



$$I(J^P) = \frac{1}{2}(\frac{1}{2}^+) \text{ Status: } ****$$

p MASS

The mass is known much more precisely in u (atomic mass units) than in MeV; see the footnote. The conversion from u to MeV, $1 \text{ u} = 931.49432 \pm 0.00028 \text{ MeV}$, involves the relatively poorly known electronic charge.

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
938.27231 ± 0.00028	¹ COHEN	87	RVUE 1986 CODATA value
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
938.2796 ± 0.0027	COHEN	73	RVUE 1973 CODATA value
¹ The mass is known much more precisely in u: $m = 1.007276470 \pm 0.000000012 \text{ u}$.			

\bar{p} MASS

See, however, the next entry in the Listings, which establishes the \bar{p} mass much more precisely.

<u>VALUE (MeV)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
938.30 ± 0.13	ROBERTS	78	CNTR
938.229 ± 0.049	ROBERSON	77	CNTR
938.179 ± 0.058	HU	75	CNTR Exotic atoms
938.3 ± 0.5	BAMBERGER	70	CNTR

\bar{p}/p CHARGE-TO-MASS RATIO, $|\frac{q_{\bar{p}}}{m_{\bar{p}}}| / (\frac{q_p}{m_p})$

A test of *CPT* invariance. Listed here are measurements involving the *inertial* masses. For a discussion of what may be inferred about the ratio of \bar{p} and p *gravitational* masses, see ERICSON 90; they obtain an upper bound of 10^{-6} – 10^{-7} for violation of the equivalence principle for \bar{p} 's.

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
1.0000000015 ± 0.0000000011	² GABRIELSE	95	TRAP Penning trap
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
1.000000023 ± 0.000000042	³ GABRIELSE	90	TRAP Penning trap
² Equation (2) of GABRIELSE 95 should read $M(\bar{p})/M(p) = 0.999\,999\,9985$ (11) (G. Gabrielse, private communication).			
³ GABRIELSE 90 also measures $m_{\bar{p}}/m_{e^-} = 1836.152660 \pm 0.000083$ and $m_p/m_{e^-} = 1836.152680 \pm 0.000088$. Both are completely consistent with the 1986 CODATA (COHEN 87) value for m_p/m_{e^-} of 1836.152701 ± 0.000037 . We use the CODATA values of the masses (they come from an overall fit to a variety of data on the fundamental constants) and don't try to take into account more recent measurements involving the masses.			

$$\left(\left| \frac{q_{\bar{p}}}{m_{\bar{p}}} - \frac{q_p}{m_p} \right| \right) / \left| \frac{q}{m} \right|_{\text{average}}$$

A test of *CPT* invariance. Taken from the \bar{p}/p charge-to-mass ratio, above.

<u>VALUE</u>	<u>DOCUMENT ID</u>
$(1.5 \pm 1.1) \times 10^{-9}$ OUR EVALUATION	

$$|q_p + q_{\bar{p}}|/e$$

A test of *CPT* invariance. Note that the \bar{p}/p charge-to-mass ratio, given above, is much better determined. See also a similar test involving the electron.

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
$< 2 \times 10^{-5}$	⁴ HUGHES	92 RVUE

⁴ HUGHES 92 uses recent measurements of Rydberg-energy and cyclotron-frequency ratios.

$$|q_p + q_e|/e$$

See DYLLA 73 for a summary of experiments on the neutrality of matter. See also "n CHARGE" in the neutron Listings.

<u>VALUE</u>	<u>DOCUMENT ID</u>	<u>COMMENT</u>
$< 1.0 \times 10^{-21}$	⁵ DYLLA	73 Neutrality of SF ₆
• • • We do not use the following data for averages, fits, limits, etc. • • •		
$< 0.8 \times 10^{-21}$	MARINELLI	84 Magnetic levitation
⁵ Assumes that $q_n = q_p + q_e$.		

p MAGNETIC MOMENT

See the "Note on Baryon Magnetic Moments" in the Λ Listings.

<u>VALUE (μ_N)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
$2.792847386 \pm 0.000000063$	COHEN	87 RVUE	1986 CODATA value
• • • We do not use the following data for averages, fits, limits, etc. • • •			
2.7928456 ± 0.0000011	COHEN	73 RVUE	1973 CODATA value

\bar{p} MAGNETIC MOMENT

A few early results have been omitted.

<u>VALUE (μ_N)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-2.800 ± 0.008 OUR AVERAGE			
-2.8005 ± 0.0090	KREISSL	88 CNTR	\bar{p} ²⁰⁸ Pb 11 → 10 X-ray
-2.817 ± 0.048	ROBERTS	78 CNTR	
-2.791 ± 0.021	HU	75 CNTR	Exotic atoms

$$(\mu_p + \mu_{\bar{p}}) / |\mu|_{\text{average}}$$

A test of *CPT* invariance. Calculated from the *p* and \bar{p} magnetic moments, above.

<u>VALUE</u>	<u>DOCUMENT ID</u>
(-2.6±2.9) × 10⁻³ OUR EVALUATION	

***p* ELECTRIC DIPOLE MOMENT**

A nonzero value is forbidden by both *T* invariance and *P* invariance.

<u>VALUE (10⁻²³ ecm)</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
- 3.7± 6.3		CHO	89 NMR	TI F molecules
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●				
< 400		DZUBA	85 THEO	Uses ¹²⁹ Xe moment
130 ± 200		⁶ WILKENING	84	
900 ± 1400		⁷ WILKENING	84	
700 ± 900	1G	HARRISON	69 MBR	Molecular beam

⁶ This WILKENING 84 value includes a finite-size effect and a magnetic effect.

⁷ This WILKENING 84 value is more cautious than the other and excludes the finite-size effect, which relies on uncertain nuclear integrals.

***p* ELECTRIC POLARIZABILITY $\bar{\alpha}_p$**

<u>VALUE (10⁻⁴ fm³)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
12.1 ± 0.8 ± 0.5	⁸ MACGIBBON	95 RVUE	global average
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●			
12.5 ± 0.6 ± 0.9	MACGIBBON	95 CNTR	γp Compton scattering
9.8 ± 0.4 ± 1.1	HALLIN	93 CNTR	γp Compton scattering
10.6 ^{+1.25+1.07} _{-1.19-1.03}	ZIEGER	92 CNTR	γp Compton scattering
10.9 ± 2.2 ± 1.3	⁹ FEDERSPIEL	91 CNTR	γp Compton scattering

⁸ MACGIBBON 95 combine the results of ZIEGER 92, FEDERSPIEL 91, and their own experiment to get a "global average" in which model errors and systematic errors are treated in a consistent way. See MACGIBBON 95 for a discussion.

⁹ FEDERSPIEL 91 obtains for the (static) electric polarizability α_p , defined in terms of the induced electric dipole moment by $\mathbf{D} = 4\pi\epsilon_0\alpha_p\mathbf{E}$, the value $(7.0 \pm 2.2 \pm 1.3) \times 10^{-4} \text{ fm}^3$.

***p* MAGNETIC POLARIZABILITY $\bar{\beta}_p$**

The electric and magnetic polarizabilities are subject to a dispersion sum-rule constraint $\bar{\alpha} + \bar{\beta} = (14.2 \pm 0.5) \times 10^{-4} \text{ fm}^3$. Errors here are anticorrelated with those on $\bar{\alpha}_p$ due to this constraint.

