The interaction of two dyons in the near field limit

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Abstract

We study the interaction of two dyons in the region of their cores where they are non-linear and non-Abelian. We assume the superposition of two dyons as a solution of the equation of motion. The terms due to the non-linearity of the strength tensor are considered as the perturbation terms which deforms the profile function of two individual dyons. As a result, the profile function of dyons are obtained to be dependent on the polar angle and the spherical symmetry is lost.

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1. Introduction

The structure of QCD vacuum is an interesting subject to study in particle physics. Calorons are among the candidates for this structure. Calorons are the periodic solutions of Euclidean Yang–Mills theory which are classified with the holonomy as an order parameter. KvBLL instanton [1][2] are described by maximally non-trivial holonomy.

In a set of papers [3][4][5], Diakonov and Petrov showed that confinement–deconfinement transition can be described by the KvBLL instantons. They studied non-interacting ensemble of KvBLL instantons or calorons by considering the Polyakov loop as an order parameter and calculated the free energy of the quark–antiquark pair and the transition temperature.

To study the interacting ensemble of calorons, the superposition of calorons should be studied. ADHM method [6] [7] is a powerful method to construct the arbitrary self-dual solutions.
of the dyons which are the constituents of the calorons. In the limit where the constituents of the caloron are far away from each other such that they can be distinguished as two dyons, we can consider the interaction of the dyons as the interaction of the calorons. In that limit, we can make two calorons close enough such that their dyons overlap and study the interaction of the dyons. Of course, the problem is not that easy since the Dirac string between the dyons inside the caloron should be taken care of very carefully and thus more projects and studies are needed to reach the final goal.

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References