Qeios

Peer Review

Review of: "Dynamical Edge Modes in Yang-Mills Theory"

Amitabh Virmani[1]

1. Chennai Mathematical Institute, Chennai, India

In this paper, the authors extend the analysis done for the splitting of bulk and edge modes from abelian Maxwell theory to non-abelian Yang-Mills theory. The presentation is very clear, and the authors make an effort to refer to and explain the related literature. As per my judgment, the results presented are sound and valid.

My more detailed comments are as follows:

A common theme among diverse discussions of edge modes is the importance of incorporating localised fields at the boundary when analysing local sub-regions (local sub-systems) in gauge theories and gravity. In this paper, the authors impose the Landau gauge. The question that is beyond the scope of the paper is whether this gauge choice is uniquely achieved or not [most likely not]. However, this is not a problem for a perturbative analysis. Under these assumptions, the authors show that the phase space factorises as a direct product: they construct two independent symplectic structures, one for the bulk modes and another for the edge modes. Then they study the Poisson brackets based on the symplectic form. They show that the bulk and the edge degrees of freedom do not talk to each other, i.e., they Poisson commute.

In section 4, they study the effects of their field decomposition on the Hamiltonian evolution for a timelike boundary of a [static] spacetime region. Unfortunately, the authors are not able to establish that if we consider an infinitesimally small hole, the result is as if there is no hole at all. This is known for abelian Maxwell theory but not for Yang-Mills theory. More interestingly, they construct the Hamiltonian for the theory. The Hamiltonian does not decouple the bulk and the edge modes. The bulk and the edge modes remain dynamically intertwined.

In section 5, they show that in a weak field expansion, the decoupling does happen at the quadratic order. In the presence of a horizon, again the decoupling does not happen. It turns out that in a limit

 doi.org/10.32388/D9QAKV

that they explain, the edge Hamiltonian term is of the same order as the bulk-edge cross term.

In summary, closely borrowing results from abelian Maxwell theory, the authors discuss Yang-Mills theory on a Cauchy surface with boundary. The main result is that the bulk and the edge degrees of freedom do not talk to each other, in the sense that they Poisson commute. However, the Hamiltonian evolution couples the bulk and the edge modes.

Declarations

Potential competing interests: No potential competing interests to declare.