Covariant calculation of strange decays of baryon resonances

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We present results for kaon decay widths of baryon resonances from a relativistic study with constituent quark models. The calculations are done in the point form of Poincaré-invariant quantum mechanics with a spectator-model decay operator. We obtain covariant predictions of the Goldstone-boson-exchange and a variant of the one-gluon-exchange constituent quark models for all kaon decay widths of established baryon resonances. They are generally characterized by underestimating the available experimental data. In particular, the widths of kaon decays with decreasing strangeness in the baryon turn out to be extremely small. We also consider the nonrelativistic limit, leading to the familiar elementary emission model, and demonstrate the importance of relativistic effects. It is found that the nonrelativistic approach evidently misses sensible influences from Lorentz boosts and some essential spin-coupling terms.

I. INTRODUCTION

Recently, we studied the nonstrange decays of light baryons with relativistic constituent quark models (CQMs) [1]. The pertinent covariant results for the partial widths calculated in point-form quantum mechanics generally led to an underestimation of the experimental data. The extension of the same type of investigations to nonstrange decays of strange baryon resonances produced congruent properties of the corresponding partial decay widths [2]. As a result quite a consistent behavior of the relativistic predictions emerged for all π and η decay widths [3,4]. Previous investigations [5–14] of these decays were performed mostly along nonrelativistic or relativized approaches and with different dynamical models and/or various decay operators. They yielded strongly varying results, and the employment of various parametrizations in the decay models made it difficult to compare them with each other.

While the nonstrange decays of baryons have received a fair amount of attention, CQM investigations of strange decays have remained rather limited. Koniuk and Isgur [5] made a first study of *K* decays along the nonrelativistic elementary emission model (EEM) employing a one-gluon-exchange (OGE) CQM. Later on, Capstick and Roberts [15] reported results for strange decays of nonstrange baryons with a quark-pair-creation operator using a relativized OGE CQM. In any case, the theoretical description of strange baryon decays lacks behind phenomenology, as there are a number of well-established data reported from experiments (see, e.g., the compilation by the Particle Data Group (PDG) [16]).

Here, we extend our relativistic studies of π and η decays of light and strange baryon resonances [1,2] to the *K* channels. We report covariant predictions for the *K* decay widths of the established *N*, Δ, Λ, Σ, and Ξ resonances below 2 GeV. We employ two types of dynamical models, namely, the Goldstone-boson-exchange (GBE) CQM [17,18] and a relativistic variant of the Bhaduri-

Cohler-Nogami OGE CQM [19] as parametrized in Ref. [14]. The calculations are performed in the framework of Poincaré-invariant quantum mechanics [20] in point form [21]. In particular, we employ the decay operator from the so-called point-form spectator model (PFSM) [1,2,22] producing frame-independent results for the partial decay widths. We also consider the nonrelativistic limit of the PFSM leading to the decay operator of the usual EEM.

II. FORMALISM

The theory of the relativistic point-form treatment of mesonic decays can be found in our earlier papers [1,2], and we follow the same notation. Here, we only give the fundamental formulae generalized to the case of a decay operator changing the strangeness contents from the incoming to the outgoing baryons. The corresponding decay width is given by

$$\Gamma_{i \to f} = \frac{|\vec{q}|}{4M^2} \frac{1}{2J+1} \sum_{M_J, M_{J'}} \frac{1}{2T+1} \sum_{M_T, M_{T'}, M_{T_m}} |F_{i \to f}|^2,$$

$$(1)$$

where $F_{i \to f}$ is the transition amplitude. The latter is defined by the matrix element of the four-momentum conserving reduced decay operator $\hat{D}_{rd}^m$ between incoming and outgoing baryon states

$$F_{i \to f} = \langle V', M', J', M_{J'}, T', M_{T'} | \hat{D}_{rd}^m | V, M, J, M_J, T, M_T \rangle.$$