<u>VALUE (10⁻⁴ fm³)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
2.1 ± 0.8 ± 0.5	¹⁰ MACGIBBON	95 RVUE	global average

• • • We do not use the following data for averages, fits, limits, etc. • • •

1.7 ±0.6 ±0.9	MACGIBBON	95	CNTR	γp	Compton scattering
4.4 ±0.4 ±1.1	HALLIN	93	CNTR	γp	Compton scattering
3.58 ^{+1.19+1.03} -1.25-1.07	ZIEGER	92	CNTR	γp	Compton scattering
3.3 ±2.2 ±1.3	FEDERSPIEL	91	CNTR	γp	Compton scattering

¹⁰ MACGIBBON 95 combine the results of ZIEGER 92, FEDERSPIEL 91, and their own experiment to get a "global average" in which model errors and systematic errors are treated in a consistent way. See MACGIBBON 95 for a discussion.

p MEAN LIFE

A test of baryon conservation. See the " p Partial Mean Lives" section below for limits that depend on decay modes. p = proton, n = bound neutron.

<u>LIMIT</u> (years)	<u>PARTICLE</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>1.6 × 10²⁵	p, n	11,12 EVANS	77

• • • We do not use the following data for averages, fits, limits, etc. • • •

>3 × 10 ²³	p	¹² DIX	70 CNTR
>3 × 10 ²³	p, n	^{12,13} FLEROV	58

¹¹ Mean lifetime of nucleons in ¹³⁰Te nuclei.

¹² Converted to mean life by dividing half-life by $\ln(2) = 0.693$.

¹³ Mean lifetime of nucleons in ²³²Th nuclei.

\bar{p} MEAN LIFE

The best limit by far, that of GOLDEN 79, relies, however, on a number of astrophysical assumptions. The other limits come from direct observations of stored antiprotons. See also " \bar{p} Partial Mean Lives" after " p Partial Mean Lives," below.

<u>LIMIT</u> (years)	<u>CL%</u>	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>0.28			GABRIELSE	90 TRAP	Penning trap
>0.08	90	1	BELL	79 CNTR	Storage ring
>1 × 10 ⁷			GOLDEN	79 SPEC	\bar{p}/p , cosmic rays
>3.7 × 10 ⁻³			BREGMAN	78 CNTR	Storage ring

ρ DECAY MODES

Below, for N decays, p and n distinguish proton and neutron partial life-times. See also the "Note on Nucleon Decay" in our 1994 edition (Phys. Rev. **D50**, 1673) for a short review.

The "partial mean life" limits tabulated here are the limits on τ/B_i , where τ is the total mean life and B_i is the branching fraction for the mode in question.

Mode	Partial mean life (10^{30} years)	Confidence level
Antilepton + meson		
τ_1 $N \rightarrow e^+ \pi$	> 130 (n), > 550 (p)	90%
τ_2 $N \rightarrow \mu^+ \pi$	> 100 (n), > 270 (p)	90%
τ_3 $N \rightarrow \nu \pi$	> 100 (n), > 25 (p)	90%
τ_4 $p \rightarrow e^+ \eta$	> 140	90%
τ_5 $p \rightarrow \mu^+ \eta$	> 69	90%
τ_6 $n \rightarrow \nu \eta$	> 54	90%
τ_7 $N \rightarrow e^+ \rho$	> 58 (n), > 75 (p)	90%
τ_8 $N \rightarrow \mu^+ \rho$	> 23 (n), > 110 (p)	90%
τ_9 $N \rightarrow \nu \rho$	> 19 (n), > 27 (p)	90%
τ_{10} $p \rightarrow e^+ \omega$	> 45	90%
τ_{11} $p \rightarrow \mu^+ \omega$	> 57	90%
τ_{12} $n \rightarrow \nu \omega$	> 43	90%
τ_{13} $N \rightarrow e^+ K$	> 1.3 (n), > 150 (p)	90%
τ_{14} $p \rightarrow e^+ K_S^0$	> 76	90%
τ_{15} $p \rightarrow e^+ K_L^0$	> 44	90%
τ_{16} $N \rightarrow \mu^+ K$	> 1.1 (n), > 120 (p)	90%
τ_{17} $p \rightarrow \mu^+ K_S^0$	> 64	90%
τ_{18} $p \rightarrow \mu^+ K_L^0$	> 44	90%
τ_{19} $N \rightarrow \nu K$	> 86 (n), > 100 (p)	90%
τ_{20} $p \rightarrow e^+ K^*(892)^0$	> 52	90%
τ_{21} $N \rightarrow \nu K^*(892)$	> 22 (n), > 20 (p)	90%
Antilepton + mesons		
τ_{22} $p \rightarrow e^+ \pi^+ \pi^-$	> 21	90%
τ_{23} $p \rightarrow e^+ \pi^0 \pi^0$	> 38	90%
τ_{24} $n \rightarrow e^+ \pi^- \pi^0$	> 32	90%
τ_{25} $p \rightarrow \mu^+ \pi^+ \pi^-$	> 17	90%
τ_{26} $p \rightarrow \mu^+ \pi^0 \pi^0$	> 33	90%
τ_{27} $n \rightarrow \mu^+ \pi^- \pi^0$	> 33	90%
τ_{28} $n \rightarrow e^+ K^0 \pi^-$	> 18	90%

Lepton + meson

τ_{29}	$n \rightarrow e^- \pi^+$	> 65	90%
τ_{30}	$n \rightarrow \mu^- \pi^+$	> 49	90%
τ_{31}	$n \rightarrow e^- \rho^+$	> 62	90%
τ_{32}	$n \rightarrow \mu^- \rho^+$	> 7	90%
τ_{33}	$n \rightarrow e^- K^+$	> 32	90%
τ_{34}	$n \rightarrow \mu^- K^+$	> 57	90%

Lepton + mesons

τ_{35}	$p \rightarrow e^- \pi^+ \pi^+$	> 30	90%
τ_{36}	$n \rightarrow e^- \pi^+ \pi^0$	> 29	90%
τ_{37}	$p \rightarrow \mu^- \pi^+ \pi^+$	> 17	90%
τ_{38}	$n \rightarrow \mu^- \pi^+ \pi^0$	> 34	90%
τ_{39}	$p \rightarrow e^- \pi^+ K^+$	> 20	90%
τ_{40}	$p \rightarrow \mu^- \pi^+ K^+$	> 5	90%

Antilepton + photon(s)

τ_{41}	$p \rightarrow e^+ \gamma$	> 460	90%
τ_{42}	$p \rightarrow \mu^+ \gamma$	> 380	90%
τ_{43}	$n \rightarrow \nu \gamma$	> 24	90%
τ_{44}	$p \rightarrow e^+ \gamma \gamma$	> 100	90%

Three (or more) leptons

τ_{45}	$p \rightarrow e^+ e^+ e^-$	> 510	90%
τ_{46}	$p \rightarrow e^+ \mu^+ \mu^-$	> 81	90%
τ_{47}	$p \rightarrow e^+ \nu \nu$	> 11	90%
τ_{48}	$n \rightarrow e^+ e^- \nu$	> 74	90%
τ_{49}	$n \rightarrow \mu^+ e^- \nu$	> 47	90%
τ_{50}	$n \rightarrow \mu^+ \mu^- \nu$	> 42	90%
τ_{51}	$p \rightarrow \mu^+ e^+ e^-$	> 91	90%
τ_{52}	$p \rightarrow \mu^+ \mu^+ \mu^-$	> 190	90%
τ_{53}	$p \rightarrow \mu^+ \nu \nu$	> 21	90%
τ_{54}	$p \rightarrow e^- \mu^+ \mu^+$	> 6	90%
τ_{55}	$n \rightarrow 3\nu$	> 0.0005	90%
τ_{56}	$n \rightarrow 5\nu$		

Inclusive modes

τ_{57}	$N \rightarrow e^+$ anything	> 0.6 (n, p)	90%
τ_{58}	$N \rightarrow \mu^+$ anything	> 12 (n, p)	90%
τ_{59}	$N \rightarrow \nu$ anything		
τ_{60}	$N \rightarrow e^+ \pi^0$ anything	> 0.6 (n, p)	90%
τ_{61}	$N \rightarrow 2$ bodies, ν -free		

$\Delta B = 2$ dinucleon modes

The following are lifetime limits per iron nucleus.

