Testing the nature of the $\Lambda(1520)$ resonance through photoproduction

March 26, 2022

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Abstract

Recent studies within the framework of chiral unitary theory produce the $\Lambda(1520)$ resonance, among several others, as a dynamically generated resonance from the interaction of the baryon decuplet and the meson octet. The $\Lambda(1520)$ qualifies as a quasibound state of $\pi \Sigma(1385)$ and this has repercussion in some observable quantities.

In the present work we show that the $\gamma p \rightarrow K^+K^-p$ reaction has a sizeable cross section for invariant $K^-p$ masses above the $\Lambda(1520)$ mass. On the other hand, we also find that the $\gamma p \rightarrow K^+\pi \Sigma(1385)$ reaction has a sizeable cross section in that energy region as a consequence of the strong coupling of the $\Lambda(1520)$ to $\pi \Sigma(1385)$, and then we make predictions for the ratio of this cross section to that of the $\gamma p \rightarrow K^+K^-p$ reaction.

The introduction of unitary techniques in the study of meson baryon interaction with chiral Lagrangians has allowed to show that many of the low lying baryonic resonances are dynamically generated in the implicit process of multiple scattering, or equivalently, they qualify as quasibound meson baryon states. Early studies in this direction pointed at the $\Lambda(1405)$ [1] and the $N^*(1535)$ [2] as dynamically generated resonances. The unitary methods to deal with the meson baryon interaction within the chiral framework have been made more systematic and a variety of them are now available, leading to remarkably similar results [3–11]. One of the consequences of these studies is that the interaction of the baryon octet and meson octet leads to two octets and one singlet of dynamically generated resonances with $J^P = 1/2^-$ [8, 11], to which the $\Lambda(1405)$ and the $N^*(1535)$ belong.
An interesting follow up of these developments has been recently done in [10] with the interaction of the baryon decuplet with the meson octet. Also in this case a number of $J^P = 3/2^-$ resonances are dynamically generated, which are easily identified with known resonances in the PDG [12], and some other ones are predicted. These results have been confirmed in another study where poles and residues in the complex plane are searched for [13], and which allows one to get the couplings of the resonance to the different coupled channels. Among these states there is one suggested in [10], and studied in detail in [14], and is formed from $\Delta K$ interaction with quantum numbers $S = 1, I = 1$, and is an exotic baryon impossible to construct with three constituent quarks, hence, a resonance as exotic as the $\Theta^+$ discovered in Spring8/Osaka [15] (see also Proceedings of the pentaquark04 Workshop for an update of the experimental and theoretical status of this issue [16]).

One of the side effects of the study of the $\Theta^+$ state is the test for the production of standard resonances, which is conducted both as a proof that the methods used to identify resonances do indeed work, and also to determine regions of phase space which are ideal to reduce backgrounds and, hence, see a clearer signal of the $\Theta^+$ state. One of the resonances thoroughly studied at Spring8/Osaka is the $\Lambda(1520)$ in the $\gamma p \rightarrow K^+ K^- p$ reaction using photons of 2.0 to 2.4 GeV [17]. The $\Lambda(1520)$ peak is clearly seen in the $K^+$ missing mass spectrum, which also shows a sizeable background at energies above the peak, even when the background from kaons coming from $\phi$ decay is eliminated. Another experimental work on this reaction was done in [18] using photons from 2.8 – 4.8 GeV, and similar features as in [17] were observed. We shall see that the interaction of coupled channels which leads to the $\Lambda(1520)$ pole, together with the D-wave character of the $\Lambda(1520)$ resonance in its $KN$ decay, can explain this background.

