Ξ^-

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

The parity has not actually been measured, but + is of course expected.

We have omitted some results that have been superseded by later experiments. See our earlier editions.

Ξ^- MASS

The fit uses the Ξ^-, $\overline{\Xi}^+$, and Ξ^0 masses and the $\Xi^- - \overline{\Xi}^+$ mass difference. It assumes that the Ξ^- and $\overline{\Xi}^+$ masses are the same.

VALUE (MeV)	EVTS		DOCUMENT ID		TECN	COMMENT
1321.71±0.07 OUR FIT						
1321.70±0.08±0.05	2478 ± 68		ABDALLAH	06E	DLPH	from Z decays
• • • We do not use the following data for averages, fits, limits, etc. • • •						
1321.46±0.34	632		DIBIANCA	75	DBC	4.9 GeV/c $K^- d$
1321.12±0.41	268		WILQUET	72	HLBC	
1321.87±0.51	195	1	GOLDWASSER	70	HBC	5.5 GeV/c $K^- p$
1321.67±0.52	6		CHIEN	66	HBC	6.9 GeV/c $\overline{p} p$
1321.4 ±1.1	299		LONDON	66	HBC	
1321.3 ±0.4	149		PJERROU	65B	HBC	
1321.1 ±0.3	241	2	BADIER	64	HBC	
1321.4 ±0.4	517	2	JAUNEAU	63D	FBC	
1321.1 ±0.65	62	2	SCHNEIDER	63	HBC	

[1] GOLDWASSER 70 uses $m_\Lambda = 1115.58$ MeV.

[2] These masses have been increased 0.09 MeV because the Λ mass increased.

$\overline{\Xi}^+$ MASS

The fit uses the Ξ^-, $\overline{\Xi}^+$, and Ξ^0 masses and the $\Xi^- - \overline{\Xi}^+$ mass difference. It assumes that the Ξ^- and $\overline{\Xi}^+$ masses are the same.

VALUE (MeV)	EVTS	DOCUMENT ID		TECN	COMMENT
1321.71±0.07 OUR FIT					
1321.73±0.08±0.05	2256 ± 63	ABDALLAH	06E	DLPH	from Z decays
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1321.6 ±0.8	35	VOTRUBA	72	HBC	10 GeV/c $K^+ p$
1321.2 ±0.4	34	STONE	70	HBC	
1320.69±0.93	5	CHIEN	66	HBC	6.9 GeV/c $\overline{p} p$

$(m_{\Xi^-} - m_{\overline{\Xi}^+}) / m_{\Xi^-}$

A test of CPT invariance.

VALUE	DOCUMENT ID		TECN	COMMENT
$(-2.5\pm8.7) \times 10^{-5}$	ABDALLAH	06E	DLPH	from Z decays

Ξ^- MEAN LIFE

Measurements with an error $> 0.2 \times 10^{-10}$ s or with systematic errors not included have been omitted.

VALUE (10^{-10} s)	EVTS	DOCUMENT ID		TECN	COMMENT
1.639±0.015 OUR AVERAGE					
1.65 ±0.07 ±0.12	2478 ± 68	ABDALLAH	06E	DLPH	from Z decays
1.652±0.051	32k	BOURQUIN	84	SPEC	Hyperon beam
1.665±0.065	41k	BOURQUIN	79	SPEC	Hyperon beam
1.609±0.028	4286	HEMINGWAY	78	HBC	4.2 GeV/c $K^- p$
1.67 ±0.08		DIBIANCA	75	DBC	4.9 GeV/c $K^- d$
1.63 ±0.03	4303	BALTAY	74	HBC	1.75 GeV/c $K^- p$
1.73 $^{+0.08}_{-0.07}$	680	MAYEUR	72	HLBC	2.1 GeV/c K^-
1.61 ±0.04	2610	DAUBER	69	HBC	
1.80 ±0.16	299	LONDON	66	HBC	
1.70 ±0.12	246	PJERROU	65B	HBC	
1.69 ±0.07	794	HUBBARD	64	HBC	
1.86 $^{+0.15}_{-0.14}$	517	JAUNEAU	63D	FBC	

