REMARK ON THE MODELS OF LINE-REVERSAL SYMMETRY BREAKING

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The analysis of two body strangeness exchange processes in baryon-antibaryon and baryon-baryon scattering could discriminate between the two existing explanations of the difference between line-reversed reactions. In the case when the pattern of line-reversal symmetry breaking in $B-B$ and $B-\bar{B}$ scattering is similar to that in the meson-baryon scattering — simple rearrangement model is favoured. In the other case the absorption model based on the dual unitarisation scheme with different Pomerons for qq and $q\bar{q}$ scattering is preferred.

As it is well known [1] the two body strangeness exchange processes for meson-baryon scattering show a specific pattern of line reversal symmetry breaking. The aim of this note is to propose a direct experimental test which could discriminate between different explanations of this phenomenon. In the following we will use interchangingly the terms

a) "real phase" and "rearrangement" processes,

b) "rotating phase" and "annihilation-creation" processes. The diagrams corresponding to (a) and (b) for meson-baryon scattering are depicted in Figs 1a and 1b, respectively.

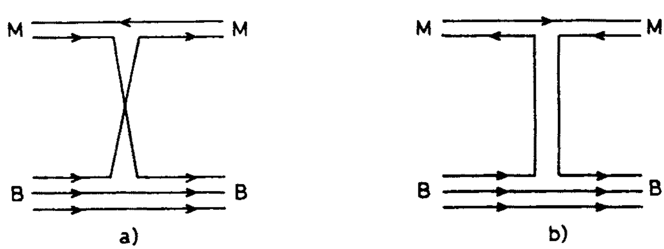

Fig. 1. Meson-baryon quantum number exchange processes related by line-reversal

The data on $\pi^+p \to K^+\Sigma$ and $K^-p \to \pi^-\Sigma$ reactions [1] yield the following inequality:

$$\frac{d\sigma}{dt}(\text{real phase}) > \frac{d\sigma}{dt}(\text{rotating phase}). \tag{1}$$

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This was always a riddle for simple absorption models, according to which the rearrangement processes should have stronger absorption and therefore should be smaller [2].

During last two years a method of unitarising the S-matrix has been developed which provides a new explanation of the line reversal symmetry breaking [3]. Let us shortly describe the first model which explains inequality (1). In Figs 2a and 2b the diagrams which represent absorptive corrections to the simple regge exchange picture are drawn [4].

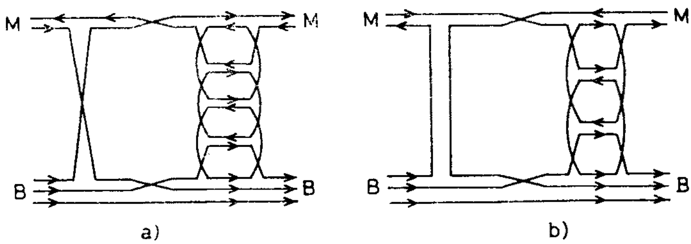

Fig. 2. The diagrammatic representation of the Reggeon-Pomeron cuts in the dual unitarisation scheme for meson-baryon scattering

The processes described by the diagrams, in which the objects produced in the intermediate state between reggeon and Pomeron exchange are uncrossed, were found to be negligible at $s < 100\ \mathrm{GeV}^2$ [5]. On the basis of the dual unitarisation scheme one can argue that the Pomerons exchanged in Figs 2a and 2b are not equal. At small energies the quark-quark elastic scattering is much larger than for a quark-antiquark pair because we need at least two loops to create a Pomeron for quark-antiquark scattering, whereas in the case of quark-quark scattering one-loop part of the Pomeron is also non-zero. At small energies when the diagrams with larger number of loops, which comprise the Pomeron, are suppressed, the quark-quark Pomeron P_{qq} is larger than the quark-antiquark Pomeron $P_{q\bar{q}}$. Accordingly, real phase type processes (Fig. 2a) are only slightly absorbed, whereas rotating phase type processes are absorbed much stronger yielding the observed pattern of the line reversal symmetry breaking.

