Massive Neutrinos and Lepton Mixing
THIS IS PART 5 OF 5

To reduce the size of this section's PostScript file, we have divided it into five PostScript files. We present the following index:

PART 1

Page #	Section name
1	Note on Massive Neutrinos and Lepton Mixing

PART 2

7	(A) Heavy neutral leptons
9	(B) Sum of neutrino masses
10	(C) Searches for neutrinoless double-beta decay

PART 3

18	(D) Other bounds from nuclear and particle decays

PART 4

28	(E) Solar nu Experiments
37	(F) Astrophysical neutrino observations

PART 5

40	(G) Reactor nubar(e) disappearance experiments
41	(H) Accelerator neutrino appearance experiments
47	(I) Disappearance experiments with accelerator & radioactive source neutrinos
49	References

(G) Reactor $\overline{\nu}_e$ disappearance experiments

In most cases, the reaction $\overline{\nu}_e p \rightarrow e^+ n$ is observed at different distances from one or more reactors in a complex.

Events (Observed/Expected) from Reactor $\overline{\nu}_e$ Experiments

VALUE	DOCUMENT ID			COMMENT
• • • We do not use the following data for averages, fits, limits, etc. • • •				
1.05 ±0.02 ±0.05		VUILLEUMIER	82	Gösgen reactor
0.955±0.035±0.110	[134]	KWON	81	$\overline{\nu}_e p \rightarrow e^+ n$
0.89 ±0.15	[134]	BOEHM	80	$\overline{\nu}_e p \rightarrow e^+ n$
0.38 ±0.21	[135,136]	REINES	80	
0.40 ±0.22	[135,136]	REINES	80	

[134] KWON 81 represents an analysis of a larger set of data from the same experiment as BOEHM 80.

[135] REINES 80 involves comparison of neutral- and charged-current reactions $\overline{\nu}_e d \rightarrow np\overline{\nu}_e$ and $\overline{\nu}_e d \rightarrow nne^+$ respectively. Combined analysis of reactor $\overline{\nu}_e$ experiments was performed by SILVERMAN 81.

[136] The two REINES 80 values correspond to the calculated $\overline{\nu}_e$ fluxes of AVIGNONE 80 and DAVIS 79 respectively.

$\overline{\nu}_e \not\rightarrow \overline{\nu}_e$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$

VALUE (eV^2)	CL%		DOCUMENT ID		TECN	COMMENT
<0.0075	90	[137]	VIDYAKIN	94		Krasnoyark reactors
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.01	90	[138]	ACHKAR	95	CNTR	Bugey reactor
<0.0083	90	[137]	VIDYAKIN	90		Krasnoyark reactors
<0.04	90	[139]	AFONIN	88	CNTR	Rovno reactor
<0.014	68	[140]	VIDYAKIN	87		$\overline{\nu}_e p \rightarrow e^+ n$
<0.019	90	[141]	ZACEK	86		Gösgen reactor
<0.02	90	[142]	ZACEK	85		Gösgen reactor
<0.016	90	[143]	GABATHULER	84		Gösgen reactor

[137] VIDYAKIN 94 bound is for L=57.0 m, 57.6 m, and 231.4 m. Supersedes VIDYAKIN 90.

[138] ACHKAR 95 bound is for L=15, 40, and 95 m.

[139] AFONIN 86 and AFONIN 87 also give limits on $\sin^2(2\theta)$ for intermediate values of $\Delta(m^2)$. (See also KETOV 92). Supersedes AFONIN 87, AFONIN 86, AFONIN 85, AFONIN 83, and BELENKII 83.

[140] VIDYAKIN 87 bound is for L = 32.8 and 92.3 m distance from two reactors.

[141] This bound is from data for L=37.9 m, 45.9 m, and 64.7 m.

[142] See the comment for ZACEK 85 in the section on $\sin^2(2\theta)$ below.

[143] This bound comes from a combination of the VUILLEUMIER 82 data at distance 37.9 m and new data at 45.9 m.

$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.02	90	[144] ACHKAR	95	CNTR	For $\Delta(m^2) = 0.6$ eV^2
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.087	68	[145] VYRODOV	95	CNTR	For $\Delta(m^2)$ >2 eV^2
<0.15	90	[146] VIDYAKIN	94		For $\Delta(m^2) > 5.0\times10^{-2}$ eV^2
<0.2	90	[147] AFONIN	88	CNTR	$\overline{\nu}_e p \rightarrow e^+ n$
<0.14	68	[148] VIDYAKIN	87		$\overline{\nu}_e p \rightarrow e^+ n$
<0.21	90	[149] ZACEK	86		$\overline{\nu}_e p \rightarrow e^+ n$
<0.19	90	[150] ZACEK	85		Gösgen reactor
<0.16	90	[151] GABATHULER	84		$\overline{\nu}_e p \rightarrow e^+ n$

[144] ACHKAR 95 bound is from data for L=15, 40, and 95 m distance from the Bugey reactor.
[145] The VYRODOV 95 bound is from data for L=15 m distance from the Bugey-5 reactor.
[146] The VIDYAKIN 94 bound is from data for L=57.0 m, 57.6 m, and 231.4 m from three reactors in the Krasnoyark Reactor complex.
[147] Several different methods of data analysis are used in AFONIN 88. We quote the most stringent limits. Different upper limits on $\sin^2 2\theta$ apply at intermediate values of $\Delta(m^2)$. Supersedes AFONIN 87, AFONIN 85, and BELENKII 83.
[148] VIDYAKIN 87 bound is for L = 32.8 and 92.3 m distance from two reactors.
[149] This bound is from data for L=37.9 m, 45.9 m, and 64.7 m distance from Gosgen reactor.
[150] ZACEK 85 gives two sets of bounds depending on what assumptions are used in the data analysis. The bounds in figure 3(a) of ZACEK 85 are progressively poorer for large $\Delta(m^2)$ whereas those of figure 3(b) approach a constant. We list the latter. Both sets of bounds use combination of data from 37.9, 45.9, and 64.7m distance from reactor. ZACEK 85 states "Our experiment excludes this area (the oscillation parameter region allowed by the Bugey data, CAVAIGNAC 84) almost completely, thus disproving the indications of neutrino oscillations of CAVAIGNAC 84 with a high degree of confidence."
[151] This bound comes from a combination of the VUILLEUMIER 82 data at distance 37.9m from Gosgen reactor and new data at 45.9m.

$\Delta(m^2)$ for given $\sin^2(2\theta)$

VALUE (eV^2)	DOCUMENT ID		COMMENT
0.2 ±0.1	[152] CAVAIGNAC	84	$\overline{\nu}_e p \rightarrow e^+ n$

[152] $\sin^2(2\theta) = 0.25 \pm 0.1$. These are from best fit to data; see CAVAIGNAC 84 for plot of allowed regions in these variables. These data from Bugey reactor.

(H) Accelerator neutrino appearance experiments

$\nu_e \rightarrow \nu_\tau$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$

VALUE (eV^2)	CL%	DOCUMENT ID		TECN	COMMENT
< 9	90	USHIDA	86C	EMUL	FNAL
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<44	90	TALEBZADEH	87	HLBC	BEBC

$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$

VALUE	*CL%*		*DOCUMENT ID*		*TECN*	*COMMENT*
<0.25	90	[153]	USHIDA	86C	EMUL	FNAL
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.36	90		TALEBZADEH	87	HLBC	BEBC

[153] USHIDA 86C published result is $\sin^2 2\theta < 0.12$. The quoted result is corrected for a numerical mistake incurred in calculating the expected number of ν_e CC events, normalized to the total number of neutrino interactions (3886) rather than to the total number of ν_μ CC events (1870).

