# $\overline{N}N$(1100–3600)

OMITTED FROM SUMMARY TABLE

This entry contains various high mass, unflavored structures coupled to the baryon-antibaryon system, as well as quasi-nuclear bound states below threshold.

## $\overline{N}N$(1100–3600) MASSES AND WIDTHS

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

| VALUE (MeV) | DOCUMENT ID |
|---|---|
| **1100 to 3600 OUR LIMIT** | |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 1107±4 | DAFTARI | 87 | DBC | 0 | 0. $\overline{p}n \rightarrow \rho^- \pi^+ \pi^-$ |
| 111±8±15 | DAFTARI | 87 | DBC | 0 | 0. $\overline{p}n \rightarrow \rho^- \pi^+ \pi^-$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 1167 ±7 | [2] CHIBA | 91 | CNTR | | $\overline{p}d \rightarrow \gamma X$ |
| 1191.0±9.9 | [2] CHIBA | 87 | CNTR | 0 | 0. $\overline{p}p \rightarrow \gamma X$ |
| 1210 ±5.0 | [2,3,4,5] RICHTER | 83 | CNTR | 0 | Stopped $\overline{p}$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 1325 ±5 | [2] CHIBA | 91 | CNTR | | $\overline{p}d \rightarrow \gamma X$ |
| 1329.2±7.6 | [2] CHIBA | 87 | CNTR | 0 | 0. $\overline{p}p \rightarrow \gamma X$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 1390.9±6.3 | [2] CHIBA | 87 | CNTR | 0 | 0. $\overline{p}p \rightarrow \gamma X$ |
| 1395 | [2,4,5,6] PAVLOPO... | 78 | CNTR | | Stopped $\overline{p}$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| ~ 1410 | BETTINI | 66 | DBC | 0 | 0. $\overline{p}N \rightarrow 5\pi$ |
| ~ 100 | BETTINI | 66 | DBC | 0 | 0. $\overline{p}N \rightarrow 5\pi$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 1468± 6 | [7] BRIDGES | 86B | DBC | 0 | 0. $\overline{p}N \rightarrow 2\pi^- \pi^+ \pi^0$ |
| 88±18 | [7] BRIDGES | 86B | DBC | 0 | 0. $\overline{p}N \rightarrow 2\pi^- \pi^+ \pi^0$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 1512 ± 7 | [2] CHIBA | 91 | CNTR | | $\overline{p}d \rightarrow \gamma X$ |
| 1523.8± 3.6 | [2] CHIBA | 87 | CNTR | 0 | 0. $\overline{p}p \rightarrow \gamma X$ |
| 1522 ± 7 | [7] BRIDGES | 86B | DBC | 0 | 0. $\overline{p}N \rightarrow 2\pi^- \pi^+$ |
| 59 ±12 | [7] BRIDGES | 86B | DBC | 0 | 0. $\overline{p}N \rightarrow 2\pi^- \pi^+$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 1577.8± 3.4 | [2] CHIBA | 87 | CNTR | 0 | 0. $\overline{p}p \rightarrow \gamma X$ |
| 1594 ± 9 | [7] BRIDGES | 86B | DBC | – | 0. $\overline{p}N \rightarrow 2\pi^- \pi^+ \pi^0$ |
| 81 ±12 | [7] BRIDGES | 86B | DBC | – | 0. $\overline{p}N \rightarrow 2\pi^- \pi^+ \pi^0$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 1633.6±4.1 | [2] CHIBA | 87 | CNTR | 0 | 0. $\overline{p}p \rightarrow \gamma X$ |
| $1637.1^{+5.6}_{-7.3}$ | ADIELS | 84 | CNTR | | $\overline{p}$He |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 1638±3.0 | [2,3,4,5] RICHTER | 83 | CNTR | 0 | Stopped $\overline{p}$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| $1644.0^{+5.6}_{-7.3}$ | ADIELS | 84 | CNTR | $\overline{p}$He |

| VALUE (MeV) | | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| 1646 | 2,4,5,6 | PAVLOPO... | 78 | CNTR | Stopped $\overline{p}$ |

