Report on *"Asymptotic safety, quantum gravity, and the swampland: a conceptual assessment"*

The so-called swampland program was initiated in the context of string theory. However, recently, there is growing interest in the understanding of the potential generality of such a program. In this work, the authors provide a thorough discussion on the status of the swampland conjectures in the context of asymptotically safe quantum gravity. The work is very well written, it is logically well structured and contains detailed discussions addressing foundational issues that are essential for a proper formulation of the swampland conjectures in a quantum-field theoretic formulation of quantum gravity. The manuscript also contributes to the effort of bringing together different approaches to quantum gravity. However, there are some points that the authors should clarify in a revised version to sharpen some of the arguments. I list them below.

- In the first paragraph of Sect. 3, the authors establish the class of QG theories *based on QFT in spacetime*. I don't understand what this means. Even if a background-metric structure is introduced in order to make sense of QFT techniques, this is not to be thought as a QFT in spacetime in the context of QG. For instance, one can make perfect sense of a QFT by means of lattice techniques and, in the context of QG, no background structure is introduced and it makes no sense to talk about a QFT *in* spacetime. It could be that the authors meant something else but in this case I suggest that an explanatory note is added.

- One of my biggest concerns lies on their argument that spacetime topology is fixed in ASQG. Formally, in a QG-bases approach, one can write the path integral as a functional integral over metrics. I do not see how such a formal construction forbids topology change to begin with. Additionally, if one writes such a path integral and use the background field method, what determines the "fixed topology" one is performing the path integral over? If one can consistently sum over *all* topologies is a different issue but I don't see how one can control the topology one is integrating over specially non-perturbatively. I emphasize that my question involves a conceptual but also a practical aspect of the ASQG program. Again, the analogy with a lattice formulation can be instructive. For instance, in a Euclidean environment, a "standard QG path integral" will sum over topologies (although, formally, the integral is over "metrics"). In my opinion, the authors should carefully state if any additional assumption about topology change is introduced in what they call QFT-based QG.

- Regarding the content of footnote 21: Does it apply if the gravitational field emerges from a field-theoretic pre-geometric setting?

- My impression is that there is some implicit assumption in what the authors call QFT in the following sense: Members of the LQG community would say that LQG *is* a QFT. Lattice approaches correspond to QFTs using a different computational scheme (compared with standard continuum techniques). Statistical models such as matrix models correspond to an alternative way of implementing the discretization in lattice approaches thus being also QFT-oriented. But in Sect. 3.4 the authors put matrix models precisely in the context of ASQG beyond QFT as if the definition of the gravitational path integral in terms of those models would correspond to a different theory. I strongly suggest that the authors establish a clear definition of what they mean by a QFT and why one should expect that a matrix (or tensor) model that would generate the same path integral of lattice QG should not agree with the continuum approach.

- One of the striking conclusions of the manuscript is that ASQG must reinterpret the meaning of BH thermodynamics. Thinking about the generalized second law and given that "standard" statistical/thermodynamical origin of entropy for matter degrees of freedom is valid how can BH entropy and Matter entropy be treated differently? My understanding is that in order to elucidate this, one should find a way to *derive* the would-be BH entropy from the fundamental theory of ASQG. But if there is no microstate counting interpretation how one would derive it in ASQG?

After addressing the questions raised above, I envision that the paper is suitable for publication even if some of the main results need to be weakened.