n

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

We have omitted some results that have been superseded by later experiments. The omitted results may be found in our 1986 edition (Physics Letters **170B**) or in earlier editions.

n MASS

The mass is known much more precisely in u (atomic mass units) than in MeV; see the footnotes. The conversion from u to MeV, 1 u = 931.49432±0.00028 MeV, involves the relatively poorly known electronic charge. The DIFILIPPO 94 value, in u, is by far the best, but when converted to MeV differs only negligibly from the 1986 CODATA value, which, for consistency, we stick with.

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
939.56563±0.00028	[1] COHEN	87	RVUE	1986 CODATA value
• • • We do not use the following data for averages, fits, limits, etc. • • •				
939.56565±0.00028	[2] DIFILIPPO	94		Penning trap
939.56564±0.00028	[3,4] GREENE	86	SPEC	$np \rightarrow d\gamma$
939.5731 ±0.0027	[4] COHEN	73	RVUE	1973 CODATA value

[1] The mass is known much more precisely in u: $m = 1.008664904 \pm 0.000000014$ u.
[2] The mass is known much more precisely in u: $m = 1.0086649235 \pm 0.0000000023$ u. We use the conversion factor given above to get the mass in MeV.
[3] The mass is known much more precisely in u: $m = 1.008664919 \pm 0.000000014$ u.
[4] These determinations are not independent of the $m_n - m_p$ measurements below.

$\overline{n}$ MASS

VALUE (MeV)	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
939.485±0.051	59	[5] CRESTI	86	HBC	$\overline{p}p \rightarrow \overline{n}n$

[5] This is a corrected result (see the erratum). The error is statistical. The maximum systematic error is 0.029 MeV.

$(m_n - m_{\overline{n}})$ / m_{average}

A test of *CPT* invariance. Calculated from the n and $\overline{n}$ masses, above.

VALUE	*DOCUMENT ID*
(9±5) × 10^{-5} OUR EVALUATION	

$m_n - m_p$

VALUE (MeV)	*DOCUMENT ID*		*TECN*	*COMMENT*
1.293318 ±0.000009	[6] COHEN	87	RVUE	1986 CODATA value
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.2933328±0.0000072	GREENE	86	SPEC	$np \rightarrow d\gamma$
1.293429 ±0.000036	COHEN	73	RVUE	1973 CODATA value

[6] Calculated by us from the COHEN 87 ratio $m_n/m_p = 1.001378404 \pm 0.000000009$. In u, $m_n - m_p = 0.001388434 \pm 0.000000009$ u.

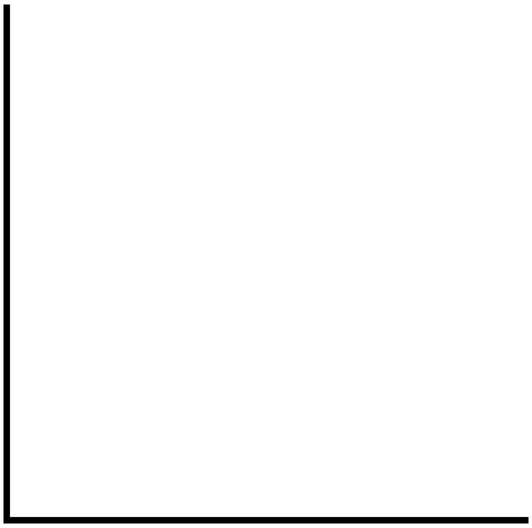
n MEAN LIFE

We now compile only direct measurements of the lifetime, not those inferred from decay correlation measurements. (Limits on lifetimes for *bound* neutrons are given in the section "p PARTIAL MEAN LIVES.")

For a review, see EROZOLIMSKII 89 and papers that follow it in an issue of NIM devoted to the "Proceedings of the International Workshop on Fundamental Physics with Slow Neutrons" (Grenoble 1989). For later reviews and/or commentary, see FREEDMAN 90, SCHRECKENBACH 92, and PENDLEBURY 93.

