

OBSERVATION OF REGGE-POLE EFFECTS IN  $\rho^0\Delta^{++}$  AND  $\omega^0\Delta^{++}$  PRODUCTION AT 3.7 GeV/c†G. S. Abrams, K. W. J. Barnham, W. R. Butler,\* D. G. Coyne, G. Goldhaber,  
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Evidence is presented for zeros in the  $\pi$ -exchange contribution to  $\rho^0\Delta^{++}$  and in the  $\rho$ -exchange contribution to  $\omega^0\Delta^{++}$  production. The position of the  $\pi$ -exchange zero is consistent with a  $\pi$  trajectory with  $\alpha_{\pi'}(0) \approx 1.2$  (GeV/c) $^{-2}$ . Evidence is also presented suggesting that the  $A_2$  chooses the Gell-Mann mechanism (nonsense choosing). A model of  $\pi$  exchange with exact  $\pi$ - $B$  exchange degeneracy is found to describe the data quantitatively.

A detailed study of  $\rho^0\Delta^{++}$  and  $\omega^0\Delta^{++}$  production has been made at 3.7 GeV/c. The data are found to strongly favor simple models with Reggeon exchange.

This analysis is based on data from an exposure of the Lawrence Radiation Laboratory 72-in. hydrogen bubble chamber to a  $\pi^+$  beam at 3.7 GeV/c. The data sample was described earlier.<sup>1</sup> The cross sections for the observed final states are<sup>2</sup>

$$\sigma(\pi^+p \rightarrow p\pi^+\pi^+\pi^-) = 3.52 \pm 0.10 \text{ mb}, \quad (1)$$

$$\sigma(\pi^+p \rightarrow p\pi^+\pi^+\pi^-\pi^0) = 3.62 \pm 0.10 \text{ mb}. \quad (2)$$

The cross sections for the double-resonance reactions, corrected for nonresonant background and for unseen decay modes, are<sup>3</sup>  $\sigma(\pi^+p \rightarrow \rho^0\Delta^{++}) = 0.90 \pm 0.10$  mb and  $\sigma(\pi^+p \rightarrow \omega^0\Delta^{++}) = 0.66 \pm 0.08$  mb, where the errors include a possible systematic misestimation of background (these errors are not included in the errors shown in Figs. 1 or 4).

The differential cross section for  $\rho\Delta$  produc-

tion [Fig. 1(a)] [we use the variable  $t' = t - t_{\min} \approx t + 0.075$  (GeV/c) $^2$ ] is more sharply peaked than the  $\omega\Delta$  distribution [Fig. 1(b)]. While the  $\rho\Delta$  data can be fitted by the simple functional form of the sum of two exponentials, with slopes  $13.0 \pm 0.5$  and  $2.4 \pm 0.5$  (GeV/c) $^{-2}$  for  $|t'| < 0.2$  and  $0.4 < |t'| < 1.0$  (GeV/c) $^2$ , respectively, the  $\omega\Delta$  data appear more complicated. Significant dips are seen in  $d\sigma/d|t'|$  for  $\omega\Delta$  near  $|t'| = 0$  and  $0.15$  (GeV/c) $^2$ . For  $|t'| > 0.2$  (GeV/c) $^2$ , the  $\omega\Delta$  data are consistent with an exponential falloff with slope  $4.02 \pm 0.20$  (GeV/c) $^{-2}$ .

In Figs. 2 and 3 we present the  $\rho\Delta$  and  $\omega\Delta$  density-matrix elements in the  $t$ -channel coordinate system.<sup>4</sup> [For these figures, the resonant events are selected by the criteria:  $\Delta^{++}$ ,  $1160 \leq M(p\pi^+) \leq 1280$ ;  $\rho^0$ ,  $680 \leq M(\pi^+\pi^-) \leq 860$ ; and  $\omega^0$ ,  $763 \leq M(\pi^+\pi^-\pi^0) \leq 803$  (MeV/c) $^2$ .] The  $|t'|$  dependence of the matrix elements has also been measured for background events (not shown), and indicates no sharp features such as are discussed below

