\[
N(1535) 1/2^- \quad I(J^P) = \frac{1}{2} (\frac{1}{2}^-) \quad \text{Status: } \ast \ast \ast \ast
\]

Older and obsolete values are listed and referenced in the 2014 edition, Chinese Physics C 38, 070001 (2014).

### N(1535) POLE POSITION

#### REAL PART

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<th>TECN</th>
<th>COMMENT</th>
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<tbody>
<tr>
<td>1490 to 1530 (≈ 1510) OUR ESTIMATE</td>
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<tr>
<td>1500± 4</td>
<td>SOKHOYAN 15A</td>
<td>DPWA</td>
<td>Multichannel</td>
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<tr>
<td>1509± 4±2</td>
<td>SVARC 14</td>
<td>L+P</td>
<td>( \pi N \rightarrow \pi N )</td>
</tr>
<tr>
<td>1502</td>
<td>ARNDT 06</td>
<td>DPWA</td>
<td>( \pi N \rightarrow \pi N, \eta N )</td>
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<tr>
<td>1487</td>
<td>HOEHLER 93</td>
<td>SPED</td>
<td>( \pi N \rightarrow \pi N )</td>
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<td>1510±50</td>
<td>CUTKOSKY 80</td>
<td>IPWA</td>
<td>( \pi N \rightarrow \pi N )</td>
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- - - We do not use the following data for averages, fits, limits, etc. - - -

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<td>DPWA</td>
<td>Multichannel</td>
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<td>1521±14</td>
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<td>10</td>
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<td>1525</td>
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<td>DPWA</td>
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#### -2×IMAGINARY PART

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<td>260±80</td>
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<td>IPWA</td>
<td>( \pi N \rightarrow \pi N )</td>
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- - - We do not use the following data for averages, fits, limits, etc. - - -

<table>
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<td>DPWA</td>
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### N(1535) ELASTIC POLE RESIDUE

#### MODULUS |\( |r| \) |

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<td>50±20 OUR ESTIMATE</td>
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<td>29± 4</td>
<td>SOKHOYAN 15A</td>
<td>DPWA</td>
<td>Multichannel</td>
</tr>
<tr>
<td>22± 2±0.4</td>
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<td>L+P</td>
<td>( \pi N \rightarrow \pi N )</td>
</tr>
<tr>
<td>16</td>
<td>ARNDT 06</td>
<td>DPWA</td>
<td>( \pi N \rightarrow \pi N, \eta N )</td>
</tr>
<tr>
<td>120±40</td>
<td>CUTKOSKY 80</td>
<td>IPWA</td>
<td>( \pi N \rightarrow \pi N )</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
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<th>TECN</th>
<th>COMMENT</th>
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<td>15</td>
<td>SHKLYAR 13</td>
<td>DPWA</td>
<td>Multichannel</td>
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<tr>
<td>31± 4</td>
<td>ANISOVICH 12A</td>
<td>DPWA</td>
<td>Multichannel</td>
</tr>
<tr>
<td>68</td>
<td>BATINIC</td>
<td>10</td>
<td>DPWA</td>
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PHASE $\theta$

<table>
<thead>
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<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tr>
<td>$-15\pm15$ OUR ESTIMATE</td>
<td>SOKHOYAN 15A</td>
<td>DPWA Multichannel</td>
<td></td>
</tr>
<tr>
<td>$-20\pm10$</td>
<td>SVARC 14</td>
<td>L+P</td>
<td>$\pi N \rightarrow \pi N$</td>
</tr>
<tr>
<td>$-5\pm 5\pm3$</td>
<td>ARNDT 06</td>
<td>DPWA</td>
<td>$\pi N \rightarrow N, \eta N$</td>
</tr>
<tr>
<td>$+15\pm45$</td>
<td>CUTKOSKY 80</td>
<td>IPWA</td>
<td>$\pi N \rightarrow \pi N$</td>
</tr>
<tr>
<td>$\cdots$</td>
<td>SHKLYAR 13</td>
<td>DPWA Multichannel</td>
<td></td>
</tr>
<tr>
<td>$-51$</td>
<td>ANISOVICH 12A</td>
<td>DPWA Multichannel</td>
<td></td>
</tr>
<tr>
<td>$-29\pm 5$</td>
<td>BATINIC 10</td>
<td>DPWA</td>
<td>$\pi N \rightarrow N\pi, N\eta$</td>
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</table>

$N(1535)$ INELASTIC POLE RESIDUE

The “normalized residue” is the residue divided by $\Gamma_{pole}/2$.