τ_{62}	$pp \rightarrow \pi^+ \pi^+$	> 0.7	90%
τ_{63}	$pn \rightarrow \pi^+ \pi^0$	> 2	90%
τ_{64}	$nn \rightarrow \pi^+ \pi^-$	> 0.7	90%
τ_{65}	$nn \rightarrow \pi^0 \pi^0$	> 3.4	90%
τ_{66}	$pp \rightarrow e^+ e^+$	> 5.8	90%
τ_{67}	$pp \rightarrow e^+ \mu^+$	> 3.6	90%
τ_{68}	$pp \rightarrow \mu^+ \mu^+$	> 1.7	90%
τ_{69}	$pn \rightarrow e^+ \bar{\nu}$	> 2.8	90%
τ_{70}	$pn \rightarrow \mu^+ \bar{\nu}$	> 1.6	90%
τ_{71}	$nn \rightarrow \nu_e \bar{\nu}_e$	> 0.000012	90%
τ_{72}	$nn \rightarrow \nu_\mu \bar{\nu}_\mu$	> 0.000006	90%

\bar{p} DECAY MODES

Mode	Partial mean life (years)	Confidence level
τ_{73} $\bar{p} \rightarrow e^- \gamma$	> 1848	95%
τ_{74} $\bar{p} \rightarrow \mu^- \gamma$	> 50000	90%
τ_{75} $\bar{p} \rightarrow e^- \pi^0$	> 554	95%
τ_{76} $\bar{p} \rightarrow \mu^- \pi^0$	> 48000	90%
τ_{77} $\bar{p} \rightarrow e^- \eta$	> 171	95%
τ_{78} $\bar{p} \rightarrow \mu^- \eta$	> 7900	90%
τ_{79} $\bar{p} \rightarrow e^- K_S^0$	> 29	95%
τ_{80} $\bar{p} \rightarrow \mu^- K_S^0$	> 4300	90%
τ_{81} $\bar{p} \rightarrow e^- K_L^0$	> 9	95%
τ_{82} $\bar{p} \rightarrow \mu^- K_L^0$	> 6500	90%
τ_{83} $\bar{p} \rightarrow \mu^- \gamma \gamma$	> 23000	90%

p PARTIAL MEAN LIVES

The "partial mean life" limits tabulated here are the limits on τ/B_i , where τ is the total mean life for the proton and B_i is the branching fraction for the mode in question.

Decaying particle: p = proton, n = bound neutron. The same event may appear under more than one partial decay mode. Background estimates may be accurate to a factor of two.

$\tau(N \rightarrow e^+ \pi)$

τ_1

LIMIT (10^{30} years)	PARTICLE	CL%	EVTS	BKGD EST	DOCUMENT ID	TECN
>1600	p	90	0	0.1	SHIOZAWA	98 SKAM
> 130	n	90	0	<0.2	HIRATA	89C KAMI

• • • We do not use the following data for averages, fits, limits, etc. • • •

> 70	<i>p</i>	90	0 0.5	BERGER	91	FREJ
> 70	<i>n</i>	90	0 ≤ 0.1	BERGER	91	FREJ
> 550	<i>p</i>	90	0 0.7	¹⁴ BECKER-SZ...	90	IMB3
> 260	<i>p</i>	90	0 <0.04	HIRATA	89C	KAMI
> 310	<i>p</i>	90	0 0.6	SEIDEL	88	IMB
> 100	<i>n</i>	90	0 1.6	SEIDEL	88	IMB
> 1.3	<i>n</i>	90	0	BARTELT	87	SOUD
> 1.3	<i>p</i>	90	0	BARTELT	87	SOUD
> 250	<i>p</i>	90	0 0.3	HAINES	86	IMB
> 31	<i>n</i>	90	8 9	HAINES	86	IMB
> 64	<i>p</i>	90	0 <0.4	ARISAKA	85	KAMI
> 26	<i>n</i>	90	0 <0.7	ARISAKA	85	KAMI
> 82	<i>p</i> (free)	90	0 0.2	BLEWITT	85	IMB
> 250	<i>p</i>	90	0 0.2	BLEWITT	85	IMB
> 25	<i>n</i>	90	4 4	PARK	85	IMB
> 15	<i>p, n</i>	90	0	BATTISTONI	84	NUSX
> 0.5	<i>p</i>	90	1 0.3	¹⁵ BARTELT	83	SOUD
> 0.5	<i>n</i>	90	1 0.3	¹⁵ BARTELT	83	SOUD
> 5.8	<i>p</i>	90	2	¹⁶ KRISHNA...	82	KOLR
> 5.8	<i>n</i>	90	2	¹⁶ KRISHNA...	82	KOLR
> 0.1	<i>n</i>	90		¹⁷ GURR	67	CNTR

¹⁴This BECKER-SZENDY 90 result includes data from SEIDEL 88.

¹⁵Limit based on zero events.

¹⁶We have calculated 90% CL limit from 1 confined event.

¹⁷We have converted half-life to 90% CL mean life.

$\tau(N \rightarrow \mu^+ \pi)$

T2

LIMIT (10 ³⁰ years)	PARTICLE	CL%	EVTS	BKGD EST	DOCUMENT ID	TECN
>100	<i>n</i>	90	0	<0.2	HIRATA	89C KAMI
>270	<i>p</i>	90	0	0.5	SEIDEL	88 IMB

• • • We do not use the following data for averages, fits, limits, etc. • • •

> 81	<i>p</i>	90	0 0.2	BERGER	91	FREJ
> 35	<i>n</i>	90	1 1.0	BERGER	91	FREJ
>230	<i>p</i>	90	0 <0.07	HIRATA	89C	KAMI
> 63	<i>n</i>	90	0 0.5	SEIDEL	88	IMB
> 76	<i>p</i>	90	2 1	HAINES	86	IMB
> 23	<i>n</i>	90	8 7	HAINES	86	IMB
> 46	<i>p</i>	90	0 <0.7	ARISAKA	85	KAMI
> 20	<i>n</i>	90	0 <0.4	ARISAKA	85	KAMI
> 59	<i>p</i> (free)	90	0 0.2	BLEWITT	85	IMB
>100	<i>p</i>	90	1 0.4	BLEWITT	85	IMB
> 38	<i>n</i>	90	1 4	PARK	85	IMB
> 10	<i>p, n</i>	90	0	BATTISTONI	84	NUSX
> 1.3	<i>p, n</i>	90	0	ALEKSEEV	81	BAKS

$\tau(N \rightarrow \nu\pi)$

T3

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
> 25	p	90	32	32.8	HIRATA	89C KAMI
>100	n	90	1	3	HIRATA	89C KAMI
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
> 13	n	90	1	1.2	BERGER	89 FREJ
> 10	p	90	11	14	BERGER	89 FREJ
> 6	n	90	73	60	HAINES	86 IMB
> 2	p	90	16	13	KAJITA	86 KAMI
> 40	n	90	0	1	KAJITA	86 KAMI
> 7	n	90	28	19	PARK	85 IMB
> 7	n	90	0		BATTISTONI	84 NUSX
> 2	p	90	≤ 3		BATTISTONI	84 NUSX
> 5.8	p	90	1		¹⁸ KRISHNA...	82 KOLR
> 0.3	p	90	2		¹⁹ CHERRY	81 HOME
> 0.1	p	90			²⁰ GURR	67 CNTR

¹⁸ We have calculated 90% CL limit from 1 confined event.

¹⁹ We have converted 2 possible events to 90% CL limit.

