SIRUNYAN	17J	CMS	$t'_L(5/3) \to tW^+$	OCCUR=2
> 750	95	[5] AAD	15BY	ATLS	$t'(5/3) \to tW^+$	
> 840	95	[6] AAD	15Z	ATLS	$t'(5/3) \to tW^+$	
> 800	95	[7] CHATRCHYAN	14T	CMS	$t'(5/3) \to tW^+$	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
>1350	95	[8] AABOUD	18AW	ATLS	$t'(5/3) \to tW^+$	

[1] AAD 23AG based on 139 fb^{-1} of pp data at $\sqrt{s}=13$ TeV. Pair production of vector-like top or b' is seached for in the mode $1\ell + \geq 4$j($\geq$ 1b-tagged) + $\not{E}_T$. The data are consistent with the SM background predictions and limits are obtained for different branching ratios. NODE=Q009TP5;LINKAGE=J

[2] SIRUNYAN 19T based on 35.9 fb^{-1} of pp data at $\sqrt{s}=13$ TeV. Signals are searched in the final states of t' pair production, with same-sign leptons (which come from a t' decay) or a single lepton (which comes from a W out of 4Ws), along with jets, and no excess over the SM expectation is found. NODE=Q009TP5;LINKAGE=G

[3] AABOUD 18CE based on 36.1 fb^{-1} of proton-proton data taken at $\sqrt{s}=13$ TeV. Events including a same-sign lepton pair are used. The limit is for the pair-produced vector-like t'. With single t' production included, assuming $t'tW$ coupling of one, the limit is $m_{t'} > 1.6$ TeV. NODE=Q009TP5;LINKAGE=F

[4] SIRUNYAN 17J based on 2.3 fb^{-1} of pp data at $\sqrt{s}=13$ TeV. Signals are searched in the final states of t' pair production, with same-sign leptons (which come from a t' decay) or a single lepton (which comes from a W out of 4Ws), along with jets, and no excess over the SM expectation is found. NODE=Q009TP5;LINKAGE=D

[5] AAD 15BY based on 20.3 fb^{-1} of pp data at $\sqrt{s}=8$ TeV. Limit on $t'(5/3)$ in pair and single production assuming its coupling to Wt is equal to one. Used events containing $\geq 2\ell + \not{E}_T + \geq 2$j ($\geq 1$ b) and including a same-sign lepton pair. NODE=Q009TP5;LINKAGE=B

[6] AAD 15Z based on 20.3 fb^{-1} of pp data at $\sqrt{s}=8$ TeV. Used events with $\ell + \not{E}_T + \geq 6$j ($\geq 1$ b) and at least one pair of jets from weak boson decay, sensitive to the final state $b\overline{b}W^+W^-W^+W^-$. NODE=Q009TP5;LINKAGE=C

[7] CHATRCHYAN 14T based on 19.5 fb^{-1} of pp data at $\sqrt{s}=8$ TeV. Non-observation of anomaly in H_T distribution in the same-sign dilepton events leads to the limit when pair produced $t'(5/3)$ quark decays exclusively into t and W^+, resulting in the final state with $b\overline{b}W^+W^-W^+W^-$. NODE=Q009TP5;LINKAGE=A

[8] AABOUD 18AW based on 36.1 fb^{-1} of pp data at $\sqrt{s}=13$ TeV. Limit on $t'(5/3)$ in pair production assuming its coupling to Wt is equal to one. Lepton-plus-jets final state is used, characterized by $\ell + \not{E}_T$ + jets (≥ 1 b-tagged). NODE=Q009TP5;LINKAGE=E

$t'(2/3)$ mass limits from single production in $p\overline{p}$ and pp collisions