<table>
<thead>
<tr>
<th>Normalized residue in $N\pi \rightarrow N(1535) \rightarrow N\eta$</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODULUS (%)</td>
<td>PHASE ($^\circ$)</td>
<td>SOKHOYAN 15A</td>
<td>DPWA Multichannel</td>
</tr>
<tr>
<td>$43\pm3$</td>
<td>$-76\pm5$</td>
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<td>DPWA Multichannel</td>
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<table>
<thead>
<tr>
<th>Normalized residue in $N\pi \rightarrow N(1535) \rightarrow \Delta\pi, D$-wave</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>MODULUS (%)</td>
<td>PHASE ($^\circ$)</td>
<td>SOKHOYAN 15A</td>
<td>DPWA Multichannel</td>
</tr>
<tr>
<td>$11\pm2$</td>
<td>$160\pm20$</td>
<td>SHKLYAR 13</td>
<td>DPWA Multichannel</td>
</tr>
<tr>
<td>$\cdots$</td>
<td>ANISOVICH 12A</td>
<td>DPWA Multichannel</td>
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</table>

<table>
<thead>
<tr>
<th>Normalized residue in $N\pi \rightarrow N(1535) \rightarrow N\sigma$</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tbody>
<tr>
<td>MODULUS (%)</td>
<td>PHASE ($^\circ$)</td>
<td>SOKHOYAN 15A</td>
<td>DPWA Multichannel</td>
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<tr>
<td>$0.16\pm0.07$</td>
<td>$25\pm40$</td>
<td>ANISOVICH 12A</td>
<td>DPWA Multichannel</td>
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<table>
<thead>
<tr>
<th>Normalized residue in $N\pi \rightarrow N(1535) \rightarrow N(1440)\pi$</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<td>MODULUS (%)</td>
<td>PHASE ($^\circ$)</td>
<td>SOKHOYAN 15A</td>
<td>DPWA Multichannel</td>
</tr>
<tr>
<td>$0.21\pm0.14$</td>
<td>$-45\pm50$</td>
<td>SHKLYAR 13</td>
<td>DPWA Multichannel</td>
</tr>
</tbody>
</table>

$N(1535)$ BREIT-WIGNER MASS

<table>
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<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1525 \rightarrow 1545 \approx 1535$ OUR ESTIMATE</td>
<td>SOKHOYAN 15A</td>
<td>DPWA Multichannel</td>
<td></td>
</tr>
<tr>
<td>$1517 \pm 4$</td>
<td>SHKLYAR 13</td>
<td>DPWA Multichannel</td>
<td></td>
</tr>
<tr>
<td>$1526 \pm 2$</td>
<td>ARNDT 06</td>
<td>DPWA</td>
<td>$\pi N \rightarrow N, \eta N$</td>
</tr>
<tr>
<td>$1550 \pm 40$</td>
<td>CUTKOSKY 80</td>
<td>IPWA</td>
<td>$\pi N \rightarrow \pi N$</td>
</tr>
<tr>
<td>$1526 \pm 7$</td>
<td>HOEHLER 79</td>
<td>IPWA</td>
<td>$\pi N \rightarrow N\pi$</td>
</tr>
<tr>
<td>$\cdots$</td>
<td>ANISOVICH 12A</td>
<td>DPWA Multichannel</td>
<td></td>
</tr>
<tr>
<td>$1519 \pm 5$</td>
<td>SHRESTHA 12A</td>
<td>DPWA Multichannel</td>
<td></td>
</tr>
<tr>
<td>$1538 \pm 1$</td>
<td>BATINIC 10</td>
<td>DPWA Multichannel</td>
<td></td>
</tr>
<tr>
<td>$1553 \pm 8$</td>
<td>ARNDT 04</td>
<td>DPWA</td>
<td>$\pi N \rightarrow N\pi, N\eta$</td>
</tr>
<tr>
<td>$1546.7\pm 2.2$</td>
<td>PENNER 02C</td>
<td>DPWA Multichannel</td>
<td></td>
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HTTP://PDG.LBL.GOV Page 2 Created: 10/1/2016 20:05
We do not use the following data for averages, fits, limits, etc.

