Dr. Ansar Fayyazuddin
Assistant Editor
Physical Review D

Response to Reports on DN10622

Dear Dr. Fayyazuddin,

Thank you for your message of March 8 containing referees' reports with regards to the above paper. We are also grateful to the referees for careful reading of the manuscript and a large number of suggestions aimed at improving our presentation. We agree with practically all suggestions and tried to do our best in revising the paper, without compromising its message, which, as both referees agree is scientifically sound.

In summary, we made all changes recommended by referee 2, adding explanations where necessary, expanding derivations and correcting typos in some formulas. To streamline our presentation, we moved a part of the main text devoted to the geometric formulation in Appendix E. Now the geometric formulation is only marginally used in Sect. 8, while all necessary definitions and facts are referred to this Appendix.

In particular, we would like to comment on two main remarks of the second referee. The first one is the remark 3 to Sect. 4. We included an explanation on p.16 that the phase factor in (4.22) does not follow from equation (4.19). It appears due to anomalous breaking of $U(1)_R$ symmetry down to Z_{2N}. We also include the complexified version of (4.19) in (4.23).

Second is the remark 2 and 4 to Sect. 5 about relation between deformation parameters $\omega = \delta\sqrt{2\beta}$ in the strong coupling phase, where renormalized β is equal to zero. As the second referee points out renormalization is involved here. The above relation is only classical definition valid for bare parameters and β is the bare coupling constant, which is non-zero. Once the renormalization is taken into account the convenient deformation parameter is ω, which now (in the revised version) we introduce in (3.9) as independent parameter. The point is that two coupling constants of the model, namely β and ω diagonalize the renormalization group equations and therefore it is convenient to use these parameters, rather than others.

We would like to mention that the work done by this referee in reading our manuscript is remarkable. We would like to thank the referees in the Acknowledgments.

We also added 4 references (in Section 8), with the appropriate comments. For convenience of the readers, we added Appendix C in which we compile and compare various definitions of the heterotic deformation parameters one can find in the literature. The large-N scaling laws for all these definitions are summarized here.

As regards to the first referee, we changed our Introduction and Section 4 in such a way that now it is perfectly clear (hopefully) what was known in the literature previously and is reviewed in our paper to prepare the theoretical set up for original studies, on the one hand, and what is our original contribution, on the other. We enhanced the citation of Refs. 28, 33 and 34.

With all due respect we do not accept, however, the statement of the first referee that Sects. 1 to 4 and Sect. 8 are not needed and should be dramatically reduced. Sections 1 and 2 present introduction. They occupy 4 pages, which seems justified given a large number of issues we address in the original part of this work. Section 3, presenting our basic model and describing relevant physics, is only 4 pages long. It is barely enough to introduce all relevant notation.

Section 4, besides reviewing our previous results, introduces all necessary machinery and theoretical methods needed for the large-N solution of the heterotic model with twisted masses. It is 9 pages long, which is indeed, somewhat on a long side. However, without explicit discussion of the machinery and methods used in our original studies, the paper looses its self-contained nature, and could not be read (nor understood, as a matter of fact), without preliminary studies of at least three previous papers.

With all due respect we disagree with the first referee with regards to Section 8. Sect. 8.1 presents a new result: construction of the mirror representation for weakly heterotically deformed CP model with twisted masses. Section 8.2 explicitly demonstrates the difference between the Veneziano-Yankielowicz-type effective Lagrangian (8.14) and the exact large-N solution at order u^2. Sect. 8.3. sheds new light on the determination of the curve of marginal stability (its form was known previously, but we use a new method to confirm previous results).

The revision we undertook is extensive. At the same time both referees note that new results we obtained on physics of the heterotically deformed CP models with twisted masses are solid and interesting. We sincerely hope that the revised version we would like to submit now will be positively evaluated and the paper can be published without further delay.

Best regards

Pavel A. Bolokhov, Mikhail Shifman, Alexei Yung