$\overline{\nu}_e \rightarrow \overline{\nu}_\tau$

$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$

VALUE	*CL%*		*DOCUMENT ID*		*TECN*	*COMMENT*
<0.7	90	[154]	FRITZE	80	HYBR	BEBC CERN SPS

[154] Authors give $P(\nu_e \rightarrow \nu_\tau) < 0.35$, equivalent to above limit.

$\nu_\mu \rightarrow \nu_e$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$

VALUE (eV^2)	*CL%*		*DOCUMENT ID*		*TECN*	*COMMENT*
<0.09	90		ANGELINI	86	HLBC	BEBC CERN PS
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.9	90		VILAIN	94C	CHM2	CERN SPS
<0.1	90		BLUMENFELD	89	CNTR	
<1.3	90		AMMOSOV	88	HLBC	SKAT at Serpukhov
<0.19	90		BERGSMA	88	CHRM	
		[155]	LOVERRE	88	RVUE	
<2.4	90		AHRENS	87	CNTR	BNL AGS
<1.8	90		BOFILL	87	CNTR	FNAL
<2.2	90	[156]	BRUCKER	86	HLBC	15-ft FNAL
<0.43	90		AHRENS	85	CNTR	BNL AGS E734
<0.20	90		BERGSMA	84	CHRM	
<1.7	90		ARMENISE	81	HLBC	GGM CERN PS
<0.6	90		BAKER	81	HLBC	15-ft FNAL
<1.7	90		ERRIQUEZ	81	HLBC	BEBC CERN PS
<1.2	95		BLIETSCHAU	78	HLBC	GGM CERN PS
<1.2	95		BELLOTTI	76	HLBC	GGM CERN PS

[155] LOVERRE 88 reports a less stringent, indirect limit based on theoretical analysis of neutral to charged current ratios.

[156] 15ft bubble chamber at FNAL.

$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$

VALUE (units 10^{-3})	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
< 2.5	90	AMMOSOV	88	HLBC	SKAT at Serpukhov

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

< 9.4	90		VILAIN	94C	CHM2	CERN SPS
< 5.6	90	[157]	VILAIN	94C	CHM2	CERN SPS
< 16	90		BLUMENFELD	89	CNTR	
< 8	90		BERGSMA	88	CHRM	$\Delta(m^2) \geq 30$ eV^2
		[158]	LOVERRE	88	RVUE	
< 10	90		AHRENS	87	CNTR	BNL AGS
< 15	90		BOFILL	87	CNTR	FNAL
< 20	90	[159]	ANGELINI	86	HLBC	BEBC CERN PS
20 to 40		[160]	BERNARDI	86B	CNTR	$\Delta(m^2)$=5–10
< 11	90	[161]	BRUCKER	86	HLBC	15-ft FNAL
< 3.4	90		AHRENS	85	CNTR	BNL AGS E734
<240	90		BERGSMA	84	CHRM	
< 10	90		ARMENISE	81	HLBC	GGM CERN PS
< 6	90		BAKER	81	HLBC	15-ft FNAL
< 10	90		ERRIQUEZ	81	HLBC	BEBC CERN PS
< 4	95		BLIETSCHAU	78	HLBC	GGM CERN PS
< 10	95		BELLOTTI	76	HLBC	GGM CERN PS

[157] VILAIN 94C limit derived by combining the ν_μ and $\overline{\nu}_\mu$ data assuming *CP* conservation.

[158] LOVERRE 88 reports a less stringent, indirect limit based on theoretical analysis of neutral to charged current ratios.

[159] ANGELINI 86 limit reaches 13×10^{-3} at $\Delta(m^2) \approx 2$ eV^2.

[160] BERNARDI 86B is a typical fit to the data, assuming mixing between two species. As the authors state, this result is in conflict with earlier upper bounds on this type of neutrino oscillations.

[161] 15ft bubble chamber at FNAL.

$\overline{\nu}_\mu \rightarrow \overline{\nu}_e$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$

VALUE (eV^2)	*CL%*	*EVTS*	*DOCUMENT ID*		*TECN*	*COMMENT*
<0.14	90		[162] FREEDMAN	93	CNTR	LAMPF

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

0.075 ± 0.030		9	[163] ATHANASSO...95			
<0.07	90		[164] HILL	95		
<0.9	90		VILAIN	94C	CHM2	CERN SPS
<3.1	90		BOFILL	87	CNTR	FNAL
<2.4	90		TAYLOR	83	HLBC	15-ft FNAL
<0.91	90		[165] NEMETHY	81B	CNTR	LAMPF
<1	95		BLIETSCHAU	78	HLBC	GGM CERN PS

[162] FREEDMAN 93 is a search at LAMPF for $\overline{\nu}_e$ generated from any of the three neutrino types ν_μ, $\overline{\nu}_\mu$, and ν_e which come from the beam stop. The $\overline{\nu}_e$'s would be detected by the reaction $\overline{\nu}_e p \rightarrow e^+ n$. FREEDMAN 93 replaces DURKIN 88.

[163] ATHANASSOPOULOS 95 error corresponds to the 2σ band in the plot, and is corrected for the 20% systematic error. The expected background is 2.1 ± 0.3 events. Corresponds to an oscillation probability of $(0.34^{+0.20}_{-0.18} \pm 0.07)$%. For a different interpretation, see HILL 95. Preprint ATHANASSOPOULOS 96 reports strengthened conclusions based on an excess of 52 events.

[164] HILL 95 is a report by one member of the LSND Collaboration, reporting a different conclusion from the analysis of the data of this experiment (see ATHANASSOPOULOS 95). Contrary to the rest of the LSND Collaboration, Hill finds no evidence for the neutrino oscillation $\overline{\nu}_\mu \rightarrow \overline{\nu}_e$ and obtains only upper limits.

[165] In reaction $\overline{\nu}_e p \rightarrow e^+ n$.

$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$

VALUE	CL%	EVTS	DOCUMENT ID		TECN	COMMENT
<0.004	95		BLIETSCHAU	78	HLBC	GGM CERN PS

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

0.007 ± 0.005		9	[166] ATHANASSO...	95		
<0.006	90		[167] HILL	95		
<4.8	90		VILAIN	94C	CHM2	CERN SPS
<5.6	90		[168] VILAIN	94C	CHM2	CERN SPS
<0.024	90		[169] FREEDMAN	93	CNTR	LAMPF
<0.04	90		BOFILL	87	CNTR	FNAL
<0.013	90		TAYLOR	83	HLBC	15-ft FNAL
<0.2	90		[170] NEMETHY	81B	CNTR	LAMPF

[166] ATHANASSOPOULOS 95 error corresponds to the 2σ band in the plot, and is corrected for the 20% systematic error. The expected background is 2.1 ± 0.3 events. Corresponds to an oscillation probability of $(0.34^{+0.20}_{-0.18} \pm 0.07)\%$. For a different interpretation, see HILL 95. Preprint ATHANASSOPOULOS 96 reports strengthened conclusions based on an excess of 52 events.

[167] HILL 95 is a report by one member of the LSND Collaboration, reporting a different conclusion from the analysis of the data of this experiment (see ATHANASSOPOULOS 95). Contrary to the rest of the LSND Collaboration, Hill finds no evidence for the neutrino oscillation $\overline{\nu}_\mu \rightarrow \overline{\nu}_e$ and obtains only upper limits.