| VALUE (MeV) | | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| $1687.1^{+5.0}_{-4.3}$ | | ADIELS | 84 | CNTR | $\overline{p}$He |
| 1684 | 2,4,5,6 | PAVLOPO... | 78 | CNTR | Stopped $\overline{p}$ |

| VALUE (MeV) | | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| 1693±2 | 2 | CHIBA | 91 | CNTR | | $\overline{p}d \rightarrow \gamma$X |
| 1694±2.0 | 2,3,4,5 | RICHTER | 83 | CNTR | 0 | Stopped $\overline{p}$ |

| VALUE (MeV) | | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| 1713.0±2.6 | 2 | CHIBA | 87 | CNTR | 0 | 0. $\overline{p}p \rightarrow \gamma$X |

| VALUE (MeV) | | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| 1731.0±1.5 | 2 | CHIBA | 87 | CNTR | 0 | 0. $\overline{p}p \rightarrow \gamma$X |

| VALUE (MeV) | | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| 1771±1.0 | 2,4,5,8 | RICHTER | 83 | CNTR | 0 | Stopped $\overline{p}$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 1856.6±5 | BRIDGES | 86D | SPEC | 0 | 0. $\overline{p}d \rightarrow \pi\pi N$ |
| 20 ±5 | BRIDGES | 86D | SPEC | 0 | 0. $\overline{p}d \rightarrow \pi\pi N$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 1873±2.5 | BRIDGES | 86D | SPEC | 0 | 0. $\overline{p}d \rightarrow \pi\pi N$ |
| < 5 | BRIDGES | 86D | SPEC | 0 | 0. $\overline{p}d \rightarrow \pi\pi N$ |

| VALUE (MeV) | | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| 1897±17 | 9 | ABASHIAN | 76 | STRC | 8 $\pi^- p \rightarrow p3\pi$ |
| 110±82 | 9 | ABASHIAN | 76 | STRC | 8 $\pi^- p \rightarrow p3\pi$ |
| 1897± 1 | | KALOGERO... | 75 | DBC | $\overline{p}n$ annihilation near threshold |
| 25± 6 | | KALOGERO... | 75 | DBC | $\overline{p}n$ annihilation near threshold |

| VALUE (MeV) | | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|---|
| ~1920 | 10 | EVANGELISTA | 79 | OMEG | 10,16 $\pi^- p \rightarrow \overline{p}p$ |
| ~ 190 | | EVANGELISTA | 79 | OMEG | 10,16 $\pi^- p \rightarrow \overline{p}p$ |

| VALUE (MeV) | EVTS | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|---|
| $1937.3^{+1.3}_{-0.7}$ | | 11 FRANKLIN | 87 | SPEC | | 0.586 $\overline{p}p$ |
| < 3.0 | | 11 FRANKLIN | 87 | SPEC | | 0.586 $\overline{p}p$ |
| 1930 ± 2 | | 12 ASTON | 80D | OMEG | | $\gamma p \rightarrow p\overline{p}$X |
| 12 ± 7 | | 12 ASTON | 80D | OMEG | | $\gamma p \rightarrow p\overline{p}$X |
| 1940 ± 1 | 36 | DAUM | 80E | CNTR | 0 | 93 $pp \rightarrow \overline{p}p$X |
| ~ 6.0 | | DAUM | 80E | CNTR | | 93 $pp \rightarrow \overline{p}p$X |
| 1949 ±10 | | 13 DEFOIX | 80 | HBC | 0 | $\overline{p}p \rightarrow 5\pi$ |
| 80 ±20 | | 13 DEFOIX | 80 | HBC | 0 | $\overline{p}p \rightarrow 5\pi$ |
| 1939 ± 2 | | 14 HAMILTON | 80B | CNTR | 0 | $S$ channel $\overline{p}p$ |
| 22 ± 6 | | 14 HAMILTON | 80B | CNTR | 0 | $S$ channel $\overline{p}p$ |
| 1935.5± 1.0 | | SAKAMOTO | 79 | HBC | 0 | 0.37–0.73 $\overline{p}p$ |
| 2.8± 1.4 | | SAKAMOTO | 79 | HBC | 0 | 0.37–0.73 $\overline{p}p$ |
| 1939 ± 3 | | BRUCKNER | 77 | SPEC | 0 | 0.4–0.85 $\overline{p}p$ |
| < 4.0 | | BRUCKNER | 77 | SPEC | 0 | 0.4–0.85 $\overline{p}p$ |
| 1935.9± 1.0 | | 15 CHALOUPKA | 76 | HBC | 0 | $\overline{p}p$ total,elastic |
| $8.8^{+4.3}_{-3.2}$ | | 16 CHALOUPKA | 76 | HBC | 0 | $\overline{p}p$ total,elastic |
| 1942 ± 5 | | 17 D'ANDLAU | 75 | HBC | 0 | 0.175–0.750 $\overline{p}p$ |

