Twisted Boundary Conditions in Lattice QCD

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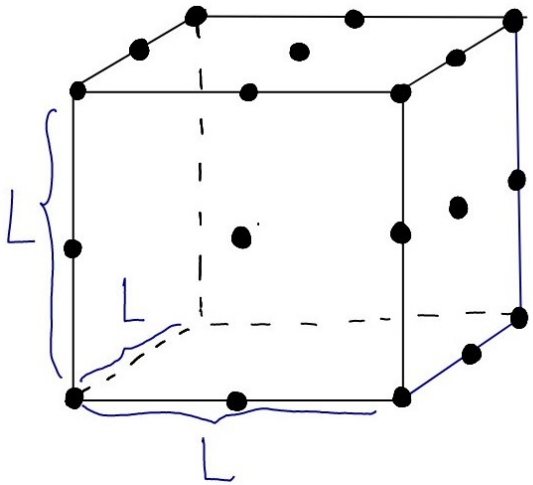
Boundary Conditions



4D LATTICE

$L \times L \times L \times T$

SPATIAL 3D

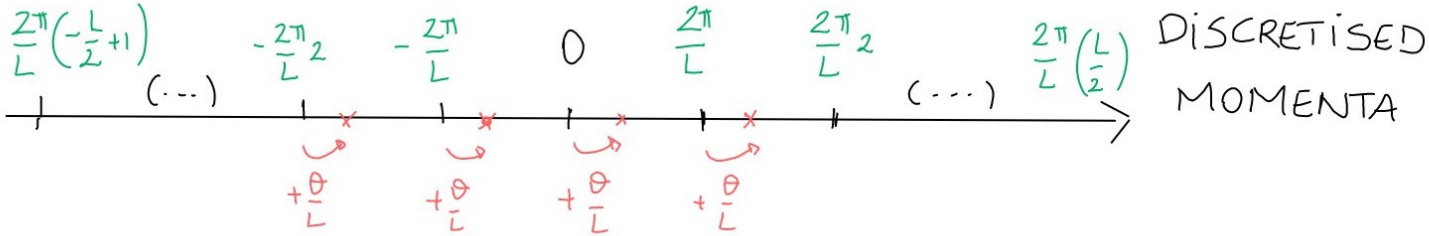
TIME

Periodic Boundary Conditions

$$\psi(t, x_i = 0) = \psi(t, x_i = L)$$

Twisted Boundary Conditions

$$\psi(t, x_i = 0) = e^{i\vartheta_i} \psi(t, x_i = L)$$



Observables on a Lattice

Observables → ex: FORM FACTORS

⇓

Correlators → ex: $\langle O_\pi(n)\,\widetilde{O}_\pi(0)\rangle$

⇓

Propagators G

$$D\,G = S \quad \Rightarrow \quad G = D^{-1}S$$

DIRAC OPERATOR — PROPAGATOR — SOURCE

$$D^{-1} \equiv (D^{-1})_{n\times n}$$

$$n > 10^6$$

$L^3 T \times 12$

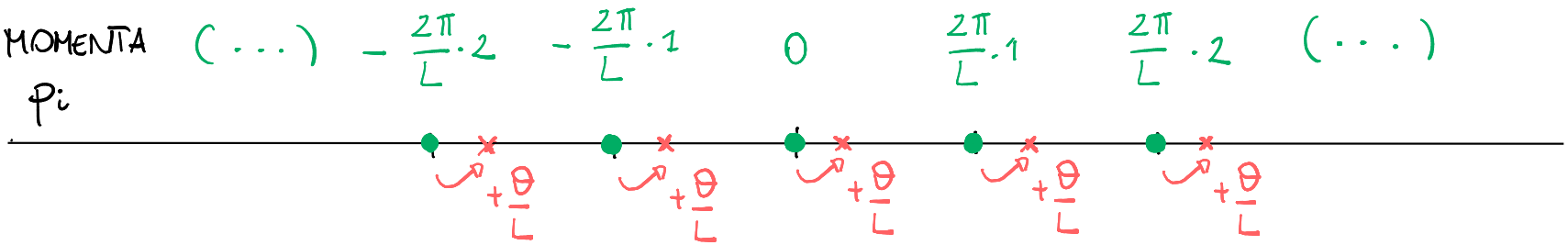
⇓

High computational costs

Idea of the Project and Possible Approaches

Assumption

D_0^{-1} is known with **high precision** ($\equiv$ high computational effort)