VALUE (s)	DOCUMENT ID		TECN	COMMENT
887.0± 2.0 OUR AVERAGE	Error includes scale factor of 1.3. See the ideogram below.			
882.6± 2.7	MAMPE	93	CNTR	Gravitational trap
888.4± 3.1± 1.1	NESVIZHEV...	92	CNTR	Gravitational trap
893.6± 3.8± 3.7	BYRNE	90	CNTR	Penning trap
878 ±27 ±14	KOSSAKOW...	89	TPC	Pulsed beam
887.6± 3.0	MAMPE	89	CNTR	Gravitational trap
877 ±10	PAUL	89	CNTR	Storage ring
876 ±10 ±19	LAST	88	SPEC	Pulsed beam
891 ± 9	SPIVAK	88	CNTR	Beam
903 ±13	KOSVINTSEV	86	CNTR	Gravitational trap
918 ±14	CHRISTENSEN	72	CNTR	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
888.4± 2.9	ALFIMENKOV	90	CNTR	See NESVIZHEVSKII 92
937 ±18	[7] BYRNE	80	CNTR	
875 ±95	KOSVINTSEV	80	CNTR	
881 ± 8	BONDAREN...	78	CNTR	See SPIVAK 88

[7] This measurement has been withdrawn (J. Byrne, private communication, 1990).



neutron mean life (s)

n MAGNETIC MOMENT

VALUE (μ_N)	DOCUMENT ID		TECN	COMMENT
−1.91304275±0.00000045	COHEN	87	RVUE	1986 CODATA value
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−1.91304277±0.00000048	[8] GREENE	82	MRS	

[8] GREENE 82 measures the moment to be $(1.04187564 \pm 0.00000026) \times 10^{-3}$ Bohr magnetons. The value above is obtained by multiplying this by $m_p/m_e = 1836.152701 \pm 0.000037$ (the 1986 CODATA value from COHEN 87).

n ELECTRIC DIPOLE MOMENT

A nonzero value is forbidden by both *T* invariance and *P* invariance. A number of early results have been omitted. See RAMSEY 90 and GOLUB 94 for reviews.

VALUE (10^{-26} e cm)	CL%	DOCUMENT ID		TECN	COMMENT
< 11	95	ALTAREV	92	MRS	$(+2.6 \pm 4.2 \pm 1.6) \times 10^{-26}$

*CITATION: L. Montanet et al., Physical Review D50, 1173 (1994) and 1995 off-year partial update for the 1996 edition (URL: http://pdg.lbl.gov/)

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

< 12	95	SMITH	90	MRS	$d = (-3 \pm 5) \times 10^{-26}$
< 26	95	ALTAREV	86	MRS	$d = (-14 \pm 6) \times 10^{-26}$
3±48		PENDLEBURY	84	MRS	Ultracold neutrons
< 60	90	ALTAREV	81	MRS	$d = (21 \pm 24) \times 10^{-26}$
<160	90	ALTAREV	79	MRS	$d = (40 \pm 75) \times 10^{-26}$

n ELECTRIC POLARIZABILITY α_n

Following is the electric polarizability α_n defined in terms of the induced electric dipole moment by $\mathbf{D} = 4\pi\epsilon_0\alpha_n\mathbf{E}$. For a review, see SCHMIEDMAYER 89.

VALUE (10^{-3} fm^3)	*DOCUMENT ID*		*TECN*	*COMMENT*
$\mathbf{1.16^{+0.19}_{-0.23}}$ **OUR AVERAGE**				
1.20±0.15±0.20	SCHMIEDM...	91	CNTR	*n* Pb transmission
$1.07^{+0.33}_{-1.07}$	ROSE	90B	CNTR	$\gamma d \rightarrow \gamma n p$
0.8 ±1.0	KOESTER	88	CNTR	*n* Pb, *n* Bi transmission
1.2 ±1.0	SCHMIEDM...	88	CNTR	*n* Pb, *n* C transmission
• • • We do not use the following data for averages, fits, limits, etc. • • •				
$1.17^{+0.43}_{-1.17}$	ROSE	90	CNTR	See ROSE 90B

n CHARGE

See also "$|q_p + q_e|$ CHARGE MAGNITUDE DIFFERENCE" in the proton Listings.