$$(2)$$

Here, $q_\mu = (q_0, \vec{q})$ denotes the four-momenta of the outgoing *K* meson. The invariant mass eigenstate of the incoming baryon resonance $|V, M, J, M_J, T, M_T\rangle$ is characterized by the eigenvalues of the velocity *V*, mass *M*, intrinsic spin *J* with *z*-component M_J, and isospin *T* with *z*-projection M_T; correspondingly the outgoing baryon eigenstate is denoted by primed eigenvalues. The matrix element in Eq. (2) can be expressed in an appropriate basis

representation using velocity states through the integral (for details of the calculation see the appendix of Ref. [1])

$$\langle V', M', J', M_{J'}, T', M_{T'} | \hat{D}_{rd}^m | V, M, J, M_J, T, M_T \rangle = \frac{2}{MM'} \sum_{\sigma_i \sigma_i'} \sum_{\mu_i \mu_i'} \int d^3\vec{k}_2 d^3\vec{k}_3 d^3\vec{k}_2' d^3\vec{k}_3' \sqrt{\frac{(\sum_i \omega_i')^3}{\prod_i 2\omega_i'}}$$

$$\times \Psi_{M'J'M_{J'}T'M_{T'}}^{\star}(\vec{k}_1', \vec{k}_2', \vec{k}_3'; \mu_1', \mu_2', \mu_3') \prod_{\sigma_i'} D_{\sigma_i'\mu_i'}^{\star(1/2)}\{R_W[k_i'; B(V')]\}$$

$$\times \langle p_1', p_2', p_3'; \sigma_1', \sigma_2', \sigma_3' | \hat{D}_{rd}^m | p_1, p_2, p_3; \sigma_1, \sigma_2, \sigma_3 \rangle$$

$$\times \prod_{\sigma_i} D_{\sigma_i\mu_i}^{1/2}\{R_W[k_i; B(V)]\} \sqrt{\frac{(\sum_i \omega_i)^3}{\prod_i 2\omega_i}} \Psi_{MJM_JTM_T}(\vec{k}_1, \vec{k}_2, \vec{k}_3; \mu_1, \mu_2, \mu_3),$$

(3)

where $\Psi_{MJM_JTM_T}(\vec{k}_1, \vec{k}_2, \vec{k}_3; \mu_1, \mu_2, \mu_3)$ and $\Psi_{M'J'M_{J'}T'M_{T'}}^{\star}(\vec{k}_1', \vec{k}_2', \vec{k}_3'; \mu_1', \mu_2', \mu_3')$ are the rest-frame wave functions of the incoming and outgoing baryons, respectively. The three-momenta $\vec{k}_i$ satisfy the rest-frame condition $\sum_i \vec{k}_i = \vec{0}$. They are connected to the four-momenta p_i by the boost relations $p_i = B(V)k_i$. The Wigner D-functions $D_{\sigma_i\mu_i}^{1/2}$, describing the effects of the Lorentz boosts on the internal spin states, follow directly from the representation of the baryon eigenstates with velocity states. The particular form of the decay operator is taken according to the PFSM construction [22] and reads as

$$\langle p_1', p_2', p_3'; \sigma_1', \sigma_2', \sigma_3' | \hat{D}_{rd}^m | p_1, p_2, p_3; \sigma_1, \sigma_2, \sigma_3 \rangle = -3 \left(\frac{M}{\sum_i \omega_i} \frac{M'}{\sum_i \omega_i'} \right)^{3/2} \frac{ig_{qqm}}{m_1 + m_1'} \frac{1}{\sqrt{2\pi}} \bar{u}(p_1', \sigma_1')\gamma_5\gamma^\mu$$

$$\times \mathcal{F}^m u(p_1, \sigma_1) q_\mu 2p_{20}\delta^3(\vec{p}_2' - \vec{p}_2)\delta_{\sigma_2\sigma_2'} 2p_{30}\delta^3(\vec{p}_3' - \vec{p}_3)\delta_{\sigma_3\sigma_3'}. \quad (4)$$

Here, g_{qqm} is the quark-meson coupling constant [23] and $\mathcal{F}^m$ the flavor-transition operator specifying the particular decay mode. The masses m_1 and m_1' refer to the active quark in the incoming and outgoing channels, respectively. The individual quark energies are given by $\omega_i = \sqrt{m_i^2 + \vec{k}_i^2}$. More details on the formalism can be found in Ref. [1] and also in Ref. [24].

