to average them together. In any case, the spread of the masses, widths, and branching fractions from the different analyses is certainly a better indication of the uncertainties than are the quoted errors. In the Baryon Summary Table, we usually give a range reflecting the spread of the values rather than a particular value with error.

For three states, the $\Lambda(1520)$, the $\Lambda(1820)$, and the $\Sigma(1775)$, there is enough information to make an overall fit to the various branching fractions. It is then necessary to use the quoted errors, but the errors obtained from the fit should not be taken seriously.

Production experiments: Partial-wave analyses of course separate partial waves, whereas a peak in a cross section or an invariant mass distribution usually cannot be disentangled from background and analyzed for its quantum numbers; and more than one resonance may be contributing to the peak. Results from partial-wave analyses and from production experiments are generally kept separate in the Listings, and in the Baryon Summary Table results from production experiments are used only for the low-mass states. The $\Sigma(1385)$ and $\Lambda(1405)$ of course lie below the $\overline{K}N$ threshold and nearly everything about them is learned from production experiments; and production and formation experiments agree quite well in the case of $\Lambda(1520)$ and results have been combined. There is some disagreement between production and formation experiments in the 1600–1700 MeV region: see the Note on the $\Sigma(1670)$.

References

1. R. Levi-Setti, in *Proceedings of the Lund International Conference on Elementary Particles* (Lund, 1969), p. 339.
2. Particle Data Group, Phys. Lett. **111B** (1982).

$\boxed{\Lambda(1405)\ S_{01}}$

$I(J^P) = 0(\frac{1}{2}^-)$ Status: ∗∗∗∗

NOTE ON THE $\Lambda(1405)$

(by R.H. Dalitz, Oxford University)

It is generally accepted that the $\Lambda(1405)$ is a well-established $J^P = 1/2^-$ resonance. It is assigned to the lowest $L = 1$ supermultiplet of the 3-quark system and paired with the $J^P = 3/2^-$ $\Lambda(1520)$. Lying about 30 MeV below the $N\overline{K}$ threshold, the $\Lambda(1405)$ can be observed directly only as a resonance bump in the $(\Sigma\pi)^0$ subsystem in final states of production experiments. It was first reported by ALSTON 61B in the reaction $K^-p \rightarrow \Sigma\pi\pi\pi$ at 1.15 GeV/c and has since been seen in at least eight other experiments. However, only two of them had enough events for a detailed analysis: THOMAS 73, with about 400 $\Sigma^\pm\pi^\mp$ events from $\pi^-p \rightarrow K^0(\Sigma\pi)^0$ at 1.69 GeV/c; and HEMINGWAY 85, with 766 $\Sigma^+\pi^-$ and 1106 $\Sigma^-\pi^+$ events from $K^-p \rightarrow (\Sigma\pi\pi)^+\pi^-$ at 4.2 GeV/c, after the selections $1600 \leq M(\Sigma\pi\pi)^+ \leq 1720$ MeV and momentum transfer ≤ 1.0 (GeV/c)^2 to purify the $\Lambda(1405) \rightarrow (\Sigma\pi)^0$ sample. These experiments agree on a mass of about 1395–1400 MeV and a width of about 60 MeV. (Hemingway's mass of 1391 ± 1 MeV is from his best, but unacceptably poor, Breit-Wigner fit.)

The Byers-Fenster tests on these data allow any spin and either parity: neither J nor P has yet been determined *directly*. The early indications for $J^P = 1/2^-$ came from finding Re $A_{I=0}$ to be large and negative in a constant-scattering-length analysis of low-energy $N\overline{K}$ reaction data (see KIM 65, SAKITT 65, and earlier references cited therein). The first multichannel energy-dependent K-matrix analysis (KIM 67) strengthened the case for a resonance around 1400–1420 MeV strongly coupled to the $I = 0$ S-wave $N\overline{K}$ system.

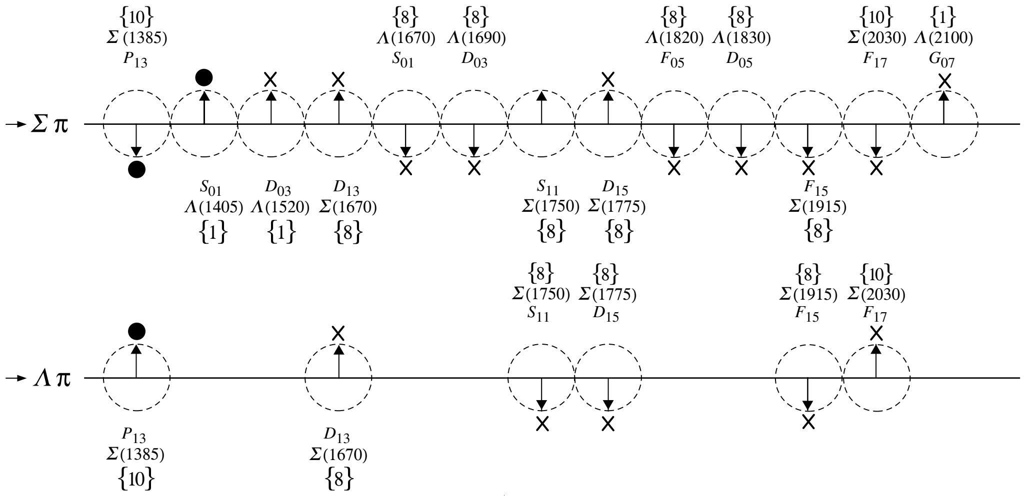

Figure 1. The signs of the imaginary parts of resonating amplitudes in the $\overline{K}N \rightarrow \Lambda\pi$ and $\Sigma\pi$ channels. The signs of the $\Sigma(1385)$ and $\Lambda(1405)$, marked with a •, are set by convention, and then the others are determined relative to them. The signs required by the SU(3) assignments of the resonances are shown with an arrow, and the experimentally determined signs are shown with an ×.