Institute for Research in Fundamental Sciences

School of Physics

Ph.D. Defense Session

Title:

ρ-form gauge fields: charges and memories

Candidate:

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Abstract:

In this thesis, we study the asymptotic structure of p-form theories on flat space. p-form theories are generalizations of Maxwell's theory of electrodynamics in which the gauge potential is a higher-rank differential form. As in the Maxwell theory, there is a choice of boundary conditions with an infinite-dimensional asymptotic symmetry group. For higher p-form theories on $(2p+2)$-dimensional flat spacetime, the surface charges are classified by the Hodge decomposition of gauge parameters on $2p$-sphere into exact and co-exact charges. For the exact parameters which are special features of higher-form theories, the surface charges are non-commuting. In presence of p-branes, there are non-trivial zero-mode charges analogous to the electric charge for point particles. Although our p-form discussion is restricted to $2p+2$ dimensions, we generalize the study of Maxwell theory not only to general dimensions but also to the anti-de Sitter background. Finally, motivated by the IR triangle of gauge theories which relate asymptotic symmetries, memory effects, and soft theorems, we introducea new kind of memory effect exerted on the internal modes of
closed and open strings. On closed string probes, soft 2-form radiation rotates left- and right-moving modes oppositely, which amounts to a unit shift in the spin of probe particles. This provides the first instance of an `internal memory effect' on a non-local object. We conclude by general remarks on the physical significance of soft modes.

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