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Variations of rational higher tangential structures

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VARIATIONS OF RATIONAL HIGHER TANGENTIAL STRUCTURES

HISHAM SATI AND MATTHEW WHEELER

ABSTRACT. The study of higher tangential structures, arising from higher connected covers of Lie groups (String, Fivebrane, Ninebrane structures), require considerable machinery for a full description, especially for connections to geometry and applications. With utility in mind, in this paper we study these structures at the rational level and by considering Lie groups as a starting point for defining each of the higher structures, making close connection to p_i -structures. We indicatively call these (rational) *Spin-Fivebrane* and *Spin-Ninebrane* structures. We study the space of such structures and characterize their variations, which reveal interesting effects whereby variations of higher structures are arranged to systematically involve lower ones. We also study the homotopy type of the gauge group corresponding to bundles equipped with the higher rational structures that we define.

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1. INTRODUCTION

Manifolds have been classically studied through structures associated with their tangent bundles leading to characterizations via obstruction theory and characteristic classes [St99][MS74][Hu94]. We examine the rationalization of tangential structures, with an emphasis on structures arising from higher connected covers of Lie groups. That is, we consider rationalizing the higher structure groups and their classifying spaces, namely String [Ki88][ST04], Fivebrane [SSS09][SSS12], and Ninebrane structures [Sa14]. This has a simplifying feature in that tangential structures from obstruction theory [St99][Hu94] are algebraically placed in the setting of rational homotopy theory [FHT01][FHT15][FOT08][GM13][BG76]. This setting allows us to filter out the torsion in our spaces thereby enabling us to have a much better handle on some aspects of these otherwise formidable structures. However, on the flip side, a complication arises when wishing to describe the rationalizations as spaces, since localization in general give rise to topological spaces which are not always nice [Fa96][Ne95][HMR75][BK72]. Our discussion will strike a balance between the two competing aspects and our goal in this paper is to highlight those features that have transparent descriptions.

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