Research Plan

I aim to perform a direct verification of the gauge/gravity correspondences for non-geometric spacetimes including generalized supergravity backgrounds recently discovered. Since the structure group of such geometries contains T-duality transformations, it is highly unclear whether holography works well in this case. Therefore, it would be an important work to verify the correspondences for such backgrounds in order to understand the applicability of the holographic principle. I moreover intend to clarify how the dual gauge theories describe the non-geometric structures of spacetime.

For this purpose, we focus on the geometries generated from the Yang-Baxter (YB) deformations of the $\mathrm{AdS}_5 \times \mathrm{S}^5$ superstring. The deformed backgrounds are solutions of not only the usual supergravity but also generalized supergravity. The remarkable property of the method is that the deformed sigma models are also integrable if the original sigma model is integrable. Therefore, by employing the integrability methods, we could compute various physical observables at the finite t'Hooft coupling, and verify the correspondences for deformed systems.

However, at the moment, we cannot directly apply the integrability methods to deformed theories. For this issue, I first study the correspondence for simple supergravity solutions (e.g., Maldacena-Russo background) generated by the YB deformations as a first step. As with the undeformed case, it is inferred that the integrable spin chain structures underlie both deformed systems. I clarify the integrable structure and generalize the integrability methods to exactly compute physical observables for deformed systems.

Next, I extend the above discussion to generalized supergravity backgrounds. More concretely, I aim to construct the dual gauge theories corresponding to them generated from YB deformations of $\mathrm{AdS}_5 \times \mathrm{S}^5$ backgrounds. The actions of such gauge theories should contain terms which reflect the non-geometric nature of generalized supergravity. I would like to clarify their physical interpretation in the context of field theory. By using the integrability methods developed in the previous paragraph, I want to verify the correspondences at the finite t'Hooft coupling λ.