The $\Lambda(1520)$ is one of the dynamically generated resonances in [10, 13]. It appears from the interaction of the coupled channels $\pi \Sigma(1385)$ and $K \Xi(1530)$, mostly the first one. In addition, the $\Lambda(1520)$ mass is just about 5 MeV below the $\pi \Sigma(1385)$ threshold. All these things make the $\Lambda(1520)$ qualify as a quasibound $\pi \Sigma(1385)$ state. However, the small branching ratio of the $\Lambda(1520)$ to $\pi \Sigma(1385)$ of about 4 percent in the only experiment available [12, 19] (about 10 percent assuming, as done in the PDG, that the $\Lambda\pi\pi$ channel is mostly $\pi \Sigma(1385)$) does not seem to indicate such a large coupling of the $\Lambda(1520)$ resonance to the $\pi \Sigma(1385)$ state. Actually, for the nominal values of the masses, the decay of the $\Lambda(1520)$ into this channel is forbidden since 1520 MeV is about 5 MeV below threshold of $\pi \Sigma(1385)$. Hence, it is the width of the $\Lambda(1520)$ and the $\Sigma(1385)$, which are both rather narrow, what makes the decay possible, however, relatively small. Also, when the channels are so close to threshold the branching ratio to these channels is always partially a matter of choice since it depends on the energy cuts one is taking. A cleaner observable to find the coupling of the $\Lambda(1520)$ resonance to $\pi \Sigma(1385)$ is hence called for. A consequence of the nature of the $\Lambda(1520)$ as an approximately quasibound state of $\pi \Sigma(1385)$ is a relatively large coupling of the resonance to this channel, which the chiral unitary approach provides [13]. One of the issues we address in this paper is how this coupling could be determined experimentally, which could shed light on the nature of the $\Lambda(1520)$ resonance. For this purpose we suggest the measurement of the ratio of cross
sections for the reactions

\[ \gamma p \rightarrow K^+ K^- p \]
\[ \gamma p \rightarrow K^+ \pi \Sigma(1385), \]

and we evaluate this ratio within the framework of the chiral unitary approach.

Preliminary results for the first reaction of Eq. (1) have been obtained at Spring8/Osaka [17], and experimental results are also available in [18]. One observes there a clear peak of the \( \Lambda(1520) \) in the \( K^- p \) invariant mass distribution on top of a moderate background at masses beyond the \( \Lambda(1520) \) peak. Another aim of the present work is to show that such a background appears naturally within the chiral unitary approach, which provides scattering amplitudes and not just poles of resonances.

Since the \( \Lambda(1520) \) is dynamically generated from the \( \pi \Sigma(1385) \) (and to a much lesser extent the \( K \Xi(1530) \) coupled channel [13]), the microscopic description of the \( \gamma p \rightarrow K^+ K^- p \) process would be given diagrammatically by the mechanism in Fig. 1, in analogy with what was done in [20] for the photoproduction of the \( \Lambda(1405) \).

![Figure 1: Schematic representation of the mechanism for the \( \gamma p \rightarrow K^+ K^- p \) reaction mediated by the \( \Lambda(1520) \), which is generated through multiple scattering of \( \pi \Sigma(1385) \) implicit in the diagram.](image)

We shall try to make our results the least model dependent possible, hence we avoid making an explicit model for the \( \gamma p \rightarrow K^+ \pi \Sigma(1385) \) amplitude at tree level (\( V_1 \)) and similarly we also avoid making a model for the final \( \pi \Sigma(1385) \) state decaying into \( \bar{K} N \).

The only important thing to keep in mind is that the transition from the \( \Lambda(1520) \) to \( \bar{K} N \) proceeds in D-wave and this implies a factor \( q^2 \) in the transition amplitude, with \( q \) the \( \bar{K} \) momentum in the \( \bar{K} N \) center of mass frame. The mechanism also involves the \( t_{\pi \Sigma^* \rightarrow \pi \Sigma^*} \) amplitude which implicitly contains the \( \Lambda(1520) \) pole. For the rest of the amplitudes we shall assume a smooth energy dependence, although this assumption will be unnecessary when we study the ratio of the cross sections of the two reactions in Eq. (1), where the same vertex appears in both cases.

