Contribution ID: **28** Type: **not specified**

# Closed flux tubes and their string description: a lesson by lattice gauge theories

During the last decade, much effort has been invested in the investigation of the effective string description of the flux-tube in SU(N) gauge theories;
this has been done both analytically and numerically (by means of extracting the flux-tube spectrum using the machinery of lattice gauge theories). Using lattice techniques, we calculate the energy spectrum of a confining flux tube that is closed around a spatial torus (this is also called a torelon), as a function of its length. We do so for various SU(N) gauge theories in D=3+1 and D=2+1 dimensions, and for various values of spin, parity and longitudinal momentum. In D=2+1 most of the low-lying states are described by the spectrum of Nambu-Goto bosonic string in flat space-time, while some other states show small deviations that vanish quickly with the flux-tube length. In D=3+1 we find that most of the low-lying states are well described by Nambu-Goto; so far this resembles our findings in D=2+1. However, and in contrast to the situation in D=2+1,
we see that there are some states with particular quantum numbers, that show large deviations from the Nambu-Goto spectrum and which display a very slow (if any) approach to that spectrum as the flux tube length increases.

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