²⁰ We have converted half-life to 90% CL mean life.

$\tau(p \rightarrow e^+ \eta)$

T4

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>140	p	90	0	<0.04	HIRATA	89C KAMI
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
> 44	p	90	0	0.1	BERGER	91 FREJ
>100	p	90	0	0.6	SEIDEL	88 IMB
>200	p	90	5	3.3	HAINES	86 IMB
> 64	p	90	0	<0.8	ARISAKA	85 KAMI
> 64	p (free)	90	5	6.5	BLEWITT	85 IMB
>200	p	90	5	4.7	BLEWITT	85 IMB
> 1.2	p	90	2		²¹ CHERRY	81 HOME

²¹ We have converted 2 possible events to 90% CL limit.

$\tau(p \rightarrow \mu^+ \eta)$

T5

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>69	p	90	1	<0.08	HIRATA	89C KAMI
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
>26	p	90	1	0.8	BERGER	91 FREJ
> 1.3	p	90	0	0.7	PHILLIPS	89 HPW
>34	p	90	1	1.5	SEIDEL	88 IMB
>46	p	90	7	6	HAINES	86 IMB
>26	p	90	1	<0.8	ARISAKA	85 KAMI
>17	p (free)	90	6	6	BLEWITT	85 IMB
>46	p	90	7	8	BLEWITT	85 IMB

$\tau(n \rightarrow \nu\eta)$

76

LIMIT (10 ³⁰ years)	PARTICLE	CL%	EVTS	BKGD EST	DOCUMENT ID	TECN
>54	<i>n</i>	90	2	0.9	HIRATA	89C KAMI
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
>29	<i>n</i>	90	0	0.9	BERGER	89 FREJ
>16	<i>n</i>	90	3	2.1	SEIDEL	88 IMB
>25	<i>n</i>	90	7	6	HAINES	86 IMB
>30	<i>n</i>	90	0	0.4	KAJITA	86 KAMI
>18	<i>n</i>	90	4	3	PARK	85 IMB
> 0.6	<i>n</i>	90	2		²² CHERRY	81 HOME

²²We have converted 2 possible events to 90% CL limit.

$\tau(N \rightarrow e^+ \rho)$

77

LIMIT (10 ³⁰ years)	PARTICLE	CL%	EVTS	BKGD EST	DOCUMENT ID	TECN
>75	<i>p</i>	90	2	2.7	HIRATA	89C KAMI
>58	<i>n</i>	90	0	1.9	HIRATA	89C KAMI
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
>29	<i>p</i>	90	0	2.2	BERGER	91 FREJ
>41	<i>n</i>	90	0	1.4	BERGER	91 FREJ
>38	<i>n</i>	90	2	4.1	SEIDEL	88 IMB
> 1.2	<i>p</i>	90	0		BARTELT	87 SOUD
> 1.5	<i>n</i>	90	0		BARTELT	87 SOUD
>17	<i>p</i>	90	7	7	HAINES	86 IMB
>14	<i>n</i>	90	9	4	HAINES	86 IMB
>12	<i>p</i>	90	0	<1.2	ARISAKA	85 KAMI
> 6	<i>n</i>	90	2	<1	ARISAKA	85 KAMI
> 6.7	<i>p</i> (free)	90	6	6	BLEWITT	85 IMB
>17	<i>p</i>	90	7	7	BLEWITT	85 IMB
>12	<i>n</i>	90	4	2	PARK	85 IMB
> 0.6	<i>n</i>	90	1	0.3	²³ BARTELT	83 SOUD
> 0.5	<i>p</i>	90	1	0.3	²³ BARTELT	83 SOUD
> 9.8	<i>p</i>	90	1		²⁴ KRISHNA...	82 KOLR
> 0.8	<i>p</i>	90	2		²⁵ CHERRY	81 HOME

²³Limit based on zero events.

²⁴We have calculated 90% CL limit from 0 confined events.

²⁵We have converted 2 possible events to 90% CL limit.

$\tau(N \rightarrow \mu^+ \rho)$

78

LIMIT (10 ³⁰ years)	PARTICLE	CL%	EVTS	BKGD EST	DOCUMENT ID	TECN
>110	<i>p</i>	90	0	1.7	HIRATA	89C KAMI
> 23	<i>n</i>	90	1	1.8	HIRATA	89C KAMI

• • • We do not use the following data for averages, fits, limits, etc. • • •

> 12	p	90	0	0.5	BERGER	91	FREJ
> 22	n	90	0	1.1	BERGER	91	FREJ
> 4.3	p	90	0	0.7	PHILLIPS	89	HPW
> 30	p	90	0	0.5	SEIDEL	88	IMB
> 11	n	90	1	1.1	SEIDEL	88	IMB
> 16	p	90	4	4.5	HAINES	86	IMB
> 7	n	90	6	5	HAINES	86	IMB
> 12	p	90	0	<0.7	ARISAKA	85	KAMI
> 5	n	90	1	<1.2	ARISAKA	85	KAMI
> 5.5	p (free)	90	4	5	BLEWITT	85	IMB
> 16	p	90	4	5	BLEWITT	85	IMB
> 9	n	90	1	2	PARK	85	IMB

$\tau(N \rightarrow \nu \rho)$

τ_9

LIMIT (10^{30} years)	PARTICLE	CL%	EVTS	BKGD EST	DOCUMENT ID	TECN
>27	p	90	5	1.5	HIRATA	89C KAMI
>19	n	90	0	0.5	SEIDEL	88 IMB

• • • We do not use the following data for averages, fits, limits, etc. • • •

> 9	n	90	4	2.4	BERGER	89	FREJ
>24	p	90	0	0.9	BERGER	89	FREJ
>13	n	90	4	3.6	HIRATA	89C	KAMI
>13	p	90	1	1.1	SEIDEL	88	IMB
> 8	p	90	6	5	HAINES	86	IMB
> 2	n	90	15	10	HAINES	86	IMB
>11	p	90	2	1	KAJITA	86	KAMI
> 4	n	90	2	2	KAJITA	86	KAMI
> 4.1	p (free)	90	6	7	BLEWITT	85	IMB
> 8.4	p	90	6	5	BLEWITT	85	IMB
> 2	n	90	7	3	PARK	85	IMB
> 0.9	p	90	2		²⁶ CHERRY	81	HOME
> 0.6	n	90	2		²⁶ CHERRY	81	HOME

²⁶We have converted 2 possible events to 90% CL limit.

$\tau(p \rightarrow e^+ \omega)$

τ_{10}

LIMIT (10^{30} years)	PARTICLE	CL%	EVTS	BKGD EST	DOCUMENT ID	TECN
>45	p	90	2	1.45	HIRATA	89C KAMI

• • • We do not use the following data for averages, fits, limits, etc. • • •

>17	p	90	0	1.1	BERGER	91	FREJ
>26	p	90	1	1.0	SEIDEL	88	IMB
> 1.5	p	90	0		BARTELT	87	SOUD
>37	p	90	6	5.3	HAINES	86	IMB
>25	p	90	1	<1.4	ARISAKA	85	KAMI
>12	p (free)	90	6	7.5	BLEWITT	85	IMB
>37	p	90	6	5.7	BLEWITT	85	IMB
> 0.6	p	90	1	0.3	²⁷ BARTELT	83	SOUD
> 9.8	p	90	1		²⁸ KRISHNA...	82	KOLR
> 2.8	p	90	2		²⁹ CHERRY	81	HOME

²⁷ Limit based on zero events.

²⁸ We have calculated 90% CL limit from 0 confined events.

²⁹ We have converted 2 possible events to 90% CL limit.

