EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

CERN/EP 82-101
15 July 1982

A PARTIAL WAVE ANALYSIS OF THE ($K\pi\pi$) SYSTEM IN THE REACTION

$\pi^- p \rightarrow (K^+ \pi^- \pi^0) \Lambda$ AT 3.95 GeV/c

CERN-Collège de France-Madrid-Stockholm Collaboration

C. Fernández, M. Aguilar-Benítez, M. Cerrada, J.A. Garzón, J.A. Rubio and
José Salicio
Junta de Energia Nuclear, Madrid, Spain*

R. Armenteros, C. Dionisi**, Ph. Gavillet, P.F. Loverre** and
M. Mazzucato***
CERN, European Organization for Nuclear Research, Geneva, Switzerland

L. Dobrzynski and D. Pennino**
Collège de France, Paris, France

I. Sjögren, S. Rodebäck and S.O. Holmgren
Department of Physics, University of Stockholm, Stockholm, Sweden

ABSTRACT

Results from a partial wave analysis of the $K\pi\pi$ system produced in the hypercharge exchange reaction $\pi^- p \rightarrow (K^+ \pi^- \pi^0) \Lambda$ at 3.95 GeV/c are presented. Significant Q_1 production is observed but no evidence is found for Q_2 production thus confirming the results obtained in a previous decay Dalitz plot analysis of the same reaction. The relative phase behaviour of the $1^+(K\rho)$ partial waves obtained with the present analysis provides additional confirmation of the resonance interpretation of the Q_1 enhancement. Information is also obtained about its production properties and the role played by the Λ polarization in the hypercharge exchange reaction. This is compared with the results obtained in the reaction $K^- p \rightarrow (\pi^+ \pi^- \pi^0) \Lambda$ at 4 GeV/c.

Submitted to Zeitschrift für Physik C

* Work partially supported by the Comisión Asesora Científica y Técnica del Ministerio de Universidades e Investigación.

** Now at the University of Rome, Italy.

*** Now at the University of Padova, Italy.

1. INTRODUCTION

In an earlier publication [1], the results of an analysis of the reactions

$$\pi^- p \rightarrow K^+ \pi^- \pi^0 \Lambda \quad (1)$$

and

$$\pi^- p \rightarrow K^0 \pi^+ \pi^- \Lambda \quad (2)$$

at an incident momentum of 3.95 GeV/c were given. The severe cuts made to obtain a clean sample of reaction (2) did not allow its use to study the J^{PC} composition of the $(K\pi\pi)$ system. This study was made with reaction (1). The production of the $J^{PC} = 1^{++}$ Q_1 -meson was clearly observed through its $K\rho$ decay mode but no evidence was seen for any Q_2 -meson decay.

These results were obtained from a Dalitz plot analysis (DPA) of the $(K^+\pi^-\pi^0)$ system produced with $t \leq 1.2 \text{ GeV}^2$, t being the squared four momentum transferred from the π^- to the $(K^+\pi^-\pi^0)$ system. This method of analysis, which is described in detail in ref. [2], studies the spin-parity contents of a 3-body system without requiring the knowledge of how it was produced.

As it is well known, the observable states Q_1 and Q_2 are supposed to result from the mixing of SU(3) states $Q_A(J^{PC} = 1^{++})$ and $Q_B(1^{+-})$ through their common accessible decay channels $K^*\pi$ and $K\rho$. Although it has been established that both Q_1 and Q_2 are observed in diffractive reactions [3,4], and that in non-diffractive processes either the Q_1 or the Q_2 are observed, never both [1,5,6,7], there is as yet no firm theoretical explanation of these observations. It has been suggested, e.g. by Irving [8], that the Q 's mixing properties could depend not only on their invariant pole position and decay couplings but also on their production amplitudes. The investigation of the Q 's production mechanism is therefore of importance. To do this we have reconsidered the data of [1] using a Partial Wave Analysis (PWA) very similar to that developed by Wagner [9]. With such a method the contributions of different $(K\pi\pi)$ helicity states to a given spin parity can be measured, thus making possible to separate natural and unnatural parity exchanges. In addition to that, the determination of complex density matrix elements gives information on relative phases between production amplitudes. Furthermore, the method can

use the extra information provided by the weak decay of the Λ . In the case of ideal statistics the PWA method would allow to determine all production amplitudes up to two phases.