[168] VILAIN 94C limit derived by combining the ν_μ and $\overline{\nu}_\mu$ data assuming *CP* conservation.

[169] FREEDMAN 93 is a search at LAMPF for $\overline{\nu}_e$ generated from any of the three neutrino types ν_μ, $\overline{\nu}_\mu$, and ν_e which come from the beam stop. The $\overline{\nu}_e$'s would be detected by the reaction $\overline{\nu}_e p \rightarrow e^+ n$. FREEDMAN 93 replaces DURKIN 88.

[170] In reaction $\overline{\nu}_e p \rightarrow e^+ n$.

$\nu_\mu(\overline{\nu}_\mu) \rightarrow \nu_e(\overline{\nu}_e)$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$

VALUE (eV^2)	CL%	DOCUMENT ID		TECN	COMMENT
<0.075	90	BORODOV...	92	CNTR	BNL E776

$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$

VALUE (units 10^{-3})	CL%	DOCUMENT ID		TECN	COMMENT
<3	90	BORODOV...	92	CNTR	BNL E776

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

<3.8	90	[171] MCFARLAND	95	CCFR	FNAL

[171] MCFARLAND 95 state that "This result is the most stringent to date for $250 < \Delta(m^2) < 450$ ev^2 and also excludes at 90%CL much of the high $\Delta(m^2)$ region favored by the recent LSND observation." See ATHANASSOPOULOS 95 and ATHANASSOPOULOS 96.

$\nu_\mu \rightarrow \nu_\tau$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$

VALUE (eV^2)	CL%	DOCUMENT ID		TECN	COMMENT
< 0.9	90	USHIDA	86C	EMUL	FNAL

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

< 1.4	90	MCFARLAND	95	CCFR	FNAL
< 4.5	90	BATUSOV	90B	EMUL	FNAL
<10.2	90	BOFILL	87	CNTR	FNAL
< 6.3	90	BRUCKER	86	HLBC	15-ft FNAL
< 4.6	90	ARMENISE	81	HLBC	GGM CERN SPS
< 3	90	BAKER	81	HLBC	15-ft FNAL
< 6	90	ERRIQUEZ	81	HLBC	BEBC CERN SPS
< 3	90	USHIDA	81	EMUL	FNAL

$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<0.004	90	USHIDA	86C	EMUL	FNAL

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

<0.0081	90	MCFARLAND	95	CCFR	FNAL
<0.06	90	BATUSOV	90B	EMUL	FNAL
<0.34	90	BOFILL	87	CNTR	FNAL
<0.088	90	BRUCKER	86	HLBC	15-ft FNAL
<0.11	90	BALLAGH	84	HLBC	15-ft FNAL
<0.017	90	ARMENISE	81	HLBC	GGM CERN SPS
<0.06	90	BAKER	81	HLBC	15-ft FNAL
<0.05	90	ERRIQUEZ	81	HLBC	BEBC CERN SPS
<0.013	90	USHIDA	81	EMUL	FNAL

$\overline{\nu}_\mu \rightarrow \overline{\nu}_\tau$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$

VALUE (eV^2)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<2.2	90	ASRATYAN	81	HLBC	FNAL

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

<1.4	90	MCFARLAND	95	CCFR	FNAL
<6.5	90	BOFILL	87	CNTR	FNAL
<7.4	90	TAYLOR	83	HLBC	15-ft FNAL

$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<4.4 $\times 10^{-2}$	90	ASRATYAN	81	HLBC	FNAL

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

<0.0081	90	MCFARLAND	95	CCFR	FNAL
<0.15	90	BOFILL	87	CNTR	FNAL
<8.8 $\times 10^{-2}$	90	TAYLOR	83	HLBC	15-ft FNAL

$\nu_\mu(\overline{\nu}_\mu) \rightarrow \nu_\tau(\overline{\nu}_\tau)$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$

VALUE (eV^2)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<1.5	90	[172] GRUWE	93	CHM2	CERN SPS

[172] GRUWE 93 is a search using the CHARM II detector in the CERN SPS wide-band neutrino beam for $\nu_\mu \rightarrow \nu_\tau$ and $\overline{\nu}_\mu \rightarrow \overline{\nu}_\tau$ oscillations signalled by quasi-elastic ν_τ and $\overline{\nu}_\tau$ interactions followed by the decay $\tau \rightarrow \nu_\tau \pi$. The maximum sensitivity in $\sin^2 2\theta$ ($< 6.4 \times 10^{-3}$ at the 90% CL) is reached for $\Delta(m^2) \simeq 50$ eV^2.

$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$

VALUE (units 10^{-3})	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<8	90	[173] GRUWE	93	CHM2	CERN SPS

[173] GRUWE 93 is a search using the CHARM II detector in the CERN SPS wide-band neutrino beam for $\nu_\mu \rightarrow \nu_\tau$ and $\overline{\nu}_\mu \rightarrow \overline{\nu}_\tau$ oscillations signalled by quasi-elastic ν_τ and $\overline{\nu}_\tau$ interactions followed by the decay $\tau \rightarrow \nu_\tau \pi$. The maximum sensitivity in $\sin^2 2\theta$ ($< 6.4 \times 10^{-3}$ at the 90% CL) is reached for $\Delta(m^2) \simeq 50$ eV^2.

$\nu_e \rightarrow (\overline{\nu}_e)_L$

This is a limit on lepton family-number violation and total lepton-number violation. $(\overline{\nu}_e)_L$ denotes a hypothetical left-handed $\overline{\nu}_e$. The bound is quoted in terms of Δ (m^2), $\sin(2\theta)$, and α, where α denotes the fractional admixture of $(V+A)$ charged current.

$\alpha\Delta(m^2)$ for $\sin^2(2\theta) = 1$

VALUE (eV^2)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<0.14	90	[174] FREEDMAN	93	CNTR	LAMPF
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<7	90	[175] COOPER	82	HLBC	BEBC CERN SPS

[174] FREEDMAN 93 is a search at LAMPF for $\overline{\nu}_e$ generated from any of the three neutrino types ν_μ, $\overline{\nu}_\mu$, and ν_e which come from the beam stop. The $\overline{\nu}_e$'s would be detected by the reaction $\overline{\nu}_e p \rightarrow e^+ n$.

[175] COOPER 82 states that existing bounds on V+A currents require α to be small.

$\alpha^2\sin^2(2\theta)$ for "Large" $\Delta(m^2)$

VALUE	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<0.032	90	[176] FREEDMAN	93	CNTR	LAMPF
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.05	90	[177] COOPER	82	HLBC	BEBC CERN SPS

[176] FREEDMAN 93 is a search at LAMPF for $\overline{\nu}_e$ generated from any of the three neutrino types ν_μ, $\overline{\nu}_\mu$, and ν_e which come from the beam stop. The $\overline{\nu}_e$'s would be detected by the reaction $\overline{\nu}_e p \rightarrow e^+ n$.

[177] COOPER 82 states that existing bounds on V+A currents require α to be small.