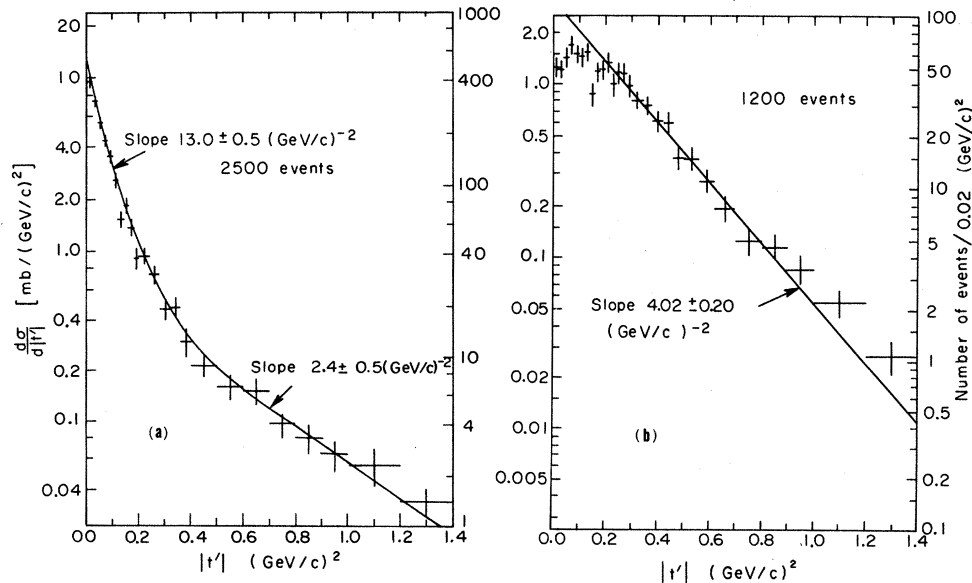


FIG. 1. Differential cross sections for vector-meson and  $\Delta^{++}$  production, corrected for nonresonant background. (a)  $\pi^+p \rightarrow \rho^0\Delta^{++}$ , (b)  $\pi^+p \rightarrow \omega^0\Delta^{++}$ .

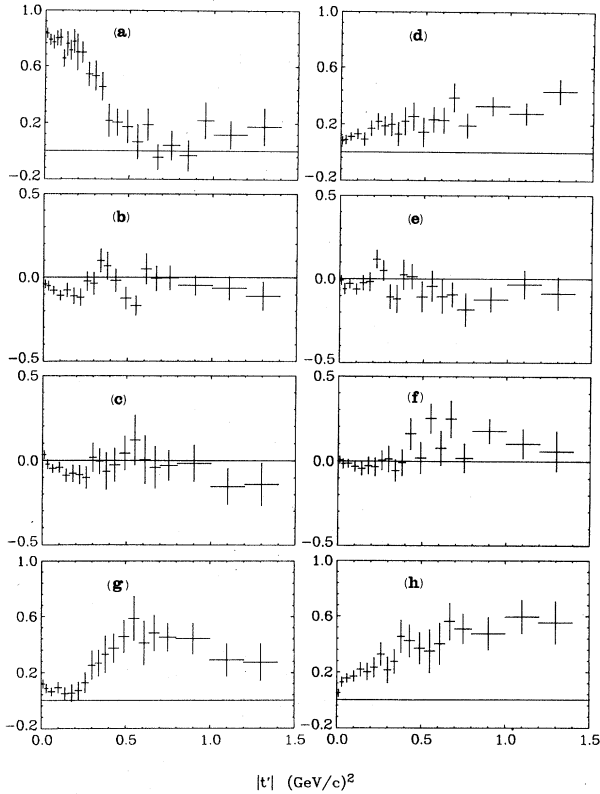


FIG. 2. Density matrix elements for  $\rho^0\Delta^{++}$  production as a function of  $|t'|$ . (a)  $\rho_{0,0}$ ; (b)  $\text{Re}\rho_{1,0}$ ; (c)  $\rho_{1,-1}$ ; (d)  $\rho_{3,3}$ ; (e)  $\text{Re}\rho_{3,1}$ ; (f)  $\text{Re}\rho_{3,-1}$ ; (g)  $\rho_{1,1} + \rho_{1,-1}$ ; and (h)  $\rho_{1,1} - \rho_{1,-1}$ .

for  $\rho\Delta$  and  $\omega\Delta$  selections.

