WICK'S RELATIVISTIC TWO-BODY EQUATION
FOR BOUND STATES.

by

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SUMMARY.

Wick's equation is the special case of the Bethe-Salpeter equation in which all the particles are scalar bosons. It simplifies if the meson carrying the interaction has zero mass. This thesis is principally concerned to investigate the solutions of Wick's equation using a suitable coordinate system in which the equation separates.

In the first two chapters the salient features of previous work on the subject are discussed. Because of its importance for the rest of the thesis, Wick's analysis is given in some detail. In the third chapter the necessary coordinate system is introduced. It is shown that in fact the equation is not strictly separable in the usual Minkowski metric but that after Wick's analytic continuation to the imaginary time axis, when the metric becomes Euclidean, separation of the variables is straightforward. The problem of determining the eigenvalues of the equation reduces to the solution of a Heun's differential equation with certain boundary conditions. The analytic properties of the solutions in momentum space are shown to be consistent with those required by Wick.

In the first part of Chapter 4 approximate expressions for the eigenvalues are obtained in the two limits - the energy of the bound state very small and the binding energy very small. It is found that solutions can be classified as normal or abnormal according as the coupling constant does or does not tend to zero when the binding energy tends to zero. In the second part of Chapter 4 the results of the numerical calculation of exact eigenvalues are compared with the approximate eigenvalues. The approximate eigenvalues for the normal solutions give good results only
in the extreme nonrelativistic region.

In Chapter 5 a detailed comparison is made of these separable solutions and the solutions of Wick and Cutkosky. They are shown to be completely equivalent.

Chapter 6 considers the corresponding equation in the instantaneous interaction approximation. The equation is not solved but an indication of the eigenvalues is given and it is suggested that the approximation is good only in the extreme nonrelativistic region.

In Chapter 7 a normalization condition differing from that previously used is developed by a method like that used for one-particle wave equations. As the solutions of Wick's equation can be normalized by the customary method and the new condition is weaker, it cannot be used to exclude any solutions.

Finally, in Chapter 8 a few additional comments and conclusions are given.