| | | | | | |
|---|---|---|---|---|---|
| 57.5± 5 | [18] D'ANDLAU | 75 | HBC | 0 | 0.175–0.750 $\overline{p}p$ |
| 1934.4$^{+\ 2.6}_{-\ 1.4}$ | [19] KALOGERO... | 75 | DBC | – | $\overline{p}N$ annihilation |
| 11 $^{+11}_{-\ 4}$ | [20] KALOGERO... | 75 | DBC | – | $\overline{p}N$ annihilation |
| 1932 ± 2 | [15] CARROLL | 74 | CNTR | | $S$ channel $\overline{p}p \rightarrow d$ |
| 9 $^{+\ 4}_{-\ 3}$ | [16] CARROLL | 74 | CNTR | | $S$ channel $\overline{p}p \rightarrow d$ |
| 1968 | [21] BENVENUTI | 71 | HBC | 0 | 0.1–0.8 $\overline{p}p$ |
| 35 | [21] BENVENUTI | 71 | HBC | 0 | 0.1–0.8 $\overline{p}p$ |
| 1940 ± 8 | CLINE | 70 | HBC | 0 | 0.25–0.74 $\overline{p}p$ |
| 49 ± 9 | CLINE | 70 | HBC | 0 | 0.25–0.74 $\overline{p}p$ |

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|
| 1949±10 | [22] DEFOIX | 80 | HBC | 0 | 0.0–1.2 $\overline{p}p \rightarrow 5\pi$ |
| 80±20 | [22] DEFOIX | 80 | HBC | 0 | 0.0–1.2 $\overline{p}p \rightarrow 5\pi$ |

| *VALUE* (MeV) | *DOCUMENT ID* | | *COMMENT* |
|---|---|---|---|
| 2011± 7 | [23] FERRER | 93 | $\pi^- p \rightarrow p p \overline{p} \pi^- \pi^0$ |
| 25$^{+10}_{-25}$ | FERRER | 93 | $\pi^- p \rightarrow p p \overline{p} \pi^- \pi^0$ |
| 2025 | GIBBARD | 79 | $e^- p \rightarrow e^- p p \overline{p}$ |
| < 30 | GIBBARD | 79 | $e^- p \rightarrow e^- p p \overline{p}$ |
| 2020± 3 | BENKHEIRI | 77 | $\pi^- p \rightarrow p p \overline{p} \pi^-$ |
| 24±12 | BENKHEIRI | 77 | $\pi^- p \rightarrow p p \overline{p} \pi^-$ |

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|
| 2022± 6 | [24] AZOOZ | 83 | HYBR | + | 6 $\overline{p}p \rightarrow p\overline{n}3\pi$ |
| 14±13 | [24] AZOOZ | 83 | HYBR | + | 6 $\overline{p}p \rightarrow p\overline{n}3\pi$ |

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|
| 2023± 5 | BODENKAMP | 83 | SPEC | 0 | $\gamma p \rightarrow \overline{p}pp$ |
| 27±12 | BODENKAMP | 83 | SPEC | 0 | $\gamma p \rightarrow \overline{p}pp$ |

