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EXCHANGE DEGENERACY TESTS IN THE RESONANCE REGION OF THE REACTIONS $\bar{K}N - \pi\Sigma$ AND $\bar{K}N - \pi\Lambda$

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CERN - Geneva

A B S T R A C T

Duality diagrams imply that the Y^* resonances in $\bar{K}N - \pi\Sigma$, $\bar{K}N - \pi\Lambda$ cancel on the average in the imaginary parts at fixed t. We test this cancellation of the Y^*'s in the positive t region (at $t = m^2_{K^*}$) using the experimental Y^* couplings. We find the predictions of duality diagrams qualitatively verified in the resonance region.

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Duality diagrams [1] imply that the amplitudes for

$$K^- p \rightarrow \pi^- \Sigma^+$$
$$K^- p \rightarrow \pi^0 \Lambda$$

are purely real at high energy and real on the average at low energy, i.e., the imaginary parts of the Y^* resonances must cancel, if we average over s at fixed t. In this article we test this cancellation of the Y^*'s.

Since the high energy amplitudes are given by K^* and K^{**} exchange, duality diagrams imply that the K^* and the K^{**} are (strongly) exchange degenerate in these channels *). The predictions of duality diagrams in these channels go beyond what can be obtained from the simple duality scheme. By simple duality we mean all that follows from : (a) analyticity ; (b) resonance dominance at low energy ; (c) Regge pole dominance at high energy.

K^* - K^{**} exchange degeneracy in the channel $K\pi$ - $K\pi$ follows in the duality scheme because $K^+\pi^+$ is an exotic channel (no resonances). In the $K\pi$ - $K\pi$ channel duality diagrams do not add anything new.

On the other hand for the case of $K^- p - \pi^- \Sigma^+$ and $K^- p - \pi^0 \Lambda$ the direct channel and the two crossed channels are all non-exotic, i.e., all three channels contain resonances : Y^*'s, N^*'s, K^*'s. Therefore duality arguments by themselves do not lead to any exchange degeneracy prediction. However, the K^* - K^{**} Regge terms

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*) By exchange degeneracy we mean strong exchange degeneracy (the trajectory and the residue functions are degenerate) as opposed to weak exchange degeneracy (only the trajectories degenerate). Strong exchange degeneracy always applies to specific channels.

must be exchange degenerate in the exotic reactions $K^+\pi^+ \to \pi^+ K^+$ and $p\Sigma^+ \to \Sigma^+ p$, $p\Lambda \to \Lambda p$. If we combine duality arguments with factorization, we can conclude that $K^* - K^{**}$ exchange degeneracy is also valid in $\bar{K}N - \pi\Sigma$, $\bar{K}N - \pi\Lambda$ and in the crossed reactions $\pi N - K\Sigma$, $\pi N - K\Lambda$. But from duality and factorization alone we cannot decide in which of the two crossed channels the full Regge amplitude is purely real and in which it has the phase $e^{-i\pi\alpha}$. This comes from the sign ambiguity in the factorization condition. Duality diagrams (or SU_3) tell us that it is the channels $\bar{K}N - \pi\Sigma$, $\bar{K}N - \pi\Lambda$ which are purely real at high energy.

The predictions of duality diagrams can be tested either at high energy or at low energy. At high energy $K^* - K^{**}$ exchange degeneracy leads to a vanishing polarization in the crossed channels, e.g., $K^-p - \pi^-\Sigma^+$ and $\pi^+p - K^+\Sigma^+$. This test fails, the polarization is sizable [2]. Even weak exchange degeneracy (only trajectories, not the residues, are degenerate) fails, since the differential cross-sections are different in the two crossed reactions [2]. Breaking exchange degeneracy also for trajectories still does not solve these problems, because $P\sigma$ must be of opposite sign and equal magnitude in the two crossed reactions, as long as we use only K^* and K^{**} exchange, but not cuts. Experimentally the polarizations are of equal sign at least for $|t| \lesssim 0.3\ \mathrm{GeV}^2$ [2]. Because of this relative sign the dominant effect which is responsible for the failure of duality diagram predictions must be cuts [3]. In addition there may or may not be a breaking of the exchange degeneracy of the poles.

The low energy tests can be done either using phase shifts or using resonance saturation. If one uses phase shifts one will work at $t \leq 0$, but unfortunately the energy range is rather restricted by the available phase shift solutions. Ferro-Luzzi et al. [4] make such a test in an interval of only $\Delta s = 1.2\ \mathrm{GeV}^2$. Therefore they cover only <u>one</u> resonance on each trajectory. We expect and verify experimentally that the consecutive numbers of each trajectory produce the cancellation. Therefore one needs an interval of at least $\Delta\alpha(s) = 2$ or $\Delta s = 2.2\ \mathrm{GeV}^2$.

It is more attractive to test the averaging to zero of the imaginary part directly in the resonance saturation scheme. With resonance saturation it is better to go to t = positive (e.g., $t = m^2_{K^*}$ or $t = m^2_{K^{**}}$) for three reasons. Firstly, resonance dominance over the non-resonating background is a better approximation (for the imaginary part) the more positive t becomes ; it is exact for $t \to \infty$ in the narrow resonance approximation [5]. Secondly, and this is a very important point in this context, the resonance contributions at $t = 0$ are proportional to the observed widths Γ_{ij} while at $t \gtrsim m^2_{K^*}$ they are proportional to the reduced widths g^2_{ij}. Since a cancellation pattern implies coupling ratios for a sequence of resonances, working at $t = 0$ implies considering ratios of Γ 's while working at $t \gtrsim m^2_{K^*}$ implies considering ratios of g^2's. But the ratio of Γ 's has no physical meaning, because it contains threshold factors. The fundamental coupling strengths are the reduced widths g^2. (E.g., SU_3 coupling ratios always refer to g^2, never to Γ .) Therefore sum rules, or more generally cancellation patterns, are more fundamental at $t \gtrsim m^2_{K^*}$ than at $t = 0$. As an illustration we assume that the $Y^*_0(\frac{3}{2}^-)$ lies exactly at the $N\bar{K}$ threshold, and we note that in that case it would not contribute at all to the cancellation pattern at $t = 0$, while at $t = m^2_{K^*}$ we observe a cancellation pattern for the sequence $1/2^+$, $3/2^-$, $5/2^+$, $7/2^-$ which goes as (+1) : (-1) : (+1) : (-1) in Im $B(\bar{K}N - \pi\Sigma)$ as we shall see below.

