

Technicolor

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[Dynamical Electroweak Symmetry Breaking: Implications of the \$H^0\$](#)

The latest unpublished results are described in “Dynamical Electroweak Symmetry Breaking” review.

MASS LIMITS for Resonances in Models of Dynamical Electroweak Symmetry Breaking

VALUE (GeV)	CL%	DOCUMENT ID	TECN	COMMENT
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
>3900	95	1 AAD	20AM ATLS	top-color Z'
		2 AAD	20W ATLS	$\rho_T \rightarrow W \pi_T \rightarrow \ell \nu q \bar{q}$
		3 AAD	16W ATLS	color octet vector resonance
>2400	95	4 KHACHATRY...16E	CMS	top-color Z'
		5 AAD	15AB ATLS	$h \rightarrow \pi_V \pi_V$
>1800	95	6 AAD	15AO ATLS	top-color Z'
		7 AAD	15BB ATLS	$\rho \rho \rightarrow \rho_T/a_{1T} \rightarrow W h$ or $Z h$
		8 AAD	15Q ATLS	$h \rightarrow \pi_V \pi_V$
>1140	95	9 AAIJ	15AN LHCb	$h \rightarrow \pi_V \pi_V$
		10 KHACHATRY...15C	CMS	$\rho_T \rightarrow W Z$
		11 KHACHATRY...15W	CMS	$H \rightarrow \pi_V \pi_V$
none 200–700, 750–890	95	12 AAD	14AT ATLS	$\rho \rho \rightarrow \omega_T \rightarrow Z \gamma$
none 275–960	95	12 AAD	14AT ATLS	$\rho \rho \rightarrow a_T \rightarrow W \gamma$
13 AAD		14V ATLS	color singlet techni-vector	
14 AAD		13AN ATLS	$\rho \rho \rightarrow a_T \rightarrow W \gamma$	
> 703	95	15 AAD	13AN ATLS	$\rho \rho \rightarrow \omega_T \rightarrow Z \gamma$
> 494		16 AAD	13AQ ATLS	top-color Z'
none 500–1740		17 CHATRCHYAN 13AP	CMS	top-color Z'
>1300	95	16 CHATRCHYAN 13BM	CMS	top-color Z'
>2100	95	18 BAAK	12 RVUE	QCD-like technicolor
none 167–687		19 CHATRCHYAN 12AF	CMS	$\rho_T \rightarrow W Z$
> 805		16 AALTONEN	11AD CDF	top-color Z'
> 805	95	16 AALTONEN	11AE CDF	top-color Z'
none 208–408		20 CHIVUKULA	11 RVUE	top-Higgs
		21 CHIVUKULA	11A RVUE	techni- π
	22 AALTONEN	10I CDF	$\rho \bar{\rho} \rightarrow \rho_T/\omega_T \rightarrow W \pi_T$	
> 280	95	23 ABAZOV	10A D0	$\rho_T \rightarrow W Z$
		24 ABAZOV	07I D0	$\rho \bar{\rho} \rightarrow \rho_T/\omega_T \rightarrow W \pi_T$
		25 ABULENCIA	05A CDF	$\rho_T \rightarrow e^+ e^-, \mu^+ \mu^-$
> 207	95	26 CHEKANOV	02B ZEUS	color octet techni- π
		27 ABAZOV	01B D0	$\rho_T \rightarrow e^+ e^-$
none 90–206.7	95	28 ABDALLAH	01 DLPH	$e^+ e^- \rightarrow \rho_T$

		29	AFFOLDER	00F	CDF	color-singlet techni- ρ , $\rho_T \rightarrow W\pi_T, 2\pi_T$
> 600	95	30	AFFOLDER	00K	CDF	color-octet techni- ρ , $\rho_{T8} \rightarrow 2\pi_{LQ}$
none 350–440	95	31	ABE	99F	CDF	color-octet techni- ρ , $\rho_{T8} \rightarrow \bar{b}b$
		32	ABE	99N	CDF	techni- ω , $\omega_T \rightarrow \gamma\bar{b}b$
none 260–480	95	33	ABE	97G	CDF	color-octet techni- ρ , $\rho_{T8} \rightarrow 2\text{jets}$

¹ AAD 20AM search for a top-color Z' decaying to $t\bar{t}$ in pp collisions at $\sqrt{s} = 13$ TeV. The quoted limit is for $\Gamma_{Z'}/M_{Z'} = 0.01$. The limit becomes $M_{Z'} > 4700$ GeV for $\Gamma_{Z'}/M_{Z'} = 0.03$.

