Selected topics of lattice gauge theory

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Sheet 8 in WiSe 19/20

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1. Temporal gauge

a) Write a routine that transforms an arbitrary 2d $U(1)$ gauge configuration $U_\mu(\vec{n})$ into a new gauge configuration $U'_\mu(\vec{n})$ that is in the temporal gauge. The temporal gauge is the gauge where all gauge links in the temporal direction have the value 1 except for the links that start out from one time slice.

b) Repeat the simulation of the theory from exercise sheet 7 task 1b) and apply the routine you have written in a) before measuring your observables. Verify that the distribution of your observables are unchanged by the transformation.

2. Configuration with topological charge $Q = 1$

In the lecture you have seen how to construct a gauge configuration that has $Q = N_s$ where N_s is the spatial extend of the lattice and

$$Q = \frac{1}{2\pi} \mathfrak{Im} \left[\sum_{\vec{n} \in \Lambda} \log P_{xt}(\vec{n}) \right]. \tag{1}$$

a) Construct a gauge configuration that has $Q = 1$.

Hint: *If you work in the temporal gauge, use the fact that in that gauge the temporal links originating from one time slice need not to be 1.*

b) Implement a routine that constructs this gauge configuration. Verify numerical it has $Q = 1$.

c) Multiply your $Q = 1$ configuration link by link to a arbitrary configuration. Observe how Q changes.