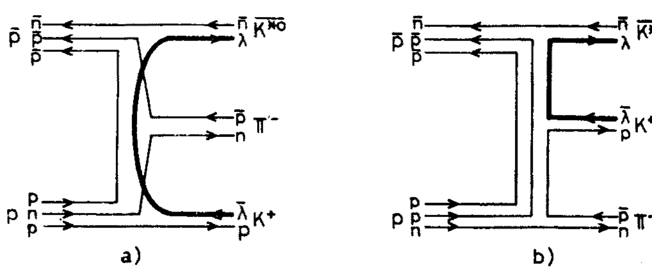

Fig. 3. Quark line diagrams for the process $\bar{p}p \to K^+\overline{K^{*0}}\pi^-$

The second model which aims to explain the observed inequality of differential cross--sections for the processes related by line-reversal is the one which states that the rearrangement of quarks is simply more probable than the annihilation and the subsequent creation of a quark-antiquark pair. This assumption is also in agreement with baryon-antibaryon annihilation into mesons where the model was originally applied [6]. The data show that the cross-section for the process visualised in Fig. 3a is much larger than for that shown in Fig. 3b despite the fact that the Regge intercepts, and the residues work in the opposite direction.

Here we would like to show that a simple experiment could discriminate between the two models we have mentioned before. The reactions we look for are

$$YB \to BY, \tag{2a}$$

and

$$\bar{B}B \to \bar{Y}Y, \tag{2b}$$

where Y is a strange baryon (Λ^0, Σ^+), and B is a nonstrange baryon (proton). The quark diagrams for these two processes are shown in Figs 4a and 4b. The rearrangement dominance models states that

$$\sigma(YB \to BY) > \sigma(\bar{B}B \to \bar{Y}Y), \tag{3}$$

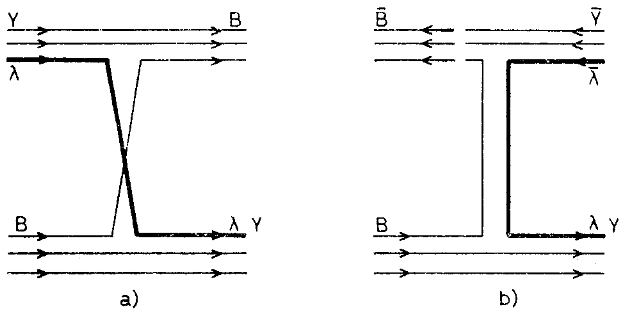

Fig. 4. Baryon-baryon and baryon-antibaryon nonexotic quantum number exchange processes related by line-reversal

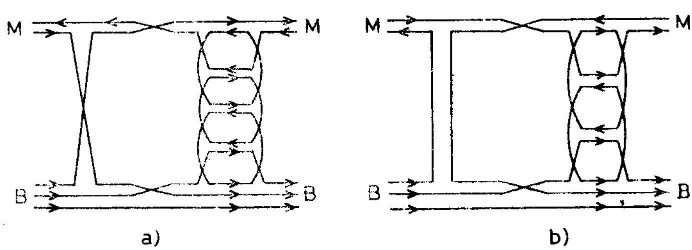

Fig. 5. The diagrammatic representation of the Reggeon-Pomeron cuts in the dual unitarisation scheme for baryon-baryon and baryon-antibaryon quantum number exchange processes

because in the reaction (2a) the baryons simply interchange their constituents, whereas in the reaction (2b) a new pair of quarks is created.

In the dual unitarisation scheme, on the other hand, we are obliged to incorporate absorption effects (Figs 5a and 5b). For real phase type processes we have absorption described by P_{qq} which according to the arguments given before should be larger than $P_{q\bar{q}}$. Thus absorption in the dual unitarisation scheme predicts

$$\sigma(YB \to BY) < \sigma(\bar{B}B \to \bar{Y}Y). \tag{4}$$

If one assignes line-reversal symmetry breaking to the breaking of exchange degeneracy in regge trajectories only as it was done tentatively in Ref. [7], then, as in the rearrangement model, one predicts

$$\sigma(YB \to BY) > \sigma(\bar{B}B \to \bar{Y}Y). \tag{5}$$

Therefore direct experimental information on the relative size of $YB \to BY$ and $\bar{B}B \to \bar{Y}Y$ cross-sections is desirable. By establishing the direction of the inequality between these two cross-sections we may rule out one of the existing models of line-reversal symmetry breaking.

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