$\nu_\mu \rightarrow (\overline{\nu}_e)_L$

See note above for $\nu_e \rightarrow (\overline{\nu}_e)_L$ limit

$\alpha\Delta(m^2)$ for $\sin^2(2\theta) = 1$

VALUE (eV^2)	*CL%*	*DOCUMENT ID*		*TECN*	*COMMENT*
<0.16	90	[178] FREEDMAN	93	CNTR	LAMPF
• • • We do not use the following data for averages, fits, limits, etc. • • •					
<0.7	90	[179] COOPER	82	HLBC	BEBC CERN SPS

[178] FREEDMAN 93 is a search at LAMPF for $\overline{\nu}_e$ generated from any of the three neutrino types ν_μ, $\overline{\nu}_\mu$, and ν_e which come from the beam stop. The $\overline{\nu}_e$'s would be detected by the reaction $\overline{\nu}_e p \rightarrow e^+ n$. The limit on $\Delta(m^2)$ is better than the CERN BEBC experiment, but the limit on $\sin^2\theta$ is almost a factor of 100 less sensitive.

[179] COOPER 82 states that existing bounds on V+A currents require α to be small.

$\alpha^2\sin^2(2\theta)$ for "Large" $\Delta(m^2)$

VALUE	CL%		DOCUMENT ID		TECN	COMMENT
<0.001	90	[180]	COOPER	82	HLBC	BEBC CERN SPS
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.07	90	[181]	FREEDMAN	93	CNTR	LAMPF

[180] COOPER 82 states that existing bounds on V+A currents require α to be small.

[181] FREEDMAN 93 is a search at LAMPF for $\overline{\nu}_e$ generated from any of the three neutrino types ν_μ, $\overline{\nu}_\mu$, and ν_e which come from the beam stop. The $\overline{\nu}_e$'s would be detected by the reaction $\overline{\nu}_e p \rightarrow e^+ n$. The limit on $\Delta(m^2)$ is better than the CERN BEBC experiment, but the limit on $\sin^2\theta$

(I) Disappearance experiments with accelerator & radioactive source neutrinos

$\nu_e \not\rightarrow \nu_e$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$

VALUE (eV^2)	CL%		DOCUMENT ID		TECN	COMMENT
< 0.17	90	[182]	BAHCALL	95	THEO	
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<14.9	90		BRUCKER	86	HLBC	15-ft FNAL
< 8	90		BAKER	81	HLBC	15-ft FNAL
<56	90		DEDEN	81	HLBC	BEBC CERN SPS
<10	90		ERRIQUEZ	81	HLBC	BEBC CERN SPS
<2.3 OR >8	90		NEMETHY	81B	CNTR	LAMPF

[182] BAHCALL 95 analyzed the GALLEX ^{51}Cr source experiment (ANSELMANN 95). They also gave a 95% CL limit of < 0.19 eV^2.

$\sin^2(2\theta)$ for "Large" $\Delta(m^2)$

VALUE	CL%		DOCUMENT ID		TECN	COMMENT
<7 $\times 10^{-2}$	90	[183]	ERRIQUEZ	81	HLBC	BEBC CERN SPS
• • • We do not use the following data for averages, fits, limits, etc. • • •						
<0.38	90	[184]	BAHCALL	95	THEO	^{51}Cr source
<0.54	90		BRUCKER	86	HLBC	15-ft FNAL
<0.6	90		BAKER	81	HLBC	15-ft FNAL
<0.3	90	[183]	DEDEN	81	HLBC	BEBC CERN SPS

[183] Obtained from a Gaussian centered in the unphysical region.

[184] BAHCALL 95 analyzed the GALLEX ^{51}Cr calibration source experiment (ANSELMANN 95). They also gave a 95% CL limit of < 0.45.

$\nu_\mu \not\rightarrow \nu_\mu$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$

These experiments also allow sufficiently large $\Delta(m^2)$.

VALUE (eV^2)	CL%	DOCUMENT ID		TECN	COMMENT
<0.23 OR >1500 OUR LIMIT					
<0.23 OR >100	90	DYDAK	84	CNTR	
<13 OR >1500	90	STOCKDALE	84	CNTR	

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

< 0.29 OR >22	90	BERGSMA	88	CHRM	
<7	90	BELIKOV	85	CNTR	Serpukhov
<8.0 OR >1250	90	STOCKDALE	85	CNTR	
<0.29 OR >22	90	BERGSMA	84	CHRM	
<8.0	90	BELIKOV	83	CNTR	

$\sin^2(2\theta)$ for $\Delta(m^2) = 100\text{eV}^2$

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.02	90	[185] STOCKDALE	85	CNTR	FNAL

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

<0.17	90	[186] BERGSMA	88	CHRM	
<0.07	90	[187] BELIKOV	85	CNTR	Serpukhov
<0.27	90	[186] BERGSMA	84	CHRM	CERN PS
<0.1	90	[188] DYDAK	84	CNTR	CERN PS
<0.02	90	[189] STOCKDALE	84	CNTR	FNAL
<0.1	90	[190] BELIKOV	83	CNTR	Serpukhov

[185] This bound applies for $\Delta(m^2) = 100$ eV^2. Less stringent bounds apply for other $\Delta(m^2)$; these are nontrivial for $8 < \Delta(m^2) < 1250$ eV^2.

[186] This bound applies for $\Delta(m^2) = 0.7$–$9.$ eV^2. Less stringent bounds apply for other $\Delta(m^2)$; these are nontrivial for $0.28 < \Delta(m^2) < 22$ eV^2.

[187] This bound applies for a wide range of $\Delta(m^2) > 7$ eV^2. For some values of $\Delta(m^2)$, the value is less stringent; the least restrictive, nontrivial bound occurs approximately at $\Delta(m^2) = 300$ eV^2 where $\sin^2(2\theta) < 0.13$ at CL = 90%.

[188] This bound applies for $\Delta(m^2) = 1.$–$10.$ eV^2. Less stringent bounds apply for other $\Delta(m^2)$; these are nontrivial for $0.23 < \Delta(m^2) < 90$ eV^2.

[189] This bound applies for $\Delta(m^2) = 110$ eV^2. Less stringent bounds apply for other $\Delta(m^2)$; these are nontrivial for $13 < \Delta(m^2) < 1500$ eV^2.

[190] Bound holds for $\Delta(m^2) = 20$–1000 eV^2.

$\overline{\nu}_\mu \not\to \overline{\nu}_\mu$

$\Delta(m^2)$ for $\sin^2(2\theta) = 1$

VALUE (eV^2)	CL%	DOCUMENT ID		TECN
<7 OR >1200 OUR LIMIT				
<7 OR >1200	90	STOCKDALE	85	CNTR

$\sin^2(2\theta)$ for 190 eV^2 < $\Delta(m^2)$ < 320 eV^2

VALUE	CL%	DOCUMENT ID		TECN	COMMENT
<0.02	90	[191] STOCKDALE	85	CNTR	FNAL

[191] This bound applies for $\Delta(m^2)$ between 190 and 320 or = 530 eV^2. Less stringent bounds apply for other $\Delta(m^2)$; these are nontrivial for $7 < \Delta(m^2) < 1200$ eV^2.