VALUE (10^{-21} *e*)	*DOCUMENT ID*		*TECN*	*COMMENT*
− 0.4± 1.1	[9] BAUMANN	88		Cold *n* deflection
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−15 ±22	[10] GAEHLER	82	CNTR	Reactor neutrons

[9] The BAUMANN 88 error ±1.1 gives the 68% CL limits about the the value −0.4.

[10] The GAEHLER 82 error ±22 gives the 90% CL limits about the the value −15.

LIMIT ON $n\overline{n}$ OSCILLATIONS

Mean Time for $n\overline{n}$ Transition in Vacuum

A test of ΔB=2 baryon number nonconservation. MOHAPATRA 80 and MOHAPATRA 89 discuss the theoretical motivations for looking for $n\overline{n}$ oscillations. DOVER 83 and DOVER 85 give phenomenological analyses. The best limits come from looking for the decay of neutrons bound in nuclei. However, these analyses require model-dependent corrections for nuclear effects. See KABIR 83, DOVER 89, and ALBERICO 91 for discussions. Direct searches for $n \rightarrow \overline{n}$ transitions using reactor neutrons are cleaner but give poorer limits.

VALUE (s)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
$\mathbf{>1.2 \times 10^8}$	90	BERGER	90	FREJ	*n* bound in iron
$\mathbf{>1.2 \times 10^8}$	90	TAKITA	86	CNTR	Kamiokande
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$>8.6 \times 10^7$	90	BALDO-...	94	CNTR	Reactor neutrons
$>1 \times 10^7$	90	BALDO-...	90	CNTR	See BALDO-CEOLIN 94
$>4.9 \times 10^5$	90	BRESSI	90	CNTR	Reactor neutrons
$>4.7 \times 10^5$	90	BRESSI	89	CNTR	See BRESSI 90
$>1 \times 10^6$	90	FIDECARO	85	CNTR	Reactor neutrons
$>8.8 \times 10^7$	90	PARK	85B	CNTR	
$>3 \times 10^7$		BATTISTONI	84	NUSX	
$> 2.7 \times 10^7$–1.1×10^8		JONES	84	CNTR	
$>2 \times 10^7$		CHERRY	83	CNTR	

n DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$p e^- \overline{\nu}_e$	100 %	
Γ_2	hydrogen-atom $\overline{\nu}_e$		

Charge conservation (Q) violating mode

Γ_3	$p \nu_e \overline{\nu}_e$	Q	$< 9 \times 10^{-24}$	90%

n BRANCHING RATIOS

$\Gamma(\text{hydrogen-atom}\,\overline{\nu}_e)/\Gamma_{\text{total}}$ Γ_2/Γ

VALUE (units 10^{-2})	CL%	DOCUMENT ID		TECN
• • • We do not use the following data for averages, fits, limits, etc. • • •				
<3	95	[11] GREEN	90	RVUE

[11] GREEN 90 infers that $\tau(\text{hydrogen-atom}\,\overline{\nu}_e) > 3 \times 10^4$ s by comparing neutron lifetime measurements made in storage experiments with those made in β-decay experiments. However, the result depends sensitively on the lifetime measurements, and does not of course take into account more recent measurements of same.

$\Gamma(p \nu_e \overline{\nu}_e)/\Gamma_{\text{total}}$ Γ_3/Γ

Forbidden by charge conservation.

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<9 $\times 10^{-24}$	90	BARABANOV	80	CNTR	^{71}Ga $\rightarrow$ ^{71}Ge X
• • • We do not use the following data for averages, fits, limits, etc. • • •					
$<9.7 \times 10^{-18}$	90	ROY	83	CNTR	^{113}Cd $\rightarrow$ ^{113m}In neut.
$<7.9 \times 10^{-21}$		VAIDYA	83	CNTR	^{87}Rb $\rightarrow$ ^{87m}Sr neut.
$<3 \times 10^{-19}$		NORMAN	79	CNTR	^{87}Rb $\rightarrow$ ^{87m}Sr neut.

