Non-perturbatively $O(a)$ improved Wilson fermions

- UKQCD/QCDSF: physically large volumes $(\gtrsim 1.5\,\mathrm{fm})$
  UKQCD: $L/a = 16$; QCDSF: also $L/a = 24$
- Independent cfgs. separated by 40 trajectories

$$\frac{N_{\mathrm{ops}}}{\text{indep. cfg.}} = C\left(\frac{L}{a}\right)^{4.55}\left(\frac{1}{am_{\mathrm{P}}}\right)^{z_2}$$

- Find $C = 0.31 \cdot 10^9$ flops, and $z_2 = 2.8(4)$
  $\rightarrow C$ is 10 times larger as in ECFA report
- But: autocorrelations are poorly understood!
  $2\tau_{\mathrm{int}} < 40$ as estimated from plaquette

CP-PACS-style benchmark for $N_{\mathrm{f}} = 2$

- smallest lattice spacing $\approx 50\%$ of CPU effort
- ditto for smallest quark mass
- $O(a)$ improvement helps continuum extrapolation:

$$\left.\begin{array}{l} a \approx 0.05\,\mathrm{fm} \\ L/a = 64 \end{array}\right\} \longrightarrow \left\{\begin{array}{l} a \approx 0.07\,\mathrm{fm} \\ L/a = 48, \end{array}\right. \qquad am_{\mathrm{P}} = 0.15$$

Total CPU effort: $\approx$ 100 Tflops years

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- ALPHA: physically small volumes $(L \ll 1\,\mathrm{fm})$; massless quarks, SF boundary conditions

$$N_{\mathrm{ops}}/[\text{indep cfg}] = C'\,(L/a)^z$$

- detailed algorithmic study (hep-lat/0009027)
  - precise autocorrelation data for observable, i.e. $\overline{g}_{\mathrm{SF}}$.
  - $z \approx 7$ for $L/a \geq 8$
- benchmark: running of α_s for $N_{\mathrm{f}} = 2$
  - $L/a = 16 - 20$ sufficient; within reach on APEmille

  Total CPU effort: $\approx$ 0.1 Tflops years