model). All the T_{ij} have the same dependence on E. As for the dipole model, we can rule out the dead-state model for the A_2 if the shape depends on charge or decay channel [see Ref. (2)].

[10]If the double-peaked structure is due to the interference of a broad resonance and a very narrow resonance, the usual SU(3) or $SU(6)_W$ prediction for the experimentally determined broad width should be approximately satisfied (if the fit is obtained from a sum of two Breit-Wigner shapes). The overlap of the resonances will have a much greater effect on the apparent width of the narrow resonance, and a direct comparison with theory is not possible unless the "isolated" width can be determined.

[11]If the background is inelastic and large it becomes difficult to specify exactly what one would mean by "isolated" widths and masses.

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Testing for Correlations in Multiparticle Peripheral Reactions Involving Clusters

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It is shown that a composite distribution in the Toller angles ω associated with a given internal vertex in multiparticle peripheral reactions is flat if certain (two-, three-, four-,...) particle correlations are absent and a particular selection of data is made.

In a previous paper[1] a method was proposed for testing independence of the multi-Regge amplitude[2] on triple subenergies (including dependence on the Toller angles ω) using data from multiparticle reactions. Only those two internal vertices nearest each end of the multiperipheral chain were treated, however. The present work removes this unnecessary restriction and also frames the test in a manner applicable to a larger quantity of data. Hopefully, applications of the test will shed light on the important but so far unresolved question of ω dependence of production amplitudes.[3]

Briefly, a composite distribution in the Toller angles associated with a given internal vertex is shown to be flat if the amplitude that describes the reaction contains no dependence on *certain* double, triple, quadruple, etc., subenergies. The reactions envisaged as being amenable to the test are those in which a directly identifiable emerging particle (called "central" below) can be associated with the internal vertex but in which the remaining particles may emerge in two distinct peripherally produced clusters. Long-range correlations connecting particles in one cluster with particles in the other cluster must be absent if the aforementioned distribution is to be flat. Correlations between the central particle and particles in either cluster are allowed, however. A simple geometrical derivation of the test is presented next.

Consider a multiparticle reaction in which the final particles can be uniquely separated into three sets (by making cuts on the kinematic variables[4] if necessary) as illustrated in Fig. 1: two peripherally produced clusters A amd B and a central particle c. Assume also that the data (with the necessary cuts) are described by amplitudes represented by this figure in which the internal lines are elementary particles or Reggeons. Then, if correlations which involve any of the $[q_i]$ with any of the $[q_j']$ are absent, the (helicity) amplitude for the process is a sum of expressions of the form

$$f \sim F_A(p_1,[q_i])G_A(\bar{q}_c,[q_i])G_B(\bar{q}_c,[q_j'])F_B(p_2,[q_j']),$$

where the sum results from the permutations of particles in each cluster.

Now for any particle a of cluster A and any particle b of cluster B, a Toller angle ω_{ab} may be defined:

$$\cos\omega_{ab}=\frac{(\vec{p}_{1A}\times\vec{q}_a)\cdot(\vec{p}_{2B}\times\vec{q}_b')}{|\vec{p}_{1A}\times\vec{q}_a|\,|\vec{p}_{2B}\times\vec{q}_b'|}\ \text{in the frame }\vec{\bar{q}}_c=0,$$

where

$$p_{1A}\equiv p_1-(q_1+q_2+\cdots+q_A)+q_a$$

and

$$p_{2B}\equiv p_2-(q_1'+q_2'+\cdots+q_B')+q_b'\ .$$

This angle, shown in Fig. 2, is intimately related[1,2] to the triple subenergy $(q_a+\bar{q}_c+q_b')^2$, which is assumed to be absent from f. The question then arises as to whether or not the distribution in ω_{ab} is flat for the assumed form of f. For this distribution to be flat there must be no constraint (kinematical or dynamical) on the variables linking the $[q_i]$ with the $[q_j']$. Although inspection shows that f implies no such explicit dynamical constraint

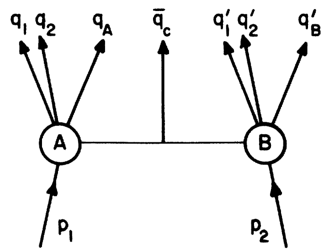

FIG. 1. Illustrating the peripheral reactions to be explored by the proposed test.

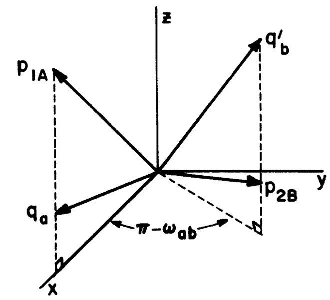

FIG. 2. The frame $\vec{\bar{q}}_c$ for defining the Toller angle ω_{ab}. $\vec{p}_{1A} - \vec{q}_a = \vec{q}_b' - \vec{p}_{2B}$ is directed along the z axis.

specification of the total-energy squared variable $s \equiv (p_1 + p_2)^2$ does introduce a kinematical constraining relation among the kinematic variables that might lead to f being dependent on ω_{ab}. Aside from f, phase space itself depends on ω_{ab} through dependence on s. Thus a flat distribution in ω_{ab} is not expected in general.

To remove this undesired reflection of fixed s on the ω_{ab} distribution it is simply necessary to restrict attention to those data in which, referring to Fig. 2, either $\vec{p}_1$ or $\vec{p}_2$ is directed along the z axis. For in this case fixing s constrains ω_{ab} in no way. That is, all values of ω_{ab} are equally likely.

The test may then be stated as follows: For data that may be classified according to the processes illustrated in Fig. 1 select those events for which, in the frame $\vec{\bar{q}}_c = 0$, either $\vec{p}_1$ and $\sum_1^A \vec{q}_i$ or $\vec{p}_2$ and $\sum_1^B \vec{q}_j'$ are collinear. (Nontriviality requires at least two particles in clusters A or B, respectively.) For these events, plot the distribution in ω_{ab} letting a and b range over the particles in clusters A and B, respectively. A flat distribution will result if cross correlations between particles in clusters A and B are absent.

[1]R. A. Morrow, Phys. Rev. D 1, 2885 (1970).

[2]N. F. Bali, G. F. Chew, and A. Pignotti, Phys. Rev. Letters 19, 614 (1967), and Phys. Rev. 163, 1572 (1967).

[3]See R. G. Lipes, Nucl. Phys. B24, 16 (1970), for a review of the assumptions (including neglect of ω dependence) underlying applications of multi-Regge theory.

[4]It is envisaged that any necessary cuts are made only on the kinematic variables that the amplitude f, below, explicitly depends on. That is, cuts are not made directly on variables such as $q_i \cdot q_j'$ for this would have a detrimental effect on the ω distribution.