t

$$I(J^P) = 0(\tfrac{1}{2}^+)$$

Charge $= \frac{2}{3}\,e$ Top $= +1$

A REVIEW GOES HERE – Check our WWW List of Reviews

t-Quark Mass in $p\overline{p}$ Collisions

The t quark has now been observed. Its mass is sufficiently high that decay is expected to occur before hadronization.

Preliminary results for the top mass based on the Run Ia+Ib data set have been presented by CDF at conferences in 1996:

$m_t = 176.8 \pm 4.4 \pm 4.8$ GeV	CDF	lepton + jets
$m_t = 159^{+24}_{-22} \pm 17$ GeV	CDF	dilepton
$m_t = 186 \pm 10 \pm 12$ GeV	CDF	hadronic

Final results intended for publication based on the full Run Ia+Ib+Ic data set have been presented by DØ at conferences in late spring 1997:

$m_t = 173.3 \pm 5.6 \pm 6.2$ GeV	DØ	lepton + jets
$m_t = 168.4 \pm 12.3 \pm 3.7$ GeV	DØ	dilepton
$m_t = 172.0 \pm 5.1 \pm 5.5$ GeV	DØ	combined ℓ + jets and $\ell\ell$

Because of the high current interest, we mention these preliminary or as yet unpublished results here but do not average them or include them in the Listings or Tables. See the note on the top quark for references.

Search limits, which are now primarily of historical interest, are based on the assumption that no nonstandard decay modes such as $t \to bH^+$ are available, except as noted in the comments.

VALUE (GeV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
180±12 OUR AVERAGE					
$199^{+19}_{-21} \pm 22$		[1] ABACHI	95	D0	ℓ + jet
$176 \pm 8 \pm 10$		[2] ABE	95F	CDF	ℓ + b-jet
• • • We do not use the following data for averages, fits, limits, etc. • • •					
		[3] ABACHI	95B	D0	$\ell\ell$ + jets, ℓ + jets
>128	95	[4] ABACHI	95F	D0	$\ell\ell$ + jets, ℓ + jets
		[5] ABE	95O	CDF	
		[6] ABE	95V	CDF	
		[7] ABE,F	95	CDF	$W + \geq 4$ jets
>131	95	[8] ABACHI	94	D0	$\ell\ell$ + jets, ℓ + jets
$174 \pm 10^{+13}_{-12}$		[9] ABE	94E	CDF	ℓ + b-jet
>118	95	[9] ABE	94E	CDF	$\ell\ell$
		[10] ABE	94H	CDF	$t \to bH^+$, $H^+ \to \tau^+\nu_\tau$
		[11] ABE	94I	CDF	$t \to bH^+$, $H^+ \to \tau^+\nu_\tau$

>91	95	[12] ABE	92	CDF	$\ell\ell$, ℓ + b-jet
		[13] ALITTI	92F	UA2	$t \rightarrow bH^+$, $H^+ \rightarrow \tau^+\nu_\tau$
>60	95	[14] ALBAJAR	91B	UA1	$t \rightarrow bH^+$, $H^+ \rightarrow \tau^+\nu_\tau$
		[15] BAER	91B	RVUE	$t \rightarrow \widetilde{t}_1 \widetilde{\chi}^0_1$
>72	95	[16] ABE	90B	CDF	$e + \mu$
>77	95	[17] ABE	90C	CDF	e + jets + missing E_T
>69	95	[18] AKESSON	90	UA2	e + jets + missing E_T
>60	95	ALBAJAR	90B	UA1	e or μ + jets, $\mu\mu$ + jet
		[19] BARGER	90E	RVUE	$t \rightarrow bH^+$
>41	95	[20] ALBAJAR	88	UA1	e or μ + jets

[1] ABACHI 95 search for $\ell\ell$+jets ($e\mu$, ee, and $\mu\mu$) and ℓ+jets (ℓ=e or μ). The ℓ+jets search is done in two ways, using either topological cuts or requiring μ tagging. They observe 17 (3 $\ell\ell$, 6 ℓ+b-jets, and 8 ℓ+jets topological) events with an expected background of 3.8 $\pm$ 0.6. These seven analysis channels combine to give a 4.6 standard deviation effect. The mass fit is from 24 ℓ+4-jet events obtained with looser cuts.