The amplitude for the \( \gamma p \rightarrow K^+ K^- p \) reaction will be given by

\[ t = \tilde{V}_1 t_{\pi \Sigma^* \rightarrow \pi \Sigma^*} \tilde{V}_2 q^2, \]

where \( \tilde{V}_1, \tilde{V}_2 \) are the vertices of Fig. 1 including, respectively, the first and last loop functions of Fig. 1 involving the \( \pi \) and \( \Sigma(1385) \) propagators. We shall assume \( \tilde{V}_1 \) and \( \tilde{V}_2 \) smooth compared with the \( t_{\pi \Sigma^* \rightarrow \pi \Sigma^*} \) amplitude which incorporates the \( \Lambda(1520) \) structure.
The details on how to evaluate this latter amplitude can be seen in [13]. In Eq. (2), $t_{\pi\Sigma^* \rightarrow \pi\Sigma^*}$ stands for the scattering amplitude of $\pi\Sigma(1385) \rightarrow \pi\Sigma(1385)$ in isospin 0 which is obtained in [13] within the framework of a chiral unitary approach using the N/D unitarization method in coupled channels [4] (or equivalently the Bethe-Salpeter equation [3]) and contains the resummation of the Dyson series involving $\pi\Sigma(1385)$ and $\pi\Xi(1530)$ loops.

The $K^-p$ invariant mass distribution for the reaction $\gamma p \rightarrow K^+(p_3)K^-(p_2)p(p_1)$ is given by

$$\frac{d\sigma}{dM_{12}} = D \int_{m_1}^{M-E_3-m_2} dE_1 M_{12} \Theta(1-A^2) \sum |t|^2,$$

(3)

where $D$ is supposed to be a constant and $A$ stands for the cosinus of the $\vec{p}_1$ and $\vec{p}_3$ angle which is fixed by the other variables and given by

$$A = \cos \theta_{13} = \frac{(M_{12} - E_1 - E_3)^2 - m_2^2 - \vec{p}_1^2 - \vec{p}_3^2}{2p_1p_3}.$$

(4)

Application of the results of [13] to the present work requires some fine tuning which we describe here. In [13] the position of the $\Lambda(1520)$ appears around 1560 MeV when using a global subtraction constant in the dispersion relation formula of [13] to reproduce the bulk of the $3/2^-$ resonances, and the width is larger than the nominal one. This is because the $\pi\Sigma(1385)$ channel is open at these energies. We can do fine tuning, changing the subtraction constant from $a = -2$ to $a = -2.72$, which brings the position of the resonance down to 1520 MeV and zero width, since it is below the $\pi\Sigma(1385)$ threshold and we are ignoring the $\Sigma(1385)$ width and the $\bar{K}N$ and $\Sigma N$ decay channels.

We calculate the coupling, $g$, of the $\Lambda(1520)$ resonance to the $\pi\Sigma(1385)$ channel by means of the residue of the $\pi\Sigma(1385) \rightarrow \pi\Sigma(1385) I = 0$ amplitude, which close to the pole behaves as

$$\frac{g^2}{z - z_R}.$$

(5)

We obtain $|g| = 1.21$ with that procedure and assume a conservative error for $g$ of 20 percent. Half of this uncertainty comes from varying the pole position of the $\Lambda(1520)$ within the experimental errors in the mass. The rest of the error would come by assuming an uncertainty of about 7 MeV in the $\Sigma(1385)$ mass to partly account for its width and from our neglect of the $\bar{K}N$ and $\pi\Sigma$ channels in the build of the $\Lambda(1520)$ resonance. As mentioned above, we obtain a $\Lambda(1520)$ pole in the real axis with this prescription, and we have used the procedure to obtain the coupling $g$ which is rather stable with respect to small variations of the parameters.