In this paper we present the results obtained in reaction (1) when using the PWA method. Basically they confirm the previous findings of ref. [1]. In addition, the resonant nature of the Q_1 effect is supported by the relative phase behaviour and its production properties are obtained. The role played by the Λ polarization in reaction (1) is discussed and compared with the results obtained in ref. [11] for the reaction

$$K^- p \rightarrow (\pi^+ \pi^- \pi^0) \Lambda \quad (3)$$

The plan of the paper is as follows: a brief description of experimental details and of the data used in the analysis is made in sect. 2. Sect. 3 deals with the partial wave analysis method and the assumptions involved. In sect. 4 we present the results and in sect. 5 the conclusions.

2. EXPERIMENTAL DETAILS AND DATA

The data come from a high statistics (~ 90 events/ μb) bubble chamber experiment. A total of 1,800,00 pictures were taken, at different periods, in the CERN 2m hydrogen bubble chamber. The π^- beam had an average incident momentum of 3.95 GeV/c. Events with at least a visible strange particle, either neutral (V^0) or charged ($V^\pm$), coming from the main interaction vertex, were selected, measured and processed through the standard geometrical and kinematical reconstruction chain of programs. The problem of kinematical ambiguities affecting the reaction of interest has been described in ref. [1]. More details concerning data selection and resolution of ambiguities can be found in ref. [10]. The final number of events used in the analysis and the corresponding number after weighting for detection losses are

$$\pi^- p \rightarrow K^+ \pi^- \pi^0 \Lambda \quad 5052 \text{ events (5450 weighted events)}$$

The number of events lost in the data selection process has been estimated to be $\leq 3.6\%$ and the contamination from other channels $\leq 7.4\%$ (at the 95% confidence level).

A partial wave analysis requires to bin the events in small t - intervals. Statistical reasons forced us to consider them only in the region

$$t_{\min} \leq |t| \leq 1.2 \text{ GeV}^2$$

A total of 2763 events (corresponding to 2974 weighted events) remained after this cut.

For these events we show in fig. 1 the $\Lambda\pi$ effective mass distributions; strong production of $\Sigma^0(1385)$ can be observed. A small signal corresponding to $\Sigma^-(1385)$ is also visible. The lines in fig. 1 indicate the cuts applied to the data to remove the unwanted contribution of the $\Sigma^0(1385)$.

After all cuts 1653 events remained for further analysis, corresponding to 1785 weighted events. We show the $K\pi\pi$ mass distributions in fig. 2, where a narrow enhancement around 1.3 GeV can be seen.

This peak has been associated with the Q_1 resonance in the analysis of ref. [1], where a fit to the mass spectrum provided the following parameters:

$$M_{Q_1} = 1294 \pm 10 \text{ MeV}$$

$$\Gamma_{Q_1} = 66 \pm 15 \text{ MeV}$$

3. THE METHOD OF ANALYSIS

The most complete and detailed description of the method used in this analysis can be found in ref. [10]. Here we will only recall the main guidelines which can also be found in the similar analysis performed to reaction (2) in ref. [11].

The differential cross section of reaction (1) can be expressed in the following way (see also ref. [9]):

$$\frac{d\sigma}{dt} = \sum_{\substack{K\pi s \\ K\pi s}} [D_{K\pi}(\tau_m) T_s^{K\pi}(\tau_p)] A_{\pi\pi}^{ss}(\hat{p}) [T_s^{K\pi}(\tau_p) D_{K\pi}(\tau_m)]^* \quad (4)$$

where $d\tau = d\tau_p d\tau_m d\hat{p}$ denotes the phase-space element consisting of three parts. The production part is $\tau_p = (m_{K\pi\pi}, t)$, $m_{K\pi\pi}$ and t being the $(K\pi\pi)$ effective mass and the four momentum transfer squared from the proton target to the outgoing Λ respectively. The meson decay part, $\tau_m = (\alpha, \beta, \gamma, \theta, \omega)$, consists of three Euler angles α, β, γ describing the orientation of a frame where the $K\pi\pi$ system is at rest with respect to the t -channel helicity frame, and the variables θ, ω which describe the quasi-two-body decay: ω is the mass of the dimeson system (or isobar) and θ is the angle, in the dimeson rest frame, of one of the mesons forming the isobar with respect to the direction of the third meson. The Λ decay part is described by using $\hat{p}$, the unit vector of the decay proton in the Λ rest frame.

