Gauge field digitization in the Hamiltonian limit

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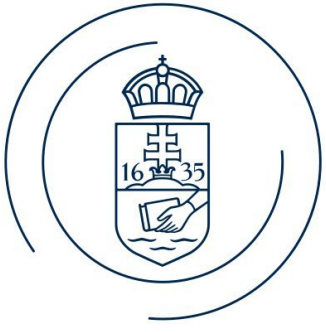

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Motivation: Complex Action Problem

partition function as a path integral

$$\mathcal{Z} = \int \mathcal{D}\phi \, e^{-S[\phi]} = \int \mathcal{D}\phi \, w[\phi]$$

if weights $w[\phi] \notin \mathbb{R}^+$ usual MCMC methods relying on importance sampling not applicable:

complex action problem

in principle, can be bypassed with the help of quantum computers

`[quant-ph/1811.03629]`

Digitizing gauge groups – U(1)

in the NISQ era the main bottlenecks are the limited

- circuit depths
- **number of qubits**

the Hilbert space for a gauge theory based on a continuous gauge group is infinite dimensional

shall be made discrete and finite via **digitization scheme**

[hep-lat/1906.11213], [hep-lat/2201.09625]

e.g. U(1) discretized to Z(N)

$$g_\infty(\varphi \in \mathbb{R}) = e^{i\varphi} \quad \mapsto \quad g_N(n \in \mathbb{Z}^+) = e^{2\pi i n/N}$$