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|
| 2026± 5 | [24] AZOOZ | 83 | HYBR | – | 4 $\overline{p}p \rightarrow \overline{p}n3\pi$ |
| 20±11 | [24] AZOOZ | 83 | HYBR | – | 4 $\overline{p}p \rightarrow \overline{p}n3\pi$ |

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|
| 2080±10 | [25] KREYMER | 80 | STRC | 0 | 13 $\pi^- d \rightarrow p\overline{p}n(n)$ |
| 110±20 | [25] KREYMER | 80 | STRC | 0 | 13 $\pi^- d \rightarrow p\overline{p}n(n)$ |

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 2090±20 | [26] KREYMER | 80 | STRC | 13 $\pi^- d \rightarrow n p \overline{p} \pi^- p$ |
| 170±50 | [26] KREYMER | 80 | STRC | 13 $\pi^- d \rightarrow n p \overline{p} \pi^- p$ |

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| ~ 2110 | [27] EVANGELISTA | 79 | OMEG | 10,16 $\pi^- p \rightarrow \overline{p}p$ |
| ~ 330 | [27] EVANGELISTA | 79 | OMEG | 10,16 $\pi^- p \rightarrow \overline{p}p$ |

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 2110±10 | [28] ROZANSKA | 80 | SPRK | 18 $\pi^- p \rightarrow p\overline{p}n$ |
| 190±10 | [28] ROZANSKA | 80 | SPRK | 18 $\pi^- p \rightarrow p\overline{p}n$ |

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|
| 2141 | [29] DONALD | 73 | HBC | 0 | $\overline{p}p$ $S$ channel |
| 14 | [29] DONALD | 73 | HBC | 0 | $\overline{p}p$ $S$ channel |

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *COMMENT* |
|---|---|---|---|---|
| 2180±10 | [30] ROZANSKA | 80 | SPRK | 18 $\pi^- p \rightarrow p\overline{p}n$ |
| 270±10 | [30] ROZANSKA | 80 | SPRK | 18 $\pi^- p \rightarrow p\overline{p}n$ |

| *VALUE* (MeV) | *DOCUMENT ID* | | *TECN* | *CHG* | *COMMENT* |
|---|---|---|---|---|---|
| 2207±13 | [31] ALLES-... | 67B | HBC | 0 | 5.7 $\overline{p}p$ |
| 62±52 | [31] ALLES-... | 67B | HBC | 0 | 5.7 $\overline{p}p$ |

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|
| $2210^{+79}_{-21}$ | EVANGELISTA 79B | OMEG | 10 $\pi^- p \rightarrow K^+ K^- n$ |
| ~ 203 | EVANGELISTA 79B | OMEG | 10 $\pi^- p \rightarrow K^+ K^- n$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 2231.9 ±0.1 | [1] BARNES | 94 | SPEC | 0–46 $\overline{p}p \rightarrow \overline{\Lambda}\Lambda$ |
| 0.59±0.25 | [1] BARNES | 94 | SPEC | 0–46 $\overline{p}p \rightarrow \overline{\Lambda}\Lambda$ |
| ~ 2229.2 | CARBONELL | 93 | RVUE | $\overline{p}p \rightarrow \Lambda\overline{\Lambda}$ |
| ~ 1.8 | CARBONELL | 93 | RVUE | $\overline{p}p \rightarrow \Lambda\overline{\Lambda}$ |

[1] Supersedes CARBONELL 93.