The third reason why we must go to t positive becomes clear when we write down the relevant sum rules. Sum rules always involve both the s and the u channel resonances, the integration goes from $-N$ to $+N$. As t becomes more positive, the gap where Im $F = 0$, i.e., the gap between the s spectral function and the u spectral function, becomes larger, and the two regions of integration become more and more separated. The two spectral functions enter with the same sign in even moment sum rules, but with opposite sign in odd moment sum rules. Consider the case of $K^-p - \pi^+\Sigma^-$, where the t channel is exotic and the FESR reduce to superconvergence relations (SCR).

Since both even and odd SCR must vanish, the cancellations must take place within each of the two spectral functions separately, the Y^* and N^* will cancel separately. In contrast at $t = 0$ there is no gap, and indeed the cancellation for $\text{Im}\, B(K^- p - \pi^+ \Sigma^-)$ is not achieved if we consider the N^*'s and Y^*'s separately, because the $1/2^+$ terms (mainly N_{940} and Λ_{1115}) dominate and cancel mainly against each other.

As input we take all of the reasonably well established $S = -1$ resonances (and bound states) and their experimentally determined parameters. However, for some bound states the couplings are unknown and we have taken SU(3) values.

The Chew-Frautschi plot of the Y_0^* resonances is shown in Fig. 1a and that of the Y_1^* resonance in Fig. 1b. As can be seen from Fig. 1a there is a leading exchange degenerate trajectory but no discernible pattern in the resonances left over. We find that the resonances which do not fit into the exchange degeneracy scheme have small contributions at $t = m^2_{K^*}$, either because they couple weakly, or because they occur in central partial waves. This has previously been shown in the $\bar{K}N$ channel by one of us [6]. In Fig. 1b, we see the Y_1^* resonances fall on two exchange degenerate trajectories $\Sigma_{\alpha\gamma}$ and $\Sigma_{\beta\delta}$, with the s wave resonance Σ_β (1750) left over.

We first consider $K^- p - \pi^\mp \Sigma^\pm$, afterwards $K^- p - \pi^0 \Lambda$. A comparison of the Y^* cancellation in

$$K^- p - \pi^+ \Sigma^-$$

and

$$K^- p - \pi^- \Sigma^+$$

is interesting. In the first reaction the Y^*'s must cancel at low energy because the high energy amplitude is zero (exotic in the t channel). In the second reaction the Y^*'s cancel at low energy because at high energy the K^* and K^{**} exchanges cancel in the imaginary part (K^*-K^{**} exchange degeneracy). The condition on the first reaction alone implies that a certain linear combination of the Y_0^*'s and the Y_1^*'s cancel, while the combined conditions on both reactions imply that the Y_0^*'s and Y_1^*'s must cancel separately. We shall see that both types of cancellation work equally well, i.e., the Y^* cancellation implied by duality diagrams works as well as the cancellation implied by the absence of any high energy Regge term.

Resonance parameters are given in Table I and the results are shown in Figs. 2 and 3. Note that the signs of the couplings are the experimental signs, except for the states below the $\bar{K}N$ threshold, where we took the signs from SU_3. We have plotted $C[\mathrm{Im}\ B]$ and $C[\mathrm{Im}\ A']$ which are the contributions of the resonances to $\int \mathrm{Im}\ B\ d\nu$ and $\int \mathrm{Im}\ A'\ d\nu$, with $\nu = (s-u)/(4\bar{M})$ and $\bar{M}$ = average baryon mass in the reaction. For the magnitudes of the resonance contributions we expect from semi-local duality at $t = m_{K^*}^2$:

$$C\left[\mathrm{Im}\ A'(\nu, t=m_{K^*}^2)\right] \sim \nu \qquad (1)$$

$$C\left[\mathrm{Im}\ B(\nu, t=m_{K^*}^2)\right] \sim \mathrm{const.} \qquad (2)$$

The main conclusion to be drawn from Figs. 2 and 3 is : Y_0^*'s and Y_1^*'s cancel separately. Therefore the Y^* cancellation works for $K^-p \to \pi^+\Sigma^-$ and for $K^-p \to \pi^-\Sigma^+$ equally well, and the duality diagram predictions are empirically as well satisfied as the superconvergence predictions. In particular, we note :

(i) The contributions of the Y_0^*'s are larger than those of the Y_1^*'s by a factor 5 (note that the vertical scales differ by a factor 5). This alone already ensures that the cancellation in the reactions $K^-p \to \pi^+\Sigma^-$ and $K^-p \to \pi^-\Sigma^+$ must be about equally good.

(ii) Although the contribution of the Y_1^*'s are down by a factor 5 on those of the Y_0^*'s, the Y_1^*'s still cancel nicely.

(iii) The resonances which fit into the exchange degeneracy scheme (see Fig. 1) cancel within experimental errors, and the resonances which do not fit in with the scheme have very small contributions, with the exception of the $\Lambda\,(3/2^-,1690)$, which is much smaller than the dominant Λ's, but larger than the Σ's.