Considering first the  $\rho^0\Delta^{++}$  channel, we see that for  $|t'| < 0.2$  ( $\text{GeV}/c$ )<sup>2</sup>  $\rho_{00}$  is large ( $\sim 0.8$ ) while the other elements are much smaller ( $\lesssim 0.1$ ), in qualitative agreement with the predictions of a model with elementary pion exchange. A new feature of the data is the appearance of a zero in  $\rho_{00}$  near  $|t'| = 0.75$  ( $\text{GeV}/c$ )<sup>2</sup> [see Fig. 2(a)]. It should be noted, however, that since a background subtraction is uncertain because of the paucity of events, it is difficult to ascertain the significance of the observed rise in  $\rho_{00}$  for larger  $|t'|$  values. Hence we view our result as highly suggestive of a zero

We thus present evidence that the unnatural parity-exchange amplitude has a zero near  $|t'| = 0.75$  ( $\text{GeV}/c$ )<sup>2</sup>. Such a zero is predicted by simple Regge-pole models<sup>5,6</sup> for nonsense wrong-signature points; if the observed zero corresponds to the point  $\alpha_\pi(t) = -1$ , then we infer a slope for a linear  $\pi$  trajectory of  $\sim 1.2$  ( $\text{GeV}/c$ )<sup>-2</sup>. While the simple form-factor model<sup>7</sup> does not predict this zero, models with interfering poles,<sup>8</sup> or pole-plus-cut contributions,<sup>9</sup> or optical mod-

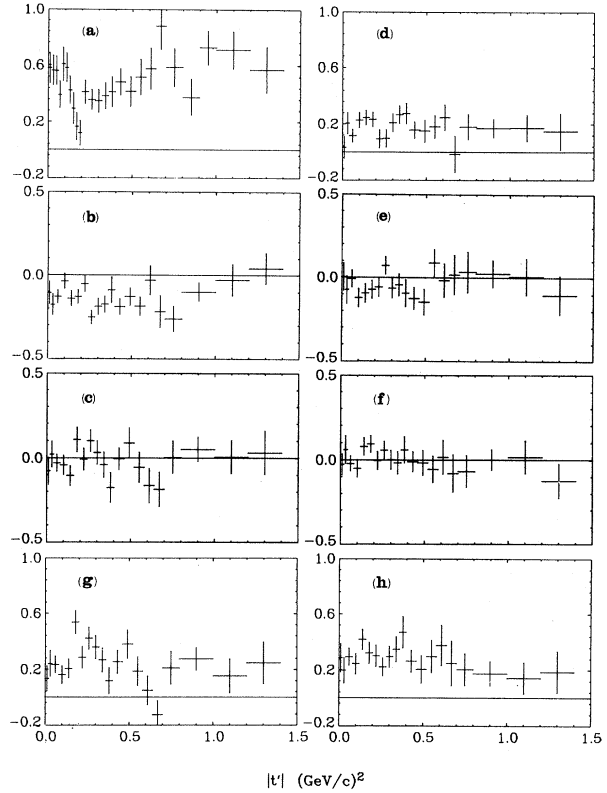


FIG. 3. Density matrix elements for  $\omega^0\Delta^{++}$  production as a function of  $|t'|$ . (a)  $\rho_{0,0}$ ; (b)  $\text{Re}\rho_{1,0}$ ; (c)  $\rho_{1,-1}$ ; (d)  $\rho_{3,3}$ ; (e)  $\text{Re}\rho_{3,1}$ ; (f)  $\text{Re}\rho_{3,-1}$ ; (g)  $\rho_{1,1} + \rho_{1,-1}$ ; and (h)  $\rho_{1,1} - \rho_{1,-1}$ .

els<sup>10</sup> also yield this type of structure.

