# An Analysis of the Centrally Produced $\pi^+\pi^-$ System at 450 GeV/$c$

Keith Laurence Norman

*A thesis submitted to the Faculty of Science of the University of Birmingham for the degree of Doctor of Philosophy*

Particle Physics Group,
School of Physics and Space Research,
Faculty of Science,
The University of Birmingham

September, 1996.

# Synopsis

The WA91 Experiment is designed to study final states formed in the reaction $\mathrm{pp} \longrightarrow \mathrm{p}_f X^0 \mathrm{p}_s$, where the subscripts $f$ and $s$ refer to the fastest and slowest particles in the laboratory frame respectively, and $X^0$ refers to the central system. Reactions of this type are predicted to be good sources of non-$\mathrm{q\overline{q}}$ final states, such as glueballs.

This thesis presents results on the $X^0 \longrightarrow \pi^+\pi^-$ channel, taken during the 1992 and 1994 experimental runs. A fit to the $\pi^+\pi^-$ mass spectrum has been performed, and it has been found necessary to include a contribution from a state with a mass of $\sim 1500$ MeV/$c^2$ and a width of $\sim 200$ MeV/$c^2$. A new parameterization of the $\pi^+\pi^-$ angular distribution has been developed, and the partial waves contributing to the $\pi^+\pi^-$ channel have been extracted. A fit to the $S$-wave using the same formalism as that used for the mass spectrum also finds it necessary to include a state at around 1500 MeV/$c^2$.

A novel effect is observed if the data are classified by the azimuthal angle between the outgoing protons. Significantly larger signal-to-background ratios of standard $\mathrm{q\overline{q}}$ states are observed for events with a "back-to-back" configuration of the outgoing proton $p_T$'s. This effect is not due to the trigger or experimental acceptance, and suggests that the exchange vertices do not factorize.