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<th>Mode</th>
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<td>$N\pi$</td>
</tr>
<tr>
<td>$\Gamma_2$</td>
<td>$N\eta$</td>
</tr>
<tr>
<td>$\Gamma_3$</td>
<td>$N\pi\pi$</td>
</tr>
<tr>
<td>$\Gamma_4$</td>
<td>$\Delta (1232) \pi$</td>
</tr>
<tr>
<td>$\Gamma_5$</td>
<td>$\Delta (1232) \pi$, $D$-wave</td>
</tr>
<tr>
<td>$\Gamma_6$</td>
<td>$N\sigma$</td>
</tr>
<tr>
<td>$\Gamma_7$</td>
<td>$N(1440) \pi$</td>
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<tr>
<td>$\Gamma_8$</td>
<td>$p\gamma$, helicity=1/2</td>
</tr>
<tr>
<td>$\Gamma_9$</td>
<td>$n\gamma$, helicity=1/2</td>
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We do not use the following data for averages, fits, limits, etc.

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<td>37 ± 1</td>
<td>SHRESTHA 12A</td>
<td>DPWA Multichannel</td>
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</tr>
<tr>
<td>46 ± 7</td>
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<td>DPWA $\pi N \rightarrow N\pi, N\eta$</td>
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<td>36 ± 1</td>
<td>PENNER 02C</td>
<td>DPWA Multichannel</td>
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<tr>
<td>35 ± 8</td>
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$\Gamma(N\eta)/\Gamma_{total}$

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<td>58 ± 4</td>
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<td>33 ± 5</td>
<td>ANISOVICH 12A</td>
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<tr>
<td>53 ± 1</td>
<td>PENNER 02C</td>
<td>DPWA Multichannel</td>
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<tr>
<td>51 ± 5</td>
<td>VRANA 00</td>
<td>DPWA Multichannel</td>
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$\Gamma(N\sigma)/\Gamma_{total}$

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<td>1.5 ± 0.5</td>
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<td>DPWA Multichannel</td>
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<td>2 ± 1</td>
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$\Gamma(N(1440)\pi)/\Gamma_{total}$

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<td>DPWA Multichannel</td>
<td>$\pi^- p \rightarrow n3\pi^0$</td>
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<td>8 ± 2</td>
<td>STAROSTIN 03</td>
<td>DPWA Multichannel</td>
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<tr>
<td>&lt; 1</td>
<td>SHRESTHA 12A</td>
<td>DPWA Multichannel</td>
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<tr>
<td>10 ± 9</td>
<td>VRANA 00</td>
<td>DPWA Multichannel</td>
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\( N(1535) \) PHOTON DECAY AMPLITUDES AT THE POLE

\[ N(1535) \rightarrow p\gamma, \text{ helicity-1/2 amplitude } A_{1/2} \]

<table>
<thead>
<tr>
<th>MODULUS (GeV(^{-1/2}))</th>
<th>PHASE (°)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
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<tbody>
<tr>
<td>0.114 ± 0.008</td>
<td>10 ± 5</td>
<td>SOKHOYAN</td>
<td>15A</td>
<td>DPWA Multichannel</td>
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\( N(1535) \) BREIT-WIGNER PHOTON DECAY AMPLITUDES

\[ N(1535) \rightarrow p\gamma, \text{ helicity-1/2 amplitude } A_{1/2} \]