MINIREVIEW GOES HERE

$n \rightarrow p e^- \nu$ DECAY PARAMETERS

See the above Note on Baryon Decay Parameters. For discussions of recent results, see the references cited at the beginning of the section on the neutron mean life. For discussions of the values of the weak coupling constants g_A and g_V obtained using the neutron and asymmetry parameter A, comparisons with other methods of obtaining these constants, and implications for particle and astrophysics, see DUBBERS 91 and WOOLCOCK 91. For tests of the $V-A$ theory of neutron decay, see EROZOLIMSKII 91B.

g_A / g_V

VALUE	DOCUMENT ID		TECN	COMMENT
−1.2573±0.0028 OUR AVERAGE				
−1.2544±0.0036	EROZOLIM...	91	CNTR	e mom-n spin corr.
−1.262 ±0.005	BOPP	86	SPEC	e mom-n spin corr.
−1.261 ±0.012	[12] EROZOLIM...	79	CNTR	e mom-n spin corr.
−1.259 ±0.017	[12] STRATOWA	78	CNTR	proton recoil spectrum
−1.258 ±0.015	[13] KROHN	75	CNTR	e mom-n spin corr.
• • • We do not use the following data for averages, fits, limits, etc. • • •				
−1.226 ±0.042	MOSTOVOY	83	RVUE	
−1.263 ±0.015	EROZOLIM...	77	CNTR	See EROZOLIMSKII 79
−1.250 ±0.036	[12] DOBROZE...	75	CNTR	See STRATOWA 78
−1.263 ±0.016	[14] KROPF	74	RVUE	n decay alone
−1.250 ±0.009	[14] KROPF	74	RVUE	n decay + nuclear ft

[12] These experiments measure the absolute value of g_A/g_V only.
[13] KROHN 75 includes events of CHRISTENSEN 70.
[14] KROPF 74 reviews all data through 1972.

β ASYMMETRY PARAMETER A

This is the neutron-spin electron-momentum correlation coefficient. Unless otherwise noted, the values are corrected for radiative effects and weak magnetism.

VALUE	DOCUMENT ID		TECN
−0.1127±0.0011 OUR AVERAGE			
−0.1116±0.0014	EROZOLIM...	91	CNTR
−0.1146±0.0019	BOPP	86	SPEC
−0.114 ±0.005	[15] EROZOLIM...	79	CNTR
−0.113 ±0.006	[15] KROHN	75	CNTR

[15] These results are not corrected for radiative effects and weak magnetism, but the corrections are small compared to the errors.

$\overline{\nu}$ ASYMMETRY PARAMETER B

This is the neutron-spin antineutrino-momentum correlation coefficient.

VALUE	DOCUMENT ID		TECN
0.997±0.028 OUR AVERAGE			
0.995±0.034	CHRISTENSEN	70	CNTR
1.00 ±0.05	EROZOLIM...	70C	CNTR

e-$\overline{\nu}$ ANGULAR CORRELATION COEFFICIENT a

VALUE	DOCUMENT ID		TECN	COMMENT
−0.102 ±0.005 OUR AVERAGE				
−0.1017±0.0051	STRATOWA	78	CNTR	Proton recoil spectrum
−0.091 ±0.039	GRIGOREV	68	SPEC	Proton recoil spectrum

ϕ_{AV}, PHASE OF g_A RELATIVE TO g_V

Time reversal invariance requires this to be 0 or 180°.