On the other hand, in order to have a shape for the $\Lambda(1520)$ excitation similar to the one found in [18], we change the subtraction constant to $a \simeq -2.51$ to $-2.54$ and simultaneously the mass of the $\Sigma(1385)$ by about 7 MeV (to simulate contributions coming from the consideration of the $\Sigma(1385)$ width). By means of this, we obtain a finite width, which allows for a realistic distribution of the strength of the resonance.
In Fig. 2 we show the experimental results for $d\sigma/dM_{K^-p}$ in the $\gamma p \rightarrow K^+K^-p$ reaction from Daresbury [18], together with results of our model for the two different values of the subtraction constants which have been fine tuned to get an approximate agreement with the experimental data from the $\Lambda(1520)$ peak onward. We have not made any attempt to reproduce the data below the $\Lambda(1520)$ peak since the deficiencies of our model (not including the $\bar{K}N$ and $\pi\Sigma$ channels, the only ones open below the $\pi\Sigma(1385)$ threshold) do not allow for a realistic description of the data in that region. However, our model contains the coupling of the $\Lambda(1520)$ to $\pi\Sigma(1385)$ which is largely dominant, and as soon as there is phase space for $\pi\Sigma(1385)$ it becomes mostly responsible for the strength of the distribution. It is interesting to note that the fine tuning of the subtraction constant changes moderately the strength at the peak but barely changes the strength in the region of 1550 – 1650 MeV. The comparatively large strength of the distribution at energies higher than the peak is due to the large $\pi\Sigma(1385) \rightarrow \pi\Sigma(1385)$ amplitude in this region, together with the $q^2$ character of the $D$–wave transition amplitude $\pi\Sigma(1385) \rightarrow \bar{K}N$. In order to give an idea of the relative size of this strength in this region, we show in the same figure the distribution produced by a naive Breit-Wigner resonance around the peak (including also the $q^2$ factor in the amplitude). We see a sizeable difference which is tied to the large $\pi\Sigma(1385) \rightarrow \pi\Sigma(1385)$ amplitude. This is why we consider this mechanism mostly responsible for the strength in this region, particularly at energies close to the tail.

Figure 2: $K^-p$ invariant mass distribution of the $\gamma p \rightarrow K^+K^-p$ reaction with photons in the range $E_\gamma = 2.8 - 4.8$ GeV. (The theoretical curves are an average within this range). Experimental results from [18].
of the \( \Lambda(1520) \) resonance, in spite that there are other terms of non resonant nature that can produce a background there, which we are not considering. We would also like to note that most models for the \( \Lambda(1520) \) (like quark models) that just provide a mass and a width for the resonance, would lead to a distribution (in the absence of the background terms neglected by us) given approximately by the Breit-Wigner distribution shown in the figure. The difference between this Breit-Wigner form and the distribution of our model is a genuine consequence of the unitary chiral dynamics assumed in our approach.

![Graph showing distribution](image)

**Figure 3:** Same as Fig. 2 but for \( E_\gamma = 2.0 - 2.4 \) GeV and implementing a binning with the experimental resolution of 12.5 MeV.

It is interesting to see what our model gives for \( d\sigma/dM_{K^-p} \) at the photon energies of Spring8/Osaka \( E_\gamma = 2.0 - 2.4 \) GeV. We show the results in Fig. 3 where we have made the average for various energies of the beam in this interval and binned the results with a resolution of 12.5 MeV of the experiment [17]. We show the results for the two different values of the subtraction constant which we used before to account for uncertainties. We see from the results that there is also a sizeable background at energies above the peak. The agreement with the preliminary data of [17], not shown in the figure, is rather fair. This exercise has served to show consistency of the preliminary data obtained in Spring8/Osaka with the old data of Daresbury [18], particularly concerning the background beyond the \( \Lambda(1520) \) peak, which is a matter of concern when testing the ability of experimental methods to deal with backgrounds and identify peaks on top of them.
The other issue we address now is the evaluation of the cross section for

\[ \gamma p \rightarrow K^+ \pi \Sigma(1385). \]  

(6)

Figure 4: Same as Fig. 1 for the \( \gamma p \rightarrow K^+ \pi \Sigma(1385) \) reaction.