In Fig. 4(a) we show  $\rho_{00}$  multiplied by  $d\sigma/d|t'|$  for the  $\rho^0\Delta^{++}$  channel (we define the quantity  $\sigma_0^- \equiv \rho_{00}d\sigma/d|t'|$ ). Aside from the zero near  $|t'| = 0.75$  ( $\text{GeV}/c$ )<sup>2</sup>, evidence for a change in slope may be seen, with the forwardmost data appearing steeper than the data at larger  $|t'|$ . The curve in this figure is from a fit to the  $\sigma_0^-$  distribution for  $0 < |t'| < 1.4$  ( $\text{GeV}/c$ )<sup>2</sup> using the Reggeized pion-exchange model described in the following Letter.<sup>11</sup> The slope of the pion trajectory is fitted to be  $1.16 \pm 0.03$  ( $\text{GeV}/c$ )<sup>-2</sup>, and is thus consistent with the position of the zero in  $\rho_{00}$ . The small error in the slope is due to the sensitivity of the model to the relatively precise measurements for  $|t'| < 0.4$  ( $\text{GeV}/c$ )<sup>2</sup>. The Regge-model fit may be seen to be in quantitative agreement with the data for all  $|t'|$ .

We next consider the helicity-flip contributions to  $\rho^0\Delta^{++}$  production,<sup>12</sup>

$$2\sigma_1^+ = \rho_{1,1} + \rho_{1,-1}, \quad (3a)$$

$$2\sigma_1^- = \rho_{1,1} - \rho_{1,-1}. \quad (3b)$$

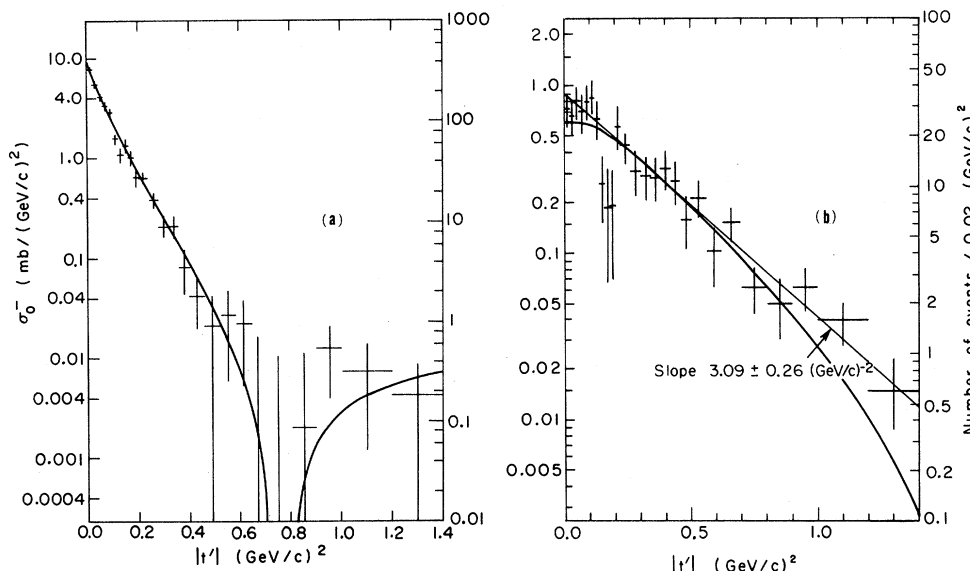


FIG. 4.  $\rho_{0,0} d\sigma/d|t'|$  for vector-meson and  $\Delta^{++}$  production. (a)  $\pi^+p \rightarrow \rho^0\Delta^{++}$ , (b)  $\pi^+p \rightarrow \omega^0\Delta^{++}$ .

where, as  $s \rightarrow \infty$ ,  $\sigma_1^+$  ( $\sigma_1^-$ ) measures the natural (unnatural) parity contribution to the vector meson in the  $t$ -channel helicity-one state. The distribution of  $\sigma_1^-$  [see Fig. 2(h)] for  $\rho\Delta$  production, which includes the  $\pi$ -exchange contribution to the helicity-one state, does not show a dip near  $|t'| = 0.75$  ( $\text{GeV}/c$ )<sup>2</sup>, where the  $\pi$  contribution to the helicity-zero state has been observed to vanish. Hence we conclude that, at least at large  $|t'|$ , the  $\pi$ -exchange contribution to  $\sigma_1^-$  is unimportant. Whether the dominant contributions to  $\sigma_1^-$  are due to cuts or to additional poles cannot be decided with the available data.