REFERENCES FOR Searches for Massive Neutrinos and Lepton Mixing

ATHANASSO... 96 PR D (subm.) Athanassopoulos, Auerbach, Burman, Cohen+(LSND Collab.)
nucl-ex/9605001
ACHKAR 95 NP B434 503 +Aleksan+ (SING, SACLD, CPPM, CDEF, LAPP)
AHLEN 95 PL B357 481 +Ambrosio, Antolini, Auriemma+ (MACRO Collab.)
ANSELMANN 95 PL B342 440 +Fockenbrock, Hampel, Heusser+ (GALLEX Collab.)
ANSELMANN 95B PL B357 237 +Hampel, Heusser, Kike+ (GALLEX Collab.)
ARMBRUSTER 95 PL B348 19 +Blair, Bodmann, Booth+ (KARMEN Collab.)
ARNOLD 95 JETPL 61 170 +Caurier, Guyonnet, Linck+ (NEMO Collab.)
Translated from ZETFP 61 168.
ATHANASSO... 95 PRL 75 2650 Athanassopoulos, Auerbach+ (LSND Collab.)
BAHCALL 95 PL B348 121 +Krastev, Lisi (IAS)
BAHRAN 95 PL B354 481 +Kalbfleisch (OKLA)
BALYSH 95 PL B356 450 +Beck, Belyaev+ (MPIH, KIAE, SASSO)
BARABASH 95 PL B345 408 +Avignone+ (ITEP, SCUC, PNL, MINN, LEBD)
BILGER 95 PL B363 41 +Clement, Denig, Fohl+ (TUBIN, KARLE, PSI)
BURACHAS 95 PAN 58 153 +Danevich, Zdesenko, Kobychev+ (KIEV)
Translated from YAF 58 195.
DANEVICH 95 PL B344 72 +Georgadze, Kobychev, Kropivyansky+ (KIEV)
DASSIE 95 PR D51 2090 +Eschbach, Hubert, Isaac, Isac+ (NEMO Collab.)
DAUM 95 ZPHY C66 417 +Rhode, Bareyre, Barloutaud+ (FREJUS Collab.)
DAUM 95B PL B361 179 +Frosch, Hajdas, Janousch+ (PSI, VIRG)
EJIRI 95 JPSJ 64 339 +Fushmii, Hazama, Kawasaki+ (OSAK, KIEV)
FARGION 95 PR D52 1828 +Khlopov, Konplich, Mignani (ROMA, KIAM, MPEI)
GALLAS 95 PR D52 6 +Abolins, Brock, Cobau+ (MSU, FNAL, MIT, FLOR)
GEORGADZE 95 PAN 58 1093
Translated from YAF 58 1170.
HAGNER 95 PR D52 1343 +Altmann, Feilitzsch, Oberauer+ (MUNT, LAPP, CPPM)
HIDDEMANN 95 JP G21 639 +Daniel, Schwentker (MUNT)
HILL 95 PRL 75 2654 (PENN)
KOBAYASHI 95 NP A586 457 +Kobayashi (KEK, SAGA)
MCFARLAND 95 PRL 75 3993 +Naples, Arroyo, Auchinchloss+ (CCFR Collab.)
VILAIN 95C PL B351 387 +Wilquet, Petrak+ (CHARM II Collab.)
Also 95 PL B343 453 Vilain, Wilquet+ (CHARM II Collab.)
VYRODOV 95 JETPL 61 163 +Kozlov, Martem'yanov, Machulin+ (KIAE, LAPP, CDEF)
Translated from ZETFP 61 161.
WIETFELDT 95 PR C52 1028 +Norman+ (LBL, UCB, SPAUL, IND, TENN)
ABDURASHI... 94 PL B328 234 Abdurashitov, Faizov, Gavrin, Gusev+ (SAGE Collab.)
ACKER 94 PL B320 320 +Pakvasa (HAWA)
ALESSAND... 94 PL B335 519 Alessandrello, Brofferio, ..., Fiorini+ (MILA)
ANSELMANN 94 PL B327 377 +Hampel, Heusser, Kiko, Kirsten+ (GALLEX Collab.)
ARPESELLA 94 EPL 27 29 +Barabash, Bellotti+ (SASSO, ITEP, MOSU, MILA, LEBD)
BAHCALL 94 PL B338 276 (IAS)
BALYSH 94 PL B322 176 +Beck, Belyaev, Bensch+ (MPIH, KIAE, SASSO)
BECK 94 PL B336 141 +Bensch, Bockholt+ (MPIH, KIAE, SASSO)
FUKUDA 94 PL B335 237 +Hayakawa, Inoue, Ishida+ (Kamiokande Collab.)
KONOPLICH 94 PAN 57 425 +Khlopov (MPEI)
PDG 94 PR D50 1173 Montanet+ (CERN, LBL, BOST, IFIC+)
PIEPKE 94 NP A577 493 +..., Klapdor-Kleingrothaus+ (MPIH, ITEP)
SMIRNOV 94 PR D49 1389 +Spergel, Bahcall (IAS, ICTP, INRM, PRIN)
VIDYAKIN 94 JETPL 59 390 +Vyrodov, Kozlov+ (KIAE)
Translated from ZETFP 59 364.
VILAIN 94C ZPHY C64 539 +Wilquet, Beyer+ (CHARM II Collab.)
ALSTON-... 93 PRL 71 831 Alston-Garnjost+ (LBL, MTHO, UNM, INEL)
ARTEMEV 93 JETPL 58 262 +Brakhman, Zeldofich, Karelin+ (ITEP, INRM)
Translated from ZETFP 58 256.
BAHCALL 93 PR D47 1298 +Bethe (IAS, CORN)
BAHRAN 93 PR D47 R754 +Kalbfleisch (OKLA)
BAHRAN 93B PR D47 R759 +Kalbfleisch (OKLA)
BARANOV 93 PL B302 336 +Batusov, Bunyatov, Klimov+ (JINR, SERP, BUDA)
BERMAN 93 PR C48 R1 +Pitt, Calaprice, Lowry (PRIN)
BERNATOW... 93 PR C47 806 Bernatowicz, Brazzle, Cowsik+ (WUSL, TATA)
FREEDMAN 93 PR D47 811 +Fujikawa, Napolitano, Nelson+ (LAMPF E645 Collab.)
GRUWE 93 PL B309 463 +Mommaert, Vilain, Wilquet+ (CHARM II Collab.)
HAMPEL 93 JPG 19 S209 (MPIH)
KALBFLEISCH 93 PL B303 355 +Bahran (OKLA)
KAWASHIMA 93 PR C47 R2452 +Takahashi, Masuda (TOKYC, RIKEN)
MORTARA 93 PRL 70 394 +Ahmad, Coulter, Freedman+ (ANL, LBL, UCB)
OHSHIMA 93 PR D47 4840 + (KEK, TUAT, RIKEN, SCUC, ROCH, TSUK, INUS)
TURCK-CHI... 93 PRPL 230 57 Turck-Chieze+ (SACLD, USC, NICEA, NICEO, MEUD)
TURCK-CHI... 93B APJ 408 347 Turck-Chieze, Lopez (SACLD)