$\overline{\Xi}^+$ MEAN LIFE

VALUE (10^{-10} s)	EVTS	DOCUMENT ID		TECN	COMMENT
1.70±0.08±0.12	2256 ± 63	ABDALLAH	06E	DLPH	from Z decays
• • • We do not use the following data for averages, fits, limits, etc. • • •					
1.55 $^{+0.35}_{-0.20}$	35	[3] VOTRUBA	72	HBC	10 GeV/c $K^+ p$
1.6 ±0.3	34	STONE	70	HBC	
1.9 $^{+0.7}_{-0.5}$	12	[3] SHEN	67	HBC	
1.51±0.55	5	[3] CHIEN	66	HBC	6.9 GeV/c $\overline{p} p$

[3] The error is statistical only.

$(\tau_{\Xi^-} - \tau_{\overline{\Xi}^+}) / \tau_{\Xi^-}$

A test of CPT invariance.

VALUE	DOCUMENT ID		TECN	COMMENT
−0.01±0.07	ABDALLAH	06E	DLPH	from Z decays

Ξ^- MAGNETIC MOMENT

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

VALUE (μ_N)	EVTS	DOCUMENT ID		TECN	COMMENT
−0.6507±0.0025 OUR AVERAGE					
−0.6505±0.0025	4.36M	DURYEA	92	SPEC	800 GeV p Be
−0.661 ±0.036 ±0.036	44k	TROST	89	SPEC	Ξ^- ∼ 250 GeV
−0.69 ±0.04	218k	RAMEIKA	84	SPEC	400 GeV pBe

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

-0.674 ± 0.021 ± 0.020	122k	HO	90	SPEC	See DURYEA 92
-2.1 ± 0.8	2436	COOL	74	OSPK	1.8 GeV/c $K^- p$
-0.1 ± 2.1	2724	BINGHAM	70B	OSPK	1.8 GeV/c $K^- p$

$\overline{\Xi}^+$ MAGNETIC MOMENT

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

VALUE (μ_N)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
+0.657±0.028±0.020	70k	HO	90	SPEC	800 GeV pBe

$(\mu_{\Xi^-} + \mu_{\overline{\Xi}^+}) / |\mu_{\Xi^-}|$

A test of *CPT* invariance. We calculate this from the Ξ^- and $\overline{\Xi}^+$ magnetic moments above.

VALUE	*DOCUMENT ID*
+0.01±0.05 OUR EVALUATION	

Ξ^- DECAY MODES

	Mode		Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\Lambda\pi^-$		(99.887 ± 0.035) %	
Γ_2	$\Sigma^-\gamma$		$(1.27 \pm0.23) \times 10^{-4}$	
Γ_3	$\Lambda e^- \overline{\nu}_e$		$(5.63 \pm0.31) \times 10^{-4}$	
Γ_4	$\Lambda\mu^- \overline{\nu}_\mu$		$(3.5 \; ^{+3.5}_{-2.2}) \times 10^{-4}$	
Γ_5	$\Sigma^0 e^- \overline{\nu}_e$		$(8.7 \pm1.7) \times 10^{-5}$	
Γ_6	$\Sigma^0 \mu^- \overline{\nu}_\mu$		$< 8 \times 10^{-4}$	90%
Γ_7	$\Xi^0 e^- \overline{\nu}_e$		$< 2.3 \times 10^{-3}$	90%
	$\Delta S = 2$ forbidden (*S2*) modes			
Γ_8	$n\pi^-$	*S2*	$< 1.9 \times 10^{-5}$	90%
Γ_9	$ne^- \overline{\nu}_e$	*S2*	$< 3.2 \times 10^{-3}$	90%
Γ_{10}	$n\mu^- \overline{\nu}_\mu$	*S2*	< 1.5 %	90%
Γ_{11}	$p\pi^-\pi^-$	*S2*	$< 4 \times 10^{-4}$	90%
Γ_{12}	$p\pi^- e^- \overline{\nu}_e$	*S2*	$< 4 \times 10^{-4}$	90%
Γ_{13}	$p\pi^- \mu^- \overline{\nu}_\mu$	*S2*	$< 4 \times 10^{-4}$	90%
Γ_{14}	$p\mu^-\mu^-$	*L*	$< 4 \times 10^{-8}$	90%

CONSTRAINED FIT INFORMATION

An overall fit to 4 branching ratios uses 5 measurements and one constraint to determine 5 parameters. The overall fit has a $\chi^2 =$ 1.0 for 1 degrees of freedom.