VALUE (°)	DOCUMENT ID		TECN	COMMENT
180.07±0.18 OUR EVALUATION	Using the average value for quantity D given in the next data block and $\lambda \equiv g_A/g_V$ in $\sin\phi_{AV} = D(1+3\lambda^2)/2\lambda$.			
180.09±0.18 OUR AVERAGE				
179.71±0.39	EROZOLIM...	78	CNTR	Polarized neutrons
180.35±0.43	EROZOLIM...	74	CNTR	Polarized neutrons
180.14±0.22	STEINBERG	74	CNTR	Polarized neutrons
• • • We do not use the following data for averages, fits, limits, etc. • • •				
181.1 ±1.3	[16] KROPF	74	RVUE	n decay

[16] KROPF 74 reviews all data through 1972.

TRIPLE CORRELATION COEFFICIENT D

These are measurements of the component of n spin perpendicular to the decay plane in β decay. Should be zero if T invariance is not violated.

VALUE	DOCUMENT ID		TECN	COMMENT
(−0.5 ±1.4) × 10^{-3} OUR AVERAGE				
+ 0.0022±0.0030	EROZOLIM...	78	CNTR	Polarized neutrons
− 0.0027±0.0050	[17] EROZOLIM...	74	CNTR	Polarized neutrons
− 0.0011±0.0017	STEINBERG	74	CNTR	Polarized neutrons

[17] EROZOLIMSKII 78 says asymmetric proton losses and nonuniform beam polarization may give a systematic error up to 0.003, thus increasing the EROZOLIMSKII 74 error to 0.005. STEINBERG 74 and STEINBERG 76 estimate these systematic errors to be insignificant in their experiment.

n REFERENCES

We have omitted some papers that have been superseded by later experiments. The omitted papers may be found in our 1986 edition (Physics Letters **170B**) or in earlier editions.

BALDO-...	94	ZPHY C63 409	Baldo-Ceolin, Benetti+	(HEID, ILLG, PADO, PAVI)
DIFILIPPO	94	PRL 73 1481	+Natarajan, Boyce, Pritchard	(MIT)
Also	93	PRL 71 1998	Natarajan, Boyce, DiFilippo, Pritchard	(MIT)
GOLUB	94	PRPL 237C 1	+Lamoreaux	(HAHN, WASH)
MAMPE	93	JETPL 57 82	+Bondarenko, Morozov+	(KIAE)
		Translated from ZETFP 57 77.		
PENDLEBURY	93	ARNPS 43 687		(ILLG)
ALTAREV	92	PL B276 242	+Borisov, Borovikova, Ivanov+	(PNPI)
NESVIZHEV...	92	JETP 75 405	Nesvizhevskii, Serebrov, Tal'daev+	(PNPI, JINR)
		Translated from ZETF 102 740.		
SCHRECK...	92	JPG 18 1	Schreckenbach, Mampe	(ILLG)
ALBERICO	91	NP A523 488	+de Pace, Pignone	(TORI)
DUBBERS	91	NP A527 239c		(ILLG)
Also	90	EPL 11 195	Dubbers, Mampe, Doehner	(ILLG, HEID)
EROZOLIM...	91	PL B263 33	Erozolimskii, Kuznetsov, Stepanenko, Kuida+	(PNPI, KIAE)
Also	90	SJNP 52 999	Erozolimskii, Kuznetsov, Stepanenko, Kuida+	(PNPI, KIAE)
		Translated from YAF 52 1583.		
EROZOLIM...	91B	SJNP 53 260	Erozolimskii, Mostovoi	(KIAE)
		Translated from YAF 53 418.		
SCHMIEDM...	91	PRL 66 1015	Schmiedmayer, Riehs, Harvey, Hill	(TUW, ORNL)
WOOLCOCK	91	MPL A6 2579		(CANB)
ALFIMENKOV	90	JETPL 52 373	+Varlamov, Vasil'ev, Gudkov+	(PNPI, JINR)
		Translated from ZETFP 52 984.		

