A Dual Model for Meson-Baryon Scattering without Parity Doublets (*)

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(riccuto il 16 Giugno 1971)

Summary. — We consider a dual model for meson-baryon scattering in which the parity partners of the leading baryons are eliminated. The first resonance on the negative-normality leading trajectory has spin $\frac{3}{2}$. The model includes the duality constraints, does not decouple for backward scattering and gives acceptable elastic widths for the baryons.

1. - Introduction.

Constraints on the hadron spectrum arising from the global duality hypothesis (that the imaginary parts of crossed Regge-pole terms should cancel in exotic channels) have been worked out (1). For meson-baryon scattering attempts have been made to construct explicit Veneziano-type amplitudes containing these duality requirements (2). However these amplitudes contain

(*) To speed up publication, the authors of this paper have agreed to not receive the proofs for correction.


parity doublets for the leading baryon resonances, whereas, experimentally, they appear to be absent. This may be seen from the MacDowell symmetry
\[ f_{l+}(\sqrt{s}) = -f_{l+}(\sqrt{s}), \]
where \( f_{l\pm} \) are the partial-wave amplitudes for \( J = l \pm \frac{1}{2} \). Veneziano poles lie at \( \alpha' s = J - \alpha_s \), where \( \alpha(s) = \alpha_s + \alpha' s \), and thus occur in both \( f_{l+} \) and \( f_{l+}(-) \). Some recent proposals have been made towards solving this problem \((^{2,4})\). These involve the Reggeization of a series of definite-parity fermions. This procedure introduces a fixed cut in the \( J \)-plane whose effect is to shift opposite-parity fermions onto an unphysical sheet.

In this paper we discuss a model proposed by Humble, Vaughn and Zia \((^4)\) which they refer to in ref. \((^4)\) as their "other fixed-cut solution". In comparison with the model of Bardakci and Halpern \((^7)\) it treats the negative-normality baryon recurrences as beginning with \( J = \frac{3}{2}^+ \) (and not \( J = \frac{1}{2}^- \)) and uses simple functions whose analytic continuation into the physical scattering region can be found (as has been demonstrated in ref. \((^4)\)). The model eliminates parity doublets for the leading baryons, accommodates the duality constraints, gives leading Regge behaviour in all channels, does not decouple in the backward direction and gives acceptable elastic widths for the baryons. The \( t \)-channel, however, is rather loosely constrained in the sense that some of the leading \( t \)-channel meson residues are dual to daughters of the negative-normality baryons. Acceptable values for \( v_B/A' \) and \( F/D \) for the vector- and tensor-meson coupling to baryons can be obtained within the framework we present.

2. - A dual model without parity doublets.

The amplitudes we shall require for pseudoscalar meson-spin-\( \frac{1}{2} \) baryon scattering are defined as follows:

\begin{align*}
(1) & \quad T(p', q'; p, q) = \bar{u}(p')[-A(s, t, u) + \frac{1}{2}(\gamma \cdot q + (\gamma \cdot q)')B(s, t, u)]u(p), \\
(2) & \quad f_1(s, t) = (A - MB + \sqrt{s}B)(E + M)/8\pi \sqrt{s}, \\
(3) & \quad f_3(s, t) = (-A + MB + \sqrt{s}B)(E - M)/8\pi \sqrt{s}, \\
(4) & \quad f_{j=\pm\frac{1}{2}}(\sqrt{s}) = \frac{1}{2} \int d(cos \theta) [P_1(cos \theta)f_1 + P_{+1}(cos \theta)f_3].
\end{align*}