The following *off-diagonal* array elements are the correlation coefficients $\left\langle\delta x_i\delta x_j\right\rangle/(\delta x_i\cdot\delta x_j)$, in percent, from the fit to the branching fractions, $x_i \equiv \Gamma_i/\Gamma_{total}$. The fit constrains the x_i whose labels appear in this array to sum to one.

x_2	−6			
x_3	−8	0		
x_4	−99	0	−1	
x_5	−5	0	0	0
	x_1	x_2	x_3	x_4

Ξ^- BRANCHING RATIOS

A number of early results have been omitted.

$\Gamma(\Sigma^-\gamma)/\Gamma(\Lambda\pi^-)$ — Γ_2/Γ_1

VALUE (units 10^{-4})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
1.27±0.24 OUR FIT					
1.27±0.23 OUR AVERAGE					
1.22±0.23±0.06	211	[4] DUBBS	94	E761	Ξ^- 375 GeV
2.27±1.02	9	BIAGI	87B	SPEC	SPS hyperon beam

[4] DUBBS 94 also finds weak evidence that the asymmetry parameter α_γ is positive ($\alpha_\gamma = 1.0 \pm 1.3$).

$\Gamma(\Lambda e^-\overline{\nu}_e)/\Gamma(\Lambda\pi^-)$ — Γ_3/Γ_1

VALUE (units 10^{-3})	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
0.564±0.031 OUR FIT					
0.564±0.031	2857	BOURQUIN	83	SPEC	SPS hyperon beam
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.30 ±0.13	11	THOMPSON	80	ASPK	Hyperon beam

$\Gamma(\Lambda\mu^-\overline{\nu}_\mu)/\Gamma(\Lambda\pi^-)$ — Γ_4/Γ_1

VALUE (units 10^{-3})	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
$0.35^{+0.35}_{-0.22}$ OUR FIT						
0.35±0.35		1	YEH	74	HBC	Effective denom.=2859
• • • We do not use the following data for averages, fits, limits, etc. • • •						
< 2.3	90	0	THOMPSON	80	ASPK	Effective denom.=1017
< 1.3			DAUBER	69	HBC	
<12			BERGE	66	HBC	

$\Gamma(\Sigma^0 e^- \overline{\nu}_e)/\Gamma(\Lambda\pi^-)$ — Γ_5/Γ_1

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
0.087±0.017 OUR FIT					
0.087±0.017	154	BOURQUIN	83	SPEC	SPS hyperon beam

$[\Gamma(\Lambda e^- \overline{\nu}_e)+\Gamma(\Sigma^0 e^- \overline{\nu}_e)]/\Gamma(\Lambda\pi^-)$ — $(\Gamma_3+\Gamma_5)/\Gamma_1$

VALUE (units 10^{-3})	EVTS	DOCUMENT ID		TECN	COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •					
0.651±0.031	3011	[5] BOURQUIN	83	SPEC	SPS hyperon beam
0.68 ±0.22	17	[6] DUCLOS	71	OSPK	

[5] See the separate BOURQUIN 83 values for $\Gamma(\Lambda e^- \overline{\nu}_e)/\Gamma(\Lambda\pi^-)$ and $\Gamma(\Sigma^0 e^- \overline{\nu}_e)/\Gamma(\Lambda\pi^-)$ above.

[6] DUCLOS 71 cannot distinguish Σ^0's from Λ's. The Cabibbo theory predicts the Σ^0 rate is about a factor 6 smaller than the Λ rate.

$\Gamma(\Sigma^0 \mu^- \overline{\nu}_\mu)/\Gamma(\Lambda\pi^-)$ — Γ_6/Γ_1

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.76	90	0	YEH	74	HBC	Effective denom.=3026
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<5			BERGE	66	HBC	

$\Gamma(\Xi^0 e^- \overline{\nu}_e)/\Gamma(\Lambda\pi^-)$ — Γ_7/Γ_1

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<2.3	90	0	YEH	74	HBC	Effective denom.=1000

$\Gamma(n\pi^-)/\Gamma(\Lambda\pi^-)$ — Γ_8/Γ_1

ΔS=2. Forbidden in first-order weak interaction.