VUILLEUMIER	93	PR D48 1009	+Busto, Farine, Jorgens+	(NEUC, CIT, VILL)
WIETFELDT	93	PRL 70 1759	+Chan, da Cruz, Garcia+	(LBL, UCB, SPAUL)
ABREU	92B	PL B274 230	+Adams, Adami, Adye+	(DELPHI Collab.)
ADRIANI	92I	PL B295 371	+Aguilar-Benitez, Ahlen, Akbari, Alcaraz+	(L3 Collab.)
ARTEMJEV	92	PL B280 159	+Brakchman, Ivanovsky, Karelin+	(ITEP)
BAHCALL	92	RMP 64 885	+Pinsonneault	(IAS, YALE)
BAHRAN	92	PL B291 336	+Kalbfleisch	(OKLA)
BALYSH	92	PL B283 32	+Belyaev, Bockholt, Demehin+	(MPIH, KIAE, SASSO)
BECKER-SZ...	92	PRL 69 1010	Becker-Szendy, Bratton, Casper, Dye+	(IMB Collab.)
BECKER-SZ...	92B	PR D46 3720	Becker-Szendy, Bratton, Casper, Dye+	(IMB Collab.)
BEIER	92	PL B283 446	+Frank, Frati, Kim, Mann+	(KAM2 Collab.)
Also	94	PTRSL A346 63	Beier, Frank	(PENN)
BERNATOW...	92	PRL 69 2341	Bernatowicz, Brannon, Brazzle, Cowsik+	(WUSL, TATA)
BLUM	92	PL B275 506	+Busto, Campagne, Dassie, Hubert+	(NEMO Collab.)
BORODOV...	92	PRL 68 274	Borodovsky, Chi, Ho, Kondakis, Lee+	(COLU, JHU, ILL)
BRITTON	92	PRL 68 3000	+Ahmad, Bryman, Burnham+	(TRIU, CARL)
Also	94	PR D49 28	Britton, Ahmad, Bryman+	(TRIU, CARL)
BRITTON	92B	PR D46 R885	+Ahmad, Bryman+	(TRIU, CARL)
CHEN	92	PRL 69 3151	+Imel, Radcliffe, Henrickson, Boehm	(CIT)
ELLIOTT	92	PR C46 1535	+Hahn, Moe+	(UCI)
HIRATA	92	PL B280 146	+Inoue, Ishida+	(Kamiokande II Collab.)
HOLZSCHUH	92B	PL B287 381	+Fritschi, Kuendig	(ZURI)
KAWAKAMI	92	PL B287 45	+ (INUS, KEK, SCUC, TUAT, RIKEN, ROCH, TSUK)	
KETOV	92	JETPL 55 564	+Machulin, Mikaelyan+	(KIAE)
		Translated from ZETFP 55 544.		
KUDOMI	92	PR C46 R2132	+Ejiri, Nagata, Okada, Shibata+	(OSAK, INUS)
MORI	92B	PL B289 463	+Hikasa, Nojiri, Oyama+	(KAM2 Collab.)
REUSSER	92	PR D45 2548	Reussser, Treichel, Boehm+	(CIT, NEUC, VILL)
ABAZOV	91B	PRL 67 3332	+Anosov, Faizov+	(SAGE Collab.)
ABREU	91F	NP B367 511	+Adam, Adami, Adye, Akesson+	(DELPHI Collab.)
ALEXANDER	91F	ZPHY C52 175	+Allison, Allport, Anderson, Arcelli+	(OPAL Collab.)
AVIGNONE	91	PL B256 559	+Brodzinski, Guerard+	(SCUC, PNL, ITEP, YERE)
BELLOTTI	91	PL B266 193	+Cremonesi, Fiorini, Gervasio+	(MILA, INFN)
CASPER	91	PRL 66 2561	+Becker-Szendy, Bratton, Cady+	(IMB Collab.)
DELEENER-...	91	PR D43 3611	De Leener-Rosier, Deutsch+	(LOUV, ZURI, LAUS)
EJIRI	91	PL B258 17	+Fushimi, Kamada, Kinoshita+	(OSAK)
GARCIA	91	PRL 67 3654	+Adelberger, Magnus, Swanson+	(WASH, CERN, LBL)
HIME	91	PL B257 441	+Jelley	(OXF)
HIRATA	91	PRL 66 9	+Inoue, Kajita, Kihara+	(Kamiokande II Collab.)
HIRATA	91B	PR D44 2241		
MORALES	91	NC 104A 1581	+Morales, Nunez-Lagos, Puimedon+	(ZARA)
NORMAN	91	JPG 17 S291	+Sur, Lesko+	(LBL)
REUSSER	91	PL B255 143	+Treichel, Boehm, Broggini+	(NEUC, CIT, PSI)
SATO	91	PR D44 2220	+Hirata, Kajita, Kifune, Kihara+	(Kamioka Collab.)
SUHONEN	91	NP A535 509	+Khadkikar, Faessler	(JYV, AHMED, TUBIN)
TURKEVICH	91	PRL 67 3211	+Economou, Cowan	(CHIC, LANL)
WONG	91	PRL 67 1218	+Boehm, Fisher, Gabathuler+	(CIT, VILL, NEUC)
YOU	91	PL B265 53	+Zhu, Lu+	(BHEP, CAST+)
ADEVA	90S	PL B251 321	+Adriani, Aguilar-Benitez, Akbari+	(L3 Collab.)
AKRAWY	90L	PL B247 448	+Alexander, Allison, Allport+	(OPAL Collab.)
BARABASH	90	PL B249 186	+Kopylov, Cherehovsky	(ITEP, INRM)
BATUSOV	90B	ZPHY C48 209	+Bunyatov, Kuznetsov, Pozharova+	(JINR, ITEP, SERP)
BERGER	90B	PL B245 305	+Froehlich, Moench, Nisius+	(FREJUS Collab.)
BURCHAT	90	PR D41 3542	+King, Abrams, Adolphsen+	(Mark II Collab.)
DECAMP	90F	PL B236 511	+Deschizeaux, Lees, Minard+	(ALEPH Collab.)
FILIPPONE	90	PL B246 546	+Vogel	(CIT)
HIRATA	90	PRL 65 1297	+Inoue, Kajita+	(Kamiokande II Collab.)
HIRATA	90B	PRL 65 1301	+Inoue, Kajita+	(Kamiokande II Collab.)
JUNG	90	PRL 64 1091	+Van Kooten, Abrams, Adolphsen+	(Mark II Collab.)
KOPEIKIN	90	JETPL 51 86	+Mikazlyan, Fayans	(KIAE)
		Translated from ZETFP 51 75.		
MILEY	90	PRL 65 3092	+Avignone, Brodzinski, Collar, Reeves	(SCUC, PNL)
STAUDT	90	EPL 13 31	+Muto, Klapdor-Kleingrothaus	(MPIH)
VASENKO	90	MPL A5 1299	+Kirpichnikov, Kuznetsov, Starostin	(ITEP, YERE)
VIDYAKIN	90	JETP 71 424	+Vyrodov, Gurevich, Koslov+	(KIAE)
		Translated from ZETF 98 764.		