The distribution of  $\sigma_1^+$  [see Fig. 2(g)] for  $\rho\Delta$ , which in a pole model would be dominated by  $A_2$  exchange, shows evidence for a change of slope near  $|t'| = 0.16$  ( $\text{GeV}/c$ )<sup>2</sup>, and appears smooth near  $|t'| = 0.6$  ( $\text{GeV}/c$ )<sup>2</sup>. A zero near  $|t'| = 0.2$  in the  $A_2$  amplitude has been inferred from finite-energy sum rules.<sup>5</sup> The lack of a dip in  $\sigma_1^+$  near  $|t'| = 0.6$  ( $\text{GeV}/c$ )<sup>2</sup> may be used to extract information about the ghost-killing mechanism of the  $A_2$ , assuming that the  $A_2$  dominates other contributions to  $\sigma_1^+$ . Noting that the  $\Delta^{++}$  density-matrix elements [Figs. 2(d)-2(f)] near  $|t'| = 0.6$  are consistent with those expected from a magnetic dipole ( $M1$ ) coupling at the  $\bar{p}A_2\Delta$  vertex ( $\rho_{3,3} = \frac{3}{8}$ ,  $\text{Re}\rho_{3,-1} = \sqrt{3}/8$ ,  $\text{Re}\rho_{3,1} = 0$ ), we surmise that there is a unit flip of helicity at the nucleon vertex. Since there exists good evidence of approximate  $\rho$ - $A_2$  exchange degeneracy,<sup>6</sup>  $\alpha_\rho \approx \alpha_{A_2}$ , and hence  $|t'| \approx 0.6$  ( $\text{GeV}/c$ )<sup>2</sup> is a sense point for the  $A_2$ . The absence of dip in  $\sigma_1^+$  near the point

$\alpha_{A_2} = 0$  is then evidence that the  $A_2$  chooses to couple to nonsense channels (Gell-Mann mechanism).

The  $\omega\Delta$  channel is amenable to a similar analysis. If  $\rho$  exchange dominates the production of  $\omega\Delta$ , we expect  $\rho_{0,0} = \rho_{1,0} = 0$  and  $\rho_{1,1} = \rho_{1,-1} = \frac{1}{2}$ , as well as  $M1$  coupling at the nucleon vertex (see the discussion of  $\sigma_1^+$  above). As may be seen in Fig. 3, the data indicate a preference for a production mechanism that resembles that of  $\rho^0\Delta^{++}$  ( $\pi$  exchange). In particular the large value of  $\rho_{0,0}$  indicates a sizable contribution from unnatural parity exchange; generically we shall call such exchanges  $B$  exchange.

For the  $\omega\Delta^{++}$  channel we isolate the  $B$  contribution to the helicity-zero state as before by plotting  $\sigma_0^-$  [Fig. 4(b)]. The distribution is seen to be much less sharply peaked than the corresponding distribution for  $\rho\Delta$ . A new feature of the data is the significant dip at  $|t'| = 0.17$  ( $\text{GeV}/c$ )<sup>2</sup>, which is contributed to by dips in both  $\rho_{0,0}$  and in  $d\sigma/d|t'|$ . It has been suggested<sup>13</sup> that such a dip could be due to the vanishing of the  $B$  amplitude at  $\alpha_B = 0$  for  $t \approx -0.25$ , near the dip observed in this experiment. However, the sharpness of the dip argues against this interpretation. Since  $d\sigma/d|t'|$  alone does not show as large a dip as  $\sigma_0^-$ , the dominant cause of the dip is a sudden change in the polarization of the  $\omega^0$  over a small interval in  $|t'|$ . While the sharpness of the dip is reminiscent of interference effects, we cannot offer a specific explanation of this effect. For  $|t'| > 0.2$  ( $\text{GeV}/c$ )<sup>2</sup> the  $\sigma_0^-$  distribution is consistent with an exponential falloff with slope  $3.09 \pm 0.26$  ( $\text{GeV}/c$ )<sup>2</sup>.

c)<sup>-2</sup>.

