論文の内容の要旨

Some Aspects of Boundary and Defect Conformal Field Theories
(境界または欠損付き共形場理論の諸相)

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In this thesis we explore various theoretical aspects of conformal field theories with boundaries and defects in order to classify and understand these theories better. For this purpose, what we want to compute is conformal anomaly coefficients, the sphere free energy and the entanglement entropy, all of which contains considerable dynamical information of theories.

In the former half of the thesis, we specifically consider the scalar O(N) symmetric field theory with $\varphi 6$ interactions in $\mathbb{R}^2 \times \mathbb{R}$. This theory exhibits an approximate conformal symmetry in $N \to \infty$ limit where we can do explicit calculations. We first study possible phases associated with boundary conditions and argue their relative stabilities. We then compute the correlation function of stress tensors in Dirichlet boundary condition, further decomposing it into bulk and boundary conformal blocks to gain the operator spectrum underlying this theory. We finally elucidate boundary conformal anomaly coefficients. We find all of these quantities depend on a quasi-marginal coupling.

In the latter half of the thesis, we investigate the sphere free energy and the entanglement entropy of conformal field theories in the presence of the boundary or the defect, since these two numbers can be means to count effective degree of freedom under RG flows. Establishing the universal relation between them, we find the sphere free energy and the

entanglement entropy are equivalent with a suitable ultraviolet regularization in the case of codimension-1 defects and boundaries, however, they differ due to the contribution from the defect when we consider higher codimensional defects. We then propose the monotonicity theorem (termed C-theorem) stating that the sphere free energy, not the entanglement, entropy should monotonically decrease under any RG flows. This proposal can unify all known C-theorems in the literature and also provides new series of them in general dimensions of the spacetime and defects. We confirm that our proposal holds in various models. In some holographic models, we are able to prove our conjecture with the assumption of the null energy condition.