[2] ABE 95F search for $\ell\ell$ (ee, $e\mu$, and $\mu\mu$) final states and ℓ + b-jet final states. They find 37 $\ell + b$-jet candidates containing 27 secondary vertex tags and 23 lepton tags with expected backgrounds of 6.7 $\pm$ 2.1 and 15.4 $\pm$ 2.0 respectively. They find 6 $\ell\ell$ events with an expected background of 1.3 $\pm$ 0.3 These three observations combine to give a 4.8 standard deviation effect. The mass fit is from 19 ℓ+4-jet events with a b-tag. The shape of the mass distribution is consistant with top and this increases the significance of the effect to 5.0σ.

[3] ABACHI 95B searched for dilepton channels $e\mu$+ jets, ee+ jets, $\mu\mu$+ jets, and single-letpon channels e+ jets and μ+ jets with and without b tagging. They found 9 events where 3.8 ± 0.9 events are expected from background. Based on an integrated luminosity of 13.5 $\pm$ 1.6pb^{-1}. These analyses combine to give a 1.9 standard deviation effect. Assuming that the observed excess signal is due to top quark production, the cross section is 8.2 $\pm$ 5.1 pb for m_t = 180 GeV.

[4] ABACHI 95F searched for dilepton channels $e\mu$+ jets, ee+ jets, $\mu\mu$+ jets, and single-lepton channels e + jets and μ + jets with and without b tagging. The lower mass bound supersedes that of ABACHI 94 and is weaker as a result of a recalibration of the integrated luminosity. Assuming that the observed excess signal is due to top quark production, the cross section is 8.2 $\pm$ 5.1 pb (9.2 $\pm$ 5.7 pb) for m_t = 180 GeV (160 GeV).

[5] ABE 95O find evidence for top production in the jet E_T distributions of W + $\geq$ 3 jet events, based on an integrated luminosity of 19.3pb^{-1}. The observed distributions are consistent with m_t = 170 GeV. Supersed by ABE 95V.

[6] ABE 95V find evidence for top production in the jet E_T distributions of W + $\geq$ 3 jet events, based on an integrated luminosity of 67pb^{-1}.

[7] ABE,F 95 compared the total transverse energy distribution of the W + $\geq$ 4-jet data with that expected from all known backgrounds and found 3.8σ deviation in the shape. The distribution agrees well with a linear combination of background and $t\overline{t}$ events, the agreement being best for m_t = 180 GeV.

[8] ABACHI 94 search for $e\mu$ + jets, ee + jets, e + jets, and μ + jets. Production cross section with soft-gluon resummation of LAENEN 94 is used. The limit decreases to >122 GeV if $\mathcal{O}(\alpha_s{}^3)$ cross section is employed for comparison with ABE 92. Superseded by ABACHI 95F.

[9] ABE 94E search for ee, $e\mu$, and $\mu\mu$ dilepton final states and single lepton + b-jet final states. They observe a total of 15 top topology tags (12 events of which three are doubly tagged) with an expected background of $5.96^{+0.49}_{-0.44}$. The mass determination is from 7 single-lepton + b-jet events which have four jets. Their $\ell\ell$ limit uses the production cross section with soft gluon resummation from LAENEN 94. Superseded by ABE 95F.

[10] ABE 94H searched for $t \rightarrow bH^+$, $H^+ \rightarrow \tau^+\nu_\tau$ with τ decaying hadronically. The search was done in the region 45 GeV $< m_{H^+} < m_t - m_b$ and 55 GeV $< m_t < m_W + m_b$. See their Fig. 3 for the 95% CL excluded regions in the (m_{H^+},m_t) plane for B($H^+ \rightarrow \tau^+\nu_\tau$) = 1, 0.75, and 0.5.