$\tau(p \rightarrow \mu^+ \omega)$

τ_{11}

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>57	p	90	2	1.9	HIRATA	89C KAMI

••• We do not use the following data for averages, fits, limits, etc. •••

>11	p	90	0	1.0	BERGER	91 FREJ
> 4.4	p	90	0	0.7	PHILLIPS	89 HPW
>10	p	90	2	1.3	SEIDEL	88 IMB
>23	p	90	2	1	HAINES	86 IMB
> 6.5	p (free)	90	9	8.7	BLEWITT	85 IMB
>23	p	90	8	7	BLEWITT	85 IMB

$\tau(n \rightarrow \nu \omega)$

τ_{12}

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>43	n	90	3	2.7	HIRATA	89C KAMI

••• We do not use the following data for averages, fits, limits, etc. •••

>17	n	90	1	0.7	BERGER	89 FREJ
> 6	n	90	2	1.3	SEIDEL	88 IMB
>12	n	90	6	6	HAINES	86 IMB
>18	n	90	2	2	KAJITA	86 KAMI
>16	n	90	1	2	PARK	85 IMB
> 2.0	n	90	2		³⁰ CHERRY	81 HOME

³⁰ We have converted 2 possible events to 90% CL limit.

$\tau(N \rightarrow e^+ K)$

τ_{13}

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>150	p	90	0	<0.27	HIRATA	89C KAMI
> 1.3	n	90	0		ALEKSEEV	81 BAKS

••• We do not use the following data for averages, fits, limits, etc. •••

> 60	p	90	0		BERGER	91 FREJ
> 70	p	90	0	1.8	SEIDEL	88 IMB
> 77	p	90	5	4.5	HAINES	86 IMB
> 38	p	90	0	<0.8	ARISAKA	85 KAMI
> 24	p (free)	90	7	8.5	BLEWITT	85 IMB
> 77	p	90	5	4	BLEWITT	85 IMB
> 1.3	p	90	0		ALEKSEEV	81 BAKS

$\tau(p \rightarrow e^+ K_S^0)$

τ_{14}

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>76	p	90	0	0.5	BERGER	91 FREJ

$\tau(p \rightarrow e^+ K_L^0)$

τ_{15}

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>44	p	90	0	≤ 0.1	BERGER	91 FREJ

$\tau(N \rightarrow \mu^+ K)$

τ_{16}

LIMIT (10^{30} years)	PARTICLE	CL%	EVTS	BKGD EST	DOCUMENT ID	TECN
>120	p	90	1	0.4	HIRATA	89C KAMI
> 1.1	n	90	0		BARTELT	87 SOUD
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
> 54	p	90	0		BERGER	91 FREJ
> 3.0	p	90	0	0.7	PHILLIPS	89 HPW
> 19	p	90	3	2.5	SEIDEL	88 IMB
> 1.5	p	90	0		³¹ BARTELT	87 SOUD
> 40	p	90	7	6	HAINES	86 IMB
> 19	p	90	1	<1.1	ARISAKA	85 KAMI
> 6.7	p (free)	90	11	13	BLEWITT	85 IMB
> 40	p	90	7	8	BLEWITT	85 IMB
> 6	p	90	1		BATTISTONI	84 NUSX
> 0.6	p	90	0		³² BARTELT	83 SOUD
> 0.4	n	90	0		³² BARTELT	83 SOUD
> 5.8	p	90	2		³³ KRISHNA...	82 KOLR
> 2.0	p	90	0		CHERRY	81 HOME
> 0.2	n	90			³⁴ GURR	67 CNTR

³¹ BARTELT 87 limit applies to $p \rightarrow \mu^+ K_S^0$.

³² Limit based on zero events.

³³ We have calculated 90% CL limit from 1 confined event.

³⁴ We have converted half-life to 90% CL mean life.

$\tau(p \rightarrow \mu^+ K_S^0)$

τ_{17}

LIMIT (10^{30} years)	PARTICLE	CL%	EVTS	BKGD EST	DOCUMENT ID	TECN
>64	p	90	0	1.2	BERGER	91 FREJ

$\tau(p \rightarrow \mu^+ K_L^0)$

τ_{18}

LIMIT (10^{30} years)	PARTICLE	CL%	EVTS	BKGD EST	DOCUMENT ID	TECN
>44	p	90	0	≤ 0.1	BERGER	91 FREJ

$\tau(N \rightarrow \nu K)$

τ_{19}

LIMIT (10^{30} years)	PARTICLE	CL%	EVTS	BKGD EST	DOCUMENT ID	TECN
>100	p	90	9	7.3	HIRATA	89C KAMI
> 86	n	90	0	2.4	HIRATA	89C KAMI

● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●

> 43	p	90	1	1.54	³⁵ ALLISON	98 SOU2
> 15	n	90	1	1.8	BERGER	89 FREJ
> 15	p	90	1	1.8	BERGER	89 FREJ
> 0.28	p	90	0	0.7	PHILLIPS	89 HPW
> 0.3	p	90	0		BARTELT	87 SOUD
> 0.75	n	90	0		³⁶ BARTELT	87 SOUD
> 10	p	90	6	5	HAINES	86 IMB
> 15	n	90	3	5	HAINES	86 IMB
> 28	p	90	3	3	KAJITA	86 KAMI
> 32	n	90	0	1.4	KAJITA	86 KAMI

> 1.8	p (free)	90	6	11	BLEWITT	85	IMB
> 9.6	p	90	6	5	BLEWITT	85	IMB
> 10	n	90	2	2	PARK	85	IMB
> 5	n	90	0		BATTISTONI	84	NUSX
> 2	p	90	0		BATTISTONI	84	NUSX
> 0.3	n	90	0		³⁷ BARTELT	83	SOUD
> 0.1	p	90	0		³⁷ BARTELT	83	SOUD
> 5.8	p	90	1		³⁸ KRISHNA...	82	KOLR
> 0.3	n	90	2		³⁹ CHERRY	81	HOME

³⁵ This ALLISON 98 limit is with no background subtraction; with subtraction the limit becomes $> 46 \times 10^{30}$ years.

³⁶ BARTELT 87 limit applies to $n \rightarrow \nu K_S^0$.

³⁷ Limit based on zero events.

³⁸ We have calculated 90% CL limit from 1 confined event.

³⁹ We have converted 2 possible events to 90% CL limit.

$\tau(p \rightarrow e^+ K^*(892)^0)$

τ_{20}

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>52	p	90	2	1.55	HIRATA	89C KAMI

• • • We do not use the following data for averages, fits, limits, etc. • • •

>10	p	90	0	0.8	BERGER	91	FREJ
>10	p	90	1	<1	ARISAKA	85	KAMI

$\tau(N \rightarrow \nu K^*(892))$

τ_{21}

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	
>22	n	90	0	2.1	BERGER	89	FREJ
>20	p	90	5	2.1	HIRATA	89C	KAMI

• • • We do not use the following data for averages, fits, limits, etc. • • •

>17	p	90	0	2.4	BERGER	89	FREJ
>21	n	90	4	2.4	HIRATA	89C	KAMI
>10	p	90	7	6	HAINES	86	IMB
> 5	n	90	8	7	HAINES	86	IMB
> 8	p	90	3	2	KAJITA	86	KAMI
> 6	n	90	2	1.6	KAJITA	86	KAMI
> 5.8	p (free)	90	10	16	BLEWITT	85	IMB
> 9.6	p	90	7	6	BLEWITT	85	IMB
> 7	n	90	1	4	PARK	85	IMB
> 2.1	p	90	1		⁴⁰ BATTISTONI	82	NUSX

⁴⁰ We have converted 1 possible event to 90% CL limit.

