TABLE I. Relative intensities of resonances in $\bar{p}n \rightarrow \pi^+\pi^-\pi^-$. Veneziano models – (A) Eq. (8) in text; (B) Ref. 4.

Veneziano model	Spin 0 ϵ	ϵ'	ϵ''	Spin 1 ρ	ρ'	ρ''
A	1.0	0.97	0.96	0.12	0.66	0.14
B	1.0	1.14	0	0	0.16	0

resonances, in particular, the f and g mesons, do *not* seem to contribute to the final state. This is in general agreement with the results of partial-wave analyses of the other three Veneziano models mentioned in Ref. 1.

The relative strengths of the physical resonances appearing in Eq. (8) are given in Table I along with the values for the Lovelace amplitude.[4] The striking feature of the comparison is the absence of the daughters of the g meson and the weak coupling of the ρ' in the Lovelace solution.

IV. CONCLUSION

The results of this analysis show that the fears about the presence of an infinite series of ancestor resonances in the Veneziano amplitude caused by taking a complex Regge trajectory are unfounded.

To summarize, we conclude that the dominant contributions to the $(\pi^+\pi^-)$ system in $\bar{p}n \rightarrow 3\pi$ comes from ϵ, ϵ', ϵ'', and ρ' daughter resonances in comparable proportions. The possibility of small contributions from the ρ meson and the ρ'' daughter cannot be excluded. We find no evidence of f and g mesons. This, with the small contribution from the ρ, confirms the leading-trajectory "decoupling" effect[3,4] in this process.

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$N^*(1470)$-p Transition Form Factor in the Chou-Yang Model

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The Chou-Yang model is used in a calculation of the $N^*(1470)$-p $M1$-transition form factor.

The Chou-Yang model[1,2] has been used in determinations of the electromagnetic form factors of various elementary particles.[2-4] These calculated form factors agree with the existing experimental data.[2,3] In this paper we apply the Chou-Yang model to the inelastic "diffractive" reactions $\pi p \rightarrow \pi N^*$ and $pp \rightarrow pN^*$ and calculate the $N^*(1470)$-p transition form factor.[5] We identify this form factor with the $M1$-transition form factor.[6]

We use the data[7] for the πN^* process at 16 GeV/c, with the assumption that the slope of $d\sigma/dt$ has essentially reached its asymptotic limit. This assumption is in agreement with the other data. For the pN^* process the situation is less clear,[8] since the measured slope of $d\sigma/dt$ fluctuates in a somewhat erratic manner. At 10, 15, 20, and 30 GeV/c, the values of the slope parameter B (from $d\sigma/dt = Ae^{Bt}$) are 22.3, 15.9, 14.4, and 23.5 $(\text{GeV}/c)^{-2}$, respectively. We have done calculations using both the 15- and the 30-GeV/c cross sections for comparison. The 30-GeV/c results are used in Table I.

The limiting value of the amplitude for $\pi p \rightarrow \pi N^*(1470)$ or for $pp \rightarrow pN^*(1470)$ is represented by

$$a^*(t) = \left[\frac{1}{\pi}\left(\frac{d\sigma}{dt}\right)_\infty\right]^{1/2}$$

TABLE I. List of calculated values of $N^*(1470)$-p transition form factor compared with corresponding values of pion and proton form factors. The pion and proton data are from Ref. 3.

$\lvert t\rvert$ $(\text{GeV}/c)^2$	$F_\pi(t)$	$F_p(t)$	$G^*(t)$ from πp	$G^*(t)$ from pp
0.0	1.000	1.000	1.00	1.00
0.1	0.846	0.810	0.54 ± 0.04	0.47 ± 0.11
0.2	0.728	0.665	0.31 ± 0.04	0.26 ± 0.10
0.3	0.636	0.553	0.18 ± 0.02	0.17 ± 0.08
0.4	0.564	0.466	0.12 ± 0.02	0.13 ± 0.06
0.5	0.505	0.399	0.06 ± 0.01	0.11 ± 0.05
0.6	0.455	0.347	0.05 ± 0.01	0.10 ± 0.03

with the parametrization

$$a^*(t)=c\,e^{gt}.$$

From Refs. 7 and 8, we immediately obtain (in an obvious notation)

$$g_\pi=8.0\pm0.7\ (\text{GeV}/c)^{-2},$$

$$g_p=8.0\pm1.5 \text{ or } 11.8\pm2.6\ (\text{GeV}/c)^{-2}.$$

The constant c is absorbed in the normalization of the form factor.

Letting $a(t)$ represent[9] the corresponding elastic amplitude,[1,2] we calculate the $N^*(1470)$-p $M1$-transition form factor $G^*(t)$ from[10,11]

$$F(t)G^*(t)=(\text{const})[a^*(t)+\tfrac{1}{2}a^*(t)\otimes a(t)+\tfrac{1}{3}a^*(t)\otimes a(t)\otimes a(t)+\cdots].$$

Here $F(t)$ is the pion or proton form factor; we used 100 terms in the sum. Numerical values for the normalized form factor $G^*(t)$ are listed in Table I.

Within the context of our model, one easily concludes that the normalized $N^*(1470)$-p transition form factor falls off more rapidly with $\lvert t\rvert$ than do the pion or proton form factors.[12] This conclusion also holds if one uses the $pp\to pN^*(1470)$ data at 15 GeV/c rather than at 30 GeV/c. The rms radius associated with this form factor is found to be 0.89 ± 0.10 F from the 16-GeV/c πp data or 1.18 ± 0.26 F from the 30-GeV/c pp data.

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[9]The amplitude $a(t)$ is parametrized for πp scattering (Ref. 3) by $3.13e^{5.38t}+1.49e^{2.29t}$ and for pp scattering (Ref. 2) by $8.04e^{5.15t}$.

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[11]We neglect double-resonance processes, $pp\to N^*N^*$, and terms containing more than one $a^*(t)$.

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