BALDO-... 90 PL B236 95 Baldo-Ceolin, Benetti, Bitter+ (PADO, PAVI, HEIDP, ILLG)
BERGER 90 PL B240 237 +Froehlich, Moench, Nisius+ (FREJUS Collab.)
BRESSI 90 NC 103A 731 +Calligarich, Cambiaghi+ (PAVI, ROMA, MILA)
BYRNE 90 PRL 65 289 +Dawber, Spain, Williams+ (SUSS, NBS, SCOT, CBNM)
FREEDMAN 90 CNPP 19 209 (ANL)
GREEN 90 JPG 16 L75 +Thompson (RAL)
RAMSEY 90 ARNPS 40 1 (HARV)
ROSE 90 PL B234 460 +Zurmuehl, Rullhusen, Ludwig+ (GOET, MPCM, MANZ)
ROSE 90B NP A514 621 +Zurmuehl, Rullhusen, Ludwig+ (GOET, MPCM)
SMITH 90 PL B234 191 +Crampin+ (SUSS, RAL, HARV, WASH, ILLG, MUNT)
BRESSI 89 ZPHY C43 175 +Calligarich, Cambiaghi+ (INFN, MILA, PAVI, ROMA)
DOVER 89 NIM A284 13 +Gal, Richard (BNL, HEBR, ISNG)
EROZOLIM... 89 NIM A284 89 Erozolimskii (PNPI)
KOSSAKOW... 89 NP A503 473 Kossakowski, Grivot+ (LAPP, SAVO, ISNG, ILLG)
MAMPE 89 PRL 63 593 +Ageron, Bates, Pendlebury, Steyerl (ILLG, RISL, SUSS, URI)
MOHAPATRA 89 NIM A284 1 (UMD)
PAUL 89 ZPHY C45 25 +Anton, Paul, Paul, Mampe (BONN, WUPP, MPIH, ILLG)
SCHMIEDM... 89 NIM A284 137 Schmiedmayer, Rauch, Riehs (WIEN)
BAUMANN 88 PR D37 3107 +Gaehler, Kalus, Mampe (BAYR, MUNI, ILLG)
KOESTER 88 ZPHY A329 229 +Waschkowski, Meier (MUNI, MUNT)
LAST 88 PRL 60 995 +Arnold, Doehner, Dubbers+ (HEIDP, ILLG, ANL)
SCHMIEDM... 88 PRL 61 1065 Schmiedmayer, Rauch, Riehs (TUW)
Also 88B PRL 61 2509 erratum Schmiedmayer, Rauch, Riehs (TUW)
SPIVAK 88 JETP 67 1735 (KIAE)
Translated from ZETF 94 1.
COHEN 87 RMP 59 1121 +Taylor (RISC, NBS)
ALTAREV 86 JETPL 44 460 +Borisov, Borovikova, Brandin, Egorov+ (PNPI)
Translated from ZETFP 44 360.
BOPP 86 PRL 56 919 +Dubbers, Hornig, Klemt, Last+ (HEIDP, ANL, ILLG)
Also 88 ZPHY C37 179 Klemt, Bopp, Hornig, Last+ (HEIDP, ANL, ILLG)
CRESTI 86 PL B177 206 +Pasquali, Peruzzo, Pinori, Sartori (PADO)
Also 88 PL B200 587 erratum Cresti, Pasquali, Peruzzo, Pinori, Sartori (PADO)
GREENE 86 PRL 56 819 +Kessler, Deslattes, Boerner (NBS, ILLG)
KOSVINTSEV 86 JETPL 44 571 +Morozov, Terekhov (KIAE)
Translated from ZETFP 44 444.
TAKITA 86 PR D34 902 +Arisaka, Kajita, Kifune+ (KEK, TOKY+)
DOVER 85 PR C31 1423 +Gal, Richard (BNL)
FIDECARO 85 PL 156B 122 +Lanceri+ (CERN, ILLG, PADO, RAL, SUSS)
PARK 85B NP B252 261 +Blewitt, Cortez, Foster+ (IMB Collab.)
BATTISTONI 84 PL 133B 454 +Bellotti, Bologna, Campana+ (NUSEX Collab.)