With our assumption that the \( \Lambda(1520) \) is a dynamically generated resonance, mostly from \( \pi \Sigma(1385) \) interaction, the mechanism for the reaction of Eq. (6) is given in Fig. 4, where we can see that it shares with that of the \( \gamma p \rightarrow K^+ K^- p \) reaction the primary production of \( \pi \Sigma(1385) \) and the full \( \pi \Sigma(1385) \rightarrow \pi \Sigma(1385) \) scattering matrix. Only the final vertices, leading to different final states, are different between these reactions. We can easily establish a link between these two vertices using simultaneously empirical information of the \( \Lambda(1520) \) decay into \( K^- p \) and the theoretical value for the coupling of the \( \Lambda(1520) \) to \( \pi \Sigma(1385) \).

In order to make the comparison between the two processes clearer, we draw schematically in Fig. 5 the previous figures 1 and 4.

Figure 5: Schematic representation of \( \gamma p \rightarrow K^+ \bar{K} N \) and \( \gamma p \rightarrow K^+ \pi \Sigma(1385) \) showing an explicit \( \Lambda(1520) \) exchange.

which shows more transparently that what we need is the coupling of the \( \Lambda(1520) \) resonance to the two decay channels. The coupling to the \( \pi \Sigma(1385) \) we already found theoretically, see Eq. (5). The one to the \( K^- p \) we find now empirically. From the PDG we know that the partial decay width of the \( \Lambda(1520) \) to \( \bar{K} N \) is 7.02 MeV. Since the vertex is of D-wave type we can take for it

\[ \frac{h}{m_K^2 q^2}, \]  

(7)

with the same normalization as the coupling of the \( \Lambda(1520) \) to \( \pi \Sigma(1385) \), by means of which the \( \Lambda(1520) \) partial decay width into \( \bar{K} N \) is given by

\[ \Gamma_{\Lambda(1520) \rightarrow \bar{K}N} = \frac{1}{2\pi} \left( \frac{h}{m_K^2} \right)^2 \frac{M_N}{M_\Lambda} q^5 \quad ; \quad (q = 244 \text{ MeV}). \]  

(8)
This gives \( h = 2.21 \).

All this said, the ratio of cross sections for the two reactions is given by

\[
R = \frac{(d\sigma^{t=0}_{\gamma p \rightarrow K^+\pi\Sigma^*})/dM_{\pi\Sigma^*}}{(d\sigma^{t=0}_{\gamma p \rightarrow K^+\bar{K}N})/dM_{\bar{K}N}} = \frac{g^2}{(h/m_K^2)^2} \frac{\int dE_1'M_1\Theta(1-A^2)|t_{\pi\Sigma^* \rightarrow \pi\Sigma^*}|^2}{\int dE_1'M_1\Theta(1-A^2)q^4|t_{\pi\Sigma^* \rightarrow \pi\Sigma^*}|^2}
\]

with \( A' \) the corresponding \( A \) variable, Eq. (4), for the kinematics of the \( \gamma p \rightarrow K^+\pi\Sigma(1385) \) channel, and \( M_1 \) is the common invariant mass of the \( \pi^0\Sigma^* \) and \( K^-p \) system. The \( \pi\Sigma(1385) \) scattering matrix cancels in the numerator and denominator in Eq. (9). Thus the ratio of mass distributions for the two processes is given by the ratio of the couplings squared and the phase space, including the factor \( q^4 \) in the \( \gamma p \rightarrow K^+\bar{K}N \) channel.

So far we have not made any distinction for the charge of the final states since we have been using the isospin basis and have taken the \( \pi\Sigma(1385) \) amplitudes in \( I = 0 \), the channel of the \( \Lambda(1520) \). The isospin decomposition of the \( \bar{K}N \) and \( \pi\Sigma(1385) \) states is given in Eqs. (10) and (11)

\[
|K^-p\rangle = -\frac{1}{\sqrt{2}}|1,0\rangle + \frac{1}{\sqrt{2}}|0,0\rangle
\]

\[
|\bar{K}^0n\rangle = \frac{1}{\sqrt{2}}|1,0\rangle + \frac{1}{\sqrt{2}}|0,0\rangle
\]

