GLUEBALLS

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The Tevatron program will undoubtably contain some experiments which, either directly or as a side goal, yield information about conventional light hadron spectroscopy. There is some fundamental interest in such experiments. QCD predicts that there should exist bound states of gluons, commonly called glueballs.[1] These are rather direct evidence for the existence of the essential ingredient of QCD, and the spectroscopy of glueballs would elucidate the quantum numbers of gluons.

The ground states of the glueball spectrum are expected to be 0^{++}, 2^{++} for 2 gluons and 0^{-+}, 1^{--}, and 3^{--} for three gluons. The masses are expected to lie between 1 and 2 GeV. They could be visable in conventional hadronic channels, such as $n\pi$, but may be more easily seen in other ways. All glueballs are isoscalars and SU(3) singlet.

One place where glueballs might be easily produced is in the decays of ψ or Υ, where the dominant hadronic modes emerge from three gluons; however, e^+e^- facilities have not had detectors with enough particle identification or mass resolution to search for these states well. A fixed-target machine can accommodate detectors and event rates which allow a better search. A glueball search would be a natural extension of the study of heavy particles at Fermilab. Capabilities which would be useful include $K\bar{K}$ and multipion reconstruction abilities (glueballs may frequently decay to 4π).

In addition, glueballs should be copiously produced in ordinary hadronic reaction (perhaps by double pomeron exchange) and photoproduction. Essentially any detector with a way to study the isoscalar meson spectrum can search for glueballs. Glueball decay to ordinary quark states should be supressed, so their widths should be narrow on conventional hadronic scales.

Reference

1. A recent review is J. F. Donoghue, invited talk at the Conference on Experimental Meson Spectroscopy, Brookhaven National Laboratory, April 1980 (available as an MIT preprint).