The index K in expression (4) abbreviates the following quantum numbers: J^P spin parity of the $K\pi\pi$ system, M absolute value of the third component of J in the t -channel helicity frame, isobar considered, and L orbital momentum between the isobar and the third meson in the quasi-two body decay picture. The index $\eta = \pm 1$ is related to natural/unnatural parity exchange and $s = \pm 1$ refers to the spin non flip/flip amplitudes at the baryon vertex.

The amplitudes $T_s^{K\eta}$ are the parameters to be determined in the fit. From them one can calculate the density matrix element $\rho_\eta^{KK'}$ in the following way:

$$\rho_\eta^{KK'} = \sum_s T_s^{K\eta} T_s^{K'\eta*} \quad (5)$$

The functions $D^{K\eta}$ are well known and can be explicitly found in ref. [9]. They describe the τ_m dependence of the quasi-two-body decay of the $K\pi\pi$ system. The A matrix depends on $\hat{p}$ and contains the information from the Λ polarization. Its explicit form depends on the amplitudes used. In our case we have used transversity amplitudes to describe the baryon vertex and the A values for different $\eta, \pi, s, \bar{s}$ are given in table 1. For a given partial wave $K\eta$ the Λ polarization can be obtained from the expression

$$P_\Lambda = |T_{s=-1}^{K\eta}|^2 - |T_{s=+1}^{K\eta}|^2 \quad (6)$$

The unknown amplitudes T in eq. (5) are determined from the data by using an extended maximum likelihood method [12]. The likelihood function is given by

$$\log L = \sum_{\text{events}} \log \sigma_i(\tau_i, T) - \int d\tau \sigma(\tau, T) A(\tau) \quad (7)$$

where the sum runs over all real events. The integral is calculated using Monte-Carlo generated events and contains an acceptance function $A(\tau)$ which includes the kinematical selections and cuts applied to the data used in the analysis. Typically we generated ~ 30 Monte-Carlo events per real event.

The $K\pi\pi$ mass bins used in the analysis are listed in table 2. Fits were performed independently in each bin. Given the low statistical level of our sample, a small number of partial waves was initially considered. New waves were added one by one and included in the final set if a significant improvement of the likelihood value was obtained. Partial waves with very small intensity in the whole $K\pi\pi$ mass range were finally dropped. A comment is in order for the special case of the partial wave $1^{+}OD(K^{*}\pi)$. When this wave is included in the fit (as it was done in ref. [1] together with $1^{+}OS(K^{*}\pi)$), there are big interference effects between both waves, mainly in the high mass region. However the total $1^{+}O(K^{*}\pi)$ contribution, as well as the contribution from other partial waves, and main features of the results are very similar to the values obtained when only one of the two waves is included in the fit. We have excluded the $1^{+}OD$ wave since the likelihood values from the fits with $1^{+}OS$ alone are better than the ones from fits with $1^{+}OD$ only. The final set of waves thus required can be found in table 3.

Different random starting values for the amplitudes in the fit were used in order to check the stability of the results. Although some independent amplitude values could vary from fit to fit, it turned out that partial wave cross sections summed over s were reasonably stable. We cannot claim that the set of waves we used and the solutions obtained are unique. However, the results we present in the next section are a common feature of all reasonable fits performed.

4. RESULTS OF THE PWA

4.1 General features

In fig. 3 we show the spin parity content of the $(K\pi\pi)$ system in reaction (1). Three spin parities 0^- , 1^+ , 2^+ are sufficient to describe well the data. We have also tried several $J^P = 2^-$ partial waves; in all cases their contribution turned out to be negligible. Fig. 3 shows that the $K\pi\pi$ system at low masses is dominated by $J^P = 1^+$ production. Before discussing the 1^+ waves in detail, we will mention some general features of the 0^- and 2^+ contributions.