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.019	90		BIAGI	82B	SPEC	SPS hyperon beam
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<3.0	90	0	YEH	74	HBC	Effective denom.=760
<1.1			DAUBER	69	HBC	
<5.0			FERRO-LUZZI	63	HBC	

$\Gamma(n e^- \overline{\nu}_e)/\Gamma(\Lambda\pi^-)$ — Γ_9/Γ_1

ΔS=2. Forbidden in first-order weak interaction.

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
< 3.2	90	0	YEH	74	HBC	Effective denom.=715
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<10	90		BINGHAM	65	RVUE	

$\Gamma(n \mu^- \overline{\nu}_\mu)/\Gamma(\Lambda\pi^-)$ — Γ_{10}/Γ_1

ΔS=2. Forbidden in first-order weak interaction.

VALUE (units 10^{-3})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<15.3	90	0	YEH	74	HBC	Effective denom.=150

$\Gamma\big(p\pi^-\pi^-\big)/\Gamma\big(\Lambda\pi^-\big)$ Γ_{11}/Γ_1

ΔS=2. Forbidden in first-order weak interaction.

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<3.7	90	0	YEH	74	HBC	Effective denom.=6200

$\Gamma\big(p\pi^-e^-\overline{\nu}_e\big)/\Gamma\big(\Lambda\pi^-\big)$ Γ_{12}/Γ_1

ΔS=2. Forbidden in first-order weak interaction.

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<3.7	90	0	YEH	74	HBC	Effective denom.=6200

$\Gamma\big(p\pi^-\mu^-\overline{\nu}_\mu\big)/\Gamma\big(\Lambda\pi^-\big)$ Γ_{13}/Γ_1

ΔS=2. Forbidden in first-order weak interaction.

VALUE (units 10^{-4})	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<3.7	90	0	YEH	74	HBC	Effective denom.=6200

$\Gamma\big(p\mu^-\mu^-\big)/\Gamma\big(\Lambda\pi^-\big)$ Γ_{14}/Γ_1

A ΔL=2 decay, forbidden by total lepton number conservation.

VALUE (units 10^{-8})	CL%	DOCUMENT ID		TECN	COMMENT
<4.0	90	RAJARAM	05	HYCP	p Cu, 800 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<3.7\times10^4$	90	[7] LITTENBERG	92B	HBC	Uses YEH 74 data

[7] This LITTENBERG 92B limit and the identical YEH 74 limits for the preceding three modes all result from nonobservance of any 3-prong decays of the Ξ^-. One could as well apply the limit to the *sum* of the four modes.

