\( \Sigma(1580) \ 3/2^- \)

\[ I(J^P) = 1(3^-) \]

Status: *  

Omitted from Summary Table  

Seen in the isospin-1 \( \bar{K}N \) cross section at BNL (LI 73, CARROLL 76) and in a partial-wave analysis of \( K^- p \rightarrow \Lambda \pi^0 \) for c.m. energies 1560–1600 MeV by LITCHFIELD 74. LITCHFIELD 74 finds \( J^P = 3/2^- \). Not seen by ENGLER 78, CAMERON 78C, OLMSTED 04, nor by PRAKHOV 04.  

Neither ZHANG 13A nor SARANTSEV 19 see any evidence for this state.

### \( \Sigma(1580) \) Pole Position

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1607^{+13}_{-11}</td>
<td>1 KAMANO 15 DPWA Multichannel</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) From the preferred solution A in KAMANO 15. Solution B reports \( M = 1492^{+4}_{-7} \) MeV.

\[ -2 \times \text{Imaginary Part} \]

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>253^{+30}_{-18}</td>
<td>2 KAMANO 15 DPWA Multichannel</td>
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<td></td>
</tr>
</tbody>
</table>

\(^2\) From the preferred solution A in KAMANO 15. Solution B reports \( M = 138^{+8}_{-14} \) MeV.

### \( \Sigma(1580) \) Pole Residues

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

#### Normalized Residue in \( N\bar{K} \rightarrow \Sigma(1580) \rightarrow N\bar{K} \)

<table>
<thead>
<tr>
<th>MODULUS</th>
<th>PHASE (( ^\circ ))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00778</td>
<td>51 (^3) KAMANO 15 DPWA Multichannel</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^3\) From the preferred solution A in KAMANO 15.

#### Normalized Residue in \( N\bar{K} \rightarrow \Sigma(1580) \rightarrow \Sigma\pi \)

<table>
<thead>
<tr>
<th>MODULUS</th>
<th>PHASE (( ^\circ ))</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0625</td>
<td>-6 (^4) KAMANO 15 DPWA Multichannel</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^4\) From the preferred solution A in KAMANO 15.
### Normalized residue in $N\bar{K} \rightarrow \Sigma(1580) \rightarrow \Lambda \pi$

<table>
<thead>
<tr>
<th>MODULUS</th>
<th>PHASE (°)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.059</td>
<td>156</td>
<td>5 KAMANO</td>
<td>15</td>
<td>DPWA Multichannel</td>
</tr>
</tbody>
</table>

5 From the preferred solution A in KAMANO 15.

### Normalized residue in $N\bar{K} \rightarrow \Sigma(1580) \rightarrow \Sigma(1385) \pi$, $S$-wave

<table>
<thead>
<tr>
<th>MODULUS</th>
<th>PHASE (°)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0368</td>
<td>−18</td>
<td>6 KAMANO</td>
<td>15</td>
<td>DPWA Multichannel</td>
</tr>
</tbody>
</table>

6 From the preferred solution A in KAMANO 15.

### Normalized residue in $N\bar{K} \rightarrow \Sigma(1580) \rightarrow \Sigma(1385) \pi$, $D$-wave

<table>
<thead>
<tr>
<th>MODULUS</th>
<th>PHASE (°)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0103</td>
<td>123</td>
<td>7 KAMANO</td>
<td>15</td>
<td>DPWA Multichannel</td>
</tr>
</tbody>
</table>

7 From the preferred solution A in KAMANO 15.

### $\Sigma(1580)$ Mass

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\approx 1580$ OUR ESTIMATE</td>
<td>8 CARROLL 76</td>
<td>DPWA</td>
<td>Isospin-1 total $\sigma$</td>
</tr>
<tr>
<td>$1583 \pm 4$</td>
<td>9 LITCHFIELD 74</td>
<td>DPWA</td>
<td>$K^- p \rightarrow \Lambda \pi^0$</td>
</tr>
</tbody>
</table>

8 CARROLL 76 sees a total-cross-section bump with $(J+1/2) \Gamma_{el} / \Gamma_{total} = 0.06$.

9 The main effect observed by LITCHFIELD 74 is in the $\Lambda \pi$ final state; the $\bar{K}N$ and $\Sigma \pi$ couplings are estimated from a multichannel fit including total-cross-section data of LI 73.