The $J^P = 0^-$ total intensity behaves rather smoothly and increases with $K\pi\pi$ mass. The most important contribution to the 0^- total intensity comes from the $0^-S(K\pi)$ partial wave. Since this wave is the most phase-space-like amplitude, a genuine 0^- contribution has to be considered with caution. It is a well known fact in this kind of analyses that these amplitudes play a role of "garbage collectors", mainly when low statistics are available and not many partial waves can be considered. Such an interpretation is also supported by the fact that these 0^- amplitudes prefer to be rather incoherent with respect to the rest of the partial waves. Unfortunately this incoherent behaviour prevents their use as a reference for phase variations.

The 2^+ intensity has a maximum in the region of the $K^*(1430)$. The curve superimposed in fig. 3(c), is a Breit-Wigner function with the accepted values of mass and width [13]. For the ratio of natural to unnatural parity exchange production we obtain

$$R = \frac{\sigma(\eta = +)}{\sigma(\eta = -)} = 0.8 \pm 0.3$$

This ratio is very similar to that obtained for A_2 production in the hypercharge exchange reaction $K^- \rightarrow A_2^0 \Lambda$ at roughly the same energy: $R_{A_2} = 0.7 \pm 0.2$ [11].

A further test has been performed by including in a few bins in the $K^*(1430)$ region the partial waves $2^+D(K\rho)$. Then we have measured the branching ratio

$$B = \frac{K^*(1430) \rightarrow K\rho}{K^*(1430) \rightarrow K^*\pi} = 0.20 \pm 0.05$$

The errors obtained are large but the central value is in good agreement with the PDG values [13].

4.2 The 1^+ waves - Q_1 production

In fig. 4 we show the contribution to the total $J^P = 1^+$ intensity in reaction (1) of the K^* and ρ isobars separately. Their shape is quite different: the former is rather structureless whereas the latter exhibits a pronounced enhancement around 1.3 GeV. The superimposed curve in fig. 4(b) describes the results of a fit including a Breit-Wigner for the Q_1 plus an incoherent polynomial background. The values for the mass and width of the Q_1 were fixed at those obtained in the fit from ref. [1]: $M = 1294$ MeV, $\Gamma = 66$ MeV. We obtained

$$\text{No. of } Q_1 \text{ events} = 316 \pm 39$$

in good agreement with the results from ref. [1]. The Q_1 peak appears in all $1^+(K\rho)$ partial waves: $M = 0 \eta = +$, $M = 1 \eta = +$ and $M = 1 \eta = -$ (see fig. 5). Q_1 production proceeds mainly by natural parity exchange

$$\frac{\sigma(\eta = 1)}{\sigma(Q_1)} \lesssim 20\%$$

On the other hand, $M = 1$ production is very important.

$$\frac{\sigma(M = -)}{\sigma(Q_1)} \sim 50\%$$

A substantial $M = 1$ component has also been measured in diffractive production [3,4].

As mentioned earlier, it is very important to measure relative phase variations. Unfortunately there is only one reference wave which is reasonably stable and significant over the whole $K\pi\pi$ mass range: $1^+OS(K^*\pi)$. The relative phase between the two amplitudes ($1^+OS(K\rho) - 1^+OS(K^*\pi)$) has played an important role in disentangling the Q_1 , Q_2 parameters in diffractive production. It is shown in fig. 6 for the reaction $AK^+\pi^-\pi^0$. The superimposed curve is not a fit. It just shows the Breit-Wigner shape expected for a Q_1 resonance of mass 1294 MeV and width 66 MeV on the assumption that the phase of the $1^+OS(K^*\pi)$ amplitude is constant.

We have checked that there is continuity in the phase variation by redoing the analysis with a different binning. The new results (not shown) again follow closely the Breit-Wigner pattern. This together with the shape of the intensity distribution indicates strongly the resonant character of the $1^+S(K\rho)$ partial wave. At the same time the result provides further evidence for the lack of structure in the $1^+S(K^*\pi)$ amplitude, i.e significant Q_2 production is excluded.

4.3 Λ polarization

The Λ polarization of individual partial waves as defined in eq. (6) suffers from ambiguities and also from large fluctuations in most of the waves. However, the total Λ polarization of reaction (1) turns out to be relatively well determined. It is shown in fig. 7 as a function of the $K\pi\pi$ mass.