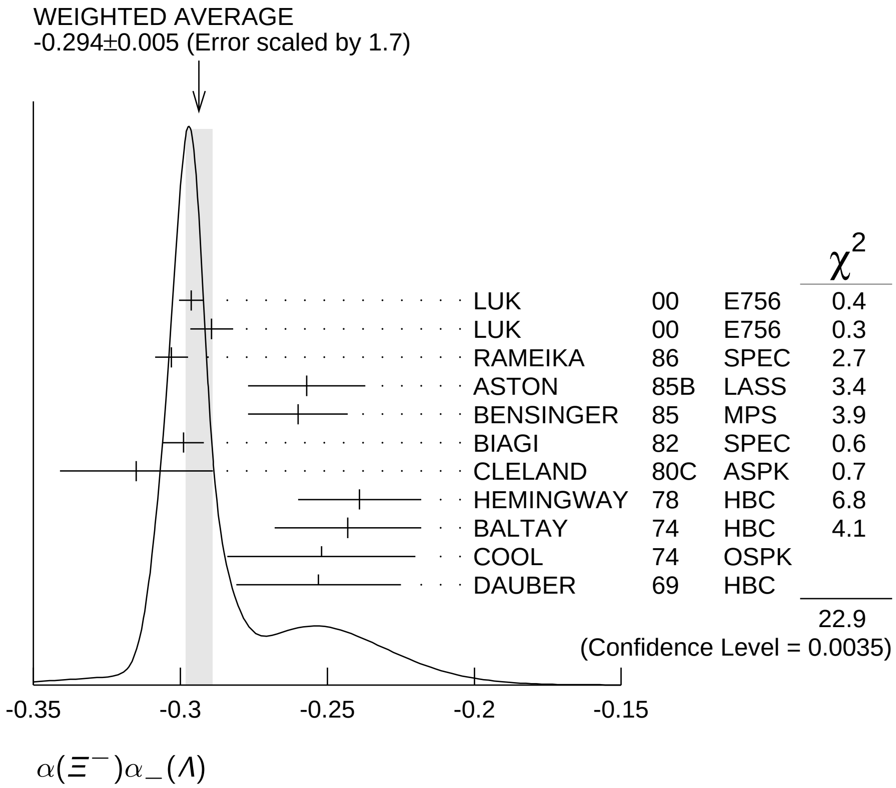
Ξ^- DECAY PARAMETERS

See the "Note on Baryon Decay Parameters" in the neutron Listings.

$\alpha(\Xi^-)\alpha_-(\Lambda)$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.294 ±0.005 OUR AVERAGE	Error includes scale factor of 1.7. See the ideogram below.				
−0.2963±0.0042	189k	LUK	00	E756	p Be, 800 GeV
−0.2894±0.0073	63k	[8] LUK	00	E756	p Be, 800 GeV
−0.303 ±0.004 ±0.004	192k	RAMEIKA	86	SPEC	400 GeV pBe
−0.257 ±0.020	11k	ASTON	85B	LASS	11 GeV/c K^-p
−0.260 ±0.017	21k	BENSINGER	85	MPS	5 GeV/c K^-p
−0.299 ±0.007	150k	BIAGI	82	SPEC	SPS hyperon beam
−0.315 ±0.026	9046	CLELAND	80C	ASPK	BNL hyperon beam
−0.239 ±0.021	6599	HEMINGWAY	78	HBC	4.2 GeV/c K^-p
−0.243 ±0.025	4303	BALTAY	74	HBC	1.75 GeV/c K^-p
−0.252 ±0.032	2436	COOL	74	OSPK	1.8 GeV/c K^-p
−0.253 ±0.028	2781	DAUBER	69	HBC	

[8] This LUK 00 value is for $\alpha(\overline{\Xi}^+)\ \alpha_+(\overline{\Lambda})$. We assume *CP* conservation here by including it in the average for $\alpha(\Xi^-)\ \alpha_-(\Lambda)$. But see the second data block below for the *CP* test.



α FOR $\Xi^- \rightarrow \Lambda\pi^-$

The above average, $\alpha(\Xi^-)\ \alpha_-(\Lambda) = -0.294 \pm 0.005$, where the error includes a scale factor of 1.7, divided by our current average $\alpha_-(\Lambda) = 0.642 \pm 0.013$, gives the following value for $\alpha(\Xi^-)$.

VALUE	DOCUMENT ID
−0.458±0.012 OUR EVALUATION	Error includes scale factor of 1.8.

$[\alpha(\Xi^-)\alpha_-(\Lambda) - \alpha(\overline{\Xi}^+)\alpha_+(\overline{\Lambda})]$ / $[\alpha(\Xi^-)\alpha_-(\Lambda) + \alpha(\overline{\Xi}^+)\alpha_+(\overline{\Lambda})]$

This is zero if *CP* is conserved. The α's are the decay-asymmetry parameters for $\Xi^- \rightarrow \Lambda\pi^-$ and $\Lambda \rightarrow p\pi^-$ and for $\overline{\Xi}^+ \rightarrow \overline{\Lambda}\pi^+$ and $\overline{\Lambda} \rightarrow \overline{p}\pi^+$.

