A NEW TRENDS IN HIGH-ENERGY PHYSICS
Current Topics in Nuclear and Particle Physics

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(Dedicated to Professor Shuji Orito,
the late chairman of High Energy Committee of Japan)

Abstract

The hottest subjects in high energy physics for the last couple of years are discussed in some details. The contents of this talk include:

I. Introduction
II. Exotic Nuclei
III. Color Ball as Pomeron
IV. Neutrino Masses and Mixings
V. Higgs Scalar Mass
VI. Superparticles
VII. Substructure of Quarks and Leptons
VIII. Structure of the Universe
IX. Conclusion and Future Prospects

Preface

I would like to dedicate this talk to Professor Shuji Orito, the late chairman of High Energy Committee of Japan, who has contributed so much to high energy physics for the last more than three decades, in a variety of fields ranging from the first muon-pair and multi-hadron productions by two-photon processes in the ADONE e-e-storage ring at Frascati in 1974 (1) and the discovery of the new particles by the DASP Collaboration in the DORIS e-e-storage ring at DESY in 1976 (2) up to the recent measurement of cosmic ray antiproton spectrum by the BESS Collaboration (3).

I. Introduction

I have been asked by Professor Jenkovszky, the chairman of the Organizing Committee of this Conference, to give a talk on the recent results of my research, in particular those connected with the substructure of quarks, predicted in our classical papers. In this talk, I am going to discuss in some details the hottest subjects in high

energy physics for the last couple of years, most of which may somehow be related to the substructure of quarks of leptons and all of which have been predicted in our classical papers. I will organize this talk in the following way. I will discuss Exotic Nuclei in II, Color-Ball as Pomeron - in III, Neutrino Masses and Mixings - in IV, Higgs Scalar Mass - in V, Superparticles - in VI, Substructure of Quarks and Leptons - in VII, Structure of the Universe - in VIII, and present Conclusion and Future Prospects - in IX. Some parts of the contents in this talk have already been published either in the recent journals or in the proceedings of the recent international conferences, to which I will refer wherever appropriate and in which you can find the mathematical details.

II. Exotic Nuclei - See Refs. 4, 35.
III. Color-Ball as Pomeron - See Refs. 36, 49.
IV. Neutrino Masses and Mixings - See Refs.50, 72.
V. Higgs Scalar Mass - See Refs. 73, 83.
VI. Superparticles - See Refs. 84, 86.
VII. Substructure of Quarks and Leptons - See Refs. 87, 99.
VIII. Structure of the Universe - See Refs. 100, 108.
IX. Conclusion and Future Prospects

I have discussed the hottest subjects in high energy physics for the last couple of years, ranging from nuclear, hadron and particle physics to cosmology. As for future prospects of high energy physics, have recently presented many discussions in various conferences including the last Crimean Conference. Instead of repeating these discussions, I wish to present a new trend in high-energy physics, in the following.

As emphasized in Section II. the stability of nuclei and, therefore, that of matter depends on the small mass difference between the proton and neutron or that between the up and down quarks due to the mass difference between the *w1* and *w2* subquarks. As emphasized in Section III. the origin of the finite and non-vanishing size of hadrons may be closely related to the Pomeron. It must also be related to the energy scale of QCD *Lambdac* ~100MeV, which may eventually be related to the small but non-vanishing up and down quark masses. As disscussed in Sections IV and VII, the non-vanishing but extremely small neutrino masses may be due to the combination of spontaneous breakdown of supersymmetry between the *w1* and *C0* subquarks, which are equal-mass and maybe massless, and breaking of iso-spin symmetry between the *w1* and *w2* subquarks, which is caused by the mass difference between them. Very lately, the observations of CP violation in the neutral B meson system have been reported both by the BABAR and Belle Collaborations (110). I suppose that the CP violation, which may be described phenomenologically in the standard model of quarks, must also be originated from subquarks in quantum subchromodynamics. I hope that we shall be able to say "The truth is out there" soon.

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