論文の内容の要旨

Entropy of the Janus interface in superconformal field theories

(超共形場理論におけるヤヌス・インターフェースのエントロピー)

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Quantum field theories (QFTs) are very basic and important ingredients in modern physics since they describe wide varieties of phenomena. One way to investigate QFTs is to use defects which are non-local objects in QFTs. By using defects, we can diagnose phases of QFTs or extract useful data in QFTs. The main subjects of this thesis are a co-dimension one defect called an interface and an its entropy. The latter is considered to be able to characterize/classify conformal field theories (CFTs) with an interface since it is conjectured to be a monotonic function along RG flows [1]. In particular we study the entropy of the Janus interface in a $4d$ $\mathcal{N}=2$ superconformal field theory (SCFT). The Janus interface entropy in a $2d$ $\mathcal{N}=(2,2)$ SCFT was investigated by Bachas, et.al. [2]. They showed that it can be written as a specific linear combination of analytically continued Kähler potentials on moduli space called Calabi's diastasis. The goal of this thesis is to show that this interesting relation also holds in $4d$ $\mathcal{N}=2$ SCFTs as conjectured in [3].

In the former half of this thesis, we derive the relation between a partition function on sphere and an interface entropy. First we define an interface entropy as a contribution from an interface to an entanglement entropy across a spherical entangling surface. Then we use a conformal map introduced by Casini, Huerta, Meyers [4] which we call the CHM map to relate the interface entropy for a conformal/superconformal interface and the sphere partition function. For a half-BPS superconformal interface we make an assumption to derive the relation between the interface entropy and the sphere partition function. We also give evidences supporting this assumption.

In the latter half of this thesis we focus on the Janus interface. The Janus interface is an interface across which a coupling constant changes its value. First we give an off-shell

construction of the Janus interface by promoting a coupling constant to a bottom component of a chiral multiplet. Then we evaluate the partition function in the presence of the Janus interface in a $4d$ $\mathcal{N} = 2$ SCFT via the SUSY localization technique. By using this result and the relation between the interface entropy and the sphere partition function, we finally show that the entropy of the Janus interface is given by Calabi's diastasis. We also give the result via the AdS/CFT correspondence which provides a nontrivial check for our formula relating the interface entropy and the sphere partition function. This thesis is based on our paper [5].

References

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