$B$  exchange is observed to contribute almost half of the  $\omega\Delta$  cross section at 3.7 GeV/c, suggesting relatively strong couplings of the  $B$  to  $\pi\omega$  and to  $\bar{p}\Delta$ . A model with  $\pi$ - $B$  exchange degeneracy<sup>11</sup> supplies such strong couplings; the smooth curve in Fig. 4(b) shows that for  $0.2 < |t'| < 1.0$  (GeV/c)<sup>2</sup> such a model is in good agreement with the data. While the dip at  $|t'| = 0.17$  (GeV/c)<sup>2</sup> is not accounted for by the model, an interesting consequence is predicted for  $|t'| < 0.14$  (GeV/c)<sup>2</sup>. It is seen that an enhancement of  $\sim 70$  events over the  $\pi$ - $B$  exchange degeneracy prediction occurs for small  $|t'|$ . This is precisely the region in which destructive  $\omega\rho$  interference was observed<sup>1</sup> for the  $M(\pi^+\pi^-)$  distribution of channel (1), where  $\sim 80$  events are removed from the  $\pi^+\pi^-$  mass distribution near the mass of the  $\omega^0$ . If the off-diagonal element of the  $\rho\omega$  mass mixing matrix is essentially real, for the observed  $\omega$ - $\rho$  production phase  $\sim 80$  events should be added to the  $\omega^0$  sample with  $|t'| < 0.14$  (GeV/c)<sup>2</sup>, in agreement with the deduced excess number of events. We further note that the observed<sup>1</sup>  $\omega$ - $\rho$  production phase  $\beta = 1.5 \pm 0.3$  rad has also been interpreted as a consequence of  $\pi$ - $B$  exchange degeneracy.<sup>14</sup>

Finally we consider the distributions of  $\sigma_1^\pm$  for  $\omega^0\Delta^{++}$  channel. It is seen [Fig. 3(h)] that  $\sigma_1^-$ , the unnatural-parity contribution, shows no sharp structure as a function of  $|t'|$ , while  $\sigma_1^+$  [see Fig. 3(g)], which measures the  $\rho$  contribution in pole models, has a zero near  $|t'| = 0.65$  (GeV/c)<sup>2</sup>. The position of this zero is thus slightly displaced from the point where  $\alpha_\rho = 0$ ,  $|t'| \approx -0.5$  (GeV/c)<sup>2</sup>. A background subtraction in the region of the zero enhances the effect, but does not increase its significance ( $\sim 2$  standard deviations). Evidence for this zero has not been seen previously in two-body final states with an  $\omega^0$  (and either a nucleon or nucleon isobar). A possible explanation for the apparent lack of a dip in other experiments is that  $\rho$  exchange is not the dominant mechanism in  $\omega^0$  production; as indicated above,  $B$  exchange is dominant at the intermediate energies studied to date. Hence the  $\rho$  contribution  $\sigma_1^+$  must be isolated with good statistics to see the appearance or lack of a dip near 0.6 (GeV/c)<sup>2</sup>. It is worth noting that since the  $\rho$  chooses  $M1$  coupling, for  $\sigma_1^+(\omega\Delta)$  there is a unit helicity flip at both the meson and the nucleon vertices in both the  $s$ - and  $t$ -channel coordinate systems. Hence the net helicity flip is either 0 or 2, so that a zero (or dip) in  $\sigma_1^+$  would be expected near  $|t'| = 0.2$  or 1.2 (GeV/c)<sup>2</sup>, re-

spectively, for models<sup>10</sup> which attribute the observed dip in  $\pi^-p \rightarrow \pi^0n$  to a zero in the Bessel function  $J_1$ . Our result thus contradicts such simple models, and favors the hypothesis that the  $\rho$ -exchange amplitude vanishes at the nonsense wrong-signature point  $\alpha_\rho = 0$ .