[11] ABE 94I searched for $t \rightarrow bH^+$, $H^+ \rightarrow \tau^+\nu_\tau$, $\tau^+ \rightarrow \ell^+\nu_\ell\overline{\nu}_\tau$. The search was done in the region 45 GeV $< m_{H^+} < m_t - m_b$ and 62 GeV $< m_t <$ 110 GeV. See their Fig. 2 for the 95% CL excluded regions in the (m_{H^+},m_t) plane for B($H^+ \rightarrow \tau^+\nu_\tau$) = 1, 0.75, and 0.5. The entire region of the plane is excluded for B($H^+ \rightarrow \tau^+\nu_\tau$) > 0.75 when $m_t < m_W + m_b$.

[12] ABE 92 search for ee, $e\mu$, $\mu\mu$ dilepton final states and (e or μ) plus a b-quark jet. The b jet is tagged by a soft muon. The 90%CL limit is 95 GeV. Superseded by ABE 94E $\ell\ell$ limit.

[13] ALITTI 92F search for $t \rightarrow bH^+$, $H^+ \rightarrow \tau^+\nu_\tau$ with τ^+ decaying hadronically. m_t between 50 and 70 GeV is excluded if $m_t - m_{H^+} = m_b + (\lesssim$ a few–10 GeV). See their Figs. 5,6 for the excluded region for B($H^+ \rightarrow \tau^+\nu_\tau$) = 1, 0.5.

[14] ALBAJAR 91B searched for the decay $t \rightarrow H^+ b$ using single muon and dimuon events and assuming B($H^+ \rightarrow \tau^+\nu$) $\geq$ 0.95. The limit holds for $m_{H^+} \lesssim m_t - m_b -$ (3–6) GeV.

[15] BAER 91B argue that a top quark as light as 60 GeV (65 GeV, if the minimal SUSY framework is assumed) may have escaped detection at CDF if a supersymmetric decay mode is open.

[16] ABE 90B exclude the region 28–72 GeV.

[17] ABE 90C cannot exclude $m_t <$ 40 GeV, but this region is ruled out by other experiments. They study events with an energetic electron, missing transverse energy and two or more jets. Only the $t\overline{t}$ contribution (not $W \rightarrow tb$) is relevant for these masses. See also ABE 91.

[18] AKESSON 90 searched for events having an electron with $p_T >$ 12 GeV, missing momentum > 15 GeV, and a jet with $E_T >$ 10 GeV, $|\eta| <$ 2.2, and excluded m_t between 30 and 69 GeV.

[19] BARGER 90E claim that ABE 90C data exclude most regions of two-Higgs-doublet models with $m_t <$ 80 GeV even if $t \rightarrow bH^+$ decay is allowed.

[20] ALBAJAR 88 value quoted here is revised using the full $O(\alpha_s^3)$ cross section of ALTARELLI 88. Superseded by ALBAJAR 90B.

t-Quark Decay Branching Fractions

VALUE (%)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<15	99	[21] HAN	96	RVUE	$t \rightarrow cg$

[21] HAN 96 studied the $t \rightarrow cg$ signal at the Tevatron collider and found that with a combined 200 pb^{-1} integrated luminosity at $\sqrt{s}$=1.8 TeV, CDF and DØ should be sensitive to the branching fraction of 15% with b-tagging. The sensitivity reduces to 28% without b-tagging.

Indirect *t*-Quark Mass from Standard Model Electroweak Fit

"OUR EVALUATION" below is from the fit to electroweak data described in the "Standard Model of Electroweak Interactions" section of this Review. This fit result does not include direct measurements of m_t. The second error corresponds to m_H=300^{+700}_{-240} GeV.

The RVUE values are based on the data described in the footnotes. RVUE's published before 1994 and superseded analyses are now omitted. For more complete listings of earlier results, see the 1994 edition (Physical Review **D50** 1173 (1994)).