In order to demonstrate the relativistic effects we also consider the nonrelativistic limit of the PFSM. It corresponds to a decay operator along the EEM, i.e.:

$$F_{i\to f}^{NR} = \sqrt{2E}\sqrt{2E'} \sum_{\mu_i\mu_i'} \int d^3k_2 d^3k_3 \Psi_{M'J'M_{J'}T'M_{T'}}^{\star}(\vec{k}_1', \vec{k}_2', \vec{k}_3'; \mu_1', \mu_2', \mu_3') \frac{-3ig_{qqm}}{m_1 + m_1'} \frac{1}{\sqrt{2\pi}} \mathcal{F}^m \left\{ \left[-\omega_m \frac{(m_1 + m_1')}{2m_1 m_1'} \vec{\sigma}_1 \cdot \vec{p}_1 \right. \right.$$

$$\left. \left. + \left(1 + \frac{\omega_m}{2m_1'}\right)\vec{\sigma}_1 \cdot \vec{q} \right] \delta_{\mu_2\mu_2'}\delta_{\mu_3\mu_3'} \right\}_{\mu_i'\mu_i} \Psi_{MJM_JTM_T}(\vec{k}_1, \vec{k}_2, \vec{k}_3; \mu_1, \mu_2, \mu_3). \quad (5)$$

A derivation of this limit can be found in Ref. [2]. Here we give the generalized result including the case with the masses m_1 and m_1' being different.

We note that such a nonrelativistic study of strange decays in the context of the EEM was already performed before, reporting, in particular, predictions of the GBE CQM [25]. However, one employed an even more simplified nonrelativistic decay operator neglecting the mass differences of the active quark in the incoming and outgoing channels. Consequently, we may consider the present nonrelativistic results, quoted in the Tables below, to supersede the ones reported in Ref. [25].

III. RESULTS

In our study we consider the baryon resonances contained in Table I. The partial K decay widths are calculated using directly the wave functions as produced by the GBE CQM and the Bhaduri-Cohler-Nogami OGE CQM, where in one calculation theoretical baryon masses and in another calculation experimental ones are used as inputs. The decay channels with increasing strangeness in the baryon are contained in Table II, the ones with decreasing strangeness in Table III. In these tables the first and second columns always denote the decaying resonances with their intrinsic spins and parities J^P, and the third columns give the experimental decay widths with their uncertainties, as quoted by the PDG [16].

The covariant CQM predictions obtained for the K decay widths confirm the picture that has already emerged with the relativistic results for the π and η decays of both the nonstrange and strange baryon resonances [1,2]. The theoretical values are usually smaller than the experimental data or at most reach them from below. The only exception appears to be the $\Lambda(1520) \to NK$ decay in the first entry of Table II. The relatively large decay widths found there, however, are mainly due to the theoretical resonance masses reproduced too large by the CQMs (cf. the values

TABLE I. Theoretical and experimental masses (in MeV) of the ground and resonance states considered in the decay calculations.