ABRAMS	89C	PRL 63 2447	+Adolphsen, Averill, Ballam+	(Mark II Collab.)
AGLIETTA	89	EPL 8 611	+Battistoni, Bellotti+	(FREJUS Collab.)
ALSTON-...	89	PRL 63 1671	Alston-Garnjost, Dougherty+	(LBL, MTHO, UNM, INEL)
BAHCALL	89	Neutrino Astrophysics, Cambridge Univ. Press		(IAS)
BARABASH	89	PL B223 273	+Kuzminov, Lobashev, Novikov+	(ITEP, INRM)
BELLOTTI	89	PL B221 209	+Cremonesi, Fiorini, Gervasio+	(MILA)
BLUMENFELD	89	PRL 62 2237	+Chi, Chichura, Chien+	(COLU, ILL, JHU)
DANEVICH	89	JETPL 49 476	+Zdesenko, Nikolaiko, Tretyak	(UZINR)
		Translated from ZETFP 49 417.		
DAVIS	89	ARNPS 39 467	+Mann, Wolfenstein	(BNL, PENN, CMU)
ENQVIST	89	NP B317 647	+Kainulainen, Maalampi	(HELS)
FISHER	89	PL B218 257	+Boehm, Bovet, Egger+	(CIT, NEUC, PSI)
MUTO	89	ZPHY A334 187	+Bender, Klapdor	(TINT, MPIH)
OYAMA	89	PR D39 1481	+Hirata, Kajita, Kifune+	(Kamiokande II Collab.)
SHAW	89	PRL 63 1342	+Blanis, Bodek, Budd+	(AMY Collab.)
AFONIN	88	JETP 67 213	+Ketov, Kopeikin, Mikaelyan+	(KIAE)
		Translated from ZETF 94 1, issue 2.		
AKERLOF	88	PR D37 577	+Chapman, Errede, Ken+	(HRS Collab.)
AMMOSOV	88	ZPHY C40 487	+Belikov+	(SKAT Collab.)
BAHCALL	88	RMP 60 297	+Ulrich	(IAS, UCLA)
BERGSMA	88	ZPHY C40 171	+Dorenbosch, Nieuwenhuis+	(CHARM Collab.)
BERNARDI	88	PL B203 332	+Carugno, Chauveau+	(PARIN, CERN, INFN, ATEN)
BIONTA	88	PR D38 768	+Blewitt, Bratton, Casper+	(IMB Collab.)
CALDWELL	88	PRL 61 510	+Eisberg, Grumm, Witherell+	(UCSB, UCB, LBL)
DURKIN	88	PRL 61 1811	+Harper, Ling+	(OSU, ANL, CIT, LBL, LSU, LANL)
ENGEL	88	PR C37 731	+Vogel, Zimbene	
LOVERRE	88	PL B206 711		(INFN)
MORALES	88	NC 100A 525	+Morales, Nunez-Lagos, Puimedon+	(ZARA)
OLIVE	88	PL B205 553	+Srednicki	(MINN, UCSB)
SREDNICKI	88	NP B310 693	+Watkins, Olive	(MINN, UCSB)
TURCK-CHI...	88	APJ 335 415	Turck-Chieze, Cahen, Casse, Doom	(SACL, BRUX)
AFONIN	87	JETPL 45 257	+Bogatov, Vershinskii+	(KIAE)
		Translated from ZETFP 45 201.		
AHLEN	87	PL B195 603	+Avignone, Brodzinski+	(BOST, SCUC, HARV, CHIC)
AHRENS	87	PR D36 702	+ (BNL, BROW, UCI, HIRO, KEK, OSAK, PENN, STON)	
BELLOTTI	87	EPL 3 889	+Cattadori, Cremonesi, Fiorini+	(MILA)
BOEHM	87	Massive Neutrinos	+Vogel	(CIT)
Cambridge Univ. Press, Cambridge				
BOFILL	87	PR D36 3309	+Busza, Eldridge+	(MIT, FNAL, MSU)
CALDWELL	87	PRL 59 419	+Eisberg, Grumm, Witherell+	(UCSB, LBL)
DAUM	87	PR D36 2624	+Kettle, Jost+	(SIN, VIRG)
GRIEST	87	NP B283 681	+Seckel	(UCSC, CERN)
Also	88	NP B296 1034 erratum	Griest, Seckel	(UCSC, CERN)
LOSECCO	87	PL B184 305	+Bionta, Blewitt, Bratton+	(IMB Collab.)
MISHRA	87	PRL 59 1397	+Auchincloss+	(COLU, CIT, FNAL, CHIC, ROCH)
OBERAUER	87	PL B198 113	+von Feilitzsch, Mossbauer	(MUNT)
TALEBZADEH	87	NP B291 503	+Guy, Venus+	(BEBC WA66 Collab.)
TOMODA	87	PL B199 475	+Faessler	(TUBIN)
VIDYAKIN	87	JETP 66 243	+Vyrodov, Gurevich, Kozlov+	(KIAE)
		Translated from ZETF 93 424.		
WENDT	87	PRL 58 1810	+Abrams, Amidei, Baden+	(Mark II Collab.)
AFONIN	86	JETPL 44 142	+Bogatov, Borovoi, Vershinskii+	(KIAE)
		Translated from ZETFP 44 111.		
ANGELINI	86	PL B179 307	+Apostolakis, Baldini+	(PISA, ATHU, PADO, WISC)
AZUELOS	86	PRL 56 2241	+Britton, Bryman+	(TRIU, CNRC)
BADIER	86	ZPHY C31 21	+Bemporad, Boucrot, Callot+	(NA3 Collab.)
BELLOTTI	86	NC 95A 1	+Cremonesi, Fiorini, Liguori+	(MILA)
BERNARDI	86	PL 166B 479	+Carugno+	(CURIN, INFN, CDEF, ATEN, CERN)
BERNARDI	86B	PL B181 173	+Carugno+	(CURIN, INFN, CDEF, ATEN, CERN)
BORGE	86	PS 34 591	+DeRujula, Hansen, Jonson+	(ISOLDE Collab.)
BRUCKER	86	PR D34 2183	+Jacques, Kalelkar, Koller+	(RUTG, BNL, COLU)
DELEENER-...	86	PL B177 228	DeLeener-Rosier, Deutsch+	(LOUV, ZURI, LAUS)
DORENBOS...	86	PL 166B 473	Dorenbosch, Allaby, Amaldi+	(CHARM Collab.)
GROTZ	86	NC C9 535	+Klapdor	(MPIH)
USHIDA	86C	PRL 57 2897	+Kondo, Tasaka, Park, Song+	(FNAL E531 Collab.)
ZACEK	86	PR D34 2621	+Feilitzsch+	(CIT-SIN-TUM Collab.)
AFONIN	85	JETPL 41 435	+Borovoi, Dobrynin+	(KIAE)
		Translated from ZETFP 41 355.		
Also	85B	JETPL 42 285	Afonin, Bogatov, Borovoi, Dobrynin+	(KIAE)
		Translated from ZETFP 42 230.		