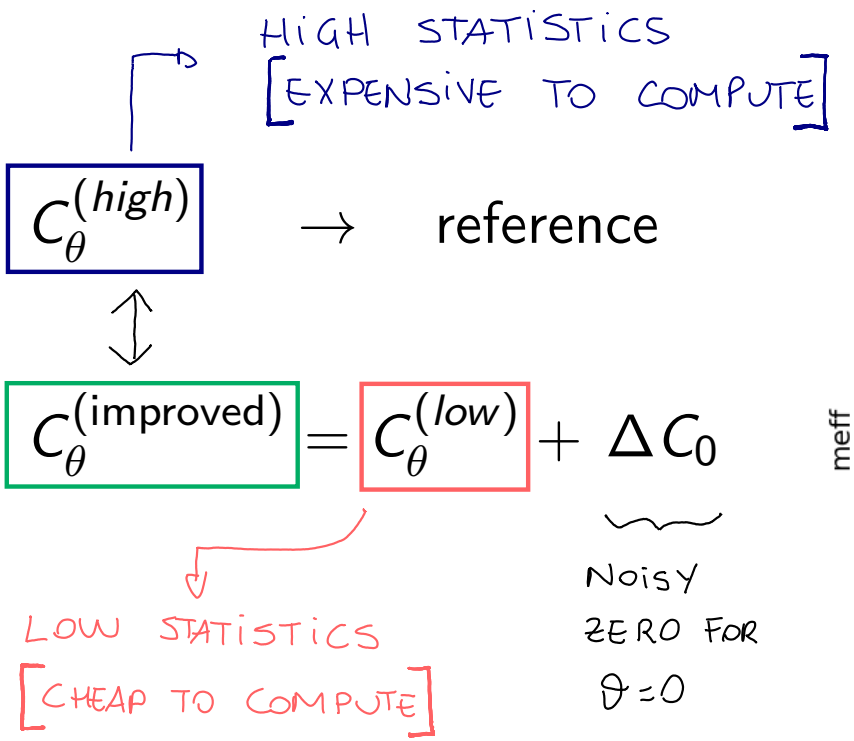
Goal

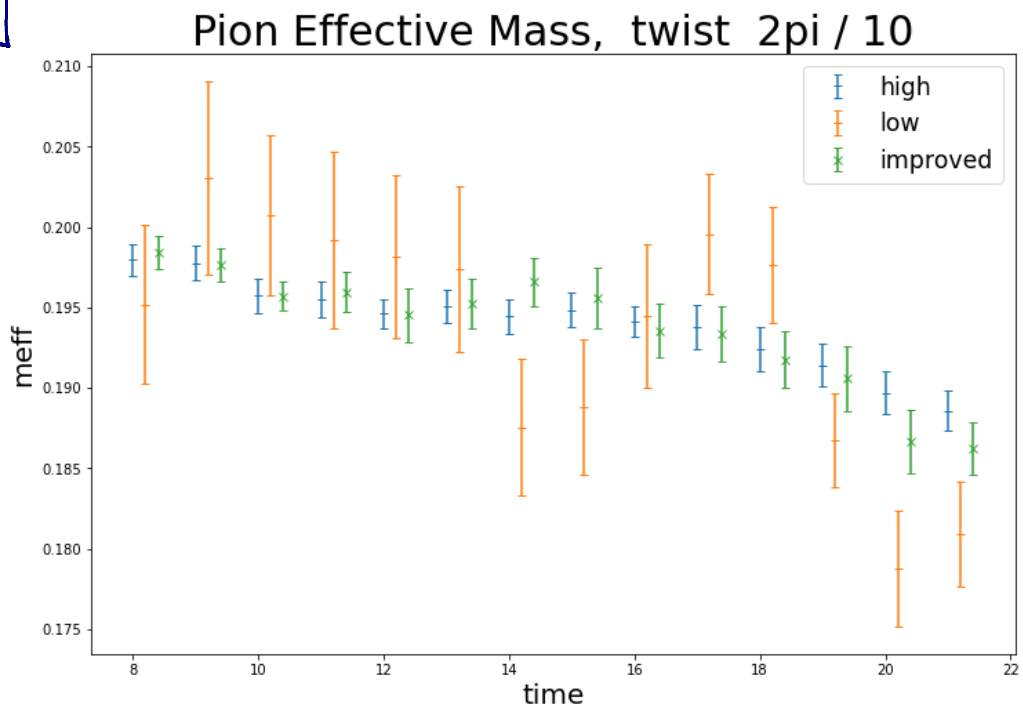
To calculate D_θ^{-1} with **high precision** in a **cheap** way using D_0^{-1}

3 APPROACHES:

1. matrix relations for $D_\theta^{-1} = (D_0 + B)^{-1}$
2. algorithmic improvement (domain decomposition)
3. variance reduction technique

Variance Reduction Technique





Observations and next steps:

- the method works well at the correlators level
- check for more general quantities (e.g. form factors)
- theoretical understanding and prediction of the improvement