NODE=Q009TPS
NODE=Q009TPS;CHECK LIMITS

VALUE (GeV)	CL%	EVTS	DOCUMENT ID		TECN	COMMENT	
>2100	95		[1] AAD	25I	ATLS	$qg \to q't'b$, $t' \to Ht$ or $t' \to Zt$	
>1800	95		[2] AAD	24AK	ATLS	$qg \to q't'b$, B($t' \to Wb$) = 0.5	
> 950	95		[3] AAD	16AV	ATLS	$qg \to q't'b$, B($t' \to Wb$)=0.5	
> 403	95		[4] ABAZOV	11F	D0	$qd \to q't' \to q'(Wd)$ $\widetilde{\kappa}_{dt'}$=1, B($t' \to Wd$)=1	
> 551	95		[4] ABAZOV	11F	D0	$qu \to qt' \to q(Zu)$ $\widetilde{\kappa}_{ut'}$=$\sqrt{2}$, B($t' \to Zu$)=1	OCCUR=2
• • • We do not use the following data for averages, fits, limits, etc. • • •							
			[5] AAD	25BH	ATLS	$t' \to Wb$	
>1850	95	ATLS	[6] AAD	25S	ATLS	$qg \to q't'b$, $t' \to Wb$	
			[7] AAD	24V	ATLS	$t' \to Zt$	
			[8] HAYRAPETY...	24AR	CMS	$t' \to Zt$, Ht	
			[9] AAD	22G	ATLS	$t' \to Ht$, singlet t'	
			[10] TUMASYAN	22X	CMS	$t' \to Zt$	

[1] AAD 25I based on 139 fb^{-1} of pp data at $\sqrt{s} = 13$ TeV. No significant excess over SM expectation is found in the search for a vector-like t' decaying into tZ or tH in hadronic and semileptonic final states. The highest mass bound is obtained for the SU(2) singlet t' with electroweak coupling, κ, of 0.5, and $\Gamma_{t'}/m_{t'} = 0.5$. NODE=Q009TPS;LINKAGE=G

[2] AAD 24AK based on 139 fb^{-1} of pp data at $\sqrt{s} = 13$ TeV. No significant excess over SM expectation is found in the search for a vector-like t' in events with a reconstructed boosted top quark and a large missing transverse momentum. $B(t' \to Wb) + B(t' \to tZ) + B(t' \to tH) = 1$ and $B(t' \to tZ) = B(t' \to tH) = 1/4$ are assumed. NODE=Q009TPS;LINKAGE=E

[3] AAD 16AV based on 20.3 fb^{-1} of pp data at $\sqrt{s} = 8$ TeV. No significant excess over SM expectation is found in the search for a fully reconstructed vector-like t' in the mode $\ell + \not{E}_T + \geq 2j$ ($\geq 1b$). A veto on massive large-radius jets is used to reject the $t\overline{t}$ background. NODE=Q009TPS;LINKAGE=A

[4] ABAZOV 11F based on 5.4 fb^{-1} of data in ppbar collisions at 1.96 TeV. It looked for single production of t' via the Z or E coupling to the first generation up or down quarks, respectively. Model independent cross section limits for the single production processes $p\overline{p} \to t'q \to (Wd)q$, and $p\overline{p} \to t'q \to (Zd)q$ are given in Figs. 3 and 4, respectively, and the mass limits are obtained for the model of ATRE 09 with degenerate bi-doublets of vector-like quarks. NODE=Q009TPS;LINKAGE=AB

[5] AAD 25BH based on 140 fb^{-1} of pp data at $\sqrt{s} = 13$ TeV. No significant excess over SM expectation is found in the search for a vector-like t' decaying into bW in semileptonic final states. Upper limits are set on the cross section times branching ratio and on the coupling of t' to the SM sector. Also similar limits are set for t' with charge -4/3. NODE=Q009TPS;LINKAGE=I

[6] AAD 25S based on 139 fb^{-1} of pp data at $\sqrt{s} = 13$ TeV. No significant excess over SM expectation is found in the search for a vector-like t' decaying into bW in the fully hadronic final states using a highly boosted W jet. The mass bound is obtained for the global coupling parameter $\kappa = 0.7$. The corresponding mass bound for a vector-like quark Y with electric charge -4/3 is 2.35 TeV. NODE=Q009TPS;LINKAGE=H

[7] AAD 24V based on 139 fb^{-1} of pp data at $\sqrt{s} = 13$ TeV. No significant excess over SM expectation is found in the search for a vector-like t' in the Zt decay channel, which consists of a pair of opposite-sign leptons from a Z-boson, b-tagged jets and forward jets. The mass range above 1 TeV is targeted and 95% CL limits on the mass and coupling strength of t' are set, in the singlet and doublet scenarios. NODE=Q009TPS;LINKAGE=D

