Phenomenological study of two-meson couplings of Θ^+

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We evaluate two-meson couplings of Θ^+, using experimental information of nucleon resonances decaying into $\pi\pi N$ channels, in which the two pions are in scalar- and vector-type correlations [1]. We examine two assignments of spin and parity of $J^P = 1/2^+$ and $3/2^-$, for which the experimental spectra of known resonances with exotic baryons are properly reproduced by an octet-antidecuplet representation mixing scheme [2]. With the obtained coupling constants, total cross sections of the reactions $\pi^- p \to K^- \Theta^+$ and $K^+ p \to \pi^+ \Theta^+$ are calculated. Substantial interference of two terms may occur in the reaction processes for the $J^P = 1/2^+$ case, whereas the interference effect is rather small for the $3/2^-$ case.

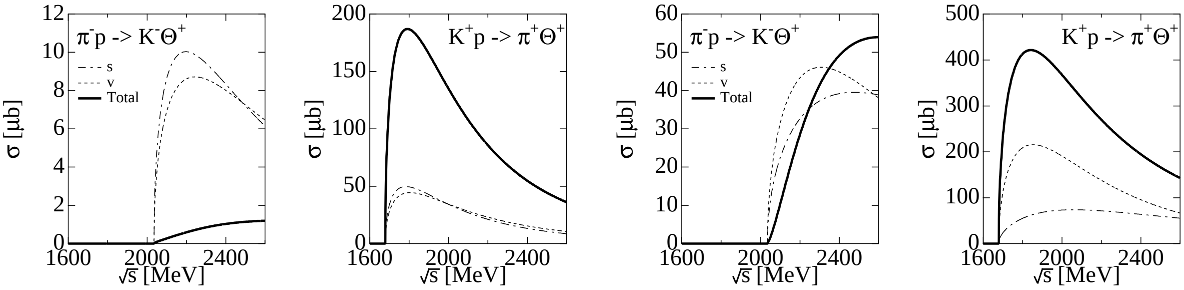

Figure 1: Total cross sections of the $\pi^- p \to K^- \Theta^+$ and $K^+ p \to \pi^+ \Theta^+$ reactions for the $J^P = 1/2^+$ case (left) and the $J^P = 3/2^-$ case (right), including a hadronic form factor. The thick line shows the result with full amplitude. Dash-dotted and dashed lines are the contributions from s and v terms, respectively.

Table 1: Summary of the coupling constants, cross sections and self-energies. $\sigma_{\pi^- p \to K^- \Theta^+}$ is the total cross section for $\pi^- p \to K^- \Theta^+$ are the values at $P_{\rm lab} = 1920$ MeV; $\sigma_{K^+ p \to \pi^+ \Theta^+}$ is that for $K^+ p \to \pi^+ \Theta^+$, which is the upper limit of the cross section at $P_{\rm lab} = 1200$ MeV.

J^P	g^s	g^v	$\sigma_{\pi^- p \to K^- \Theta^+}$ [μb]	$\sigma_{K^+ p \to \pi^+ \Theta^+}$ [μb]	ReΣ_Θ [MeV]
$1/2^+$	1.59	−0.27	4.1	<1928	−78
	1.37	−0.23	3.2	<1415	−58
	1.80	−0.31	5.0	<2506	−100
$3/2^-$	0.104	0.209	4.1	< 113	−23
	0.125	0.25	5.9	< 162	−32
	0.22	0.44	18	< 502	−100

References

[1] T. Hyodo and A. Hosaka, Phys. Rev. C72, 055202 (2005).

[2] T. Hyodo and A. Hosaka, Phys. Rev. D71, 054017 (2005).