

# CLS – Who Are we? What Do We Do?

## The CLS effort

### CLS (Coordinated Lattice Simulations)

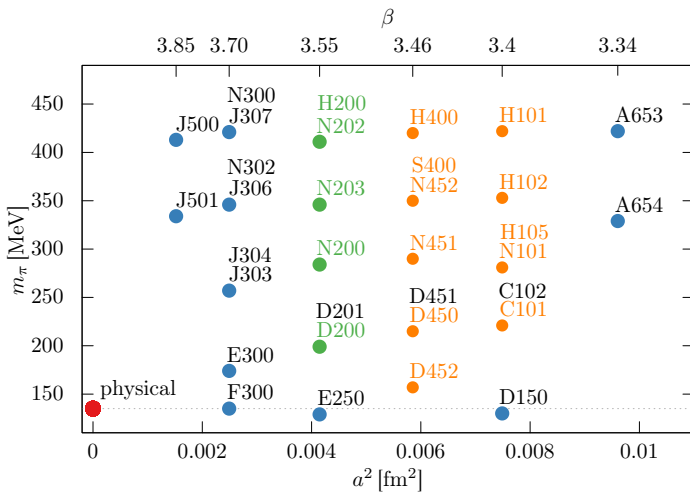
- combines people and resources from HU Berlin, CERN, TC Dublin, Krakow, UA Madrid, Mainz, Milano Bicocca, Münster, Odense/CP3-Origins, Regensburg, Roma I, Roma II, Wuppertal, DESY Zeuthen;
- uses
  - $N_f = 2 + 1$  flavours of non-perturbatively improved Wilson quarks,
  - tree-level improved Symanzik gauge action,
  - with open boundary conditions in time to avoid topological freezing,
  - but also some ensembles with (anti-)periodic boundary conditions in time ( $a \gtrsim 0.06$  fm),
  - openQCD code;
- has generated ensembles
  - at six fine lattice spacings  $a \in [0.039, 0.1]$  fm
  - at quark masses from the symmetric to the physical point
  - on three chiral trajectories ( $\text{Tr}[M] = \text{const.}$ ,  $m_s \approx \text{const.}$ ,  $m_s = m_l$ )
  - in large volumes satisfying  $M_\pi L \geq 4$  throughout
  - with statistics typically  $\gtrsim 2,000$  MDU.

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## Reweighting

- two reweighting factors needed:
  - light quark action is stabilized by a twisted-mass term in simulations  
↪ need to reweight to target action,
  - strange quark is simulated using rational approximation of  $\sqrt{D^\dagger D}$   
↪ need to reweight to correct for approximation,
- in the case of the strange quark, a negative sign of  $\det D$  can occur  
↪ need to correct for the wrong sign of the reweighting factor;
- fortunately, the fraction of configurations with a negative reweighting factor is very small (or zero) for most ensembles.
- Reweight by calculating  $\langle O \rangle = \frac{\langle O w \rangle}{\langle w \rangle}$  with observable  $O$  and combined (signed) reweighting factor  $w$ .

## CLS – What Do We Have?



# CLS – How Do We Manage Data? How To Get It?

## Data

- 149,766 configurations (1.3842 PB) stored on tape (redundantly in Zeuthen and Regensburg),
- openQCD data format (double precision binary format with non-ILDG layout).

## Metadata

- (internal) webpage available with overview and details of existing ensembles,
- metadata collected via automated scripts:
  - data provenance (machine, code version, responsible person),
  - simulation setup (input parameters),
  - stability of HMC trajectories ( $\Delta H$ , acceptance, solver iteration counts, timings),
  - ergodicity and autocorrelations along Markov chain (plaquette,  $Q$ ,  $Y_t$ ,  $Q_t$ ,  $t_0$ ),
  - data integrity (multiple checksums).
- Reweighting factors and strange determinant minus signs measured separately.

# CLS – How Do We Manage Data? How To Get It?

## CLS Ensembles on the ILDG

- a first batch of ensembles (shown in green) uploaded to ILDG:
  - O(7000) configs, 50 TB in one week,
  - limited by network/tape bandwidth,
  - automated XML generation (extraction from existing database);
- further ensembles (shown in yellow) will follow soon,
- the remainder will follow at some later time (after analyses have been published);
- reweighting factors are included in Config XML,
- input parameters are included in Ensemble XML.
- ILDG can replace previous manual transfers and access-granting (on per-project basis and by request).