VALUE (GeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
$179\pm 8^{+17}_{-20}$ OUR EVALUATION				
• • • We do not use the following data for averages, fits, limits, etc. • • •				
157^{+16}_{-12}	[22] ELLIS	96C	RVUE	Z parameters, m_W, low energy
$175\pm11^{+17}_{-19}$	[23] ERLER	95	RVUE	Z parameters, m_W, low energy
$180\pm9^{+19}_{-21}\mp2.6\pm4.8$	[24] MATSUMOTO	95	RVUE	
$157^{+36}_{-48}{}^{+19}_{-20}$	[25] ABREU	94	DLPH	Z parameters
$158^{+32}_{-40}\pm19$	[26] ACCIARRI	94	L3	Z parameters
$132^{+41}_{-48}{}^{+24}_{-18}$	[27] AKERS	94	OPAL	Z parameters
$190^{+39}_{-48}{}^{+12}_{-14}$	[28] ARROYO	94	CCFR	ν_μ iron scattering
$184^{+25}_{-29}{}^{+17}_{-18}$	[29] BUSKULIC	94	ALEP	Z parameters
153 ± 15	[30] ELLIS	94B	RVUE	Electroweak
$177\pm 9^{+16}_{-20}$	[31] GURTU	94	RVUE	Electroweak
$174^{+11}_{-13}{}^{+17}_{-18}$	[32] MONTAGNA	94	RVUE	Electroweak
$171\pm12^{+15}_{-21}$	[33] NOVIKOV	94B	RVUE	Electroweak
160^{+50}_{-60}	[34] ALITTI	92B	UA2	m_W, m_Z

[22] ELLIS 96C result is a the two-parameter fit with free m_t and m_H, yielding also m_H=65^{+117}_{-37} GeV.

[23] ERLER 95 result is from fit with free m_t and $\alpha_s(m_Z)$, yielding $\alpha_s(m_Z)$ = 0.127(5)(2).

[24] MATSUMOTO 95 result is from fit with free m_t to Z parameters, M_W, and low-energy neutral-current data. The second error is for $m_H = 300^{+700}_{-240}$ GeV, the third error is for $\alpha_s(m_Z) = 0.116 \pm 0.005$, the fourth error is for $\delta\alpha_{\rm had} = 0.0283 \pm 0.0007$.

[25] ABREU 94 value is for $\alpha_s(m_Z)$ constrained to 0.123 ± 0.005. The second error corresponds to $m_H = 300^{+700}_{-240}$ GeV.

[26] ACCIARRI 94 value is for $\alpha_s(m_Z)$ constrained to 0.124 ± 0.006. The second error corresponds to $m_H = 300^{+700}_{-240}$ GeV.

[27] AKERS 94 result is from fit with free α_s. The second error corresponds to m_H=300^{+700}_{-240} GeV. The 95%CL limit is m_t <210 GeV.

[28] ARROYO 94 measures the ratio of the neutral-current and charged-current deep inelastic scattering of ν_μ on an iron target. By assuming the SM electroweak correction, they obtain $1-m_W^2/m_Z^2 = 0.2218 \pm 0.0059$, yielding the quoted m_t value. The second error corresponds to $m_H = 300^{+700}_{-240}$ GeV.

[29] BUSKULIC 94 result is from fit with free α_s. The second error is from m_H=300^{+700}_{-240} GeV.

[30] ELLIS 94B result is fit to electroweak data available in spring 1994, including the 1994 A_{LR} data from SLD. m_t and m_H are two free parameters of the fit for $\alpha_s(m_Z) = 0.118 \pm 0.007$ yielding m_t above, and $m_H = 35^{+70}_{-22}$ GeV. ELLIS 94B also give results for fits including constraints from CDF's direct measurement of m_t and CDF's and DØ 's production cross-section measurements. Fits excluding the A_{LR} data from SLD are also given.

[31] GURTU 94 result is from fit with free m_t and $\alpha_s(m_Z)$, yielding m_t above and $\alpha_s(m_Z) = 0.125 \pm 0.005^{+0.003}_{-0.001}$. The second errors correspond to $m_H = 300^{+700}_{-240}$ GeV. Uses LEP, M_W, νN, and SLD electroweak data available in spring 1994.