(iv) The $\Sigma_{\alpha\gamma}$ and $\Sigma_{\beta\delta}$ trajectories cancel independently as they contribute to A' and B with opposite relative signs. Also the contributions of the two trajectories are comparable unlike in $\bar{K}N$ [6].

We now consider $K^-p - \pi^0\Lambda$. The resonance parameters are given in Table II and the cancellation pattern is shown in Fig. 4. We see again that the resonance cancellation implied by duality diagrams works well. Also we see again that the resonances on the $\Sigma_{\alpha\gamma}$ and $\Sigma_{\beta\delta}$ trajectories cancel independently and that the contribution of the resonance which does not fit in the exchange degeneracy scheme is suppressed. The contributions of the two trajectories are comparable, with the $\Sigma_{\beta\delta}$ perhaps slightly larger. This would seem to invalidate the Regge fit to $\pi^-p - K^0\Lambda$ backward scattering by Barger, Cline and Matos [7] in which they neglected the $\Sigma_{\beta\delta}$, retaining only the $\Sigma_{\alpha\gamma}$. They obtained their polarization by forgetting the exchange degeneracy implied by duality diagrams. In Ref. 8), we shall show how the large polarization in $\pi^-p - K^0\Lambda$ is naturally explained and its sign predicted by a pole model incorporating $\Sigma_\alpha - \Sigma_\gamma$ and $\Sigma_\delta - \Sigma_\beta$ exchange degeneracy.

We have observed similar cancellation patterns at $t = m_{K^{**}}^2$, except that the magnitudes in A' go like ν^2 and in B like ν, as is predicted by semi-local duality. To save space we do not show the corresponding figures.

Let us finally look at these cancellation patterns from a different angle. Up to now we have focused on the $K^* - K^{**}$ exchange degeneracy, and we have talked about the Y^* cancellations in the sense of a sum rule or of semi-global duality. Why not talk directly about the Y^* exchange degeneracy, which is also implied by duality diagrams ? The condition of (strong) exchange degeneracy on the residue functions reads, e.g., for the Λ_α and Λ_γ trajectories

$$\beta_\alpha(s) = -\beta_\gamma(s) \tag{3}$$

The minus sign makes the Y^* resonances cancel in the forward direction (and the Regge amplitude be real for $t \to +\infty$), while in the case of ordinary exchange degeneracy, e.g., in $\bar{K}N - \bar{K}N$, the resonances cancel in the backward direction (and the Regge amplitude is real for $u \to +\infty$).

The residues $\beta(s)$ have a direct physical meaning in the scattering amplitude only for $t \to \pm\infty$. Equation (3) can be tested for $t \to -\infty$, $s < 0$, e.g., in $\pi^- p - K^0\Lambda$ backward scattering [8]. But here we want to test it in the resonance region, i.e. for $s > 0$. Unfortunately the left-side of Eq. (3) is known experimentally only at $s = m^2(1/2^+), m^2(5/2^+), \ldots,$ while the right side is known only at $s = m^2(3/2^-), \ldots$ Equation (3) for positive s is useful only if we can analytically continue (or interpolate) $\beta(s)$ between resonances. Therefore we must assume that we already know the functional form, and then we can test magnitude and sign. The Veneziano model or semi-local duality gives us the functional form. If we do not want to get involved with the difficulties of the Veneziano amplitude in the case of fermions, we use directly semi-local duality, Eqs. (1), (2) *). With the interpolation implied by semi-local duality, Figs. 2-4 can be interpreted as a direct test of the Y^* exchange degeneracy, Eq. (3).

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*) In addition we use the fact that for a fixed t and $s < s_c(t)$ the parent resonances dominate over the daughters ; this dominance by parents is neatly illustrated by the figures.

Another way to say it : since we must analytically continue in s, we must use the reduced residue functions ($\sim g^2$) in Eq. (3) and not the unreduced ones ($\sim \Gamma$) which go to zero as s crosses a threshold *). Therefore it is out of question to work with the amplitudes at $t = 0$, if we are interested in Eq. (3). Literally we should go with the amplitudes to $t \to \pm\infty$ to test Eq. (3), but since the g^2 have different dimensions for different J, we cannot compare them, unless we choose some mass t_o in $A \sim \beta(s)\ (t/t_o)^{\alpha(s)}$. The most physical way of choosing that mass is to consider directly the amplitude at $t = m^2_{K^*}$, or $t = m^2_{K^{**}}$, etc.

We have shown that the exchange degeneracy conditions on the couplings are experimentally reasonably well satisfied. On the other hand one knows that these conditions cannot be exactly fulfilled if one only uses the well established and dominant trajectories : $(1/2^+,8) - (3/2^-,1\text{-}8) - (5/2^+,8) - \dots$ and $(3/2^+,10) - (5/2^-,8) - \dots$ Barger and Michael [9] have used additional multiplets (whose couplings turn out to be small) and fulfil the conditions exactly. Mandula, Weyers and Zweig [10] break duality in a specific way : in meson-baryon scattering they completely neglect the conditions implied by the absence of a meson exchange diagram (e.g., in $K^-p - \pi^+\Sigma^-$), while they strictly fulfil the condition implied by the absence of a baryon exchange diagram (e.g., in $K^-p - K^-p$). We, on the other hand, conclude from Figs. 2-4 and Ref. 6) that both types of conditions are equally well satisfied within the experimental accuracy, there is no experimental evidence that one set of conditions is better or less well fulfilled than the other set. Theoretically, a 30 % breaking is needed if one minimizes the breaking in both sets of conditions.