² AAD 20W search for techni- ρ decaying to $\pi_T W$ in pp collisions at $\sqrt{s} = 13$ TeV. See their Fig. 5a for limits on $\sigma \cdot B$.

³ AAD 16W search for color octet vector resonance decaying to bB in pp collisions at $\sqrt{s} = 8$ TeV. The vector like quark B is assumed to decay to bH . See their Fig.3 and Fig.4 for limits on $\sigma \cdot B$.

⁴ KHACHATRYAN 16E search for top-color Z' decaying to $t\bar{t}$. The quoted limit is for $\Gamma_{Z'}/m_{Z'} = 0.012$. Also exclude $m_{Z'} < 2.9$ TeV for wider topcolor Z' with $\Gamma_{Z'}/m_{Z'} = 0.1$.

⁵ AAD 15AB search for long-lived hidden valley π_V particles which are produced in pairs by the decay of a scalar boson. π_V is assumed to decay into dijets. See their Fig. 10 for the limit on σB .

⁶ AAD 15AO search for top-color Z' decaying to $t\bar{t}$. The quoted limit is for $\Gamma_{Z'}/m_{Z'} = 0.012$.

⁷ AAD 15BB search for minimal walking technicolor (MWT) isotriplet vector and axial-vector resonances decaying to Wh or Zh . See their Fig. 3 for the exclusion limit in the MWT parameter space.

⁸ AAD 15Q search for long-lived hidden valley π_V particles which are produced in pairs by the decay of scalar boson. π_V is assumed to decay into dijets. See their Fig. 5 and Fig. 6 for the limit on σB .

⁹ AAIJ 15AN search for long-lived hidden valley π_V particles which are produced in pairs by the decay of scalar boson with a mass of 120GeV. π_V is assumed to decay into dijets. See their Fig. 4 for the limit on σB .

¹⁰ KHACHATRYAN 15C search for a vector techni-resonance decaying to WZ . The limit assumes $M_{\pi_T} = (3/4) M_{\rho_T} - 25$ GeV. See their Fig.3 for the limit in $M_{\pi_T} - M_{\rho_T}$ plane of the low scale technicolor model.

¹¹ KHACHATRYAN 15W search for long-lived hidden valley π_V particles which are produced in pairs in the decay of heavy higgs boson H . π_V is assumed to decay into $\ell^+ \ell^-$. See their Fig. 7 and Fig. 8 for the limits on σB .

¹² AAD 14AT search for techni- ω and techni- a resonances decaying to $V\gamma$ with $V = W(\rightarrow \ell\nu)$ or $Z(\rightarrow \ell^+ \ell^-)$.

¹³ AAD 14V search for vector techni-resonances decaying into electron or muon pairs in pp collisions at $\sqrt{s} = 8$ TeV. See their table IX for exclusion limits with various assumptions.

¹⁴ AAD 13AN search for vector techni-resonance a_T decaying into $W\gamma$.

¹⁵ AAD 13AN search for vector techni-resonance ω_T decaying into $Z\gamma$.

¹⁶ Search for top-color Z' decaying to $t\bar{t}$. The quoted limit is for $\Gamma_{Z'}/m_{Z'} = 0.012$.

¹⁷ CHATRCHYAN 13AP search for top-color leptophobic Z' decaying to $t\bar{t}$. The quoted limit is for $\Gamma_{Z'}/m_{Z'} = 0.012$.

¹⁸ BAAK 12 give electroweak oblique parameter constraints on the QCD-like technicolor models. See their Fig. 28.

