The presence of field configurations with non-trivial topology, and the consequences related to the possible presence of a topological parameter theta, are among the most interesting features of non-abelian gauge theories, and are strictly related to their non-perturbative properties.

How theta-dependence changes as one increases the number of colors, or as one crosses the deconfinement temperature, gives us a fundamental insight into various theoretical aspects of gauge theories. On the other hand, from a phenomenological point of view, the study of topological properties in the high temperature regime of QCD can be strictly connected to the physics of axions and to their possible role as dark matter candidates.

I will present a general perspective on the subject, with a focus on results obtained by lattice QCD simulations and on the open numerical challenges.