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*) Exceptions are : (i) s wave resonances, which contribute to the $t = 0$ sum rules even at threshold and (ii) p wave resonances in the sum rules for the amplitudes A and B, which cannot be measured at $t = 0$. The amplitude A', which can be measured at $t = 0$, has the p waves vanish at threshold.

It is interesting that the Y^* exchange degeneracies (and the corresponding cancellation patterns) work qualitatively in the resonance region at the parent level, while the $K^* - K^{**}$ tests in the scattering region at high energy (polarization = 0, $d\sigma/d\Omega$ equal) do not work. This could be a (second) indication that cuts are responsible for the failure in high energy tests.

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Resonance (or particle)	J^P	Γ_{tot} in MeV	$x_{\bar{K}N}$ (or $g^2/4\pi$) *)	$x_{\pi\Sigma}$ (or $g^2/4\pi$) *)	$t_{ij} = \sqrt{x_{\bar{K}N}\, x_{\pi\Sigma}}$
$\Lambda_\alpha(1115)$	$\frac{1}{2}^+$	-	8.4 ± 3 *)a)	7 *)b)	- b)
$\Lambda_\beta(1405)$	$\frac{1}{2}^-$	40 ± 10	0.32 *)c)	1	+ d)
$\Lambda_\gamma(1520)$	$\frac{3}{2}^-$	16 ± 2	0.46 ± 0.01	0.41 ± 0.01	+
$\Lambda_\beta(1670)$	$\frac{1}{2}^-$	30			- 0.25 ± 0.06
$\Lambda_\gamma(1690)$	$\frac{3}{2}^-$	40(27-85)	0.20	0.55	- 0.33 ± 0.02
$\Lambda_\alpha(1815)$	$\frac{5}{2}^+$	75 ± 10	0.65 ± 0.01	0.11 ± 0.01	- 0.27 ± 0.01
$\Lambda_\beta(1830)$	$\frac{5}{2}^-$	75(66-145)			- 0.15 ± 0.02
$\Lambda_\gamma(2100)$	$\frac{7}{2}^-$	140 ± 30 e)			+ 0.16 ± 0.02 e)
$\Sigma_\alpha(1190)$	$\frac{1}{2}^+$	-	0.5 *)b)	9.3 *)b)	- b)
$\Sigma_\delta(1385)$	$\frac{3}{2}^+$	36 ± 3	2.2 ± 0.3 *)c)	0.10 ± 0.03	- d)
$\Sigma_\gamma(1660)$	$\frac{3}{2}^-$	49 ± 4	0.08	0.50	+ 0.20 ± 0.01
$\Sigma_\beta(1765)$	$\frac{5}{2}^-$	100(60-146)			+ 0.07 ± 0.02
$\Sigma_\alpha(1915)$	$\frac{5}{2}^+$	60 ± 20 e)			- 0.08 ± 0.03 e)
$\Sigma_\delta(2030)$	$\frac{7}{2}^+$	120 ± 30 e)			- 0.10 ± 0.02 e)

All t_{ij} values except those marked are CERN-Heidelberg-Saclay values [11]; but all widths and branching ratios except those marked are the values of the particle data group [12]. For our calculations we used the direct measurements of t_{ij} where available.

*) The number given is a rationalized coupling constant $(g^2/4\pi)$ to either K^-p or $\Sigma^+\pi^-$.

a) Ref. 13).

b) SU(3) value where we have taken f = F/F+D = 0.4 for the $\frac{1}{2}^+$ octet and $(g^2/4\pi)_{\pi NN}$ = = 14.5.

c) Ref. 14). [For the Σ (1385) our definition is related to theirs by a factor $1/m_N^2$].

d) SU(3) value.

e) Ref. 15).

- Table I -

Resonance parameters for $\bar{K}N \to \pi\Sigma$.

Resonance (or particle)	J^P	Γ_{tot} in MeV	$x_{\bar{K}N}$ (or $g^2/4\pi$) *)	$x_{\pi\Lambda}$ (or $g^2/4\pi$) *)	$t = \sqrt{x_{\bar{K}N}\, x_{\pi\Lambda}}$
$\Sigma_\alpha(1190)$	$\frac{1}{2}^+$	-	0.5 *)a)	7 *)a)	- a)
$\Sigma_\delta(1385)$	$\frac{3}{2}^+$	36 ± 3	2.2 b)	0.90 ± 0.03	+ c)
$\Sigma_\gamma(1660)$	$\frac{3}{2}^-$	48 ± 11 d)			+ 0.10 ± 0.05 d)
$\Sigma_\beta(1750)$	$\frac{1}{2}^-$	~ 80			~ (-0.20)
$\Sigma_\beta(1765)$	$\frac{5}{2}^-$	100(60 - 146)	0.45 ± 0.01	0.15 ± 0.02	- 0.27 ± 0.02
$\Sigma_\alpha(1915)$	$\frac{5}{2}^+$	60 ± 20 e)			- 0.10 ± 0.02 e)
$\Sigma_\delta(2030)$	$\frac{7}{2}^+$	165 ± 40 e)			+ 0.20 ± 0.02 e)

*) The number given is a rationalized coupling constant $(g^2/4\pi)$ to either K^-p or $\pi^0\Lambda^0$.

a) SU(3) value where we have taken f = F/F+D = 0.4 for the $\frac{1}{2}^+$ octet and $(g^2/4\pi)_{\pi NN}$ = = 14.5.

b) Ref. 14). [For the $\Sigma(1385)$ our definition is related to theirs by a factor $1/m_N^2$.]

c) SU(3) value.

d) Ref. 16).

e) Ref. 17).

- Table II -

Resonance parameters for $\bar{K}N \to \pi\Lambda$.

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FIGURE CAPTIONS

Figure 1 Chew-Frautschi plot of :
(a) the Y_o^* resonances ;
(b) the Y_1^* resonances.

