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Classical Models of Confinement II

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Dedicated to the memory of Kurt Symanzik

Abstract. We generalize the class of Abelian models of paper I which lead to a linear potential between opposite charges. The electric field E is here taken as a power series in the electric displacement D raised to the σ^{th} power. We solve to first order the case of two opposite static point charges asymptotically for large separations.

1. Introduction

In a recent paper [1] (hereafter referred to as I), we investigated classical models of confinement. These models are essentially those previously studied by Pagels and Tomboulis [2] and more extensively by Adler and Piran [3]. They can be viewed as ordinary electrostatics with a field-dependent dielectric constant.

In I we considered the case

$$E=f(D)=E_0+b_1D+b_2D^2+\dots, \tag{1.1}$$

with $b_1>0$. Without loss of generality we can set $E_0=b_1=1$. For two unit static charges of opposite sign, separated by a large distance $2R$, it was found that the flux is confined within an ellipsoid of revolution with semi-minor axis $(2R/\sqrt{\pi})^{1/2}$, leading to a linear potential with a correction of order $\ln R$. We also studied briefly the more general case,

$$E=f(D)=1+D^\sigma+\dots, \tag{1.2}$$

with $\sigma>0$ and we showed that the transverse dimension of the confinement domain increases as $R^{1/(1+\sigma)}$ for large R.

It is the purpose of the present note to examine further the case (1.2). This more general case is of interest in view of the uncertainty in the shape of the confinement domain for a realistic theory such as QCD.

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