[32] MONTAGNA 94 result is from fit with free m_t and $\alpha_s(m_Z)$, yielding m_t above and $\alpha_s(m_Z) = 0.124$. The second errors correspond to $m_H = 300^{+700}_{-240}$ GeV. Errors in $\alpha(m_Z)$ and m_b are taken into account in the fit. Uses LEP, SLC, and M_W/M_Z data available in spring 1994.

[33] NOVIKOV 94B result is from fit with free m_t and $\alpha_s(m_Z)$, yielding m_t above and $\alpha_s(m_Z) = 0.125 \pm 0.005 \pm 0.002$. The second errors correspond to $m_H = 300^{+700}_{-240}$ GeV. Uses LEP and CDF electroweak data available in spring 1994.

[34] ALITTI 92B assume $m_H = 100$ GeV. The 95%CL limit is $m_t < 250$ GeV for $m_H <$ 1 TeV.

MASS LIMITS for *t* Quark or Hadron Independent of *t* Decay Mode

These limits are derived from $\Gamma(W)$ values shown in the W width section. Independent of the top decay mode, any W decay to $t\overline{b}$ would increase the total width of the W boson. Since the discovery of top, this section is of historical interest only.

VALUE (GeV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
>62	95	[35] ABE	95W	CDF	$E^{p\overline{p}}_{cm}$= 1800 GeV
>62	95	[36] ABE	94B	CDF	$E^{p\overline{p}}_{cm}$= 1800 GeV
>45	95	[37] ABE	92I	CDF	$E^{p\overline{p}}_{cm}$= 1800 GeV
>53	95	[38] ALITTI	92	UA2	$E^{p\overline{p}}_{cm}$= 630 GeV
>55	95	[39] ALITTI	92	RVUE	
>43	95	[40] ABE	91C	CDF	$E^{p\overline{p}}_{cm}$= 1800 GeV
>38	90	[41] ALBAJAR	91	UA1	$E^{p\overline{p}}_{cm}$= 630 GeV
>51	90	[42] ALBAJAR	91	RVUE	$\Gamma(W)$

[35] ABE 95W result is from $\Gamma(W \rightarrow e\nu_e)/\Gamma(W) = 0.1094 \pm 0.0033(\text{stat}) \pm 0.0031(\text{syst.})$. In addition they obtain $\Gamma(W) = 2.064 \pm 0.060(\text{stat}) \pm 0.059(\text{syst.})$.

[36] ABE 94B result is from $\Gamma(W) = 2.063 \pm 0.061 \pm 0.060$ GeV. Superseded by ABE 95W.

[37] ABE 92I data include both e and μ final states. The result is derived from $\Gamma(W)$=2.16 ± 0.17 GeV. At 90%CL, the limit is >49 GeV.

[38] ALITTI 92 result is derived from $\Gamma(W) = 2.10 \pm 0.16$ GeV.

[39] Limit is from combined data of ALBAJAR 91, ALITTI 92, and ABE 90: $\Gamma(W) = 2.15 \pm 0.11$ GeV.

[40] ABE 91C result is derived from $\Gamma(W) = 2.12 \pm 0.20$ GeV. At 90%CL, the limit is $>$ 48 GeV.
[41] ALBAJAR 91 result is derived from $\Gamma(W) = 2.18^{+0.26}_{-0.24} \pm 0.04$ GeV.
[42] Limit is from combined data of ALBAJAR 91, ALITTI 90C, and ABE 90.

MASS LIMITS for Top Hadrons in e^+e^- Collisions

The last column specifies measured quantities: S = Sphericity, T = Thrust.

For limits prior to 1987, see our 1990 edition, Physics Letters **B239**, p. VII.167 (1990). Since the discovery of top, this section is of historical interest only.