\[
|\pi^+\Sigma^-\rangle = -\frac{1}{\sqrt{6}}|2,0\rangle - \frac{1}{\sqrt{2}}|1,0\rangle - \frac{1}{\sqrt{3}}|0,0\rangle
\]

\[
|\pi^-\Sigma^+\rangle = \frac{1}{\sqrt{6}}|2,0\rangle - \frac{1}{\sqrt{2}}|1,0\rangle + \frac{1}{\sqrt{3}}|0,0\rangle
\]

\[
|\pi^0\Sigma^0\rangle = \frac{\sqrt{2}}{3}|2,0\rangle - \frac{1}{\sqrt{3}}|0,0\rangle.
\]

We see in the equations that, neglecting the \( I = 2 \), for which the amplitudes in the chiral unitary approach are very small, the \( \pi^0\Sigma^0(1385) \) channel is purely of \( I = 0 \). This channel is hence ideal to isolate the \( I = 0 \) term. On the other hand, similarly to what was done in [20] in the photoproduction of the \( \Lambda(1405) \), one can see that the cross sections are proportional to

\[
\frac{1}{2}|T^{(1)}|^2 + \frac{1}{3}|T^{(0)}|^2 + \frac{2}{\sqrt{6}}Re(T^{(0)}T^{(1)*}) ; \quad \pi^+\Sigma^-
\]

\[
\frac{1}{2}|T^{(1)}|^2 + \frac{1}{3}|T^{(0)}|^2 - \frac{2}{\sqrt{6}}Re(T^{(0)}T^{(1)*}) ; \quad \pi^-\Sigma^+
\]

\[
\frac{1}{3}|T^{(0)}|^2 ; \quad \pi^0\Sigma^0
\]

Thus, both the \( \pi^0\Sigma^0(1385) \) channel and the average of the \( \pi^+\Sigma^- \) and \( \pi^-\Sigma^+ \) cross sections can be used to isolate the \( I = 0 \) cross section, provided that the \( I = 1 \)
cross section is relatively small compared to the \( I = 0 \) one. This exercise of removing the interference term between \( I = 0 \) and \( I = 1 \), may be important in case the \( I = 1 \) component was not much smaller that the \( I = 0 \) one, since \(|T^{(1)}|^2\) can be small compared to \(|T^{(0)}|^2\) but not the interference term. This could be the case since in the region close to 1670 MeV, there is another \( 3/2^- \) dynamically generated resonance, the \( \Sigma(1670) \), constructed from the same building blocks than the \( \Lambda(1520) \), \( \pi\Sigma(1385) \), together with \( \Delta K \) to which the resonance couples with largest strength. Actually, the \( \Sigma(1670) \) should in principle be already seen in the experiment of Spring8, [17], but there is no trace of this resonance in this experiment. This could be understood in terms of the small branching ratio of that resonance to the \( K\bar{N} \) system, which is about 10 percent according to the PDG by contrast to the 45 percent of the \( \Lambda(1520) \). On the other hand, we also have a small branching ratio of the \( \Sigma(1670) \) to \( \pi\Sigma(1385) \) which is also of the order of 10 percent as reconstructed from the \((\Gamma_1\Gamma_7)^{1/2}/\Gamma\) ratio of the PDG. This indicates that the background of \( I = 1 \) in the spectrum of \( K\bar{N} \), or in the one of \( \pi\Sigma(1385) \), should be relatively small, and we can rely upon the \( I = 0 \) dominance of the amplitudes of Eq. (2), particularly in the region between the \( \Lambda(1520) \) and \( \Sigma(1670) \), this is, around 1550-1630 MeV. Given the Clebsch-Gordan coefficients for the isospin decomposition of the \( K^-p \) and \( \pi^0\Sigma^0(1385) \) states in Eqs. (10) and (11), we then conclude that the ratio of mass distributions for these observable channels is given by

\[
R = \frac{(d\sigma_{\gamma p \rightarrow K^+\pi^0\Sigma^0})/dM_{\pi^0\Sigma^0}}{(d\sigma_{\gamma p \rightarrow K^0\pi^-})/dM_{K^-p}} = \frac{1/3}{1/2} \frac{g^2}{(h/m_K^2)^2} \int dE' \Theta(1-A'^2) \int dE' \Theta(1-A^2) q^4
\]