<table>
<thead>
<tr>
<th>VALUE (GeV(^{-1/2}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tbody>
<tr>
<td>+0.115 ± 0.015 OUR ESTIMATE</td>
<td>SOKHOYAN</td>
<td>15A</td>
<td>DPWA Multichannel</td>
</tr>
<tr>
<td>0.101 ± 0.007</td>
<td>WORKMAN</td>
<td>12A</td>
<td>DPWA ( \gamma N \rightarrow N\pi )</td>
</tr>
<tr>
<td>0.128 ± 0.004</td>
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<td></td>
</tr>
<tr>
<td>0.091 ± 0.002</td>
<td>DUGGER</td>
<td>07</td>
<td>DPWA ( \gamma N \rightarrow \pi N )</td>
</tr>
<tr>
<td></td>
<td>SOKHOYAN</td>
<td>13</td>
<td>DPWA Multichannel</td>
</tr>
<tr>
<td></td>
<td>ANISOVICH</td>
<td>12A</td>
<td>DPWA Multichannel</td>
</tr>
<tr>
<td></td>
<td>SHRESTHA</td>
<td>12A</td>
<td>DPWA Multichannel</td>
</tr>
<tr>
<td></td>
<td>DRECHSEL</td>
<td>07</td>
<td>DPWA ( \gamma N \rightarrow \pi N )</td>
</tr>
<tr>
<td></td>
<td>PENNER</td>
<td>02D</td>
<td>DPWA Multichannel</td>
</tr>
</tbody>
</table>

\[ N(1535) \rightarrow n\gamma, \text{ helicity-1/2 amplitude } A_{1/2} \]

<table>
<thead>
<tr>
<th>VALUE (GeV(^{-1/2}))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
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<tbody>
<tr>
<td>−0.075 ± 0.020 OUR ESTIMATE</td>
<td>ANISOVICH</td>
<td>13B</td>
<td>DPWA Multichannel</td>
</tr>
<tr>
<td>−0.093 ± 0.011</td>
<td>CHEN</td>
<td>12A</td>
<td>DPWA ( \gamma N \rightarrow \pi N )</td>
</tr>
<tr>
<td>−0.058 ± 0.006</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>−0.049 ± 0.003</td>
<td>SHRESTHA</td>
<td>12A</td>
<td>DPWA Multichannel</td>
</tr>
<tr>
<td>−0.051</td>
<td>DRECHSEL</td>
<td>07</td>
<td>DPWA ( \gamma N \rightarrow \pi N )</td>
</tr>
<tr>
<td>−0.024</td>
<td>PENNER</td>
<td>02D</td>
<td>DPWA Multichannel</td>
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\[ N(1535) \rightarrow N\gamma, \text{ ratio } A_{1/2}^n/A_{1/2}^p \]

<table>
<thead>
<tr>
<th>VALUE (GeV(^{-1/2}))</th>
<th>DOCUMENT ID</th>
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<th>COMMENT</th>
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<tbody>
<tr>
<td>0.84 ± 0.15</td>
<td>MUKHOPAD…95B</td>
<td>IPWA</td>
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</table>

\( N(1535) \) FOOTNOTES

1. Fit to the amplitudes of HOEHLER 79.
2. This STAROSTIN 03 value is an estimate made using simplest assumptions.

\( N(1535) \) REFERENCES

For early references, see Physics Letters 111B 1 (1982).

SOKHOYAN 15A EPJ A51 95 V. Sokhoyan et al. (CBELSA/TAPS Collab.)
PDG 14 CPC 38 070001 K. Olive et al. (PDG Collab.)
SVARC 14 PR C89 045205 A. Svarc et al.
ANISOVICH 13B EPJ A49 67 A.V. Anisovich et al.
SHRESTHA 13 EPJ A51 95 V. Shklyar, H. Lenske, U. Mosel (GIES)
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Conference/Journal</th>
<th>Page</th>
<th>Institution(s)</th>
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<tr>
<td>ANISOVICH</td>
<td>EPJ A48 15</td>
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