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Formal Group Laws and Toposes in Gauge Theory

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Abstract : One of the main problems in high energy physics is the fact that we do not have a complete understanding of the interaction between local and global effects in gauge theory. This has an increasing impact on our ability to access the non-perturbative regime of most of our theories. Our theories, while being based on gauge groups considered to be simple or semi-simple and connected, are expected to be described by their simple local linear approximation, namely the Lie algebras. However, higher homotopy properties resulting in gauge anomalies appear frequently in theories of physical interest. Our assumption that the groups we deal with are simple and simply connected is probably not suitable, and ways to go beyond such assumptions, particularly in gauge theories, where the Lie algebra linear approximation is prevalent, are not known. We approach this problem from two directions: on one side we are explaining the potential role of formal group laws in describing certain higher homotopical properties and interferences with local or perturbative effects, and on the other side, we employ a categorical approach leading to synthetic theory and a way of looking at gauge theories. The topos approach is based on a geometry where the fundamental logic is intuitionistic logic, and hence the 'tertium non datur' principle is abandoned. This has a remarkable impact on understanding conformal symmetry and its anomalies in string theory in various dimensions.

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