$\tau(p \rightarrow e^+ \pi^+ \pi^-)$

τ_{22}

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	
>21	p	90	0	2.2	BERGER	91	FREJ

$\tau(p \rightarrow e^+ \pi^0 \pi^0)$

τ_{23}

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	
>38	p	90	1	0.5	BERGER	91	FREJ

$\tau(n \rightarrow e^+ \pi^- \pi^0)$ **T24**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>32	<i>n</i>	90	1	0.8	BERGER	91 FREJ

$\tau(p \rightarrow \mu^+ \pi^+ \pi^-)$ **T25**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>17	<i>p</i>	90	1	2.6	BERGER	91 FREJ

• • • We do not use the following data for averages, fits, limits, etc. • • •

> 3.3	<i>p</i>	90	0	0.7	PHILLIPS	89 HPW
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$\tau(p \rightarrow \mu^+ \pi^0 \pi^0)$ **T26**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>33	<i>p</i>	90	1	0.9	BERGER	91 FREJ

$\tau(n \rightarrow \mu^+ \pi^- \pi^0)$ **T27**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>33	<i>n</i>	90	0	1.1	BERGER	91 FREJ

$\tau(n \rightarrow e^+ K^0 \pi^-)$ **T28**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>18	<i>n</i>	90	1	0.2	BERGER	91 FREJ

$\tau(n \rightarrow e^- \pi^+)$ **T29**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>65	<i>n</i>	90	0	1.6	SEIDEL	88 IMB

• • • We do not use the following data for averages, fits, limits, etc. • • •

>55	<i>n</i>	90	0	1.09	BERGER	91B FREJ
>16	<i>n</i>	90	9	7	HAINES	86 IMB
>25	<i>n</i>	90	2	4	PARK	85 IMB

$\tau(n \rightarrow \mu^- \pi^+)$ **T30**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>49	<i>n</i>	90	0	0.5	SEIDEL	88 IMB

• • • We do not use the following data for averages, fits, limits, etc. • • •

>33	<i>n</i>	90	0	1.40	BERGER	91B FREJ
> 2.7	<i>n</i>	90	0	0.7	PHILLIPS	89 HPW
>25	<i>n</i>	90	7	6	HAINES	86 IMB
>27	<i>n</i>	90	2	3	PARK	85 IMB

$\tau(n \rightarrow e^- \rho^+)$

T31

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>62	<i>n</i>	90	2	4.1	SEIDEL	88 IMB
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
>12	<i>n</i>	90	13	6	HAINES	86 IMB
>12	<i>n</i>	90	5	3	PARK	85 IMB

$\tau(n \rightarrow \mu^- \rho^+)$

T32

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>7	<i>n</i>	90	1	1.1	SEIDEL	88 IMB
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
>2.6	<i>n</i>	90	0	0.7	PHILLIPS	89 HPW
>9	<i>n</i>	90	7	5	HAINES	86 IMB
>9	<i>n</i>	90	2	2	PARK	85 IMB

$\tau(n \rightarrow e^- K^+)$

T33

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>32	<i>n</i>	90	3	2.96	BERGER	91B FREJ
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
> 0.23	<i>n</i>	90	0	0.7	PHILLIPS	89 HPW

$\tau(n \rightarrow \mu^- K^+)$

T34

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>57	<i>n</i>	90	0	2.18	BERGER	91B FREJ
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
> 4.7	<i>n</i>	90	0	0.7	PHILLIPS	89 HPW

$\tau(p \rightarrow e^- \pi^+ \pi^+)$

T35

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>30	<i>p</i>	90	1	2.50	BERGER	91B FREJ
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
> 2.0	<i>p</i>	90	0	0.7	PHILLIPS	89 HPW

$\tau(n \rightarrow e^- \pi^+ \pi^0)$

T36

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>29	<i>n</i>	90	1	0.78	BERGER	91B FREJ

$\tau(p \rightarrow \mu^- \pi^+ \pi^+)$

T37

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>17	<i>p</i>	90	1	1.72	BERGER	91B FREJ
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
> 7.8	<i>p</i>	90	0	0.7	PHILLIPS	89 HPW

$\tau(n \rightarrow \mu^- \pi^+ \pi^0)$ **T38**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>34	<i>n</i>	90	0	0.78	BERGER	91B FREJ

$\tau(p \rightarrow e^- \pi^+ K^+)$ **T39**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>20	<i>p</i>	90	3	2.50	BERGER	91B FREJ

$\tau(p \rightarrow \mu^- \pi^+ K^+)$ **T40**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>5	<i>p</i>	90	2	0.78	BERGER	91B FREJ

$\tau(p \rightarrow e^+ \gamma)$ **T41**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>460	<i>p</i>	90	0	0.6	SEIDEL	88 IMB

• • • We do not use the following data for averages, fits, limits, etc. • • •

>133	<i>p</i>	90	0	0.3	BERGER	91 FREJ
>360	<i>p</i>	90	0	0.3	HAINES	86 IMB
> 87	<i>p</i> (free)	90	0	0.2	BLEWITT	85 IMB
>360	<i>p</i>	90	0	0.2	BLEWITT	85 IMB
> 0.1	<i>p</i>	90			⁴¹ GURR	67 CNTR

⁴¹We have converted half-life to 90% CL mean life.

$\tau(p \rightarrow \mu^+ \gamma)$ **T42**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>380	<i>p</i>	90	0	0.5	SEIDEL	88 IMB

• • • We do not use the following data for averages, fits, limits, etc. • • •

>155	<i>p</i>	90	0	0.1	BERGER	91 FREJ
> 97	<i>p</i>	90	3	2	HAINES	86 IMB
> 61	<i>p</i> (free)	90	0	0.2	BLEWITT	85 IMB
>280	<i>p</i>	90	0	0.6	BLEWITT	85 IMB
> 0.3	<i>p</i>	90			⁴² GURR	67 CNTR

⁴²We have converted half-life to 90% CL mean life.

$\tau(n \rightarrow \nu \gamma)$ **T43**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>24	<i>n</i>	90	10	6.86	BERGER	91B FREJ

• • • We do not use the following data for averages, fits, limits, etc. • • •

> 9	<i>n</i>	90	73	60	HAINES	86 IMB
>11	<i>n</i>	90	28	19	PARK	85 IMB

$\tau(p \rightarrow e^+ \gamma \gamma)$ **T44**

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>100	<i>p</i>	90	1	0.8	BERGER	91 FREJ

$\tau(p \rightarrow e^+ e^+ e^-)$

T45

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>510	<i>p</i>	90	0	0.3	HAINES	86 IMB
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
>147	<i>p</i>	90	0	0.1	BERGER	91 FREJ
> 89	<i>p</i> (free)	90	0	0.5	BLEWITT	85 IMB
>510	<i>p</i>	90	0	0.7	BLEWITT	85 IMB

$\tau(p \rightarrow e^+ \mu^+ \mu^-)$

T46

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>81	<i>p</i>	90	0	0.16	BERGER	91 FREJ
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
> 5.0	<i>p</i>	90	0	0.7	PHILLIPS	89 HPW

$\tau(p \rightarrow e^+ \nu \nu)$

T47

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>11	<i>p</i>	90	11	6.08	BERGER	91B FREJ

$\tau(n \rightarrow e^+ e^- \nu)$

T48

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>74	<i>n</i>	90	0	< 0.1	BERGER	91B FREJ
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
>45	<i>n</i>	90	5	5	HAINES	86 IMB
>26	<i>n</i>	90	4	3	PARK	85 IMB

$\tau(n \rightarrow \mu^+ e^- \nu)$

T49

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>47	<i>n</i>	90	0	< 0.1	BERGER	91B FREJ

$\tau(n \rightarrow \mu^+ \mu^- \nu)$

T50

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>42	<i>n</i>	90	0	1.4	BERGER	91B FREJ
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
> 5.1	<i>n</i>	90	0	0.7	PHILLIPS	89 HPW
>16	<i>n</i>	90	14	7	HAINES	86 IMB
>19	<i>n</i>	90	4	7	PARK	85 IMB

$\tau(p \rightarrow \mu^+ e^+ e^-)$

T51

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>91	<i>p</i>	90	0	≤ 0.1	BERGER	91 FREJ

$\tau(p \rightarrow \mu^+ \mu^+ \mu^-)$

752

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>190	p	90	1	0.1	HAINES	86 IMB
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
>119	p	90	0	0.2	BERGER	91 FREJ
> 10.5	p	90	0	0.7	PHILLIPS	89 HPW
> 44	p (free)	90	1	0.7	BLEWITT	85 IMB
>190	p	90	1	0.9	BLEWITT	85 IMB
> 2.1	p	90	1		⁴³ BATTISTONI	82 NUSX

⁴³We have converted 1 possible event to 90% CL limit.