JONES 84 PRL 52 720 +Bionta, Blewitt, Bratton+ (IMB Collab.)
PENDLEBURY 84 PL 136B 327 +Smith, Golub, Byrne+ (SUSS, HARV, RAL, ILLG)
CHERRY 83 PRL 50 1354 +Lande, Lee, Steinberg, Cleveland (PENN, BNL)
DOVER 83 PR D27 1090 +Gal, Richards (BNL)
KABIR 83 PRL 51 231 (HARV)
MOSTOVOY 83 JETPL 37 196 (KIAE)
Translated from ZETFP 37 162.
ROY 83 PR D28 1770 +Vaidya, Ephraim, Datar, Bhatki+ (TATA)
VAIDYA 83 PR D27 486 +Roy, Ephraim, Datar, Bhattacherjee (TATA)
GAEHLER 82 PR D25 2887 +Kalus, Mampe (BAYR, ILLG)
GREENE 82 Metrologia 18 93 + (YALE, HARV, ILLG, SUSS, ORNL, CENG)
ALTAREV 81 PL 102B 13 +Borisov, Borovikova, Brandin, Egorov+ (PNPI)
BARABANOV 80 JETPL 32 359 +Veretenkin, Gavrin+ (PNPI)
Translated from ZETFP 32 384.
BYRNE 80 PL 92B 274 +Morse, Smith, Shaikh, Green, Greene (SUSS, RL)
KOSVINTSEV 80 JETPL 31 236 +Kushnir, Morozov, Terekhov (JINR)
Translated from ZETFP 31 257.
MOHAPATRA 80 PRL 44 1316 +Marshak (CUNY, VPI)
ALTAREV 79 JETPL 29 730 +Borisov, Brandin, Egorov, Ezhov, Ivanov+ (PNPI)
Translated from ZETFP 29 794.
EROZOLIM... 79 SJNP 30 356 Erozolimskii, Frank, Mostovoy+ (KIAE)
Translated from YAF 30 692.
NORMAN 79 PRL 43 1226 +Seamster (WASH)
BONDAREN... 78 JETPL 28 303 Bondarenko, Kurguzov, Prokofev+ (KIAE)
Translated from ZETFP 28 328.
Also 82 Smolenice Conf. Bondarenko (KIAE)
EROZOLIM... 78 SJNP 28 48 Erozolimskii, Mostovoy, Fedunin, Frank+ (KIAE)
Translated from YAF 28 98.
STRATOWA 78 PR D18 3970 +Dobrozemsky, Weinzierl (SEIB)
EROZOLIM... 77 JETPL 23 663 Erozolimskii, Frank, Mostovoy+ (KIAE)
Translated from ZETFP 23 720.
STEINBERG 76 PR D13 2469 +Liaud, Vignon, Hughes (YALE, ISNG)
DOBROZE... 75 PR D11 510 Dobrozemsky, Kerschbaum, Moraw, Paul+ (SEIB)
KROHN 75 PL 55B 175 +Ringo (ANL)
EROZOLIM... 74 JETPL 20 345 Erozolimskii, Mostovoy, Fedunin, Frank+
Translated from ZETFP 20 745.
KROPF 74 ZPHY 267 129 +Paul (LINZ)
Also 70 NP A154 160 Paul (VIEN)
STEINBERG 74 PRL 33 41 +Liaud, Vignon, Hughes (YALE, ISNG)
COHEN 73 JPCRD 2 663 +Taylor (RISC, NBS)
CHRISTENSEN 72 PR D5 1628 +Nielson, Bahnsen, Brown+ (RISO)
CHRISTENSEN 70 PR C1 1693 +Krohn, Ringo (ANL)
EROZOLIM... 70C PL 33B 351 Erozolimskii, Bondarenko, Mostovoy, Obinyakov+ (KIAE)
GRIGOREV 68 SJNP 6 239 Grigor'ev, Grishin, Vladimirsky, Nikolaevskii+ (ITEP)
Translated from YAF 6 329.