Past, current and future projects

GRK Annual Retreat 2015

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24. November 2015

Westfälische Wilhelms-Universität Münster

institut für theoretische physik

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- wide-scale application: Master thesis in Lattice Field Theory ("Confinement-Kriterium für dynamische Materiefelder bei endlichen Temperaturen")

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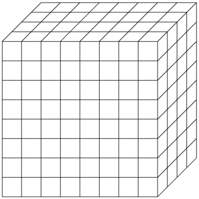

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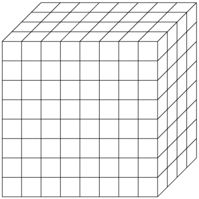

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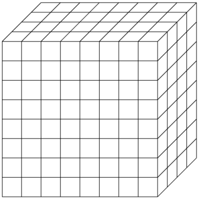

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- gauge fields are realised on links connecting lattice points

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- "scalar quarks" require less computing resources

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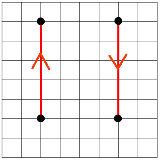

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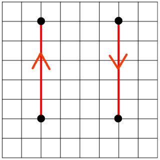

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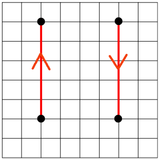

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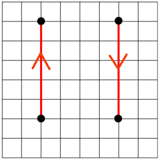

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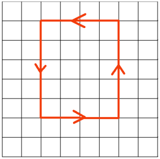

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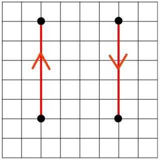
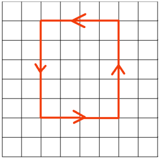


- Wilson-loop $W(\mathscr{C})$ is product of gauge links
- has good overlap with states corresponding to flux-tube $\rightarrow$ large signal



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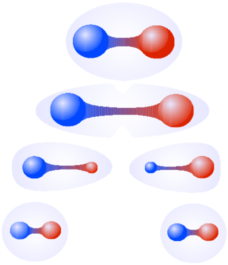

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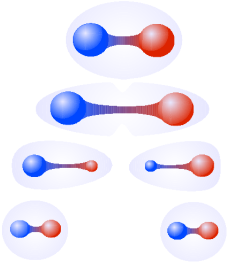

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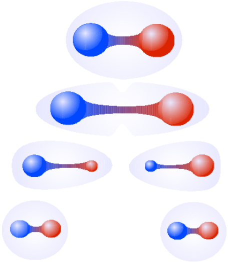

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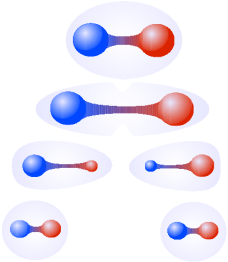

Problems for Wilson-loop criterion:

- Wilson-loop has poor overlap with mesonic states
- Wilson-loop exhibits circumference-law behaviour in both phases

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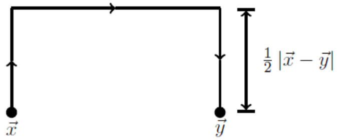
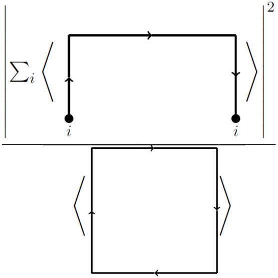
- pictographic representation:



- complete Fredenhagen-Marcu-operator (FM-operator):

$$\rho_{FM} = \lim_{R=|x-y|\to\infty} \frac{|\langle \Phi_{xy}^{(n)}|0\rangle|^2}{|\Phi_{xy}^{(n)}|^2} = \lim_{R=|x-y|\to\infty} \frac{|\sum_i \langle 0|\overline{\Psi}_i(x)U^{(n)}(\mathscr{C}_{xy})\Psi_i(y)|0\rangle|^2}{\langle \mathscr{C}_{xy}\cdot\Theta\mathscr{C}_{xy}\rangle}$$

$\rho_{FM} = \lim_{|x-y|\to\infty}$



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BUT:

In confinement phase R must be larger than string-breaking distance!

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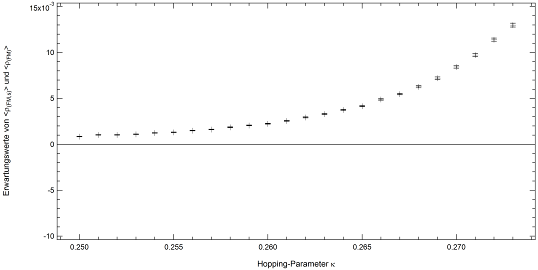

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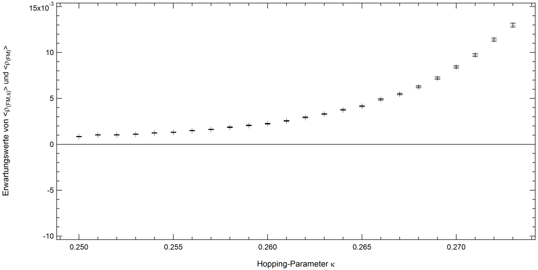

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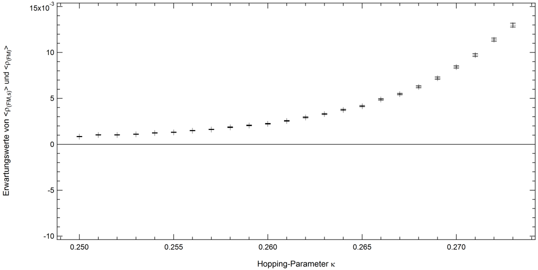

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- FM-operator shows signs of phase-transition, but no convincing evidence

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- decay constant f_D can be determined via LQCD

$$\langle 0|\overline{q}\gamma_\mu\gamma_5 c(0)|D(\vec{p})\rangle = i f_D p_\mu$$

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- $\rightarrow$ give precise constraints on unitarity and CP-violation
- may improve understanding of recent experimental findings of larger than expected CP-violation in the charm quark sector (e.g. by LHCb)
  $\rightarrow$ hint to new physics?

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- compare data obtained from CLS configurations (with $n_f = 2 + 1$, no dynamical charm quark) with simulations including dynamical charm
  $\rightarrow$ estimate corrections of dynamical charm to derived quantities

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- $\rightarrow$ calculation of experimentally important quantities ($\rightarrow$ methods applicable to PANDA), but also get insight in detector physics (interplay of detector parts, resolution, limitations)

Thank you for your attention!