

Response to referee reports

In this document the authors present their response to the anonymous referee reports, together with an overview of the revisions made based on their suggestions.

- **Journal:** SciPost Physics
- **Article number:** 2204.07583v2
- **Title:** Quantum chaos in 2D gravity
- **Authors:** Alexander Altland, Boris Post, Julian Sonner, Jeremy van der Heijden, Erik Verlinde

Dear editor-in-charge,

We thank the referees for their positive review and constructive criticism of our paper ‘Quantum chaos in 2D gravity’, submitted to SciPost Physics on 2022-07-01. The referees clearly showed an interest in our paper and a sharp eye for its possible improvements. After reading the referee reports and Editorial Recommendation, we have incorporated the suggestions made therein, resulting in this revised version of the article submission. We will now list the changes made compared to version 1, in response to both reports.

Overview of revisions

The main revision to the article is a rewriting of the Introduction. As both referees have independently noted, the original introduction lacked clarity of presentation as well as a clear statement of the new results presented in this article. We believe that the new Introduction is more structured and unambiguously states the main aim, ideas and equations derived in the body of the work. Moreover, the original overview diagram (Figure 2 in the first version) has been replaced by a slimmed down diagram which highlights the principal connections made in the paper.

The other structural revision has been to combine all the reviewed material and necessary prior knowledge in a separate section, aptly titled ‘Setting the scene’. The new material following this section has been made self-contained and more flowing. Moreover, some extra details of the computation are added where necessary. Lastly, a few minor typos were fixed and some references were added.

Referee report 1

The report submitted on 2022-8-13 rightfully points out that the potential of the flavor matrix integral is (for the non-Gaussian case) in general different than the potential of the color matrix integral. The new version rectifies this statement (see below Eq.2.2) and we thank the referee for pointing it out to us. Secondly, the referee has identified some ambiguous or imprecise statements in the Introduction. We believe that the new Introduction is precise and correct in its claims, resolving the issues put forth in the referee report. Lastly, the referee found the review section about causal symmetry breaking in disbalance with the main material in section 3 and 4. The new structure, in which all the review material is collected in a single section (which may be skipped by experts), puts more focus on the main new material. This should restore the balance between old and new ideas that the referee was looking for.

Referee report 2

In the second report, submitted on 2022-8-29, the referee once again stresses the need to revise the Introduction such that it outlines the main ideas and makes the work accessible to a wider audience. We believe that the new Introduction does precisely this: it explains the motivation to connect JT gravity to the field of quantum chaos, using the tools and intuition from (topological) string theory, after which it presents the main new equations derived in Section 3, followed by an open string interpretation and finally its relevance to SYK. The old 'metro map' figure is gone and has been replaced by a more coherent overview diagram (Figure 1).

Furthermore, the referee points out that to fully appreciate the connections made in the article, the reader needs to be an expert in both fields. In order to increase readability we have made changes throughout highlighting the steps taken and ideas required. We now introduce and collect background material in Section 2. The other ingredients are presented in small doses as one goes along. We believe that this way the reader will stay with us without being intimidated by too much review content. In combination with a better explanation of the overall picture, the current article increases the accessibility to a wider audience that the referee sought for.

We hope that the revisions made to our submission have adequately resolved the principal critiques of the referees. We once again thank the referees for their feedback and the editor-in-charge for their Editorial Recommendation. We look forward to a publication of our paper in SciPost Physics.

Sincerely,

The authors.

November 11, 2022