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| ~ 2260 | [32] EVANGELISTA 79 | | OMEG | 10,16 $\pi^- p \rightarrow \overline{p}p$ |
| ~ 440 | [32] EVANGELISTA 79 | | OMEG | 10,16 $\pi^- p \rightarrow \overline{p}p$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 2307± 6 | ALPER | 80 | CNTR | 0 | 62 $\pi^- p \rightarrow K^+ K^- n$ |
| 245±20 | ALPER | 80 | CNTR | 0 | 62 $\pi^- p \rightarrow K^+ K^- n$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 2380±10 | [33] ROZANSKA | 80 | SPRK | 18 $\pi^- p \rightarrow p\overline{p}n$ |
| 380±20 | [33] ROZANSKA | 80 | SPRK | 18 $\pi^- p \rightarrow p\overline{p}n$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | COMMENT |
|---|---|---|---|---|
| 2450±10 | [34] ROZANSKA | 80 | SPRK | 18 $\pi^- p \rightarrow p\overline{p}n$ |
| 280±20 | [34] ROZANSKA | 80 | SPRK | 18 $\pi^- p \rightarrow p\overline{p}n$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 2480±30 | [35] CARTER | 77 | CNTR | 0 | 0.7–2.4 $\overline{p}p \rightarrow \pi\pi$ |
| 210±25 | [35] CARTER | 77 | CNTR | 0 | 0.7–2.4 $\overline{p}p \rightarrow \pi\pi$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| ~ 2500 | [36] CARTER | 78B | CNTR | 0 | 0.7–2.4 $\overline{p}p \rightarrow K^- K^+$ |
| ~ 150 | [36] CARTER | 78B | CNTR | 0 | 0.7–2.4 $\overline{p}p \rightarrow K^- K^+$ |

| VALUE (MeV) | DOCUMENT ID | TECN | COMMENT |
|---|---|---|---|
| 2710±20 | ROZANSKA 80 | SPRK | 18 $\pi^- p \rightarrow p\overline{p}n$ |
| 170±40 | ROZANSKA 80 | SPRK | 18 $\pi^- p \rightarrow p\overline{p}n$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 2850±5 | [37] BRAUN | 76 | DBC | – | 5.5 $\overline{p}d \rightarrow N\overline{N}\pi$ |
| < 39 | [37] BRAUN | 76 | DBC | – | 5.5 $\overline{p}d \rightarrow N\overline{N}\pi$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 3370±10 | [38] ALEXANDER | 72 | HBC | 0 | 6.94 $\overline{p}p$ |
| 150±40 | [38] ALEXANDER | 72 | HBC | 0 | 6.94 $\overline{p}p$ |

| VALUE (MeV) | DOCUMENT ID | | TECN | CHG | COMMENT |
|---|---|---|---|---|---|
| 3600±20 | [38] ALEXANDER | 72 | HBC | 0 | 6.94 $\overline{p}p$ |
| 140±20 | [38] ALEXANDER | 72 | HBC | 0 | 6.94 $\overline{p}p$ |

[2] Not seen by GRAF 91.
[3] Not seen by CHIBA 88, ANGELOPOULOS 86, ADIELS 86.
[4] They looked for radiative transitions to bound $p\overline{p}$ states, mono-energetic $\gamma$ rays detected.
[5] Observed widths consistent with experimental resolution.
[6] Not seen by ADIELS 86.
[7] From analysis of difference of $\pi^-$ and $\pi^+$ spectra.
[8] Not seen by CHIBA 88, ANGELOPOULOS 86.
[9] Produced backwards.
[10] $I(J^P) = 1(1^-)$ from a mass dependent partial-wave analysis taking solution A.
[11] From reanalysis of data from JASTRZEMBSKI 81.
[12] Not seen by BUSENITZ 89.
[13] From energy dependence of $5\pi$ cross section. $I^G = 1^-$ from observation of $\omega\rho$ decay. $P = +$ and $J > 1$. $a_2(1320)\pi\pi$ also seen.