Figure 2 Contributions of the Y_o^*'s in the reactions $K^- p \rightarrow \pi^{\mp} \Sigma^{\pm}$ at $t = m_{K^*}^2$.

Figure 3 Contributions of the Y_1^*'s in the reactions $K^- p \rightarrow \pi^- \Sigma^+$ at $t = m_{K^*}^2$. For $K^- p \rightarrow \pi^+ \Sigma^-$ all signs have to be reversed.

Figure 4 Contributions of the Y_1^*'s in the reactions $K^- p \rightarrow \pi^o \Lambda$ at $t = m_{K^*}^2$.

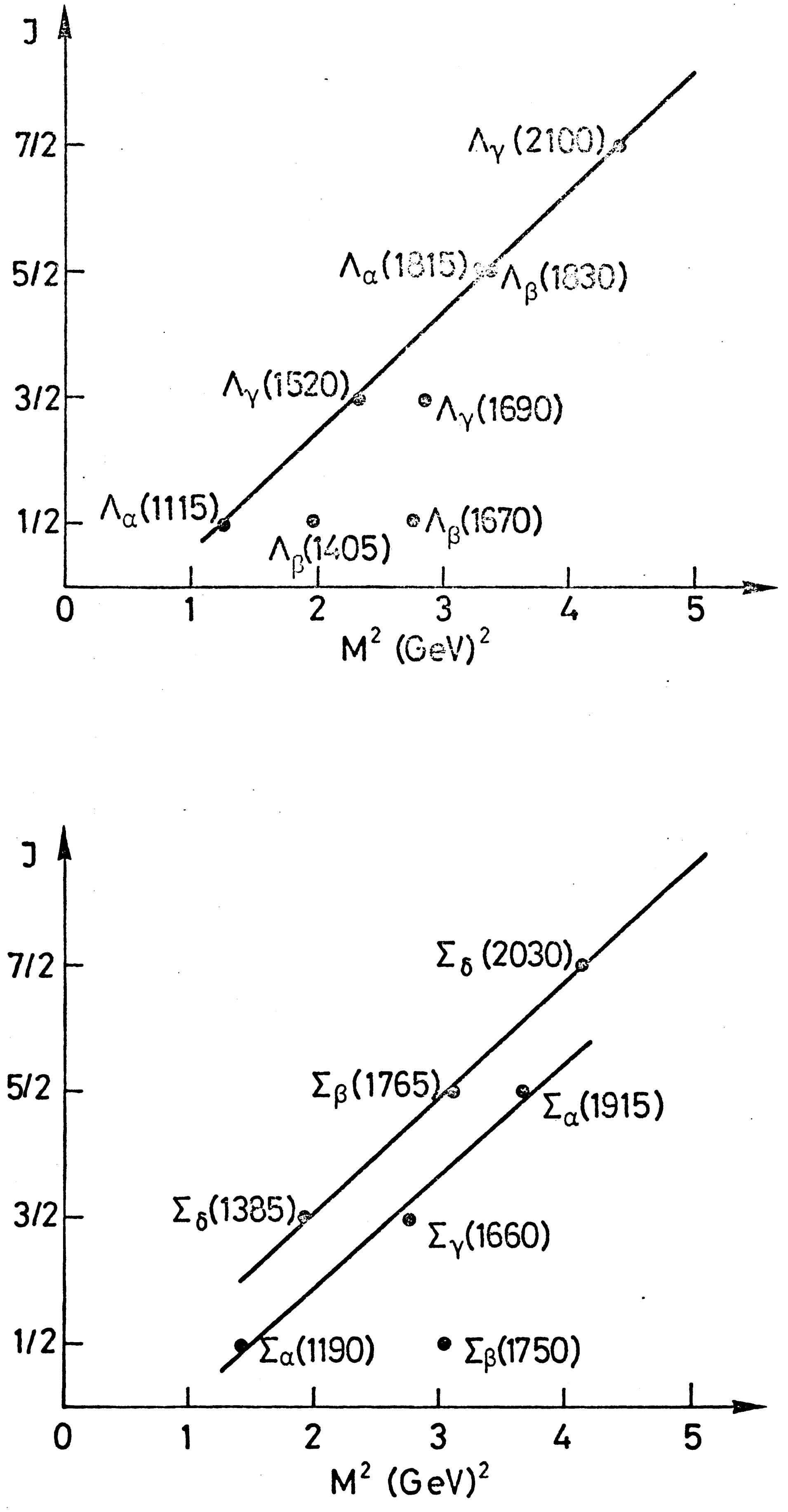
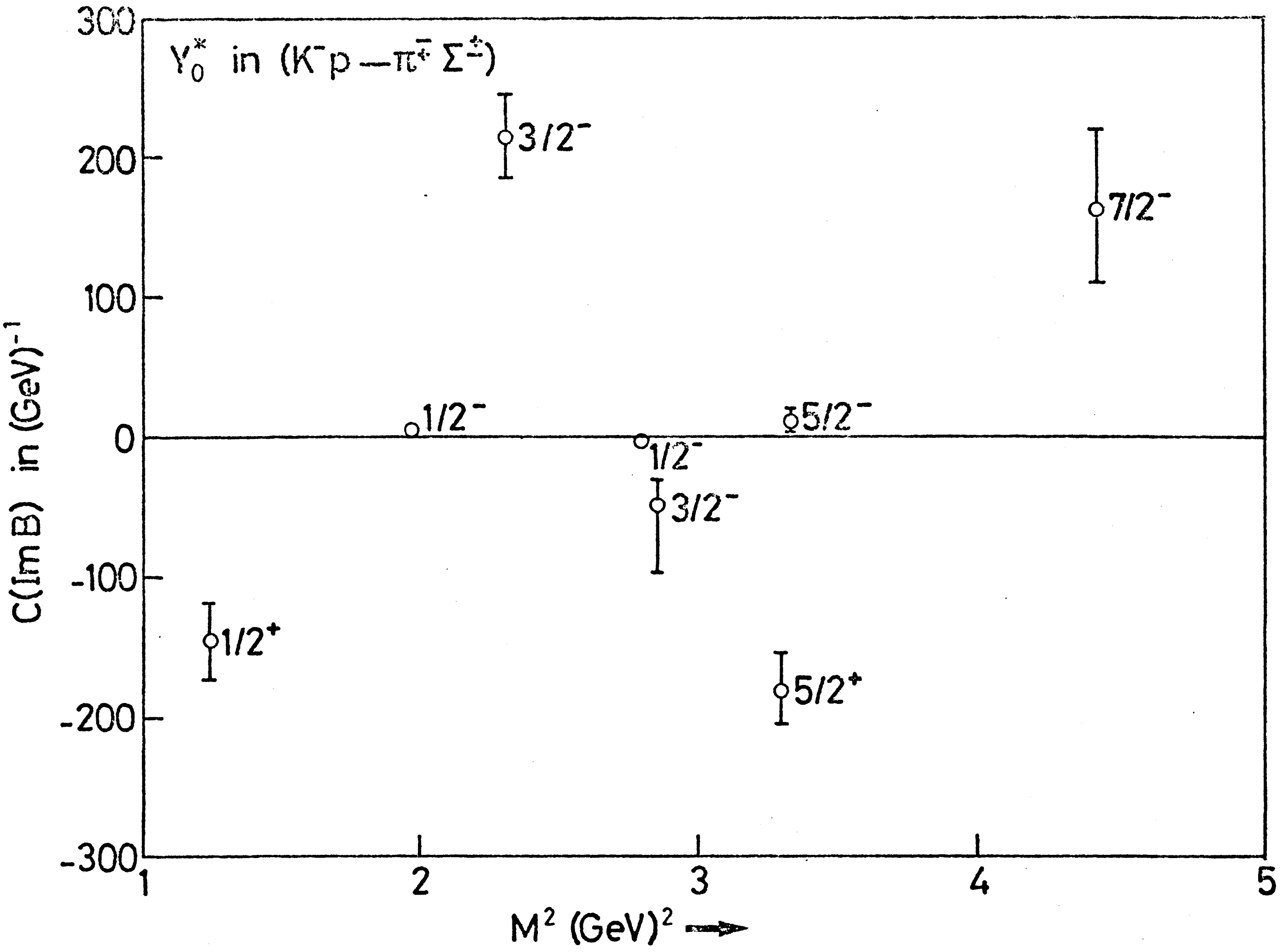
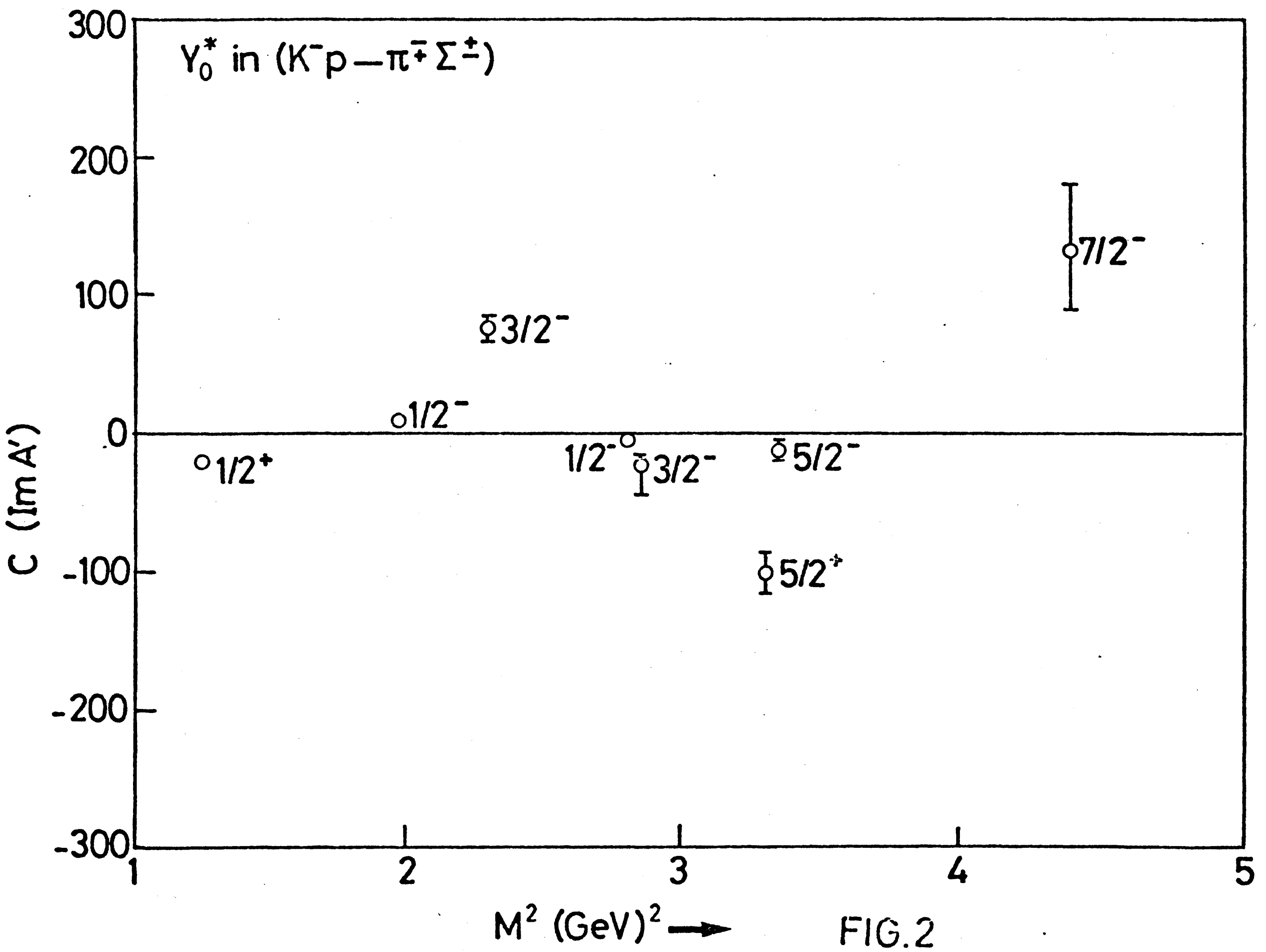