In conclusion, evidence is found for structure in  $t$  for both  $\rho^0\Delta^{++}$  and  $\omega^0\Delta^{++}$  production which is readily accounted for by simple Regge-pole models. Evidence for nonsense wrong-signature zeroes is seen for both the  $\pi$  and the  $\rho$  trajectories, and  $\pi$ - $B$  exchange degeneracy appears to be consistent with the  $\rho\Delta$ ,  $\omega\Delta$  data. Data consistent with the hypothesis of  $\rho\omega$  interference effects appearing in the  $\pi^+\pi^-\pi^0$  events are also presented, although the unexplained dip in  $\sigma_0^-(\omega\Delta)$  at  $|t'| = 0.17$  (GeV/c)<sup>2</sup> clouds the complete theoretical interpretation of the data.

We wish to acknowledge many fruitful discussions with Dr. Uri Maor concerning the phenomenological analysis. We thank our co-workers Dr. John Kadyk and Dr. George Trilling for their contributions to other phases of this experiment. We further thank the Alvarez Group bubble chamber crew, the Bevatron crew, and the FSD staff, as well as our scanning, measuring, and computing staffs, for their invaluable assistance.

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<sup>1</sup>G. Goldhaber, W. R. Butler, D. G. Coyne, B. H. Hall, J. N. MacNaughton, and G. H. Trilling, Phys. Rev. Lett. **23**, 1351 (1969).

<sup>2</sup>On a sample of  $\sim \frac{1}{3}$  of the film all events were measured. Correcting for scanning and measuring losses, a bias against finding small-angle elastic scatters, and proton contamination in the beam (via comparison with film exposed to a proton beam), we use the  $\pi^+p$  total cross section at 3.7 GeV/c [28.1 mb interpolated value, A. Citron *et al.*, Phys. Rev. **144**, 1101 (1966)] and the corrected number of events (39 500) to yield 0.712  $\mu\text{b}/\text{event}$ . Scaling by the ratio of events from Reaction (1) in the  $\sim \frac{1}{3}$  sample to the number in the total sample gives the flux of 3 events/ $\mu\text{b}$ .

<sup>3</sup>For the mass bands considered the double-resonance background is  $\sim 10$ -20% in the forward direction, and increases as the scattering angle increases. Interference with background processes (e.g.,  $A_1^+p$ ) is neglected; if such interference were important the interpretation of our results would not be clear. The branching fraction of  $\rho^0 \rightarrow \pi^+\pi^-$  was taken to be 1.0, and of  $\omega^0 \rightarrow \pi^+\pi^-\pi^0$  to be  $0.87 \pm 0.04$  [N. Barash-Schmidt *et al.* Rev. Mod. Phys. **42**, 87 (1970)].

<sup>4</sup>K. Gottfried and J. D. Jackson, Nuovo Cimento **33**, 309 (1964). The quantization ( $z$ ) axis is chosen as the

direction of the beam (target) particle in the vector-meson ( $\Delta^{++}$ ) rest frame, the  $y$  axis is along  $\vec{\pi}_{\text{beam}} \times \vec{V}$ , where  $V$  stands for vector meson, evaluated in the overall center-of-mass system, and  $\hat{x} = \hat{y} \times \hat{z}$ . The polarization analyzer is the decay  $\pi^+$  for the  $\rho^0$ , the decay proton for the  $\Delta^{++}$ , and the normal to the decay plane for the  $\omega^0$ ,  $\vec{\pi}^+ \times \vec{\pi}^-$ , each direction defined in the respective resonance's rest frame.

<sup>5</sup>See the recent review by J. D. Jackson, *Rev. Mod. Phys.* **42**, 12 (1970), for a survey of the literature on models for high-energy processes. A useful glossary of Regge-pole terminology is included in the appendix.

<sup>6</sup>A recent review of the Regge-pole model is given by G. E. Hite, *Rev. Mod. Phys.* **41**, 669 (1969). This reference and Ref. 5 may also be used as glossaries to the Regge-pole effects discussed.

<sup>7</sup>G. Wolf, *Phys. Rev.* **182**, 1538 (1969).