$\tau(p \rightarrow \mu^+ \nu \nu)$

753

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>21	p	90	7	11.23	BERGER	91B FREJ

$\tau(p \rightarrow e^- \mu^+ \mu^+)$

754

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>6.0	p	90	0	0.7	PHILLIPS	89 HPW

$\tau(n \rightarrow 3\nu)$

755

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>0.00049	n	90	2	2	⁴⁴ SUZUKI	93B KAMI
● ● ● We do not use the following data for averages, fits, limits, etc. ● ● ●						
>0.0023	n	90			⁴⁵ GLICENSTEIN	97 KAMI
>0.00003	n	90	11	6.1	⁴⁶ BERGER	91B FREJ
>0.00012	n	90	7	11.2	⁴⁶ BERGER	91B FREJ
>0.0005	n	90	0		LEARNED	79 RVUE

⁴⁴The SUZUKI 93B limit applies to any of $\nu_e \nu_e \bar{\nu}_e$, $\nu_\mu \nu_\mu \bar{\nu}_\mu$, or $\nu_\tau \nu_\tau \bar{\nu}_\tau$.

⁴⁵GLICENSTEIN 97 uses Kamioka data and the idea that the disappearance of the neutron's magnetic moment should produce radiation.

⁴⁶The first BERGER 91B limit is for $n \rightarrow \nu_e \nu_e \bar{\nu}_e$, the second is for $n \rightarrow \nu_\mu \nu_\mu \bar{\nu}_\mu$.

$\tau(n \rightarrow 5\nu)$

756

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>0.0017	n	90			⁴⁷ GLICENSTEIN	97 KAMI

⁴⁷GLICENSTEIN 97 uses Kamioka data and the idea that the disappearance of the neutron's magnetic moment should produce radiation.

$\tau(N \rightarrow e^+ \text{ anything})$

757

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>0.6	p, n	90			⁴⁸ LEARNED	79 RVUE

⁴⁸The electron may be primary or secondary.

$\tau(N \rightarrow \mu^+ \text{anything})$

T58

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>12	p, n	90	2		49,50 CHERRY	81 HOME
• • • We do not use the following data for averages, fits, limits, etc. • • •						
> 1.8	p, n	90			50 COWSIK	80 CNTR
> 6	p, n	90			50 LEARNED	79 RVUE

⁴⁹We have converted 2 possible events to 90% CL limit.

⁵⁰The muon may be primary or secondary.

$\tau(N \rightarrow \nu \text{anything})$

T59

Anything = π, ρ, K , etc.

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •						
>0.0002	p, n	90	0		LEARNED	79 RVUE

$\tau(N \rightarrow e^+ \pi^0 \text{anything})$

T60

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
>0.6	p, n	90	0		LEARNED	79 RVUE

$\tau(N \rightarrow 2 \text{ bodies, } \nu\text{-free})$

T61

<u>LIMIT</u> (10^{30} years)	<u>PARTICLE</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>
• • • We do not use the following data for averages, fits, limits, etc. • • •						
>1.3	p, n	90	0		ALEKSEEV	81 BAKS

$\tau(pp \rightarrow \pi^+ \pi^+)$

T62

<u>LIMIT</u> (10^{30} years)	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>0.7	90	4	2.34	BERGER	91B FREJ	τ per iron nucleus

$\tau(pn \rightarrow \pi^+ \pi^0)$

T63

<u>LIMIT</u> (10^{30} years)	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>2.0	90	0	0.31	BERGER	91B FREJ	τ per iron nucleus

$\tau(nn \rightarrow \pi^+ \pi^-)$

T64

<u>LIMIT</u> (10^{30} years)	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>0.7	90	4	2.18	BERGER	91B FREJ	τ per iron nucleus

$\tau(nn \rightarrow \pi^0 \pi^0)$

T65

<u>LIMIT</u> (10^{30} years)	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>3.4	90	0	0.78	BERGER	91B FREJ	τ per iron nucleus

$\tau(pp \rightarrow e^+ e^+)$

T66

<u>LIMIT</u> (10^{30} years)	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>5.8	90	0	<0.1	BERGER	91B FREJ	τ per iron nucleus

$\tau(pp \rightarrow e^+ \mu^+)$ **T67**

<u>LIMIT</u> <u>(10³⁰ years)</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>3.6	90	0	<0.1	BERGER	91B FREJ	τ per iron nucleus

$\tau(pp \rightarrow \mu^+ \mu^+)$ **T68**

<u>LIMIT</u> <u>(10³⁰ years)</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>1.7	90	0	0.62	BERGER	91B FREJ	τ per iron nucleus

$\tau(pn \rightarrow e^+ \bar{\nu})$ **T69**

<u>LIMIT</u> <u>(10³⁰ years)</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>2.8	90	5	9.67	BERGER	91B FREJ	τ per iron nucleus

$\tau(pn \rightarrow \mu^+ \bar{\nu})$ **T70**

<u>LIMIT</u> <u>(10³⁰ years)</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>1.6	90	4	4.37	BERGER	91B FREJ	τ per iron nucleus

$\tau(nn \rightarrow \nu_e \bar{\nu}_e)$ **T71**

<u>LIMIT</u> <u>(10³⁰ years)</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>0.000012	90	5	9.7	BERGER	91B FREJ	τ per iron nucleus

$\tau(nn \rightarrow \nu_\mu \bar{\nu}_\mu)$ **T72**

<u>LIMIT</u> <u>(10³⁰ years)</u>	<u>CL%</u>	<u>EVTS</u>	<u>BKGD EST</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>0.000006	90	4	4.4	BERGER	91B FREJ	τ per iron nucleus

\bar{p} PARTIAL MEAN LIVES

The "partial mean life" limits tabulated here are the limits on $\bar{\tau}/B_i$, where $\bar{\tau}$ is the total mean life for the antiproton and B_i is the branching fraction for the mode in question.