J
7/2
5/2
3/2
1/2
Λ_γ (2100)
Λ_α(1815)
Λ_β(1830)
Λ_γ(1520)
Λ_γ(1690)
Λ_α(1115)
Λ_β(1405)
Λ_β(1670)
0
1
2
3
4
5
M^2 (GeV)^2
J
7/2
5/2
3/2
1/2
Σ_δ (2030)
Σ_β(1765)
Σ_α(1915)
Σ_δ(1385)
Σ_γ(1660)
Σ_α(1190)
Σ_β(1750)
0
1
2
3
4
5
M^2 (GeV)^2

FIG.1

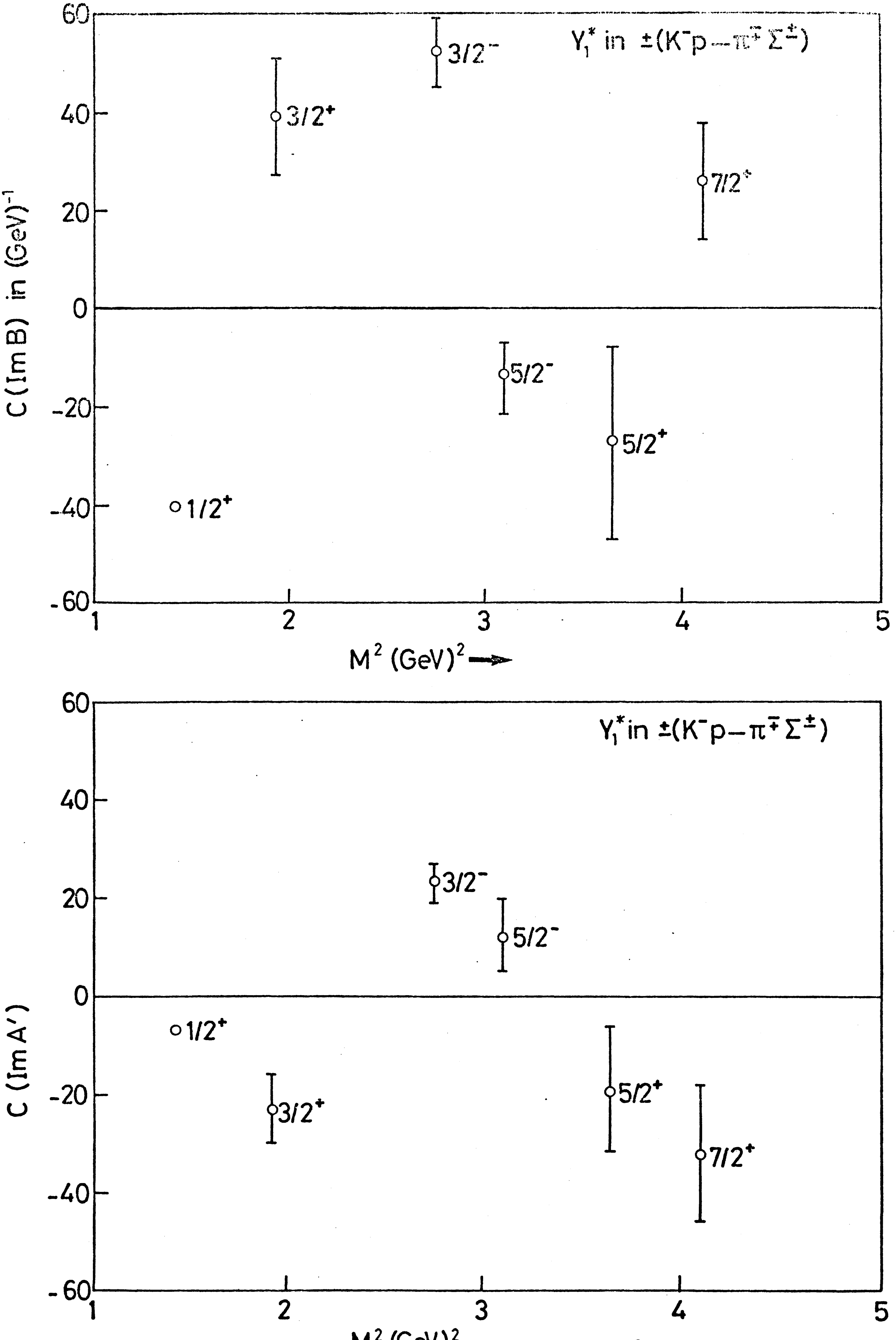


Y_0^* in ($K^-p - \pi^{\mp}\Sigma^{\pm}$)
300
200
100
0
-100
-200
-300
C(Im B) in (GeV)$^{-1}$
3/2$^-$
7/2$^-$
1/2$^-$
1/2$^-$
5/2$^-$
3/2$^-$
1/2$^+$
5/2$^+$
1
2
3
4
5
M^2 (GeV)^2