[8] HAYRAPETYAN 24AR based on 138 fb^{-1} of pp data at $\sqrt{s} = 13$ TeV. No deviation from the SM expectation is found in the search for a vector-like t' in the all-hadronic final state where the t' is reconstructed as five jets, with three of them being b-jets. 95% CL upper limits are set on the product of the t'-production cross section and the branching ratio $B(t' \to tZ)$ or $B(t' \to tH)$. NODE=Q009TPS;LINKAGE=F

[9] AAD 22G based on 139 fb^{-1} of pp data at $\sqrt{s} = 13$ TeV. No significant excess over SM expectation is found in the search for a vector-like t' in the Ht decay channel, where H and t are reconstructed as single jets. The mass range between 1.0 and 2.3 TeV is targeted and 95% CL limits on the production section times the decay branching fraction are set depending on the coupling and mass of t'. NODE=Q009TPS;LINKAGE=B

[10] TUMASYAN 22X based on 137 fb^{-1} of pp data at $\sqrt{s} = 13$ TeV. No significant excess over SM expectation is found in the search for a vector-like t' in the Zt decay channel, where Z decays to neutrinos and t decays hadronically. The 95% CL limits on the production section times the decay branching fraction are set depending on the coupling and mass of t'. NODE=Q009TPS;LINKAGE=C

$t'(5/3)$ mass limits from single production in $p\overline{p}$ and pp collisions

NODE=Q009T5S
NODE=Q009T5S

VALUE (GeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •				
	[1] SIRUNYAN	19AI	CMS	$tW \to t'(5/3) \to tW$

[1] SIRUNYAN 19AI based on 35.9 fb^{-1} of pp data at $\sqrt{s} = 13$ TeV. Exclusion limits are set on the product of the production cross section and branching fraction for the $b'(-1/3) + t$ and $t'(5/3) + t$ modes as a function of the vector-like quark mass in Fig. 8 and Tab. 2 for relative vector-like quark widths between 1 and 30% for left- and right-handed vector-like quark couplings. No significant deviation from the SM prediction is observed. NODE=Q009T5S;LINKAGE=A

REFERENCES FOR Searches for (Fourth Generation) t' Quark

NODE=Q009

AAD	25BH	JHEP 2512 012	G. Aad *et al.*	(ATLAS Collab.)	REFID=63719
AAD	25I	PR D111 012012	G. Aad *et al.*	(ATLAS Collab.)	REFID=63369
AAD	25S	JHEP 2502 075	G. Aad *et al.*	(ATLAS Collab.)	REFID=63439
AAD	24AK	JHEP 2405 263	G. Aad *et al.*	(ATLAS Collab.)	REFID=62859
AAD	24BP	PR D110 052009	G. Aad *et al.*	(ATLAS Collab.)	REFID=63079
AAD	24N	PL B854 138743	G. Aad *et al.*	(ATLAS Collab.)	REFID=62755
AAD	24V	PR D109 112012	G. Aad *et al.*	(ATLAS Collab.)	REFID=62813
HAYRAPETY...	24AR	PR D110 072012	A. Hayrapetyan *et al.*	(CMS Collab.)	REFID=63088
AAD	23AG	EPJ C83 719	G. Aad *et al.*	(ATLAS Collab.)	REFID=62172
AAD	23AV	PL B843 138019	G. Aad *et al.*	(ATLAS Collab.)	REFID=62364
TUMASYAN	23AX	JHEP 2309 057	A. Tumasyan *et al.*	(CMS Collab.)	REFID=62525
TUMASYAN	23V	JHEP 2307 020	A. Tumasyan *et al.*	(CMS Collab.)	REFID=62165
AAD	22G	PR D105 092012	G. Aad *et al.*	(ATLAS Collab.)	REFID=61744
TUMASYAN	22X	JHEP 2205 093	A. Tumasyan *et al.*	(CMS Collab.)	REFID=61801

