In this research we focus on a theory that describes all forces of nature in a unified framework, namely string theory. This theory describes elementary particles as little strings. Surprisingly, string theory predicts that gravity in \(d\) spatial dimensions and one time dimension can equivalently be described as a field theory in one less spatial dimension with special properties like invariance under scale transformations, or more specifically conformal transformations. This equivalence is also called holographic duality and the field theory is called conformal field theory. To this date it is not known to what extent the extra dimension of spacetime is emergent from the field theory. An important concept is ‘entanglement entropy’, which measures the uncertainty of an observer that only has access to observables on a spatial part of the field theory. In particular it has previously been found that entanglement entropy is holographically described by the area of a boundary anchored minimal surface in the gravitational spacetime.

We consider certain surfaces that are extremal but not minimal and we propose a quantity in the field theory that is related to the entanglement entropy of internal degrees of freedom. Such a quantity is important to reconstruct certain holographic spacetimes from entropy. Further in this research we study particular correlations (or better correlation functions) in the field theory and investigate how they are influenced by the constraints of conformal symmetry. We find that specific correlation functions are holographically computed by scattering of light fields off a heavy particle. Lastly, we study the dynamics of entanglement entropy. We focus in particular on states that are suddenly excited by an external source and subsequently evolve freely (i.e., without a source). From such a situation we can learn a lot about how field theories relax to thermal equilibrium. In the case of a conformal field theory in one spatial dimension and one time dimensions, we find no thermalization. This is due to the constraints of conformal symmetry.