Commun. Math. Phys. 103, 637–668 (1986)

Communications in Mathematical Physics

Absence of Charged States in the U(1) Higgs Lattice Gauge Theory

J. C. A. Barata[1,*] and W. F. Wreszinski[2,**]

1 Instituto de Fisica, Universidade de São Paulo, São Paulo, Brazil
2 Institut für Theoretische Physik der Universität Zürich, Schönberggasse 9, CH-8001 Zürich, Switzerland

Abstract. We show that a sequence of dipole states of finite energy introduced by Fredenhagen and Marcu is chargeless upon removal of one of the charges to spatial infinity in certain subsets of the phase diagram of the U(1)-Higgs lattice gauge theory. It is also explicitly seen how this phenomenon is related to the existence of exponential clustering (i.e., of a mass gap). Related properties of dipole states are briefly discussed.

I. Introduction and Summary

In a beautiful paper, Fredenhagen and Marcu [1] showed that a certain sequence of dipole states of finite energy acquires a charge when one of the charges is removed to infinity in a subset of the phase diagram of a $Z(2)$-Higgs lattice gauge theory. They also proved that the same states are chargeless in certain subsets of the confinement/screening regions of the model.

In this paper we prove the absence of charge for the same sequence of dipole states introduced in [1] in a subregion of the screening/confinement diagram of the U(1)-Higgs lattice gauge theory. Our main motivation in so doing is that this theory involves additive (in contrast to multiplicative in the $Z(2)$ case, treated in [1]) charges, implying a different structure, more akin to the more interesting nonabelian gauge theories. In particular, the connection between the absence of charges and exponential clustering (i.e., a mass gap) seems to appear more directly in the present model (see Sect. III). This statement is related to a remarkable theorem of Swieca [2] (a rigorous version of which was formulated and proved in [3]), a general result in the framework of (continuum) relativistic quantum field theory which roughly states that in abelian gauge theories with a mass gap there

* Supported by the Fundacão de Amparo à Pesquisa do Estado de São Paulo (FAPESP). Address after September 1985: II. Institut für Theoretische Physik der Universität Hamburg, Luruper Chaussee 149, D-2000 Hamburg 50, Federal Republic of Germany

** Supported by FAPESP. Permanent address: Instituto de Fisica, Universidade de São Paulo, São Paulo, Brazil