SIRUNYAN	19AI	EPJ C79 90	A.M. Sirunyan *et al.*	(CMS Collab.)	REFID=59702
SIRUNYAN	19AQ	EPJ C79 364	A.M. Sirunyan *et al.*	(CMS Collab.)	REFID=59721
SIRUNYAN	19BW	PR D100 072001	A.M. Sirunyan *et al.*	(CMS Collab.)	REFID=60010
SIRUNYAN	19T	JHEP 1903 082	A.M. Sirunyan *et al.*	(CMS Collab.)	REFID=59657
AABOUD	18AW	JHEP 1808 048	M. Aaboud *et al.*	(ATLAS Collab.)	REFID=59145
AABOUD	18CE	JHEP 1812 039	M. Aaboud *et al.*	(ATLAS Collab.)	REFID=59369
AABOUD	18CL	PR D98 092005	M. Aaboud *et al.*	(ATLAS Collab.)	REFID=59472
AABOUD	18CP	PR D98 112010	M. Aaboud *et al.*	(ATLAS Collab.)	REFID=59500
AABOUD	18CR	PRL 121 211801	M. Aaboud *et al.*	(ATLAS Collab.)	REFID=59532
SIRUNYAN	18BM	JHEP 1808 177	A.M. Sirunyan *et al.*	(CMS Collab.)	REFID=59137
SIRUNYAN	18Q	PR D97 072008	A.M. Sirunyan *et al.*	(CMS Collab.)	REFID=58920
SIRUNYAN	18W	PL B779 82	A.M. Sirunyan *et al.*	(CMS Collab.)	REFID=58999
AABOUD	17L	JHEP 1708 052	M. Aaboud *et al.*	(ATLAS Collab.)	REFID=57829
SIRUNYAN	17AU	JHEP 1711 085	A.M. Sirunyan *et al.*	(CMS Collab.)	REFID=58344
SIRUNYAN	17J	JHEP 1708 073	A.M. Sirunyan *et al.*	(CMS Collab.)	REFID=57831
AAD	16AV	EPJ C76 442	G. Aad *et al.*	(ATLAS Collab.)	REFID=57383
AAD	15AR	JHEP 1508 105	G. Aad *et al.*	(ATLAS Collab.)	REFID=56648
AAD	15BY	JHEP 1510 150	G. Aad *et al.*	(ATLAS Collab.)	REFID=56863
AAD	15Z	PR D91 112011	G. Aad *et al.*	(ATLAS Collab.)	REFID=56592
KHACHATRY...	15AI	JHEP 1506 080	V. Khachatryan *et al.*	(CMS Collab.)	REFID=56636
AAD	14AZ	JHEP 1411 104	G. Aad *et al.*	(ATLAS Collab.)	REFID=56201
CHATRCHYAN	14A	PL B729 149	S. Chatrchyan *et al.*	(CMS Collab.)	REFID=55674
CHATRCHYAN	14T	PRL 112 171801	S. Chatrchyan *et al.*	(CMS Collab.)	REFID=55839
AAD	13F	PL B718 1284	G. Aad *et al.*	(ATLAS Collab.)	REFID=54843
CHATRCHYAN	13I	JHEP 1301 154	S. Chatrchyan *et al.*	(CMS Collab.)	REFID=54941
AAD	12AR	PRL 108 261802	G. Aad *et al.*	(ATLAS Collab.)	REFID=54227
AAD	12BC	PR D86 012007	G. Aad *et al.*	(ATLAS Collab.)	REFID=54358
AAD	12C	PRL 108 041805	G. Aad *et al.*	(ATLAS Collab.)	REFID=54080
CHATRCHYAN	12BC	PL B718 307	S. Chatrchyan *et al.*	(CMS Collab.)	REFID=54693
CHATRCHYAN	12BH	PR D86 112003	S. Chatrchyan *et al.*	(CMS Collab.)	REFID=54772
CHATRCHYAN	12P	PL B716 103	S. Chatrchyan *et al.*	(CMS Collab.)	REFID=54183
AALTONEN	11AH	PRL 107 191803	T. Aaltonen *et al.*	(CDF Collab.)	REFID=53835
AALTONEN	11AL	PRL 107 261801	T. Aaltonen *et al.*	(CDF Collab.)	REFID=53945
AALTONEN	11O	PRL 106 191801	T. Aaltonen *et al.*	(CDF Collab.)	REFID=16449
ABAZOV	11F	PRL 106 081801	V.M. Abazov *et al.*	(D0 Collab.)	REFID=16469
ABAZOV	11Q	PRL 107 082001	V.M. Abazov *et al.*	(D0 Collab.)	REFID=53709
ATRE	09	PR D79 054018	A. Atre *et al.*		REFID=54081
AALTONEN	08H	PRL 100 161803	T. Aaltonen *et al.*	(CDF Collab.)	REFID=52231
HUANG	08	PR D77 037302	P.Q. Hung, M. Sher	(UVA, WILL)	REFID=52505