AHRENS	85	PR D31 2732	+Aronson+	(BNL, BROW, KEK, OSAK, PENN+)
ALBRECHT	85I	PL 163B 404	+Binder, Drescher, Schubert+	(ARGUS Collab.)
ALTZITZOG...	85	PRL 55 799	Altzitzoglou, Calaprice, Dewey+	(PRIN)
APALIKOV	85	JETPL 42 289	+Boris, Golutvin, Laptin, Lubimov+	(ITEP)
		Translated from ZETFP 42 233.		
BELIKOV	85	SJNP 41 589	+Volkov, Kochetkov, Mukhin+	(SERP)
		Translated from YAF 41 919.		
COOPER-...	85	PL 160B 207	Cooper-Sarkar+	(CERN, LOIC, OXF, SACL+)
COWSIK	85	PL 151B 62		(TATA)
DATAR	85	Nature 318 547	+Baba, Bhattacherjee, Bhuinya, Roy	(BHAB, TATA)
HUBERT	85	NC 85A 19	+Leccia, Dassie, Mennrath+	(BCEN, ZARA)
MARKEY	85	PR C32 2215	+Boehm	(CIT)
OHI	85	PL 160B 322	+Nakajima, Tamura+	(TOKY, INUS, KEK)
SIMPSON	85	PRL 54 1891		(GUEL)
STOCKDALE	85	ZPHY C27 53	+Bodek+	(ROCH, CHIC, COLU, FNAL)
ZACEK	85	PL 164B 193	+Zacek, Boehm+	(MUNI, CIT, SIN)
BALLAGH	84	PR D30 2271	+Bingham+	(UCB, LBL, FNAL, HAWA, WASH, WISC)
BERGSMA	84	PL 142B 103	+Dorenbosch, Allaby, Abt+	(CHARM Collab.)
CAVAIGNAC	84	PL 148B 387	+Hoummada, Koang+	(ISNG, LAPP)
DYDAK	84	PL 134B 281	+Feldman+	(CERN, DORT, HEIDH, SACL, WARS)
FORSTER	84	PL 138B 301	+Kwon, Markey, Boehm, Henrikson	(CIT)
FREESE	84	NP B233 167	+Schramm	(CHIC, FNAL)
GABATHULER	84	PL 138B 449	+Boehm+	(CIT, SIN, MUNI)
HAXTON	84	PPNP 12 409	+Stevenson	
MINEHART	84	PRL 52 804	+Ziock, Marshall, Stephens, Daum+	(VIRG, SIN)
SCHRAMM	84	PL 141B 337	+Steigman	(FNAL, BART)
STOCKDALE	84	PRL 52 1384	+Bodek+	(ROCH, CHIC, COLU, FNAL)
AFONIN	83	JETPL 38 436	+Bogatov, Borovoi, Vershinskii+	(KIAE)
		Translated from ZETFP 38 361.		
AVIGNONE	83	PRL 50 721	+Brodzinski, Brown, Evans, Hensley+	(SCUC, PNL)
BELENKII	83	JETPL 38 493	+Dobrynin, Zemlyakov, Mikaelyan+	(KIAE)
		Translated from ZETFP 38 406.		
BELIKOV	83	JETPL 38 661	+Volkov, Kochetkov, Mukhin, Sviridov+	(SERP)
		Translated from ZETFP 38 547.		
BERGSMA	83	PL 122B 465	+Dorenbosch, Jonker+	(CHARM Collab.)
BERGSMA	83B	PL 128B 361	+Dorenbosch+	(CHARM Collab.)
BRYMAN	83B	PRL 50 1546	+Dubois, Numao, Olaniya, Olin+	(TRIU, CNRC)
Also	83	PRL 50 7	Bryman, Dubois, Numao, Olaniya+	(TRIU, CNRC)
DEUTSCH	83	PR D27 1644	+Lebrun, Prieels	(LOUV)
FILIPPONE	83	PRL 50 412	+Elwyn, Davids+	(ANL, CHIC, VALP)
GRONAU	83	PR D28 2762		(HAIF)
KIRSTEN	83	PRL 50 474	+Richter, Jessberger	(MPIH)
Also	83B	ZPHY 16 189	Kirsten, Richter, Jessberger	(MPIH)
SCHRECK...	83	PL 129B 265	Schreckenbach, Colvin+	(ISNG, ILLG)
TAYLOR	83	PR D28 2705	+Cence, Harris, Jones+	(HAWA, LBL, FNAL)
BAHCALL	82	RMP 54 767	+Huebner, Lubow+	(IAS, LANL, HPC, YALE, UCLA)
COOPER	82	PL 112B 97	+Guy, Michette, Tyndel, Venus	(RL)
FILIPPONE	82	APJ 253 393	+Schramm	(ANL, EFI)
FOWLER	82	A.I.P. 96 80		(CIT)
HAXTON	82	PR D25 2360	+Stephenson, Strottman	(LANL, PURD)
HAYANO	82	PRL 49 1305	+Taniguchi, Yamanaka+	(TOKY, KEK, TSUK)
OLIVE	82	PR D25 213	+Turner	(CHIC, UCSB)
VUILLEUMIER	82	PL 114B 298	+Boehm, Egger+	(CIT, SIN, MUNI)
ABELA	81	PL 105B 263	+Daum, Eaton, Frosch, Jost, Kettle, Steiner	(SIN)
ARMENISE	81	PL 100B 182	+Fogli-Muciaccia+	(BARI, CERN, MILA, LALO)
ASANO	81	PL 104B 84	+Hayano, Kikutani, Kurokawa+	(KEK, TOKY, INUS, OSAK)
Also	81	PR D24 1232	Shrock	(STON)
ASRATYAN	81	PL 105B 301	+Efremenko, Fedotov+	(ITEP, FNAL, SERP, MICH)
BAKER	81	PRL 47 1576	+Connolly, Kahn, Kirk, Murtagh+	(BNL, COLU)
Also	78	PRL 40 144	Cnops, Connolly, Kahn, Kirk+	(BNL, COLU)
BERNSTEIN	81	PL 101B 39	+Feinberg	(STEV, COLU)
BOLIEV	81	SJNP 34 787	+Butkevich, Zakidyshev, Makoev+	(INRM)
		Translated from YAF 34 1418.		

CALAPRICE	81	PL 106B 175	+Schreiber, Schneider+	(PRIN, IND)
DEDEN	81	PL 98B 310	+Grassler, Boeckmann, Mermikides+	(BEBC Collab.)
ERRIQUEZ	81	PL 102B 73	+Natali+ (BARI, BIRM, BRUX, EPOL, RHEL, SACL+)	
HAXTON	81	PRL 47 153	+Stephenson, Strottman	(PURD, LASL)
KWON	81	PR D24 1097	+Boehm, Hahn, Henrikson+	(CIT, ISNG, MUNI)
NEMETHY	81B	PR D23 262	+ (YALE, LBL, LASL, MIT, SACL, SIN, CNRC, BERN)	
SHROCK	81	PR D24 1232		(STON)
SHROCK	81B	PR D24 1275		(STON)
SILVERMAN	81	PRL 46 467	+Soni	(UCI, UCLA)
SIMPSON	81B	PR D24 2971		(GUEL)
USHIDA	81	PRL 47 1694	+ (AICH, FNAL, KOBE, SEOU, MCGI, NAGO, OSU+)	
AVIGNONE	80	PR C22 594	+Greenwood	(SCUC)
BAHCALL	80	PRL 45 945	+Lubow, Huebner+	(IAS, LASL, YALE, LLL, UCLA)
Also	76	Science 191 264	Bahcall, Davis	(IAS, BNL)
BOEHM	80	PL 97B 310	+Cavaignac, Feilitzsch+	(ILLG, CIT, ISNG, MUNI)
FRITZE	80	PL 96B 427	(AACH3, BONN, CERN, LOIC, OXF, SACL)	
REINES	80	PRL 45 1307	+Sobel, Pasierb	(UCI)
Also	59	PR 113 273	Reines, Cowan	(LASL)
Also	66	PR 142 852	Nezrick, Reines	(CASE)
Also	76	PRL 37 315	Reines, Gurr, Sobel	(UCI)
SHROCK	80	PL 96B 159		(STON)
DAVIS	79	PR C19 2259	+Vogel, Mann, Schenter	(CIT)
BLIETSCHAU	78	NP B133 205	+Deden, Hasert, Krenz+	(Gargamelle Collab.)
CROUCH	78	PR D18 2239	+Landecker, Lathrop, Reines+	(CASE, UCI, WITW)
MEYER	77	PL 70B 469	+Nguyen, Abrams+	(SLAC, LBL, NWES, HAWA)
VYSOTSKY	77	JETPL 26 188	+Dolgov, Zeldovich	(ITEP)
		Translated from ZETFP 26 200.		
BELLOTTI	76	LNC 17 553	+Cavalli, Fiorini, Rollier	(MILA)
SZALAY	76	AA 49 437	+Marx	(EOTV)
SZALAY	74	APAH 35 8	+Marx	(EOTV)
COWSIK	72	PRL 29 669	+McClelland	(UCB)
MARX	72	Nu Conf. Budapest	+Szalay	(EOTV)
GERSHTEIN	66	JETPL 4 120	+Zeldovich	(KIAM)
		Translated from ZETFP 4 189.		