[14] $I = 0$ favored, $J = 0$ or 1, seen in total $\overline{p}p$ total cross section. Primarily from annihilation reactions. Not seen in $\overline{p}d$ total and annihilation cross sections.
[15] Narrow bump seen in total $\overline{p}p$, $\overline{p}d$ cross sections. Isospin uncertain. Not seen in $\overline{p}p$ charge exchange by ALSTON-GARNJOST 75, CHALOUPKA 76. Integrated cross section three times larger than BRUCKNER 77.
[16] Narrow bump seen in total $\overline{p}p$, $\overline{p}d$ cross sections. Isospin uncertain. Not seen in $\overline{p}p$ charge exchange by ALSTON-GARNJOST 75, CHALOUPKA 76. Integrated cross section three times larger than BRUCKNER 77. Not seen by CLOUGH 84.
[17] From energy dependence of far backward elastic scattering. Some indication of additional structure.
[18] From energy dependence of far backward elastic scattering. Some indication of additional structure.
[19] Not seen by ALBERI 79 with comparable statistics.
[20] Not seen by ALBERI 79 with comparable statistics.
[21] Seen as a bump in the $\overline{p}p \rightarrow K^0_S K^0_L$ cross section with $J^{PC} = 1^{--}$.
[22] Isospin 1 favored.
[23] Not seen by AJALTOUNI 82, ARMSTRONG 79.
[24] Not seen by BIONTA 80, CARROLL 80, HAMILTON 80, BANKS 81, CHUNG 81, BARNETT 83.
[25] Neutron spectator. See also $np\overline{p}\pi^-(p)$ channel following.
[26] Proton spectator. See also $p\overline{p}n(n)$ channel above.
[27] $I(J^P) = 1(3^-)$ from a mass dependent partial-wave analysis taking solution A.
[28] $I(J^P) = 1(3^-)$ from amplitude analysis assuming one-pion exchange.
[29] Seen in final state $\omega\pi^+\pi^-$.
[30] $I(J^P) = 0(2^+)$ from amplitude analysis assuming one-pion exchange.
[31] ALLES-BORELLI 67B see neutral mode only $\pi^+\pi^-\pi^0$.
[32] $I(J^P) = 0(4^+)$ from a mass dependent partial-wave analysis taking solution A.
[33] $I(J^P) = 0(4^+)$ from amplitude analysis assuming one-pion exchange.
[34] $I(J^P) = 1(5^-)$ from amplitude analysis assuming one-pion exchange.
[35] $I(J^P) = 1(5^-)$ from amplitude analysis of $\overline{p}p \rightarrow \pi\pi$.
[36] I=0,1 $J^P = 5^-$ from Barrelet-zero analysis.
[37] Decays to $\overline{N}N$ and $\overline{N}N\pi$. Not seen by BARNETT 83.
[38] Decays to $4\pi^+ 4\pi^-$.