Baryon	J^P	Theory		Experiment [16]
		GBE	OGE	
N	$\frac{1}{2}^+$	939	939	938–940
$N(1440)$	$\frac{1}{2}^+$	1459	1577	1420–1470
$N(1520)$	$\frac{3}{2}^-$	1519	1521	1515–1525
$N(1535)$	$\frac{1}{2}^-$	1519	1521	1525–1545
$N(1650)$	$\frac{1}{2}^-$	1647	1690	1645–1670
$N(1675)$	$\frac{5}{2}^-$	1647	1690	1670–1680
$N(1700)$	$\frac{3}{2}^-$	1647	1690	1650–1750
$N(1710)$	$\frac{1}{2}^+$	1776	1859	1680–1740
Δ	$\frac{3}{2}^+$	1240	1231	1231–1233
$\Delta(1600)$	$\frac{3}{2}^+$	1718	1854	1550–1700
$\Delta(1620)$	$\frac{1}{2}^-$	1642	1621	1600–1660
$\Delta(1700)$	$\frac{3}{2}^-$	1642	1621	1670–1750
Λ	$\frac{1}{2}^+$	1136	1113	1116
$\Lambda(1405)$	$\frac{1}{2}^-$	1556	1628	1402–1410
$\Lambda(1520)$	$\frac{3}{2}^-$	1556	1628	1519–1521
$\Lambda(1600)$	$\frac{1}{2}^+$	1625	1747	1560–1700
$\Lambda(1670)$	$\frac{1}{2}^-$	1682	1734	1660–1680
$\Lambda(1690)$	$\frac{3}{2}^-$	1682	1734	1685–1695
$\Lambda(1800)$	$\frac{1}{2}^-$	1778	1844	1720–1850
$\Lambda(1810)$	$\frac{1}{2}^+$	1799	1957	1750–1850
$\Lambda(1830)$	$\frac{5}{2}^-$	1778	1844	1810–1830
Σ	$\frac{1}{2}^+$	1180	1213	1189–1197
$\Sigma(1660)$	$\frac{1}{2}^+$	1616	1845	1630–1690
$\Sigma(1670)$	$\frac{3}{2}^-$	1677	1732	1665–1685
$\Sigma(1750)$	$\frac{1}{2}^-$	1759	1784	1730–1800
$\Sigma(1775)$	$\frac{5}{2}^-$	1736	1829	1770–1780
$\Sigma(1880)$	$\frac{1}{2}^+$	1911	2049	1806–2025
$\Sigma(1940)$	$\frac{3}{2}^-$	1736	1829	1900–1950
Ξ	$\frac{1}{2}^+$	1348	1346	1315–1321
$\Xi(1820)$	$\frac{3}{2}^-$	1792	1894	1818–1828

quoted in Table I). The decay widths calculated with the experimental mass of 1520 MeV also remain below experiment.

The differences between the direct predictions of the GBE and OGE CQMs are caused by two effects, the different theoretical baryon masses and the different wave functions. In the calculations with experimental masses as input the former (mass) effect is wiped out in the comparison of the two CQMs. The corresponding results only reflect the variations in the CQM wave functions. While the general behavior of the decay widths is similar for both types of CQMs, we nevertheless find some differences from the dynamics in certain decay channels.

In the last two rows of Table II we also give the K decay widths of the $\Xi(1820)$ resonance. In view of a total width of about 24 MeV they are reported by the PDG [16] to be "large" and "small" for the ΛK and ΣK channels, respectively. The relative sizes of the corresponding partial decay widths are opposite in the theoretical CQM predictions. Only, in the case of the OGE CQM, when the theoretical mass is replaced by the experimental one, the K decay width of $\Xi(1820) \to \Lambda K$ becomes larger than the one of $\Xi(1820) \to \Sigma K$. This behavior, however, is only found for the relativistic PFSM and not in the nonrelativistic limit.

The CQM predictions for the decays with decreasing strangeness in the baryon shown in Table III are extremely small, practically vanishing; there, figures smaller than 0.1 MeV are quoted as approximately zero. However, there is one striking exception, namely, the decay $N(1710) \to \Sigma K$. Obviously, the corresponding results are dominated by the phase-space factor. When removing the effects from the theoretical masses, the decay widths are much reduced, even though a sensible effect remains to be evident from the wave function in the case of the OGE CQM. We note that the threshold for this K decay channel is rather close to the (central) mass value of the $N(1710)$ resonance. Consequently, this particular decay width is also expected to be rather small, as it can even vanish within the experimental bounds of the involved masses. With regard to the decays with decreasing strangeness in the baryon the PDG quotes data only for four channels. Unfortunately, the uncertainties are still rather large, and the present data could well allow for rather small phenomenological decay widths, in line with the tendency of our results.

