Summary: We analyse in detail the language of partially non-abelian Deligne cohomology and of twisted differential $K$-theory, in order to describe the geometry of type II superstring backgrounds with D-branes. This description will also provide the opportunity to show some mathematical results of independent interest. In particular, we begin classifying the possible gauge theories on a D-brane or on a stack of D-branes using the intrinsic tool of long exact sequences. Afterwards, we recall how to construct two relevant models of differential twisted $K$-theory, paying particular attention to the dependence on the twisting cocycle within its cohomology class. In this way we will be able to define twisted $K$-homology and twisted Cheeger-Simons $K$-characters in the category of simply-connected manifolds, eliminating any unnatural dependence on the cocycle. The ambiguity left for non simply-connected manifolds will naturally correspond to the ambiguity in the gauge theory, following the previous classification. This picture will allow for a complete characterization of D-brane world-volumes, the Wess-Zumino action and topological D-brane charges within the $K$-theoretical framework, that can be compared step by step to the old cohomological classification. This has already been done for backgrounds with vanishing $B$-field; here we remove this hypothesis.

MSC:

- 81T30 String and superstring theories; other extended objects (e.g., branes) in quantum field theory
- 81T60 Supersymmetric field theories in quantum mechanics
- 18G50 Nonabelian homological algebra (category-theoretic aspects)
- 19L50 Twisted $K$-theory; differential $K$-theory
- 70S15 Yang-Mills and other gauge theories in mechanics of particles and systems
- 46M18 Homological methods in functional analysis (exact sequences, right inverses, lifting, etc.)

Full Text: DOI

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