### $\Sigma(1580)$ Width

<table>
<thead>
<tr>
<th>VALUE (MeV)</th>
<th>DOCUMENT ID</th>
<th>TECN</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>10 CARROLL 76</td>
<td>DPWA</td>
<td>Isospin-1 total $\sigma$</td>
</tr>
<tr>
<td>$11 \pm 4$</td>
<td>11 LITCHFIELD 74</td>
<td>DPWA</td>
<td>$K^- p \rightarrow \Lambda \pi^0$</td>
</tr>
</tbody>
</table>

10 CARROLL 76 sees a total-cross-section bump with $(J+1/2) \Gamma_{el} / \Gamma_{total} = 0.06$.

11 The main effect observed by LITCHFIELD 74 is in the $\Lambda \pi$ final state; the $\bar{K}N$ and $\Sigma \pi$ couplings are estimated from a multichannel fit including total-cross-section data of LI 73.
**Σ(1580) DECAY MODES**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Gamma_1 )</td>
<td>( N \bar{K} )</td>
</tr>
<tr>
<td>( \Gamma_2 )</td>
<td>( \Lambda \pi )</td>
</tr>
<tr>
<td>( \Gamma_3 )</td>
<td>( \Sigma \pi )</td>
</tr>
<tr>
<td>( \Gamma_4 )</td>
<td>( \Sigma(1385)\pi, S\text{-wave} )</td>
</tr>
<tr>
<td>( \Gamma_5 )</td>
<td>( \Sigma(1385)\pi, D\text{-wave} )</td>
</tr>
<tr>
<td>( \Gamma_6 )</td>
<td>( N \bar{K}^*(892), S=1/2, D\text{-wave} )</td>
</tr>
<tr>
<td>( \Gamma_7 )</td>
<td>( N \bar{K}^*(892), S=3/2, S\text{-wave} )</td>
</tr>
<tr>
<td>( \Gamma_8 )</td>
<td>( N \bar{K}^*(892), S=3/2, D\text{-wave} )</td>
</tr>
</tbody>
</table>

**Σ(1580) BRANCHING RATIOS**

See “Sign conventions for resonance couplings” in the Note on \( \Lambda \) and \( \Sigma \) Resonances.

<table>
<thead>
<tr>
<th>( \Gamma(N \bar{K})/\Gamma_{\text{total}} )</th>
<th>( \Gamma_1/\Gamma )</th>
<th>( \Gamma_2/\Gamma )</th>
<th>( \Gamma_3/\Gamma )</th>
<th>( \Gamma_4/\Gamma )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Gamma(N \bar{K})/\Gamma_{\text{total}} )</td>
<td>( +0.03 \pm 0.01 )</td>
<td>( 0.490 )</td>
<td>( 0.387 )</td>
<td>( 0.12 )</td>
</tr>
<tr>
<td><strong>VALUE</strong></td>
<td><strong>DOCUMENT ID</strong></td>
<td><strong>TECN</strong></td>
<td><strong>COMMENT</strong></td>
<td><strong>COMMENT</strong></td>
</tr>
<tr>
<td>( \Gamma(N \bar{K})/\Gamma_{\text{total}} )</td>
<td>( +0.03 \pm 0.01 )</td>
<td>12 LITCHFIELD 74</td>
<td>DPWA ( \bar{K}N ) multichannel</td>
<td>( 0.490 )</td>
</tr>
<tr>
<td>( \Gamma(N \bar{K})/\Gamma_{\text{total}} )</td>
<td>( 0.387 )</td>
<td>15 KAMANO 15</td>
<td>DPWA Multichannel</td>
<td>( 0.12 )</td>
</tr>
<tr>
<td>( \Gamma(N \bar{K})/\Gamma_{\text{total}} )</td>
<td>( 0.12 )</td>
<td>16 KAMANO 15</td>
<td>DPWA Multichannel</td>
<td>( 0.12 )</td>
</tr>
<tr>
<td>( \Gamma(N \bar{K})/\Gamma_{\text{total}} )</td>
<td>( 0.12 )</td>
<td>16 KAMANO 15</td>
<td>DPWA Multichannel</td>
<td>( 0.12 )</td>
</tr>
</tbody>
</table>

