EDITORIAL INTRODUCTION

100th anniversary of Ettore Majorana

THIS SPECIAL ISSUE *is dedicated to the 100th anniversary of the great Italian physicist Ettore Majorana and to his article on neutral particles [1], which is alive till now through years [2-5]. I mean the article, of course, while other researchers invent some mysteries about his death. The well documented review is in ref. [6]. The special issue includes the works by S. M. Bilenky, C. Lim, G. Ziino, G. Lochak, S. Esposito, G. Volkov, M. Khlopov, R. Plaga, E. Ma, A. Studenikin, N. Mankoč-Borštnik and her collaborator H. B. Nielsen, S. Kruglov. The key problem is neutrino mass in modern models. It was indeed surprising that even after the experimental discovery of the mass of neutrinos several researchers, which are considered now to be its advocates, did not believe in it (just ask participants of the Latin American School of 1995, XXX ELAF, what told Prof. J. G. Hirsch about my statements about the LANL experiments). Now it seems everybody to be convinced that the Standard Model should be generalized. But, remember that the way to the neutrino mass was opened by the Majorana paper [1].*

As for the papers of this special issue I want to make some comments. S. M. Bilenky (one of collaborators of B. Pontecorvo who theoretically predicted neutrino oscillations [7]) first reviews the Majorana paper [1]. I noted an important point in his paper: he seems to understand the importance of the anti-self charge conjugate field χ_2. The historical aspect is also important. Racah and Furry proposed a method [2] which could allow to test, whether the neutrino is Majorana or Dirac particle. Nevertheless, he claims that "it is impossible in foreseeable future to reveal neutrino nature in neutrino experiments of the Racah type" (see the recent discussion [8]). His paper also presents a concise anal-

ysis of the present-day experimental data (neutrinoless double β-decay, SuperKamiokande, CUORCINO, etc). Finally, Prof. Bilenky indicates the astrophysical aspect of the problem related to the possible existence of the heavy Majorana particles. His conclusion is: "There is no theory of neutrino masses at present. There exist different strategies and models."

Dirac particles (almost) with tiny Majorana masses are discussed in the Lim paper. They are called the pseudo-Dirac neutrinos. The author tries to explain almost maximal mixing in the atmospheric neutrino oscillations. He explains that "the chiral partner of the left-handed fermion can be the antiparticle of the left-handed fermion itself", and introduces a 6×6 mass matrix. In a sketchy way he presents formulas following from his model, discusses its advantages and disadvantages.

Next, G. Ziino develops his dual model for massive spin-1/2 particles. This scheme (in the massless limit) appears to be fully compatible with the present-day electroweak model, as claimed by the author. However, in my opinion, it is better to say that he presents an extension of the standard model. In the quantum case the scheme includes an extension of the Fock space, the idea which was discussed by many authors in the last decades. It is interesting that our Journal was the first one to have published this model long ago.

G. Lochak continues to analyze the magnetic monopole models with "chiral gauge invariance", compare with my previous works [9]. In fact, his old pioneer works hepled me to understand many features of the $(1/2, 0) \oplus (0, 1/2)$ representation space of the Lorentz group [4].

S. Esposito discusses a bit different things which are related to the path-integral approach to quantum mechanics. His paper is based on the unpublished manuscript of E. Majorana. It is rather historical. The author tries to analyze the Majorana manuscript in the context of the famous works by P. Dirac and R. Feynman (see refs. [8,13] in the Esposito paper).

The following G. Volkov paper tries to find connections between own ideas of this authors (mainly, in superstring theories, ternary approach and Calabi-Yau spaces). M. Khlopov presents his own ideas too. This time these ideas are about the dark matter problem. It is indeed the hot topic which should be solved soon, in my opinion. Hopefully, readers would encounter relations with Majorana works themselves. R. Plaga has begun an exciting discussion a few years ago [8]. In this volume he claims that there are no Majorana physical neutrinos in the standard

model. We discussed this statement in editorial correspondence extensively. I decided to publish this paper. E. Ma presents a sketch of supersymmetric models. The supersymmetric radiative seesaw mechanism can be of great interest for our readers. However, they should look for previous papers of this author (see the references in the paper). I agree that, indeed, "dark matter may not be as boring as usually assumed". A. Studenikin again tries to attract the attention to polarization tensor and chiral gauge transformations [9]. The author accounts "effective potentials" "in the presence of matter"? Mankoč-Borštnik (as many others) looks for "a new way beyond the standard model". Her way (and that of her collaborator Nielsen) is the higher dimensions like in superstring theories. Undoubtedly, working out higher dimensions one can explain many specific peculiarities of $d = 1 + 3$ *in many different ways [10]. Finally, we found the paper of S. Kruglov with "higher derivatives scalar field theory". Yes, he acknowledges that "it was discovered that there are some difficulties with negative norm (ghosts) and unitarity in HD theories". Perhaps, it is the time to explain them?*

For physics students, I believe, I should give the references to the recent textbooks [11]. I wish them good luck with the journey to the Majorana Physics. Hopefully, this special issue would help them understand it too.

We extend our special thanks to our Publisher, our authors, our referees and our friends.

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