$\tau(\bar{p} \rightarrow e^- \gamma)$ **T73**

<u>VALUE (years)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>1848	95	GEER	94 CALO	8.9 GeV/c \bar{p} beam

$\tau(\bar{p} \rightarrow \mu^- \gamma)$ **T74**

<u>VALUE (years)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>5.0 × 10 ⁴	90	HU	98B APEX	8.9 GeV/c \bar{p} beam

$\tau(\bar{p} \rightarrow e^- \pi^0)$ **T75**

<u>VALUE (years)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>554	95	GEER	94 CALO	8.9 GeV/c \bar{p} beam

$\tau(\bar{p} \rightarrow \mu^- \pi^0)$ **T76**

<u>VALUE (years)</u>	<u>CL%</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
>4.8 × 10 ⁴	90	HU	98B APEX	8.9 GeV/c \bar{p} beam

$\tau(\bar{p} \rightarrow e^- \eta)$					τ_{77}
VALUE (years)	CL%	DOCUMENT ID	TECN	COMMENT	
>171	95	GEER	94 CALO	8.9 GeV/c \bar{p} beam	
$\tau(\bar{p} \rightarrow \mu^- \eta)$					τ_{78}
VALUE (years)	CL%	DOCUMENT ID	TECN	COMMENT	
>7.9 × 10³	90	HU	98B APEX	8.9 GeV/c \bar{p} beam	
$\tau(\bar{p} \rightarrow e^- K_S^0)$					τ_{79}
VALUE (years)	CL%	DOCUMENT ID	TECN	COMMENT	
>29	95	GEER	94 CALO	8.9 GeV/c \bar{p} beam	
$\tau(\bar{p} \rightarrow \mu^- K_S^0)$					τ_{80}
VALUE (years)	CL%	DOCUMENT ID	TECN	COMMENT	
>4.3 × 10³	90	HU	98B APEX	8.9 GeV/c \bar{p} beam	
$\tau(\bar{p} \rightarrow e^- K_L^0)$					τ_{81}
VALUE (years)	CL%	DOCUMENT ID	TECN	COMMENT	
>9	95	GEER	94 CALO	8.9 GeV/c \bar{p} beam	
$\tau(\bar{p} \rightarrow \mu^- K_L^0)$					τ_{82}
VALUE (years)	CL%	DOCUMENT ID	TECN	COMMENT	
>6.5 × 10³	90	HU	98B APEX	8.9 GeV/c \bar{p} beam	
$\tau(\bar{p} \rightarrow \mu^- \gamma\gamma)$					τ_{83}
VALUE (years)	CL%	DOCUMENT ID	TECN	COMMENT	
>2.3 × 10⁴	90	HU	98B APEX	8.9 GeV/c \bar{p} beam	

p REFERENCES

ALLISON	98	PL B427 217	W.W.M. Allison+	(Soudan-2 Collab.)
HU	98B	PR D58 111101	M. Hu+	(FNAL APEX Collab.)
SHIOZAWA	98	PRL 81 3319	M. Shiozawa+	(Super-Kamiokande Collab.)
GLICENSTEIN	97	PL B411 326	J.F. Glicenstein	(SACL)
GABRIELSE	95	PRL 74 3544	+Phillips, Quint+	(HARV, MANZ, SEOUL)
MACGIBBON	95	PR C52 2097	+Garino, Lucas, Nathan+	(ILL, SASK, INRM)
GEER	94	PRL 72 1596	+Marriner, Ray+	(FNAL, UCLA, PSU)
HALLIN	93	PR C48 1497	+Amendt, Bergstrom+	(SASK, BOST, ILL)
SUZUKI	93B	PL B311 357	+Fukuda, Hirata, Inoue+	(KAMIOKANDE Collab.)
HUGHES	92	PRL 69 578	+Deutch	(LANL, AARH)
ZIEGER	92	PL B278 34	+Van de Vyver, Christmann, DeGraeve+	(MPCM)
Also	92B	PL B281 417 (erratum)	Zieger, ..., Van den Abeele, Ziegler	(MPCM)
BERGER	91	ZPHY C50 385	+Froehlich, Moench, Nisius+	(FREJUS Collab.)
BERGER	91B	PL B269 227	+Froehlich, Moench, Nisius+	(FREJUS Collab.)
FEDERSPIEL	91	PRL 67 1511	+Eisenstein, Lucas, MacGibbon+	(ILL)
BECKER-SZ...	90	PR D42 2974	+Becker-Szendy, Bratton, Cady, Casper+	(IMB-3 Collab.)
ERICSON	90	EPL 11 295	+Richter	(CERN, DARM)
GABRIELSE	90	PRL 65 1317	+Fei, Orozco, Tjoelker+	(HARV, MANZ, WASH, IBS)
BERGER	89	NP B313 509	+Froehlich, Moench+	(FREJUS Collab.)
CHO	89	PRL 63 2559	+Sangster, Hinds	(YALE)
HIRATA	89C	PL B220 308	+Kajita, Kifune, Kihara+	(Kamiokande Collab.)
PHILLIPS	89	PL B224 348	+Matthews, Aprile, Cline+	(HPW Collab.)
KREISSL	88	ZPHY C37 557	+Hancock, Koch, Koehler, Poth+	(CERN PS176 Collab.)
SEIDEL	88	PRL 61 2522	+Bionta, Blewitt, Bratton+	(IMB Collab.)
BARTELT	87	PR D36 1990	+Courant, Heller+	(Soudan Collab.)
Also	89	PR D40 1701 erratum	Bartelt, Courant, Heller+	(Soudan Collab.)
COHEN	87	RMP 59 1121	+Taylor	(RISC, NBS)

HAINES	86	PRL 57 1986	+Bionta, Blewitt, Bratton, Casper+	(IMB Collab.)
KAJITA	86	JPSJ 55 711	+Arisaka, Koshiha, Nakahata+	(Kamiokande Collab.)
ARISAKA	85	JPSJ 54 3213	+Kajita, Koshiha, Nakahata+	(Kamiokande Collab.)
BLEWITT	85	PRL 55 2114	+LoSecco, Bionta, Bratton+	(IMB Collab.)
DZUBA	85	PL 154B 93	+Flambaum, Silvestrov	(NOVO)
PARK	85	PRL 54 22	+Blewitt, Cortez, Foster+	(IMB Collab.)
BATTISTONI	84	PL 133B 454	+Bellotti, Bologna, Campana+	(NUSEX Collab.)
MARINELLI	84	PL 137B 439	+Morpurgo	(GENO)
WILKENING	84	PR A29 425	+Ramsey, Larson	(HARV, VIRG)
BARTELT	83	PRL 50 651	+Courant, Heller, Joyce, Marshak+	(MINN, ANL)
BATTISTONI	82	PL 118B 461	+Bellotti, Bologna, Campana+	(NUSEX Collab.)
KRISHNA...	82	PL 115B 349	Krishnaswamy, Menon+	(TATA, OSKC, INUS)
ALEKSEEV	81	JETPL 33 651	+Bakatanov, Butkevich, Voevodskii+	(PNPI)
		Translated from ZETFP 33 664.		
CHERRY	81	PRL 47 1507	+Deakayne, Lande, Lee, Steinberg+	(PENN, BNL)
COWSIK	80	PR D22 2204	+Narasimhan	(TATA)
BELL	79	PL 86B 215	+Calvetti, Carron, Chaney, Cittolin+	(CERN)
GOLDEN	79	PRL 43 1196	+Horan, Mauger, Badhwar, Lacy+	(NASA, PSLI)
LEARNED	79	PRL 43 907	+Reines, Soni	(UCI)
BREGMAN	78	PL 78B 174	+Calvetti, Carron, Cittolin, Hauer, Herr+	(CERN)
ROBERTS	78	PR D17 358		(WILL, RHEL)
EVANS	77	Science 197 989	+Steinberg	(BNL, PENN)
ROBERSON	77	PR C16 1945	+King, Kunselman+	(WYOM, CIT, CMU, VPI, WILL)
HU	75	NP A254 403	+Asano, Chen, Cheng, Dugan+	(COLU, YALE)
COHEN	73	JPCRD 2 663	+Taylor	(RISC, NBS)
DYLLA	73	PR A7 1224	+King	(MIT)
BAMBERGER	70	PL 33B 233	+Lynen, Piekarz+	(MPIH, CERN, KARL)
DIX	70	Thesis Case		(CASE)
HARRISON	69	PRL 22 1263	+Sandars, Wright	(OXF)
GURR	67	PR 158 1321	+Kropp, Reines, Meyer	(CASE, WITW)
FLEROV	58	DOKL 3 79	+Klochkov, Skobkin, Terentev	(ASCI)