- 19 CHATRCHYAN 12AF search for a vector techni-resonance decaying to WZ . The limit assumes $M_{\pi_T} = (3/4) M_{\rho_T} - 25 \text{ GeV}$. See their Fig. 3 for the limit in $M_{\pi_T} - M_{\rho_T}$ plane of the low scale technicolor model.
- 20 Using the LHC limit on the Higgs boson production cross section, CHIVUKULA 11 obtain a limit on the top-Higgs mass $> 300 \text{ GeV}$ at 95% CL assuming 150 GeV top-pion mass.
- 21 Using the LHC limit on the Higgs boson production cross section, CHIVUKULA 11A obtain a limit on the technipion mass ruling out the region $110 \text{ GeV} < m_P < 2m_t$. Existence of color techni-fermions, top-color mechanism, and $N_{TC} \geq 3$ are assumed.
- 22 AALTONEN 10I search for the vector techni-resonances (ρ_T, ω_T) decaying into $W\pi_T$ with $W \rightarrow \ell\nu$ and $\pi_T \rightarrow b\bar{b}, b\bar{c}, \text{ or } b\bar{u}$. See their Fig. 3 for the exclusion plot in $M_{\pi_T} - M_{\rho_T}$ plane.
- 23 ABAZOV 10A search for a vector techni-resonance decaying into WZ . The limit assumes $M_{\rho_T} < M_{\pi_T} + M_W$.
- 24 ABAZOV 07I search for the vector techni-resonances (ρ_T, ω_T) decaying into $W\pi_T$ with $W \rightarrow e\nu$ and $\pi_T \rightarrow b\bar{b} \text{ or } b\bar{c}$. See their Fig. 2 for the exclusion plot in $M_{\pi_T} - M_{\rho_T}$ plane.
- 25 ABULENCIA 05A search for resonances decaying to electron or muon pairs in $p\bar{p}$ collisions. at $\sqrt{s} = 1.96 \text{ TeV}$. The limit assumes Technicolor-scale mass parameters $M_V = M_A = 500 \text{ GeV}$.
- 26 CHEKANOV 02B search for color octet techni- π P decaying into dijets in ep collisions. See their Fig. 5 for the limit on $\sigma(ep \rightarrow ePX) \cdot B(P \rightarrow 2j)$.
- 27 ABAZOV 01B searches for vector techni-resonances (ρ_T, ω_T) decaying to e^+e^- . The limit assumes $M_{\rho_T} = M_{\omega_T} < M_{\pi_T} + M_W$.
- 28 The limit is independent of the π_T mass. See their Fig. 9 and Fig. 10 for the exclusion plot in the $M_{\rho_T} - M_{\pi_T}$ plane. ABDALLAH 01 limit on the techni-pion mass is $M_{\pi_T} > 79.8 \text{ GeV}$ for $N_D=2$, assuming its point-like coupling to gauge bosons.
- 29 AFFOLDER 00F search for ρ_T decaying into $W\pi_T$ or $\pi_T\pi_T$ with $W \rightarrow \ell\nu$ and $\pi_T \rightarrow \bar{b}b, \bar{b}c$. See Fig. 1 in the above Note on "Dynamical Electroweak Symmetry Breaking" for the exclusion plot in the $M_{\rho_T} - M_{\pi_T}$ plane.
- 30 AFFOLDER 00K search for the ρ_{T8} decaying into $\pi_{LQ}\pi_{LQ}$ with $\pi_{LQ} \rightarrow b\nu$. For $\pi_{LQ} \rightarrow c\nu$, the limit is $M_{\rho_{T8}} > 510 \text{ GeV}$. See their Fig. 2 and Fig. 3 for the exclusion plot in the $M_{\rho_{T8}} - M_{\pi_{LQ}}$ plane.
- 31 ABE 99F search for a new particle X decaying into $b\bar{b}$ in $p\bar{p}$ collisions at $E_{\text{cm}} = 1.8 \text{ TeV}$. See Fig. 7 in the above Note on "Dynamical Electroweak Symmetry Breaking" for the upper limit on $\sigma(p\bar{p} \rightarrow X) \times B(X \rightarrow b\bar{b})$. ABE 99F also exclude top gluons of width $\Gamma=0.3M$ in the mass interval $280 < M < 670 \text{ GeV}$, of width $\Gamma=0.5M$ in the mass interval $340 < M < 640 \text{ GeV}$, and of width $\Gamma=0.7M$ in the mass interval $375 < M < 560 \text{ GeV}$.
- 32 ABE 99N search for the techni- ω decaying into $\gamma\pi_T$. The technipion is assumed to decay $\pi_T \rightarrow b\bar{b}$. See Fig. 2 in the above Note on "Dynamical Electroweak Symmetry Breaking" for the exclusion plot in the $M_{\omega_T} - M_{\pi_T}$ plane.
- 33 ABE 97G search for a new particle X decaying into dijets in $p\bar{p}$ collisions at $E_{\text{cm}} = 1.8 \text{ TeV}$. See Fig. 5 in the above Note on "Dynamical Electroweak Symmetry Breaking" for the upper limit on $\sigma(p\bar{p} \rightarrow X) \times B(X \rightarrow 2j)$.