VALUE (GeV)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
• • • We do not use the following data for averages, fits, limits, etc. • • •					
		[43] ADRIANI	93G	L3	Quarkonium
>41.8	95	ADRIANI	93M	L3	$\Gamma(Z)$
>43	95	[44] ABREU	91F	DLPH	$\Gamma(Z)$
>30.2	95	ABE	90D	VNS	Event shape
>44.5	95	[44] ABREU	90D	DLPH	Event shape
>44.0	95	[44,45] ABREU	90D	DLPH	$t \to bH^+$, $H^+ \to c\overline{s}$, $\tau^+\nu$
>33.5	95	[46] ABREU	90D	DLPH	$\Gamma(Z \to$ hadrons)
>44.5	95	[47] AKRAWY	90B	OPAL	Acoplanarity
>44.3	95	[48] AKRAWY	90B	OPAL	$t \to bH^+$, $H^+ \to c\overline{s}$, $\tau\nu$
>45.8	95	[44] DECAMP	90F	ALEP	isolated charged particle and aplanarity
>40.7	95	[49] ABRAMS	89C	MRK2	Event shape
>42.5	95	ABRAMS	89C	MRK2	$t \to bH^+$, $H^+ \to c\overline{s}$
>29.9	95	[50] ADACHI	89C	TOPZ	μ
>29.9	95	[51] ENO	89	AMY	μ, e
>25.8	95	[52] ADACHI	88	TOPZ	R, T, Acoplanarity
>25.9	95	[53] IGARASHI	88	AMY	T + (μ,e)
>25.9	95	[54] SAGAWA	88	AMY	R, T
none E_{cm}=50	95	[55] ABE	87	VNS	R, T, Acoplanarity
>25.5	95	[56] YOSHIDA	87	VNS	R, T, Acoplanarity

[43] ADRIANI 93G search for vector quarkonium states near Z and give limit on quarkonium-Z mixing parameter $\delta m^2 <$(10–30) GeV^2 (95%CL) for the mass 88–94.5 GeV. Using Richardson potential, a 1S toponium state is excluded for the mass range 87.9–88.7, 89.1–94.3 GeV. This range is very sensitive to the potential choice.
[44] Search was near the Z peak at LEP.
[45] Assumed $m_{H^+} < m_t - 6$ GeV.
[46] Superseded by ABREU 91F.
[47] AKRAWY 90B search was restricted to data near the Z peak at E_{cm} = 91.26 GeV at LEP. The excluded region is between 23.4 and 44.5 GeV if no H^+ decays exist.
[48] AKRAWY 90B limit applies for any H^+ branching ratio B($c\overline{s}$). Limit increases to 45.2 GeV if B($c\overline{s}$) = 1. The lower end of the excluded region is m_{H^+} + 5 GeV.
[49] The ABRAMS 89C limit from an isolated track search is 40.0 GeV.
[50] ADACHI 89C search was at E_{cm} = 56.5–60.8 GeV at TRISTAN using multi-hadron events accompanying muons.
[51] ENO 89 search at E_{cm} = 50–60.8 GeV at TRISTAN.

[52] ADACHI 88 set limit σ(top) $<$ 8.2 pb at CL=95% for top-flavored-hadron production from event shape analyses at $E_{\rm cm}$ = 52 GeV. By using the quark-parton model cross-section formula with first-order QCD corrections near the threshold, the above limit leads to a lower mass limit of 25.8 GeV at 95% confidence level for top quarks.

[53] IGARASHI 88 searches for leptons in low-thrust events and gives $\Delta R(t) <$ 0.15 (95% CL) at $E_{\rm cm}$ = 50–52 GeV.

[54] SAGAWA 88 set limit σ(top) $<$ 6.1 pb at CL=95% for top-flavored hadron production from event shape analyses at $E_{\rm cm}$ = 52 GeV. By using the quark parton model cross-section formula near threshold, the above limit leads to lower mass bounds of 25.9 GeV for charge 2/3 quarks.

[55] ABE 87 set limit σ(top) $<$ 16 pb at CL=95% for top-flavored hadron production, which should be compared with the full top-quark production cross section of 45.9 pb.