VALUE (units 10^{-4})	EVTS	DOCUMENT ID		TECN	COMMENT
0.0± 5.1±4.4	158M	HOLMSTROM	04	HYCP	p Cu, 800 GeV
• • • We do not use the following data for averages, fits, limits, etc. • • •					
+120 ±140	252k	LUK	00	E756	p Be, 800 GeV

ϕ ANGLE FOR $\Xi^- \rightarrow \Lambda\pi^-$ $(\tan\phi = \beta/\gamma)$

VALUE (°)	EVTS	DOCUMENT ID		TECN	COMMENT
− 2.1 ± 0.8 OUR AVERAGE					
− 2.39± 0.64±0.64	144M	[9] HUANG	04	HYCP	p Cu, 800 GeV
− 1.61± 2.66±0.37	1.35M	[10] CHAKRAVO...	03	E756	p Be, 800 GeV
5 ±10	11k	ASTON	85B	LASS	$K^- p$
14.7 ±16.0	21k	[11] BENSINGER	85	MPS	5 GeV/c $K^- p$

11	± 9	4303	BALTAY	74	HBC	1.75 GeV/c $K^- p$
5	±16	2436	COOL	74	OSPK	1.8 GeV/c $K^- p$
−14	±11	2781	DAUBER	69	HBC	Uses $\alpha_\Lambda = 0.647 \pm 0.020$
0	±12	1004	[12] BERGE	66	HBC	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
−26	±30	2724	BINGHAM	70B	OSPK	
0	±20.4	364	[12] LONDON	66	HBC	Using α_Λ=0.62
54	±30	356	[12] CARMONY	64B	HBC	

[9] From this result and α_Ξ, HUANG 04 gets $\beta_\Xi = -0.037 \pm 0.011 \pm 0.010$ and $\gamma_\Xi = 0.888 \pm 0.0004 \pm 0.006$. And the strong p–s phase difference for $\Lambda\pi^-$ scattering is $(4.6 \pm 1.4 \pm 1.2)^\circ$.

[10] From this result and α_Ξ, CHAKRAVORTY 03 obtains $\beta_\Xi = -0.025 \pm 0.042 \pm 0.006$ and $\gamma_\Xi = 0.889 \pm 0.001 \pm 0.007$. And the strong p–s phase difference for $\Lambda\pi^-$ scattering is $(3.17 \pm 5.28 \pm 0.73)^\circ$.

[11] BENSINGER 85 used $\alpha_\Lambda = 0.642 \pm 0.013$.

[12] The errors have been multiplied by 1.2 due to approximations used for the Ξ polarization; see DAUBER 69 for a discussion.

g_A / g_V FOR $\Xi^- \rightarrow \Lambda e^- \overline{\nu}_e$

VALUE	EVTS	DOCUMENT ID		TECN	COMMENT
−0.25±0.05	1992	[13] BOURQUIN	83	SPEC	SPS hyperon beam

[13] BOURQUIN 83 assumes that $g_2 = 0$. Also, the sign has been changed to agree with our conventions, given in the "Note on Baryon Decay Parameters" in the neutron Listings.

Ξ^- REFERENCES

We have omitted some papers that have been superseded by later experiments. See our earlier editions.

