DIQUARK FRAGMENTATION

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There exist many "hard" interactions in which a quark gets knocked out of a baryon. The system left behind, which we call a diquark, is a unique object since it is composite (essentially having the extended structure of a hadron) and at the same time colored. Effectively, diquarks are in many respects "colored hadrons" or spatially extended color sources which fragment into a jet of hadrons due to color confinement.

A particularly good place to study diquark fragmentation is to look at deep inelastic collisions of neutrinos (antineutrinos) on protons and neutrons at Tevatron energies. Such a study of charged current events (see Fig. 1) has several advantages: (1) The flavor content of the fragmenting quark and diquark systems is known. (2) At the Tevatron, there is sufficient energy W^2 in the fragmenting hadronic systems so that jet structure is unambiguous. (3) Fragmentation functions into a variety of hadrons can be measured since the FNHS has the capacity for good particle identification.

A complete measurement of fragmentation functions would be very interesting, since one of the foremost aims of jet studies is to understand parton dynamics (for example, in which hadrons do the jet-initiating partons go).

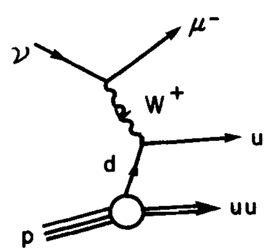

Fig. 1 Deep inelastic νp scattering usually produces a u-quark jet and a uu-diquark jet.

For quark jets, the recursive cascade model[1] seems to adequately describe available data; however, thus far, diquark fragmentation has not received much attention from either theorists or experimentalists. Nevertheless, currently available data does point to some new and interesting physics.

For example, in analogy with quark jets, it is generally thought that a fragmenting diquark picks up a quark to become a baryon leaving behind a $\bar{q}$ jet (see Fig. 2). This simple viewpoint, which ignores the extended nature of a diquark, is apparently in conflict with recent preliminary data. In particular, the simple model cannot explain why diquark fragmentation into Λ's observed in $\bar{\nu}p$ and $\bar{\nu}n$ reactions is roughly the same.[2] It also cannot account for the large π^+/π^- ratio in νp scattering at large Z.[3]

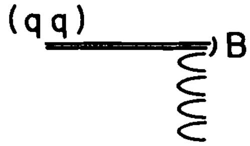

Fig. 2

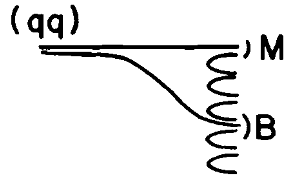

Fig. 3

Motivated by the above-described experimental data, a new cascade model for diquark fragmentation into mesons and baryons has recently been formulated.[4] This model incorporates the extended nature of diquarks in a physically reasonable way and makes numerous novel predictions on particle ratios and the shapes of fragmentation functions for various species of mesons and baryons. The model contains the process $qq \to B + \bar{q}$ (Fig. 2) as well as $qq \to M + (qq)$ shown in Fig. 3. Experimental tests at Tevatron energies should yield better understanding of how the partons in a diquark behave during hadronization. They will also improve our understanding of low-p_T multiparticle production in hadronic collisions, since there are strong indications[5] that diquark fragmentation plays a crucial role.

References

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