[56] YOSHIDA 87 set limit σ(top) $<$ 17 pb at CL=95% for top-flavored hadron production from event shape analyses at $E_{\rm cm}$ = 52 GeV. This limit should be compared with the full top-quark production cross section of 34 pb, which takes into account the effect of weak neutral current but neglects its axial-vector coupling contribution expected to be suppressed near threshold. After considering the radiative effects, top quarks of mass below 25.5 GeV can be excluded by the above limit.

t-Quark REFERENCES

ELLIS	96C	PL B389 321	+Fogli, Lisi	(CERN, BARI)
HAN	96	PL B385 311	+Whisnant, Young, Zhang	(UCD, ISU, BHEP)
ABACHI	95	PRL 74 2632	+Abbott, Abolins, Acharya, Adam+	(D0 Collab.)
ABACHI	95B	PRL 74 2422	+Abbott, Abolins, Acharya, Adam, Adams+	(D0 Collab.)
ABACHI	95F	PR D52 4877	+Abbott, Abolins, Acharya, Adam, Adams+	(D0 Collab.)
ABE	95F	PRL 74 2626	+Akimoto, Akopian, Albrow, Amendolia+	(CDF Collab.)
ABE	95O	PR D51 4623	+Albrow, Amendolia, Amidei, Antos+	(CDF Collab.)
ABE	95V	PR D52 R2605	+Akimoto, Akopian, Albrow, Amendolia+	(CDF Collab.)
ABE	95W	PR D52 2624	+Albrow, Amendolia, Amidei, Antos+	(CDF Collab.)
ABE,F	95	PRL 75 3997	Abe, Akimoto, Akopian, Albrow, Amendolia+	(CDF Collab.)
ERLER	95	PR D52 441	+Langacker	(PENN)
MATSUMOTO	95	MPL A10 2553		(KEK)
ABACHI	94	PRL 72 2138	+Abbott, Abolins, Acharya, Adam+	(D0 Collab.)
ABE	94B	PRL 73 220	+Albrow, Amidei, Anway-Wiese+	(CDF Collab.)
ABE	94E	PR D50 2966	+Albrow, Amendolia, Amidei, Antos+	(CDF Collab.)
Also	94F	PRL 73 225	Abe, Albrow, Amidei, Antos, Anway-Weise+	(CDF Collab.)
ABE	94H	PRL 72 1977	+Albrow, Amidei, Anway-Wiese, Apollinari+	(CDF Collab.)
ABE	94I	PRL 73 2667	+Albrow, Amidei, Antos, Anway-Wiese+	(CDF Collab.)
ABREU	94	NP B418 403	+Adam, Adye, Agasi+	(DELPHI Collab.)
ACCIARRI	94	ZPHY C62 551	+Adam, Adriani, Aguilar-Benitez+	(L3 Collab.)
AKERS	94	ZPHY C61 19	+Alexander, Allison+	(OPAL Collab.)
ARROYO	94	PRL 72 3452	+King, Bachman+	(COLU, CHIC, FNAL, ROCH, WISC)
BUSKULIC	94	ZPHY C62 539	+Casper, De Bonis, Decamp, Ghez, Goy+	(ALEPH Collab.)
ELLIS	94B	PL B333 118	+Fogli, Lisi	(CERN, BARI)
GURTU	94	MPL A9 3301		(TATA)
LAENEN	94	PL B321 254	+Smith, van Neerven	(FNAL, UTRE, LEID)
MONTAGNA	94	PL B335 484	+Nicrosini, Passarino, Piccinini	(INFN, PAVI, CERN, TORI)
NOVIKOV	94B	MPL A9 2641	+Okun, Rozanov, Vysotsky	(GUEL, CERN, ITEP)
PDG	94	PR D50 1173	Montanet+	(CERN, LBL, BOST, IFIC+)
ADRIANI	93G	PL B313 326	+Aguilar-Benitez, Ahlen, Alcaraz, Aloisio+	(L3 Collab.)
ADRIANI	93M	PRPL 236 1	+Aguilar-Benitez, Ahlen, Alcaraz, Aloisio+	(L3 Collab.)
ABE	92	PRL 68 447	+Amidei, Apollinari, Atac, Auchincloss+	(CDF Collab.)
Also	92G	PR D45 3921	Abe, Amidei, Apollinari, Atac, Auchincloss+	(CDF Collab.)
ABE	92I	PRL 69 28	+Amidei, Apollinari, Atac, Auchincloss+	(CDF Collab.)
ALITTI	92	PL B276 365	+Ambrosini, Ansari, Autiero, Bareyre+	(UA2 Collab.)
ALITTI	92B	PL B276 354	+Ambrosini, Ansari, Autiero, Bareyre+	(UA2 Collab.)
ALITTI	92F	PL B280 137	+Ambrosini, Ansari, Autiero, Bareyre+	(UA2 Collab.)
ABE	91	PR D43 664	+Amidei, Apollinari, Atac, Auchincloss+	(CDF Collab.)