ABDALLAH	06E	PL B639 179	J. Abdallah *et al.*	(DELPHI Collab.)
RAJARAM	05	PRL 94 181801	D. Rajaram *et al.*	(FNAL HyperCP Collab.)
HOLMSTROM	04	PRL 93 262001	T. Holmstrom *et al.*	(FNAL HyperCP Collab.)
HUANG	04	PRL 93 011802	M. Huang *et al.*	(FNAL HyperCP Collab.)
CHAKRAVO...	03	PRL 91 031601	A. Chakravorty *et al.*	(FNAL E756 Collab.)
LUK	00	PRL 85 4860	K.B. Luk *et al.*	(FNAL E756 Collab.)
DUBBS	94	PRL 72 808	T. Dubbs *et al.*	(FNAL E761 Collab.)
DURYEA	92	PRL 68 768	J. Duryea *et al.*	(MINN, FNAL, MICH, RUTG)
LITTENBERG	92B	PR D46 R892	L.S. Littenberg, R.E. Shrock	(BNL, STON)
HO	90	PRL 65 1713	P.M. Ho *et al.*	(MICH, FNAL, MINN, RUTG)
Also		PR D44 3402	P.M. Ho *et al.*	(MICH, FNAL, MINN, RUTG)
TROST	89	PR D40 1703	L.H. Trost *et al.*	(FNAL-715 Collab.)
BIAGI	87B	ZPHY C35 143	S.F. Biagi *et al.*	(BRIS, CERN, GEVA+)
RAMEIKA	86	PR D33 3172	R. Rameika *et al.*	(RUTG, MICH, WISC+)
ASTON	85B	PR D32 2270	D. Aston *et al.*	(SLAC, CARL, CNRC, CINC)
BENSINGER	85	NP B252 561	J.R. Bensinger *et al.*	(CHIC, ELMT, FNAL+)
BOURQUIN	84	NP B241 1	M.H. Bourquin *et al.*	(BRIS, GEVA, HEIDP+)
RAMEIKA	84	PRL 52 581	R. Rameika *et al.*	(RUTG, MICH, WISC+)
BOURQUIN	83	ZPHY C21 1	M.H. Bourquin *et al.*	(BRIS, GEVA, HEIDP+)
BIAGI	82	PL 112B 265	S.F. Biagi *et al.*	(BRIS, CAVE, GEVA+)
BIAGI	82B	PL 112B 277	S.F. Biagi *et al.*	(LOQM, GEVA, RL+)
CLELAND	80C	PR D21 12	W.E. Cleland *et al.*	(PITT, BNL)
THOMPSON	80	PR D21 25	J.A. Thompson *et al.*	(PITT, BNL)
BOURQUIN	79	PL 87B 297	M.H. Bourquin *et al.*	(BRIS, GEVA, HEIDP+)
HEMINGWAY	78	NP B142 205	R.J. Hemingway *et al.*	(CERN, ZEEM, NIJM+)
DIBIANCA	75	NP B98 137	F.A. Dibianca, R.J. Endorf	(CMU)
BALTAY	74	PR D9 49	C. Baltay *et al.*	(COLU, BING) J
COOL	74	PR D10 792	R.L. Cool *et al.*	(BNL)
Also		PRL 29 1630	R.L. Cool *et al.*	(BNL)

YEH	74	PR D10 3545	N. Yeh *et al.*	(BING, COLU)
MAYEUR	72	NP B47 333	C. Mayeur *et al.*	(BRUX, CERN, TUFTS, LOUC)
VOTRUBA	72	NP B45 77	M.F. Votruba, A. Safder, T.M. Ratcliffe	(BIRM+)
WILQUET	72	PL 42B 372	G. Wilquet *et al.*	(BRUX, CERN, TUFTS+)
DUCLOS	71	NP B32 493	J. Duclos *et al.*	(CERN)
BINGHAM	70B	PR D1 3010	G.M. Bingham *et al.*	(UCSD, WASH)
GOLDWASSER	70	PR D1 1960	E.L. Goldwasser, P.F. Schultz	(ILL)
STONE	70	PL 32B 515	S.L. Stone *et al.*	(ROCH)
DAUBER	69	PR 179 1262	P.M. Dauber *et al.*	(LRL) J
SHEN	67	PL 25B 443	B.C. Shen, A. Firestone, G. Goldhaber	(UCB+)
BERGE	66	PR 147 945	J.P. Berge *et al.*	(LRL)
CHIEN	66	PR 152 1171	C.Y. Chien *et al.*	(YALE, BNL)
LONDON	66	PR 143 1034	G.W. London *et al.*	(BNL, SYRA)
BINGHAM	65	PRSL 285 202	H.H. Bingham	(CERN)
PJERROU	65B	PRL 14 275	G.M. Pjerrou *et al.*	(UCLA)
Also		Thesis	G.M. Pjerrou	(UCLA)
BADIER	64	Dubna Conf. 1 593	J. Badier *et al.*	(EPOL, SACL, ZEEM)
CARMONY	64B	PRL 12 482	D.D. Carmony *et al.*	(UCLA) J
HUBBARD	64	PR 135 B183	J.R. Hubbard *et al.*	(LRL)
FERRO-LUZZI	63	PR 130 1568	M. Ferro-Luzzi *et al.*	(LRL)
JAUNEAU	63D	Siena Conf. 4	L. Jauneau *et al.*	(EPOL, CERN, LOUC+)
Also		PL 5 261	L. Jauneau *et al.*	(EPOL, CERN, LOUC+)
SCHNEIDER	63	PL 4 360	J. Schneider	(CERN)