REFERENCES FOR Technicolor

AAD	20AM JHEP 2010 061	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	20W JHEP 2006 151	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	16W PL B758 249	G. Aad <i>et al.</i>	(ATLAS Collab.)
KHACHATRY...	16E PR D93 012001	V. Khachatryan <i>et al.</i>	(CMS Collab.)
AAD	15AB PR D92 012010	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	15AO JHEP 1508 148	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	15BB EPJ C75 263	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	15Q PL B743 15	G. Aad <i>et al.</i>	(ATLAS Collab.)

AAIJ	15AN	EPJ C75 152	R. Aaij <i>et al.</i>	(LHCb Collab.)
KHACHATRY...	15C	PL B740 83	V. Khachatryan <i>et al.</i>	(CMS Collab.)
KHACHATRY...	15W	PR D91 052012	V. Khachatryan <i>et al.</i>	(CMS Collab.)
AAD	14AT	PL B738 428	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	14V	PR D90 052005	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	13AN	PR D87 112003	G. Aad <i>et al.</i>	(ATLAS Collab.)
Also		PR D91 119901 (errat.)	G. Aad <i>et al.</i>	(ATLAS Collab.)
AAD	13AQ	PR D88 012004	G. Aad <i>et al.</i>	(ATLAS Collab.)
CHATRCHYAN	13AP	PR D87 072002	S. Chatrchyan <i>et al.</i>	(CMS Collab.)
CHATRCHYAN	13BM	PRL 111 211804	S. Chatrchyan <i>et al.</i>	(CMS Collab.)
Also		PRL 112 119903 (errat.)	S. Chatrchyan <i>et al.</i>	(CMS Collab.)
BAAK	12	EPJ C72 2003	M. Baak <i>et al.</i>	(Gfitter Group)
CHATRCHYAN	12AF	PRL 109 141801	S. Chatrchyan <i>et al.</i>	(CMS Collab.)
AALTONEN	11AD	PR D84 072003	T. Aaltonen <i>et al.</i>	(CDF Collab.)
AALTONEN	11AE	PR D84 072004	T. Aaltonen <i>et al.</i>	(CDF Collab.)
CHIVUKULA	11	PR D84 095022	R.S. Chivukula <i>et al.</i>	
CHIVUKULA	11A	PR D84 115025	R. S. Chivukula <i>et al.</i>	
AALTONEN	10I	PRL 104 111802	T. Aaltonen <i>et al.</i>	(CDF Collab.)
ABAZOV	10A	PRL 104 061801	V.M. Abazov <i>et al.</i>	(D0 Collab.)
ABAZOV	07I	PRL 98 221801	V.M. Abazov <i>et al.</i>	(D0 Collab.)
ABULENCIA	05A	PRL 95 252001	A. Abulencia <i>et al.</i>	(CDF Collab.)
CHEKANOV	02B	PL B531 9	S. Chekanov <i>et al.</i>	(ZEUS Collab.)
ABAZOV	01B	PRL 87 061802	V.M. Abazov <i>et al.</i>	(D0 Collab.)
ABDALLAH	01	EPJ C22 17	J. Abdallah <i>et al.</i>	(DELPHI Collab.)
AFFOLDER	00F	PRL 84 1110	T. Affolder <i>et al.</i>	(CDF Collab.)
AFFOLDER	00K	PRL 85 2056	T. Affolder <i>et al.</i>	(CDF Collab.)
ABE	99F	PRL 82 2038	F. Abe <i>et al.</i>	(CDF Collab.)
ABE	99N	PRL 83 3124	F. Abe <i>et al.</i>	(CDF Collab.)
ABE	97G	PR D55 5263	F. Abe <i>et al.</i>	(CDF Collab.)