## $\overline{N}N$(1100–3600) REFERENCES


| | | | |
|---|---|---|---|
| BARNES | 94 | PL B331 203 | +Birien+ (PS185 Collab.) |
| CARBONELL | 93 | PL B306 407 | +Protasov, Dalkarov (ISNG, LEBD) |
| FERRER | 93 | NP A558 191c | +Grigonian (WA56 Collab.) |
| CHIBA | 91 | PR D44 1933 | +Fujitani+ (FUKI, KEK, SANG, OSAK, TMU) |
| GRAF | 91 | PR D44 1945 | +Fero, Gee+(UCI, PENN, NMSU, KARLK, KARLE, ATHU) |
| BUSENITZ | 89 | PR D40 1 | +Olszewski, Callahan+ (ILL, FNAL) |
| CHIBA | 88 | PL B202 447 | +Doi (FUKI, INUS, KEK, SANG, OSAK, TMU) |
| CHIBA | 87 | PR D36 3321 | +Doi+ (FUKI, INUS, KEK, SANG, OSAK, TMU) |
| DAFTARI | 87 | PRL 58 859 | +Gray, Kalogeropoulos, Roy (SYRA) |
| FRANKLIN | 87 | PL B184 81 | |
| ADIELS | 86 | PL B182 405 | +Backenstoss+ (STOH, BASL, LASL, THES, CERN) |
| ANGELOPO... | 86 | PL B178 441 | Angelopoulos+(ATHU, UCI, KARLK, KARLE, NMSU, PENN) |
| BRIDGES | 86B | PRL 56 215 | +Daftari, Kalogeropoulos, Debbe+ (SYRA, CASE) |
| BRIDGES | 86D | PL B180 313 | +Brown, Daftari+ (SYRA, BNL, CASE, UMD, COLU) |
| ADIELS | 84 | PL 138B 235 | + (BASL, KARLK, KARLE, STOH, STRB, THES) |
| CLOUGH | 84 | PL 146B 299 | +Beard, Bugg+ (SURR, LOQM, ANIK, TRST, GEVA) |
| AZOOZ | 83 | PL 122B 471 | +Butterworth (LOIC, RHEL, SACL, SLAC, TOHOK+) |
| BARNETT | 83 | PR D27 493 | +Blockus, Burka, Chien, Christian+ (JHU) |
| BODENKAMP | 83 | PL 133B 275 | +Fries, Behrend, Fenner+ (KARLK, KARLE, DESY) |
| RICHTER | 83 | PL 126B 284 | +Adiels (BASL, KARLK, KARLE, STOH, STRB, THES) |
| AJALTOUNI | 82 | NP B209 301 | +Bachman+ (+, CERN, NEUC+) |
| BANKS | 81 | PL 100B 191 | +Booth, Campbell, Armstrong+ (LIVP, CERN) |
| CHUNG | 81 | PRL 46 395 | +Bensinger+ (BNL, BRAN, CINC, FSU, MASD) |
| JASTRZEM... | 81 | PR D23 2784 | Jastrzembski, Mandelkern+ (TEMP, UCI, UNM) |
| ALPER | 80 | PL 94B 422 | +Becker+ (AMST, CERN, CRAC, MPIM, OXF+) |
| ASTON | 80D | PL 93B 517 | (BONN, CERN, EPOL, GLAS, LANC, MCHS, ORSAY+) |
| BIONTA | 80 | PRL 44 909 | +Carroll, Edelstein+ (BNL, CMU, FNAL, MASD) |
| CARROLL | 80 | PRL 44 1572 | +Chiang, Johnson, Cester, Webb+ (BNL, PRIN) |
| DAUM | 80E | PL 90B 475 | +Hertzberger+ (AMST, CERN, CRAC, MPIM, OXF+) |
| DEFOIX | 80 | NP B162 12 | +Dobrzynski, Angelini, Bigi+ (CDEF, PISA) |
| HAMILTON | 80 | PRL 44 1179 | +Pun, Tripp, Lazarus+ (LBL, BNL, MTHO) |
| HAMILTON | 80B | PRL 44 1182 | +Pun, Tripp, Lazarus+ (LBL, BNL, MTHO) |
| KREYMER | 80 | PR D22 36 | +Baggett, Fieguth+ (IND, PURD, SLAC, VAND) |
| ROZANSKA | 80 | NP B162 505 | +Blum, Dietl, Grayer, Lorenz+ (MPIM, CERN) |
| ALBERI | 79 | PL 83B 247 | +Alvear, Castelli, Poropat+ (TRST, CERN, IFRJ) |
| ARMSTRONG | 79 | PL B85 304 | +Baccari, Belletti, Booth+ (DESY, GLAS) |

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|---|---|---|---|---|
| EVANGELISTA | 79 | NP B153 253 | + | (BARI, BONN, CERN, DARE, GLAS, LIVP+) |
| EVANGELISTA | 79B | NP B154 381 | + | (BARI, BONN, CERN, DARE, GLAS, LIVP+) |
| GIBBARD | 79 | PRL 42 1593 | +Ahrens, Berkelman, Cassel, Day, Harding+ | (CORN) |
| SAKAMOTO | 79 | NP B158 410 | +Hashimoto, Sai, Yamamoto+ | (INUS) |
| CARTER | 78B | NP B141 467 | | (LOQM) |
| PAVLOPO... | 78 | PL 72B 415 | Pavlopoulos+ | (KARLK, KARLE, BASL, CERN, STOH, STRB) |
| BENKHEIRI | 77 | PL 68B 483 | +Boucrot+ | (CERN, CDEF, EPOL, LALO) |
| BRUCKNER | 77 | PL 67B 222 | +Granz, Ingham, Kilian+ | (MPIH, HEIDP, CERN) |
| CARTER | 77 | PL 67B 117 | +Coupland, Eisenhandler, Astbury+ | (LOQM, RHEL) JP |
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| CHALOUPKA | 76 | PL 61B 487 | + | (CERN, LIVP, MONS, PADO, ROMA, TRST) |
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