In Tables II and III we also quote the nonrelativistic limit of our results; they correspond to the usual EEM. The reduction of the PFSM consists in neglecting the Lorentz boosts and a nonrelativistic expansion of the transition amplitude (for details see Ref. [2]). As has already been found before, this implies a truncation of certain spin-coupling terms, what may cause considerable effects in some decay channels. Similar findings are made with the K decays. The biggest changes are seen in the cases of $\Lambda(1670)$, $\Sigma(1750)$, and $\Sigma(1880)$ decays. While the PFSM results are practically vanishing, the nonrelativistic decay widths acquire respectable magnitudes. Sizable enhancements furthermore occur for the $J^P = \frac{3}{2}^-$ resonances. The nonrelativistic reduction also causes the predictions from the two CQMs to compare differently to each other than is observed in the relativistic PFSM results.

In the last columns of Tables II and III we quote for comparison results from K decay investigations by Feynman, Kislinger, and Ravndal [26] (FKR), Koniuk and Isgur [5] (KI), as well as Capstick and Roberts [15] (CR). While the first study is different in nature, the latter two are done with CQMs. The calculations by KI are essentially nonrelativistic using a decay operator of the EEM type. In the work of CR a relativistic OGE CQM

TABLE II. Covariant predictions by the GBE CQM [17] and the OGE CQM [14] for K decay widths with increasing strangeness in the baryon. Experimental data as reported by the PDG [16]. Both theoretical and experimental masses are used as input. In the last three columns a comparison is given to results by FKR [26], KI [5], as well as CR [15]. Regarding the FKR result for $\Lambda(1810)$ the $*$ indicates that this state was attributed a different intrinsic spin of $J^P = \frac{5}{2}^+$.

| Decay | J^P | Experiment [MeV] | With theoretical mass | | | | With experimental mass | | | | Literature | |
| | | | Relativistic | | Nonrelativistic EEM | | Relativistic | | Nonrelativistic EEM | | | |
			GBE	OGE	GBE	OGE	GBE	OGE	GBE	OGE	FKR	KI
$\rightarrow NK$												
$\Lambda(1520)$	$\frac{3}{2}^-$	$(7.02 \pm 0.16)^{+0.46}_{-0.44}$	12	24	23	63	6	5	13	19	7	9.0
$\Lambda(1600)$	$\frac{1}{2}^+$	$(33.75 \pm 11.25)^{+30}_{-15}$	15	35	4.1	23	14	21	3.8	11		29
$\Lambda(1670)$	$\frac{1}{2}^-$	$(8.75 \pm 1.75)^{+4.5}_{-2}$	0.3	≈ 0	45	86	0.4	0.4	45	76	415	11
$\Lambda(1690)$	$\frac{3}{2}^-$	$(15 \pm 3)^{+3}_{-2}$	1.2	1.0	4.2	6.5	1.2	0.8	4.5	4.7	102	15
$\Lambda(1800)$	$\frac{1}{2}^-$	$(97.5 \pm 22.5)^{+40}_{-25}$	4.2	6.4	3.1	8.6	4.5	5.5	3.3	7.4		8.4
$\Lambda(1810)$	$\frac{1}{2}^+$	$(52.5 \pm 22.5)^{+50}_{-20}$	4.1	12	23	44	4.8	2.2	24	31	35*	33
$\Lambda(1830)$	$\frac{5}{2}^-$	$(6.18 \pm 3.33)^{+1.05}_{-1.05}$	0.1	0.9	0.1	0.1	1.2	0.5	0.2	0.1	0	2.3
$\Sigma(1660)$	$\frac{1}{2}^+$	$(20 \pm 10)^{+30}_{-6}$	0.9	0.9	0.4	≈ 0	1.2	0.5	0.5	0.02		1.4
$\Sigma(1670)$	$\frac{3}{2}^-$	$(6.0 \pm 1.8)^{+2.6}_{-1.4}$	1.1	1.0	1.9	2.0	1.1	0.6	1.8	1.3	3	4.4
$\Sigma(1750)$	$\frac{1}{2}^-$	$(22.5 \pm 13.5)^{+28}_{-3}$	≈ 0	1.4	10	48	≈ 0	0.8	10	45	14	17
$\Sigma(1775)$	$\frac{5}{2}^-$	$(48.0 \pm 3.6)^{+6.5}_{-5.6}$	11	15	20	41	13	12	26	30	66	45
$\Sigma(1880)$	$\frac{1}{2}^+$		≈ 0	≈ 0	5.4	13	≈ 0	0.1	5.1	8.1		3.2
$\Sigma(1940)$	$\frac{3}{2}^-$	$(22 \pm 22)^{+16}$	1.1	1.5	3.3	6.8	2.3	2.1	10	12		19
$\rightarrow \Lambda K$												
$\Xi(1820)$	$\frac{3}{2}^-$	large	2.7	6.2	6	4.5	3.5	19	10	11	15	
$\rightarrow \Sigma K$												
$\Xi(1820)$	$\frac{3}{2}^-$	small	4.1	9.3	10	31	5.1	4.7	12	17	17	