In spite of the large errors, it is interesting to compare it qualitatively with the Λ polarization obtained in the related reaction $K^- \rightarrow \Lambda(\pi^+\pi^-\pi^0)$ (see fig. 18 of ref. [11]). In the K^- reaction P_Λ is small and positive, becoming more important in the region 1.2-1.3 GeV where the A_1 and A_2 resonances are produced. In our reaction P_Λ is small and negative, and the two bins where it is significantly different from 0 correspond to the Q_1 resonance region. To investigate further a possible relation between the total Λ polarization and Q_1 production, we have calculated the average Λ polarization of all $1^+(K\rho)$ partial waves in these two bins. This would correspond to the Λ polarization of the reaction $\pi^-p \rightarrow Q_1\Lambda$. We have obtained the following result:

$$P_\Lambda(Q_1) = -0.5 \pm 0.2$$

Comparing the Λ polarization in the π^-p and K^-p reactions there appears to exist a strong similarity in the shape of the Λ polarization, although they have opposite signs.

Given the poor statistical significance of our data we cannot make a detailed study. However, this pattern agrees well with the observations made about reactions dominated by natural parity exchange at this energy e.g. $K^-p \rightarrow \phi\Lambda$, $\omega\Lambda$, $\rho\Lambda$ [14] or $\pi^-p \rightarrow K^*\Lambda$ [15]. According to them, the

reactions corresponding to planar quark diagrams lead to negative polarization of the Λ while those corresponding to non-planar quark diagrams have similar size and shape but positive sign for their Λ polarization. Recent theoretical ideas [16] attempt to explain these features from first principles.

5. CONCLUSIONS

We have performed a partial wave analysis of the $(K\pi\pi)^0$ system produced by hypercharge exchange in the reaction $\pi^-p \rightarrow (K^+\pi^-\pi^0)\Lambda$ at 3.95 GeV/c. Significant Q_1 production has been found. This confirms the results from a previous analysis [1].

The measurement of the relative phase between the two main partial wave amplitudes ($1^{+OS}(K\rho) - 1^{+OS}(K^*\pi)$) has allowed us to confirm the resonant nature of the Q_1 signal. These results exclude significant Q_2 production. Q_1 production proceeds mainly by natural parity exchange and has a strong t-channel helicity flip component.

$K^*(1430)$ production proceeds by both natural and unnatural parity exchange, with a ratio very similar to the one measured for A_2 production in the reaction $K^-p \rightarrow A_2\Lambda$.

The Λ polarization has been found to be important in the reaction $\pi^-p \rightarrow Q_1\Lambda$. We have measured $P_\Lambda(Q_1) = -0.5 \pm 0.2$. The shape of the total polarization as a function of $K\pi\pi$ mass is very similar to that measured in the related reaction $K^-p \rightarrow (\pi^+\pi^-\pi^0)\Lambda$ but has the opposite sign.

REFERENCES

- [1] S. Rodebäck et al., Z. Phys. C9 (1981) 9.
- [2] J.A. Rubio, Ph. D. Thesis (Madrid) 1973;
P. Gavillet, Ph. D. Thesis Orsay (Paris) 1979.
- [3] C.W. Brandenburg et al., Phys. Rev. Lett. 36 (1976) 703, Nucl. Phys. B127 (1977) 509.
- [4] C. Daum et al., Nucl. Phys. B187 (1981) 1.
- [5] W. Beusch et al., Phys. Lett. 74B (1978) 282.
- [6] R. Armenteros et al., Phys. Lett. B9 (1964) 207.
- [7] Ph. Gavillet et al., Phys. Lett. 76B (1978) 517.
- [8] A.C. Irving, J. Phys. G., Nucl. Phys. 6 (1980) 153.
- [9] F. Wagner, Nucl. Phys. B111 (1976) 67.
- [10] C. Fernández, Ph. D. Thesis (Madrid) 1981.
- [11] M. Cerrada et al., Nucl. Phys. B126 (1977) 241.
- [12] J. Orear, UCRL - 8417 (1958).
- [13] Particle Data Group, Rev. Mod. Phys., vol. 52, No. 2, 1980.
- [14] M.J. Losty et al., Nucl. Phys. B133 (1978) 38.
- [15] M. Aguilar-Benítez et al., Z. Phys. C6 (1980) 195.
- [16] B. Andersson et al., Phys. Lett. 85B (1979) 417;
T.A. Grand and H.I. Miettinen, Phys. Rev. D23 (1981) 1227.

