

Lattice Field Theory

- Goal:
Get any observable of interest from theory in question (e.g. QCD)
- Often solved for infinite resources.
- Methods which do not incorporate physics fail.
- Need methods adapted to
 - ▶ physics of the theory
 - ▶ particular observable
- Get correct answers also with finite resources.

→ Leads to understanding of QCD.

Chiral symmetry

- Methods for simulations with chiral fermions.
- Computation of low-energy constants of the chiral lagrangian

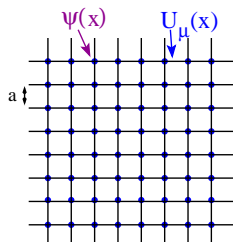
Light Quarks

- Improved sampling of the QCD vacuum in the presence of light quarks.

Charm quarks

- Computation of decay constants f_D, f_{D_s} , quark mass m_c
- Improving methods to simulate large lattices at small sea quark masses.
- ongoing project

Problem to solve



- Calculations done at several values of lattice spacing a
- Always need to take **continuum limit**
 $a \rightarrow 0$
- Severe **critical slowing down** observed

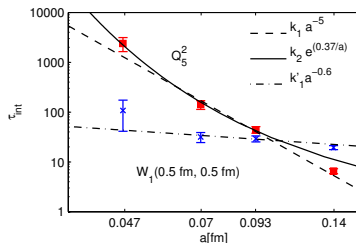
$$\text{cost of simulation} \propto a^{-10}$$

- continuum limit \leftrightarrow continuous phase transition

Problem to solve

- Time to get an independent field configuration.

Schaefer, Virotta, Sommer'10



- ... if looking at, e.g., topological charge of gauge configuration
- Need to find better method:
better understanding of dynamics of QCD vacuum required
- Why are some observables much more affected than others?
- Needs to be translated into an algorithm.