\( \Gamma_1/\Gamma \): We do not use the following data for averages, fits, limits, etc. \( \left. \right| \) \( \left. \right| \) \( \left. \right| \)

\( \Gamma_2/\Gamma \): We do not use the following data for averages, fits, limits, etc. \( \left. \right| \) \( \left. \right| \) \( \left. \right| \)

\( \Gamma_3/\Gamma \): We do not use the following data for averages, fits, limits, etc. \( \left. \right| \) \( \left. \right| \) \( \left. \right| \)

\( \Gamma_4/\Gamma \): We do not use the following data for averages, fits, limits, etc. \( \left. \right| \) \( \left. \right| \) \( \left. \right| \)
<table>
<thead>
<tr>
<th>( \Gamma(\Sigma(1385)^0) ), D-wave (/ \Gamma_{\text{total}} )</th>
<th>( \Gamma_5/\Gamma )</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALUE</td>
<td>DOCUMENT ID</td>
</tr>
<tr>
<td>( \bullet \cdot \bullet ) We do not use the following data for averages, fits, limits, etc.</td>
<td>17 KAMANO 15</td>
</tr>
</tbody>
</table>
| 0.001 | 17 KAMANO 15 | DPWA Multichannel | From the preferred solution A in KAMANO 15.

<table>
<thead>
<tr>
<th>( \Gamma(N^{\ast}(892), S=1/2) ), D-wave (/ \Gamma_{\text{total}} )</th>
<th>( \Gamma_6/\Gamma )</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALUE</td>
<td>DOCUMENT ID</td>
</tr>
</tbody>
</table>
| \( \bullet \cdot \bullet \) We do not use the following data for averages, fits, limits, etc. | 18 KAMANO 15 | DPWA Multichannel | From the preferred solution A in KAMANO 15.
| not seen | 18 KAMANO 15 | DPWA Multichannel | |

<table>
<thead>
<tr>
<th>( \Gamma(N^{\ast}(892), S=3/2) ), S-wave (/ \Gamma_{\text{total}} )</th>
<th>( \Gamma_7/\Gamma )</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALUE</td>
<td>DOCUMENT ID</td>
</tr>
</tbody>
</table>
| \( \bullet \cdot \bullet \) We do not use the following data for averages, fits, limits, etc. | 19 KAMANO 15 | DPWA Multichannel | From the preferred solution A in KAMANO 15.
| not seen | 19 KAMANO 15 | DPWA Multichannel | |

<table>
<thead>
<tr>
<th>( \Gamma(N^{\ast}(892), S=3/2) ), D-wave (/ \Gamma_{\text{total}} )</th>
<th>( \Gamma_8/\Gamma )</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALUE</td>
<td>DOCUMENT ID</td>
</tr>
</tbody>
</table>
| \( \bullet \cdot \bullet \) We do not use the following data for averages, fits, limits, etc. | 20 KAMANO 15 | DPWA Multichannel | From the preferred solution A in KAMANO 15.
| not seen | 20 KAMANO 15 | DPWA Multichannel | |