was employed and the decay operator was taken according to the $^3P_0$ model. In both of the latter works additional parametrizations of the decay amplitudes were introduced to explore a possible fitting of the data. Consequently, it is

not surprising that in most cases an obvious agreement with experimental data is reached.

Some useful insights can be gained from the comparison with the FKR results even though much care has to be

TABLE III. Same as Table II but for K decays with decreasing strangeness in the baryon.

| Decay | J^P | Experiment [MeV] | With theoretical mass | | | | With experimental mass | | | | Literature | | |
| | | | Relativistic | | Nonrelativistic EEM | | Relativistic | | Nonrelativistic EEM | | | | |
			GBE	OGE	GBE	OGE	GBE	OGE	GBE	OGE	FKR	KI	CR
$\rightarrow \Lambda K$													
$N(1650)$	$\frac{1}{2}^-$	$(11.6 \pm 6.6)^{+2.2}_{-0.6}$	≈ 0	0.1	≈ 0	0.1	0.1	≈ 0	0.1	≈ 0	0	9	27
$N(1675)$	$\frac{5}{2}^-$	<1.7	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0	0	0.01	0
$N(1700)$	$\frac{3}{2}^-$	$(1.5 \pm 1.5)^{+1.5}$	≈ 0	0.1	≈ 0	≈ 0	0.1	0.1	≈ 0	≈ 0		0.04	0.16
$N(1710)$	$\frac{1}{2}^+$	$(15 \pm 10)^{+37.5}_{-2.5}$	≈ 0	≈ 0	0.1	≈ 0	≈ 0	≈ 0	≈ 0	≈ 0		4.4	7.8
$\rightarrow \Sigma K$													
$N(1700)$	$\frac{3}{2}^-$						≈ 0	≈ 0	≈ 0	0.1		small	0
$N(1710)$	$\frac{1}{2}^+$		3.9	389	2.8	739	0.4	27	0.3	42		0.16	0.01
$\Delta(1700)$	$\frac{3}{2}^-$						≈ 0	≈ 0	≈ 0	0.1		0.16	0.01
$\rightarrow \Xi K$													
$\Lambda(1830)$	$\frac{5}{2}^-$			≈ 0		≈ 0	≈ 0	≈ 0	0.1	0.5			
$\Sigma(1880)$	$\frac{1}{2}^+$		0.1	0.1	≈ 0	≈ 0	0.1	0.2	≈ 0	≈ 0			
$\Sigma(1940)$	$\frac{3}{2}^-$						≈ 0	≈ 0	≈ 0	≈ 0			