<sup>8</sup>F. Arbab and R. C. Brower, *Phys. Rev.* **175**, 1991 (1968).

<sup>9</sup>F. Henyey, G. L. Kane, J. Pumplin, and M. H. Ross, *Phys. Rev.* **182**, 1579 (1969).

<sup>10</sup>See, for example, the review by H. Harari, in *Proceedings of the International Symposium on Interactions of Electrons and Photons of High Energies, Liverpool, England, September 1969*, edited by D. W. Braben (Daresbury Nuclear Physics Laboratory, Daresbury, Lancashire, England, 1970).

<sup>11</sup>G. S. Abrams and U. Maor, *Phys. Rev. Lett.* **25**, 621 (1970).

<sup>12</sup>J. P. Ader, M. Capdeville, G. Cohen-Tannoudji, and Ph. Salin, *Nuovo Cimento A* **56**, 952 (1968). While this separation of the cross section into natural- and unnatural-parity contributions is strictly valid only at infinite energies, we plot the suggested combinations of density-matrix elements to investigate the perseverance of asymptotic properties at our momentum, 3.7 GeV/c.

<sup>13</sup>H. Högaasen and H. J. Lubatti, *Phys. Lett. B* **26**, 166 (1968); G. S. Abrams, B. Eisenstein, and H. Gordon, *Phys. Rev. Lett.* **23**, 673 (1969).

<sup>14</sup>A. S. Goldhaber, G. C. Fox, and C. Quigg, *Phys. Lett. B* **30**, 249 (1969).

### $\pi$ -B EXCHANGE-DEGENERATE MODEL FOR $V^0\Delta^{++}$ PRODUCTION\*

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The forward differential cross section of  $\rho\Delta$  production is shown to be reproduced quantitatively by an evasive Reggeized one-pion-exchange model which smoothly reduces to the Born term at the pion pole. Assuming exact  $\pi$ -B exchange degeneracy leads to predictions for  $\omega\Delta$  production which are in agreement with the experimental  $s$  and  $t$  dependences. Similar agreement is found for  $K^*\Delta$  production.

The  $t$ -channel one-pion exchange (OPE) appears as the dominant forward-production mechanism at medium energies in many two-body reactions. There is, however, a considerable controversy as to the detailed features of this process. The proximity of the pion pole to the physical  $t$  region suggests the importance of the Born term. Nevertheless, it is clear that the experimental momentum-transfer distributions in the relevant reactions force rather severe modifications of the Born amplitude. Such modifications have been suggested (and applied) taking into account off-mass-shell corrections,<sup>1</sup> absorption,<sup>2</sup> and a variety of Regge-pole and cut models.<sup>3-5</sup>

In this Letter we offer evidence that the OPE contribution to the reaction

$$\pi^+p \rightarrow \rho^0\Delta^{++} \quad (1)$$

is consistent with the exchanged pion lying on an evasive ( $M=0$ ) Regge trajectory with a slope near the "universal" value of  $1 \text{ (GeV}/c)^{-2}$ . This result is suggested by a recent high-statistics

experiment<sup>6</sup> at 3.7 GeV/c which provides differential cross sections and spin density matrix elements to a  $|t|$  value as large as  $1.5 \text{ (GeV}/c)^2$ . A similar analysis of the reaction

$$\pi^+p \rightarrow \omega^0\Delta^{++} \quad (2)$$

then provides a stringent test of  $\pi$ -B exchange degeneracy which is well satisfied by the data.<sup>6</sup> Our results are readily extended to the reaction

$$K^+p \rightarrow K^*\Delta^{++} \quad (3)$$

but cannot properly describe either charged-pion photoproduction or  $n\bar{p}$  charge-exchange scattering.<sup>7</sup> However, our approach when coupled to models such as the one suggested by Jackson and Quigg<sup>5</sup> may provide an overall description which is quite satisfactory.

It has been noted<sup>1,3</sup> that the differential cross section of Reaction (1) exhibits shrinkage of the forward peak with increasing primary energy. This behavior suggests a simple Regge-pole parametrization with a steep evasive  $\pi$  trajec-