(13)

For the reasons given above, the average of the \( \pi^+\Sigma^-(1385) \) and \( \pi^-\Sigma^+(1385) \) cross sections could be similarly used instead of the \( \pi^0\Sigma^0(1385) \) one, which is not observable at present in some labs like Spring8.

In Fig. 6 we plot the ratio of Eq. (13) as a function of the \( K^-p \) and \( \pi^0\Sigma^0(1385) \) invariant mass for \(|g| = 1.21 \) and \( E_\gamma = 2.4 \) GeV. In our model, this ratio is independent of the photon energy. However, the photon energy is relevant to establish the maximum invariant mass where the ratio can be defined. We can see in Fig. 6 that, in the region we suggest, 1550 – 1630 MeV, the ratio \( R \) decreases from values around 0.6 to 0.3. Note that the bump in Fig. 6 has nothing to do with the \( \Lambda(1520) \) resonance, since the amplitudes producing it have canceled in the ratio. It comes essentially from the phase space of the two reactions. With assumed uncertainties of about 20 percent in \(|g|\), which would lead to about 40 percent uncertainties in the ratio of Fig. 6 and extra uncertainties from approximations done, we assume that an error of about 50 percent is a conservative estimate of the uncertainties in the calculations.

The results obtained are essentially related to the theoretical coupling, \( g \), of the \( \Lambda(1520) \) to the \( \pi\Sigma(1385) \) channel which is predicted by the theory. Hence the actual measurement of the ratio discussed, when compared with theoretical predictions, would produce an experimental measurement of that coupling which could substantiate the claim that the \( \Lambda(1520) \) is a dynamically generated resonance from the interaction of the \( \pi\Sigma(1385) \) and \( K\Xi(1530) \) coupled channels, and particularly from the first one.

At the same time it would be interesting to evaluate the same coupling with present
Summarizing the results, we have done a study of some implications of the nature of the \( \Lambda(1520) \) resonance from a perspective of chiral unitary dynamics in which framework the resonance appears as a dynamically generated state, mostly from the \( \pi \Sigma(1385) \) interaction in \( L = 0 \) and \( I = 0 \).

First we have addressed the origin of the cross section for the \( \gamma p \rightarrow K^+ K^- p \) reaction at invariant masses close and above the \( \Lambda(1520) \) mass. The dynamical origin of the \( \Lambda(1520) \) within the chiral unitary approach, together with the \( D \)-wave character of the \( \Lambda(1520) \rightarrow \bar{K}N \) decay, are responsible in our model for this relatively large strength, which is tied to a large coupling of the \( \Lambda(1520) \) to the \( \pi \Sigma(1385) \) channel and a fairly large \( \pi \Sigma(1385) \rightarrow \pi \Sigma(1385) \) amplitude in \( I = 0 \).

Second we have made predictions of the ratio of the \( \gamma p \rightarrow K^+ \pi \Sigma(1385) \) to the \( \gamma p \rightarrow K^+ K^- p \) cross sections, which is closely tied to the value of the \( \Lambda(1520) \) coupling to \( \pi \Sigma(1385) \), and which is provided by the chiral unitary approach. Therefore, an experimental measurement of such ratio would provide a test of the claimed nature of this resonance.
1 Acknowledgments

One of us, L.R., acknowledges support from the Ministerio de Educación y Ciencia. We would like to thank T. Nakano for useful discussions. This work is partly supported by the Spanish CSIC and JSPS collaboration, the DGICYT contract number BFM2003-00856, and the E.U. EURIDICE network contract no. HPRN-CT-2002-00311.

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