ABE	91C	PR D44 29	+Amidei, Apollinari, Atac, Auchincloss+	(CDF Collab.)
ABREU	91F	NP B367 511	+Adam, Adami, Adye, Akesson+	(DELPHI Collab.)
ALBAJAR	91	PL B253 503	+Albrow, Allkofer, Ankoviak, Apsimon+	(UA1 Collab.)
ALBAJAR	91B	PL B257 459	+Albrow, Allkofer, Ankoviak, Apsimon+	(UA1 Collab.)
BAER	91B	PR D44 725	+Drees, Godbole+	(FSU, DESY, BOMB, UCD, HAWA)
ABE	90	PRL 64 152	+Amidei, Apollinari, Atac, Auchincloss+	(CDF Collab.)
ABE	90B	PRL 64 147	+Amidei, Apollinari, Atac, Auchincloss+	(CDF Collab.)
ABE	90C	PRL 64 142	+Amidei, Apollinari, Atac+	(CDF Collab.)
Also	91	PR D43 664	Abe, Amidei, Apollinari, Atac, Auchincloss+	(CDF Collab.)
ABE	90D	PL B234 382	+Amako, Arai, Asano+	(VENUS Collab.)
ABREU	90D	PL B242 536	+Adam, Adami, Adye, Alekseev, Allaby+	(DELPHI Collab.)
AKESSON	90	ZPHY C46 179	+Alitti, Ansari, Ansorge, Bagnaia+	(UA2 Collab.)
AKRAWY	90B	PL B236 364	+Alexander, Allison, Allport, Anderson+	(OPAL Collab.)
ALBAJAR	90B	ZPHY C48 1	+Albrow, Allkofer, Andrieu, Ankoviak+	(UA1 Collab.)
ALITTI	90C	ZPHY C47 11	+Ansari, Ansorge, Bagnaia+	(UA2 Collab.)
BARGER	90E	PR D41 3421	+Hewett, Phillips	(WISC, RAL)
DECAMP	90F	PL B236 511	+Deschizeaux, Lees, Minard+	(ALEPH Collab.)
ABRAMS	89C	PRL 63 2447	+Adolphsen, Averill, Ballam+	(Mark II Collab.)
ADACHI	89C	PL B229 427	+Aihara, Doser, Enomoto, Fujii+	(TOPAZ Collab.)
ENO	89	PRL 63 1910	+Auchincloss, Blanis, Bodek, Budd+	(AMY Collab.)
ADACHI	88	PRL 60 97	+Aihara, Dijkstra+	(TOPAZ Collab.)
ALBAJAR	88	ZPHY C37 505	+Albrow, Allkofer+	(UA1 Collab.)
ALTARELLI	88	NP B308 724	+Diemoz, Martinelli, Nason	(CERN, ROMA, ETH)
IGARASHI	88	PRL 60 2359	+Myung, Chiba, Hanaoka+	(AMY Collab.)
SAGAWA	88	PRL 60 93	+Mori, Abe+	(AMY Collab.)
ABE	87	JPSJ 56 3763	+Amako, Arai+	(VENUS Collab.)
YOSHIDA	87	PL B198 570	+Chiba, Endo+	(VENUS Collab.)