<table>
<thead>
<tr>
<th>( (\Gamma_1 \Gamma_2)^{1/2}/\Gamma_{\text{total}} ) in ( N^\ast \rightarrow \Sigma(1580) \rightarrow \Lambda \pi )</th>
<th>( (\Gamma_1 \Gamma_2)^{1/2}/\Gamma )</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALUE</td>
<td>DOCUMENT ID</td>
</tr>
<tr>
<td>not seen</td>
<td>CAMERON 78C</td>
</tr>
<tr>
<td>not seen</td>
<td>ENGLER 78</td>
</tr>
<tr>
<td>( +0.10 \pm 0.02 )</td>
<td>21 LITCHFIELD 74</td>
</tr>
<tr>
<td>( +0.10 \pm 0.02 )</td>
<td>21 LITCHFIELD 74</td>
</tr>
</tbody>
</table>

21 The main effect observed by LITCHFIELD 74 is in the \( \Lambda \pi \) final state; the \( \overline{K} N \) and \( \Sigma \pi \) couplings are estimated from a multichannel fit including total-cross-section data of \( \Lambda \pi \) at 73.

<table>
<thead>
<tr>
<th>( (\Gamma_1 \Gamma_3)^{1/2}/\Gamma_{\text{total}} ) in ( N^\ast \rightarrow \Sigma(1580) \rightarrow \Sigma \pi )</th>
<th>( (\Gamma_1 \Gamma_3)^{1/2}/\Gamma )</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALUE</td>
<td>DOCUMENT ID</td>
</tr>
<tr>
<td>not seen</td>
<td>CAMERON 78C</td>
</tr>
<tr>
<td>not seen</td>
<td>ENGLER 78</td>
</tr>
<tr>
<td>( +0.03 \pm 0.04 )</td>
<td>22 LITCHFIELD 74</td>
</tr>
<tr>
<td>( +0.03 \pm 0.04 )</td>
<td>22 LITCHFIELD 74</td>
</tr>
</tbody>
</table>

22 The main effect observed by LITCHFIELD 74 is in the \( \Lambda \pi \) final state; the \( \overline{K} N \) and \( \Sigma \pi \) couplings are estimated from a multichannel fit including total-cross-section data of \( \Lambda \pi \) at 73.
\( \Sigma(1580) \) REFERENCES

<table>
<thead>
<tr>
<th>Name</th>
<th>Volume</th>
<th>Journal</th>
<th>Pages</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sarantsev</td>
<td>19</td>
<td>EPJ A55</td>
<td>180</td>
<td>A.V. Sarantsev et al. (BONN, PNPI)</td>
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<tr>
<td>Kamano</td>
<td>15</td>
<td>PR C92</td>
<td>025205</td>
<td>H. Kamano et al. (ANL, OSAK)</td>
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<tr>
<td>Zhang</td>
<td>13A</td>
<td>PR C88</td>
<td>035205</td>
<td>H. Zhang et al. (KSU)</td>
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<tr>
<td>Olmsted</td>
<td>04</td>
<td>PL B588</td>
<td>29</td>
<td>J. Olmsted et al. (BNL Crystal Ball Collab.)</td>
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<td>Prakhov</td>
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<td>Cameron</td>
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<td>189</td>
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<td>Engler</td>
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<td>3061</td>
<td>A. Engler et al. (CMU, ANL)</td>
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<td>Carroll</td>
<td>76</td>
<td>PRL 37</td>
<td>806</td>
<td>A.S. Carroll et al. (BNL)</td>
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<tr>
<td>Litchfield</td>
<td>74</td>
<td>PL 51B</td>
<td>509</td>
<td>P.J. Litchfield (CERN)</td>
</tr>
<tr>
<td>Li</td>
<td>73</td>
<td>Purdue Conf. 283</td>
<td>K.K. Li</td>
<td>(BNL)</td>
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</table>

**Citation:** P.A. Zyla et al. (Particle Data Group), Prog. Theor. Exp. Phys. 2020, 083C01 (2020)