A Study of the Centrally Produced K^+K^- System at the CERN Ω Spectrometer

Brian Christopher Earl

Thesis submitted to the Faculty of Science
of the University of Birmingham for the degree of
Doctor of Philosophy

Omega Group, Particle Physics
School of Physics and Astronomy
The University of Birmingham

March, 1999

Synopsis

QCD predicts that glueballs, particles composed of bound states of gluons should exist. The WA102 experiment is designed to study final states formed in the glue-rich double Pomeron exchange interaction $\mathrm{pp} \longrightarrow \mathrm{p_f}(\mathrm{X}^0)\mathrm{p_s}$, where the subscripts f and s refer to the fastest and slowest particles in the laboratory respectively, and X^0 refers to the central system. This interaction has been predicted to be a good source of glueballs. The WA102 experiment ran for 100 days of data-taking in 1996, resulting in 30 868 events of the type $\mathrm{X}^0 \longrightarrow \mathrm{K}^+\mathrm{K}^-$ after all cuts.

This thesis presents the extraction of the $\mathrm{K}^+\mathrm{K}^-$ channel, the results of a partial wave analysis on the 1996 $\mathrm{K}^+\mathrm{K}^-$ data, and a simple fit to the partial waves. It is found that the mass spectrum is composed of $\sim$80% S-wave and $\sim$10% D_0-wave, with no other statistically significant partial waves contributing. The mass spectrum contains in its S-wave resonances compatible with the $\mathrm{f}_0(980)$, $\mathrm{f}_0(1500)$, and $\theta/\mathrm{f_J}(1710)$; and in its D_0-wave resonances compatible with the $\mathrm{f}_2(1270)/\mathrm{a}_2(1320)$, $\mathrm{f}_2'(1525)$, and $\mathrm{f}_2(2150)$. Thus the $\mathrm{K}^+\mathrm{K}^-$ S-wave contains the two glueball candidates, the $\mathrm{f}_0(1500)$ and the $\theta/\mathrm{f_J}(1710)$.

A key aim of this analysis was to measure the spin of the $\theta/\mathrm{f_J}(1710)$, as this undetermined quantum number has a great significance in the search for the lightest glueball. From a full partial wave analysis it is conclusively found that the $\theta/\mathrm{f_J}(1710)$ is a spin-zero particle, while there is found to be no statistically significant activity in any of the D-waves in the $\theta/\mathrm{f_J}(1710)$ mass region.