

ABSTRACT

In this dissertation, I summarize my work on supergravity solutions involving the spindle $\Sigma \equiv \mathbb{WCP}^1_{[m_-, m_+]}$ and its generalizations, which give rise to \mathbb{M}_4 , four-dimensional orbifolds. These solutions are relevant to holography, as they are supersymmetric and explicitly contain an Anti-de Sitter factor or are asymptotically locally AdS_4 . The first part of the thesis focuses on compact four-dimensional orbifolds, which can be described by compact labeled polytopes, referred to as quadrilaterals. These take the form of $\mathbb{M}_4^{(1)} = \Sigma_g \times \Sigma_2$ or $\mathbb{M}_4^{(2)} = \Sigma_1 \times \Sigma_2$, representing a non-trivial fibration of a spindle Σ_2 over either a smooth Riemann surface Σ_g of genus $g > 1$ or another spindle Σ_1 , respectively. Both classes can be thought of as orbifold generalizations of Hirzebruch surfaces, and we describe $\mathbb{M}_4^{(2)}$ in terms of toric geometry. A more sophisticated generalization, where each facet of the polytope corresponds to a different spindle, is presented later. I demonstrate how the entropies of $\text{AdS}_2 \times \mathbb{M}_4$ solutions and the gravitational central charges of $\text{AdS}_3 \times \mathbb{M}_4$ are reproduced by extremizing an off-shell free energy, constructed by gluing simple factors known as gravitational blocks. The second part of the thesis deals with non-compact four-dimensional solutions, arising as the total space of complex line bundles over the spindle. The on-shell action, computed via holographic renormalization, reveals a rich structure linked to the twist or anti-twist realization of supersymmetry on the spindle bolt. This structure is then compared to general predictions derived from the equivariant localization of the action, finding perfect agreement.