TABLE CAPTIONS

Table 1 $A_{\eta\bar{\eta}}^{S\bar{S}}$ matrix elements.

Table 2 $K\pi\pi$ mass bins used in the partial wave analysis of the reaction
 $\pi^-p \rightarrow \Lambda K^+\pi^-\pi^0$.

Table 3 Final set of waves used in the partial wave analysis of the
reaction $\pi^-p \rightarrow \Lambda K^+\pi^-\pi^0$.

TABLE 1

$$A_{\eta\bar{\eta}}^{ss} = \begin{pmatrix} \begin{array}{cc|cc} \overbrace{\bar{\eta} = +} & & \overbrace{\bar{\eta} = -} & \\ \bar{s} = + & \bar{s} = - & \bar{s} = + & \bar{s} = 1 \\ 1 - \alpha P_y & 0 & 0 & \alpha P_z + i\alpha P_x \\ 0 & 1 + \alpha P_y & \alpha P_z - i\alpha P_x & 0 \\ \hline 0 & \alpha P_z + i\alpha P_x & 1 - \alpha P_y & 0 \\ \alpha P_z - i\alpha P_s & 0 & 0 & 1 + \alpha P_y \end{array} & \left. \begin{array}{l} s = + \\ s = - \end{array} \right\} \eta = + \\ \left. \begin{array}{l} s = + \\ s = - \end{array} \right\} \eta = - \end{pmatrix}$$

TABLE 2

Interval (GeV)		Number of events (weighted)
0.90	1.07	45
1.07	1.15	100
1.15	1.23	176
1.23	1.31	354
1.31	1.39	311
1.39	1.47	319
1.47	1.55	226
1.55	1.65	254

TABLE 3

$\Lambda K^0 \pi^+ \pi^-$ final state
0 - OS($\kappa\pi$) ⁺
1 + OS(K [*] π) ⁺
1 + OS(Kρ) ⁺
1 + 1S(Kρ) ⁺
1 + 1S(K [*] π) ⁻
1 + 1S(Kρ) ⁻
2 + OD(K [*] π) ⁻
2 + 1D(K [*] π) ⁺

FIGURE CAPTIONS

- Fig. 1 $\Lambda\pi^0$ and $\Lambda\pi^-$ mass distributions selecting the events with $t < 1.2 \text{ GeV}^2$.
- Fig. 2 $K\pi\pi$ mass distribution selecting the events with $t < 1.2 \text{ GeV}^2$ and after removing $\Sigma^-(1385)$.
- Fig. 3 Spin-parity content of $(K\pi\pi)$ system.
- Fig. 4 Contribution to the total $J^P = 1^+$ intensity from the K^* and ρ isobars.
- Fig. 5. Contributions to the total $J^P = 1^+$ intensity from the different $J_{M\eta}^P$ partial waves with a ρ isobar.
- Fig. 6 Relative phase between the $1 + OS(K\rho)$ and $1 + OS(K^*\pi)$ amplitudes.
- Fig. 7 Total Λ polarization as a function of the $K\pi\pi$ mass.

$$\pi^- p \rightarrow \Lambda \kappa^+ \pi^- \pi^0$$

FIG. 1

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

FIG. 2

$\pi^- \rho^- \rightarrow \Lambda \ K^+ \pi^- \pi^0$

$M(K\pi\pi) \text{ (GeV)}$

FIG. 3

$$\pi^- \rho^- \rightarrow \Lambda^0 \kappa^+ \pi^- \pi^0$$

$$J^P(\text{ISOBAR}) = 1^+ (\kappa^*)$$

$$J^P(\text{ISOBAR}) = 1^+ (\rho)$$

FIG. 4

$J^P M \eta(\kappa)$ PARTIAL WAVES $\pi^- p \rightarrow \Lambda^0 K^+ \pi^- \pi^0$

$M(K\pi\pi)$ GeV

FIG. 5

$$\pi^- \rho \rightarrow \Lambda^0 K^+ \pi^- \pi^0$$

RELATIVE PHASE

$$1^+0S(K\rho) - 1^+0S(K^*\pi)$$

FIG. 6

Λ POLARIZATION

$$\pi^- \rho \rightarrow \Lambda^0 \kappa^+ \pi^- \pi^0$$

FIG. 7

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.

10. 10. 10. 10. 10.