taken. The *K* decay widths reported by FKR are generally also rather small with the exception of a few cases. Notable are the extremely large decay widths of $\Lambda(1670)$ and $\Lambda(1690)$ going to *NK*. Both of these results were questioned already by the authors themselves and for the $\Lambda(1670)$ a delicate cancellation among spin-coupling terms was observed. We find a similar behavior in this decay channel. In the fully relativistic PFSM calculation there occurs a nearly complete cancellation of spin-coupling terms, while the truncation in the EEM case picks up large contributions from terms surviving the nonrelativistic reduction. On the other hand, FKR have not seen a similar reason in case of $\Lambda(1690)$. This is again congruent with our observation that effects of truncated spin-coupling terms are not prevailing in this channel. Regarding the FKR result reported for $\Lambda(1810)$ one should note that FKR attributed a J^P different from the established $\frac{1}{2}^+$. Therefore this entry must be considered as obsolete. For the *K* decays with decreasing strangeness in the baryon (Table III) FKR give two zero results quite similar to the extremely small (almost vanishing) predictions we get.

IV. SUMMARY AND CONCLUSIONS

We have presented first covariant results for strange decays of baryon resonances in the quark-model approach. In particular, we have given predictions of the relativistic GBE and OGE CQMs of Refs. [14,17], respectively, for *K* decay widths calculated with the PFSM transition operator. It has been found that the theoretical results obtained in this approach generally underestimate the existing experimental data and are thus in line with the findings made in preceding calculations of π and η decays [1,2]. As has become evident by the comparison to the nonrelativistic limit of the PFSM, which leads to the EEM often used in previous investigations, relativistic effects play a decisive role. Boost effects and all relativistic spin-coupling terms especially have to be included in order to arrive at reliable theoretical results.

When comparing the class of *K* decays with increasing strangeness in the baryon to the one with decreasing strangeness, one observes a striking distinction. All decay widths of the latter turn out to be extremely small and may basically be considered as zero. In any case, sizable *K* decay widths are only found when the strangeness increases from the decaying resonance to the final baryon.

In general, the CQMs with two different kinds of dynamics lead to congruent results. In a majority of cases the predictions of the GBE and OGE CQMs produce rather

similar predictions, at least when effects from different theoretical resonance masses are removed, i.e., in the calculations with experimental masses used as input. In some cases, however, also noticeable influences from different CQM wave functions are found. Striking examples are the $\Lambda(1810) \rightarrow NK$ or the $\Xi(1820) \rightarrow \Lambda K$ decays. Of particular interest may also be the $N(1710) \rightarrow \Sigma K$ decay, since the magnitude of the corresponding decay width is largely governed by threshold effects. It might be advised to focus the attention of future experiments to such decay channels with a sensible dependence on different quark-quark dynamics.

In summary quite a consistent picture emerges for both the strange and nonstrange decays. From the present approach one obtains CQM predictions for decay widths that remain in general smaller than the experimentally measured ones. In some cases the experimental data are at most reached from below. These observations apply to all of our results for π, η, and *K* decays of nonstrange and strange baryons considered so far along the relativistic PFSM. By finding essentially all decay widths being too small a consistent deficiency becomes apparent that resides either in the underlying CQMs and/or in the applied decay mechanism. As a consequence one may not yet explain the phenomenology of the mesonic decays of baryon resonances following the present approach. Still, we consider establishing these results to be necessary benchmarks for future studies. As we have not introduced any additional parametrizations beyond the direct CQM predictions, they provide a fundamental basis for further refinements. As a most promising approach we consider the inclusion of additional mesonic degrees of freedom directly on the baryon level (e.g., similar to the method developed in Ref. [27]). In particular, one could include effects relating to final-state interactions. For the improvement of the decay operator a number of ways are possible to go beyond the current spectator model. For example, one could take into account different quark-meson couplings and/or extended meson wave functions. More involved would be the construction of a relativistic decay operator with explicit many-body contributions.

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