The Structure of Strong Interactions in Anisotropic Chromodynamics.

II. - The Meson Spectrum.

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Summary. — We have applied anisotropic chromodynamics (ACD) to a calculation of the first approximation of the meson (q̅q) spectrum. We show that ACD affords a consistent and remarkably successful description of this spectrum in terms of 5 parameters only: 4 quark masses and the "string tension" $\mu$. We can clearly delineate which higher-order effects should act, and how, in order to produce a systematic and accurate account of the parameters of all known mesons including their decay properties.

I. - Introduction.

In a previous paper, hereafter referred to as I (1), we have laid out a possible strategy to compute systematically the dynamics of the strong interactions starting from a well-defined field theory: anisotropic chromodynamics (ACD).

In this paper we wish to present the first results of our programme. There are strong indications that the path we have chosen to follow does seem to be extremely fruitful, not only because it allows us to approach the complex problem of hadrodynamics in a systematically feasible way, but also because in so doing an incredibly large number of experimental facts find their accurate and physically meaningful explanation.

In order to preserve as much as possible an objective perception of what we are accomplishing, we would like to state clearly that, although the approach we are pursuing has a completely new and definitely unconventional theoretical background (2,3), many of the notions we shall be dealing with are by no means uncommon in present-day high-energy theoretical physics. Whether or not the mentioned theoretical background will be able to lead us to some radically new insight into the world of subnuclear particles, only time will tell. Our purpose, for the time being, is to show that, starting from a Lagrangian approach (whether it is an effective Lagrangian or a fundamental theory is not really relevant in the present work) involving an extremely small number of input parameters, one can reproduce in a quite precise fashion the basic features of the meson (q̅q) spectrum. Again, whether or not a similarly powerful description can eventually be generated by quantum chromodynamics (QCD) (4) should not detract, we believe, from what we have accomplished.

The plan of the paper is as follows: in sect. 2 we briefly review the main theoretical ideas of ACD with a special attention to the aspects relevant to our analysis. Section 3 contains the statement of our problem and the strategy chosen to solve it. In sect. 4 we derive the relevant spectrum equation and discuss a few of its properties. We present our main results in sect. 5, together with a discussion of the main limitations affecting our calculations. Finally sect. 6 contains our conclusions and an outlook on the possibilities open to our approach in the near future.

2. – Anisotropic chromodynamics.

Anisotropic chromodynamics (ACD) (2,3) is a gauge theory of the colour $SU_3_c$ symmetry group of the hadronic interactions, whose base space is larger than the Minkowskian manifold $M_4$. In the anisotropic space-time (AST)

\begin{equation}
M_4 \times \mathbb{R}_4
\end{equation}

(2.1)