Y_0^* in ($K^-p - \pi^{\mp}\Sigma^{\pm}$)
300
200
100
0
-100
-200
-300
C (Im A')
7/2$^-$
3/2$^-$
1/2$^-$
1/2$^+$
1/2$^-$
3/2$^-$
5/2$^-$
5/2$^+$
1
2
3
4
5
M^2 (GeV)^2

FIG.2



Y_1^* in $\pm(K^-p \to \pi^{\mp}\Sigma^{\pm})$
C (Im B) in (GeV)$^{-1}$
60
40
20
0
-20
-40
-60
3/2$^-$
3/2$^+$
7/2$^+$
5/2$^-$
5/2$^+$
1/2$^+$
1
2
3
4
5
M^2 (GeV)^2 →
Y_1^* in $\pm(K^-p \to \pi^{\mp}\Sigma^{\pm})$
C (Im A′)
3/2$^-$
5/2$^-$
1/2$^+$
3/2$^+$
5/2$^+$
7/2$^+$
M^2 (GeV)^2 →

FIG. 3

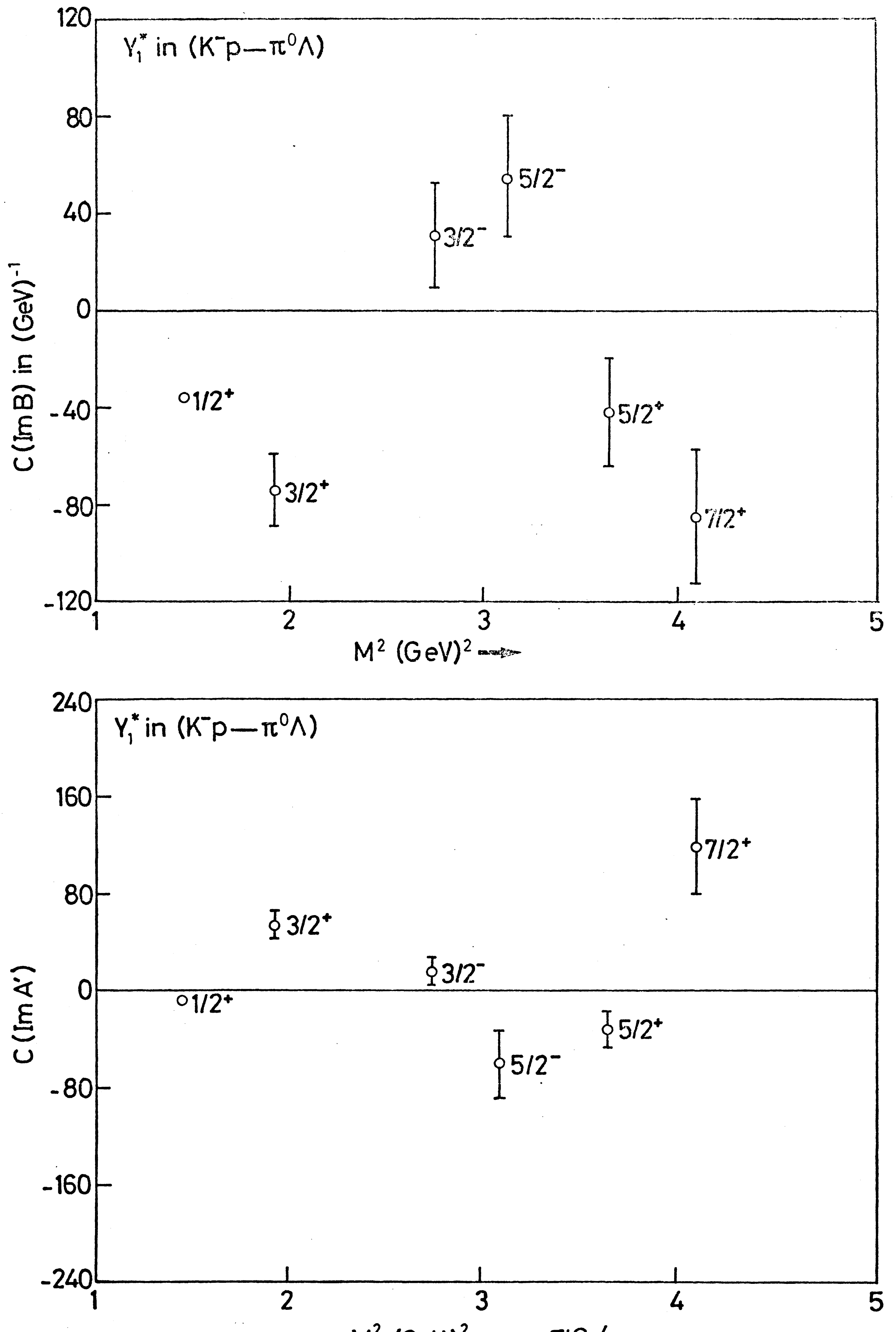

Y₁* in (K⁻p—π⁰Λ)
C (ImB) in (GeV)⁻¹
120
80
40
0
-40
-80
-120
1/2⁺
3/2⁺
3/2⁻
5/2⁻
5/2⁺
7/2⁺
1
2
3
4
5
M² (GeV)²
Y₁* in (K⁻p—π⁰Λ)
C (ImA')
240
160
80
0
-80
-160
-240
7/2⁺
3/2⁺
3/2⁻
1/2⁺
5/2⁺
5/2⁻
1
2
3
4
5
M² (GeV)²

FIG.4