1 - 26 Are There Three Ξ(1950) States?

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There exists scarce data on cascade resonances. This is because they can only be produced as a part of a final state, the production cross sections are small, and the final states are topologically complicated and difficult to study with electronic techniques. Thus, the bulk of information about cascade states came entirely from old bubble chamber experiments where the numbers of events are small. There are just two four star resonances, Ξ(1318) and Ξ(1530) with spin-parity $J^P=1/2^+$ and $3/2^+$, respectively. The other two three star cascade resonances quoted in the review of particle physics[1] are the Ξ(1950) and Ξ(2030) states, which spin-parity have not been determined yet. In this short note, we will focus in these two states, in particular in the Ξ(1950) resonance.

The Ξ(1950) resonance was discovered in 1965 by Badier et al.[2] in the decay channels $K^- p \to \Xi^- K^0 \pi^+$ and $K^- p \to \Xi^- K^+ \pi^0$. The Briet-Wigner parametrization fit resulted in a mass and width of $M=(1933\pm16)$ MeVand $\Gamma=(140\pm35)$ MeV, respectively. Three years later, Alitti et al.[3] confirmed the existence of a cascade resonance with $M=(1930\pm20)$ MeV and $\Gamma=(80\pm40)$ MeV in the $K^- p \to \Xi^- \pi^- \pi^+ K^+$ channel. However, the Ξ(1950) has not been observed in several works searching for Ξ^* states. The possibility that there may be several cascade resonances in the 1900～2000 MeV region was suggested for the first time by Briefel et al.[4], which noticed that different values for the mass of the Ξ(1950) resonance were to be found in different decay channels.

In the present work we use the Gell-Mann-Okubo mass relation to identify possible cascade resonances with masses not far from 1950 MeV and then try to match the predicted decay widths, assuming the Ξ(1950) belongs to a particular multiplet. In particular we have identified the missing cascade members of a $1/2^-$ decuplet and the $5/2^+$ and $5/2^-$ octets as possible candidates for explaining different appearances of the Ξ(1950). While the $1/2^-$ decuplet signal would be quite indistinct, the $5/2^-$ octet identification fits into the experimental observations of broad structures in the Ξπ invariant mass distribution, while the $5/2^+$ assignment is compatible with the observation of a narrower state in the ΛKbar decay channel and with a mass of about 1965 MeV.

References

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[3] J. Alitti, et al., Phys. Rev. Lett., 21(1968)1119.
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