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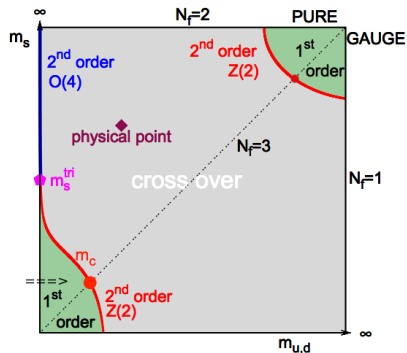
THE UPPER RIGHT CORNER OF THE COLUMBIA PLOT WITH STAGGERED FERMIONS

Ruben Kara
and

S. Borsányi, J. N. Guenther, P. Parotto, A. Pásztor, D. Sexty

Quark Matter 2022

Columbia plot



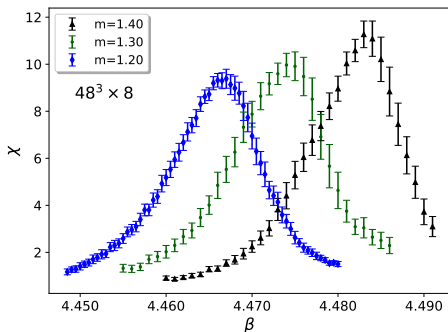
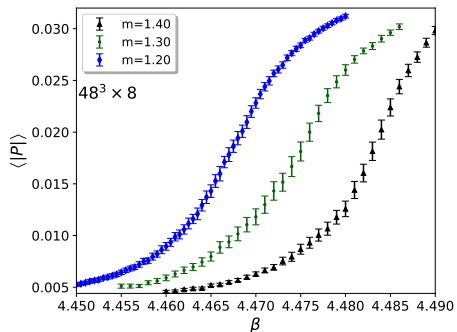
"Columbia group" 10.1103/PhysRevLett.65.2491.
Fig. from Forcrand et. al. 1702.00330.

Quenched QCD

- Latent heat in conti. lim. Shirogane: [1605.02997], Borsányi: [2202.05234] \implies 1st order
- Decreasing quark masses \implies transition gets weaker
- Investigations for $N_f = 2$ Wilson fermions Cuteri: [2009.14033]
- Goal: Determination of the critical mass m_c for $N_f = 3$

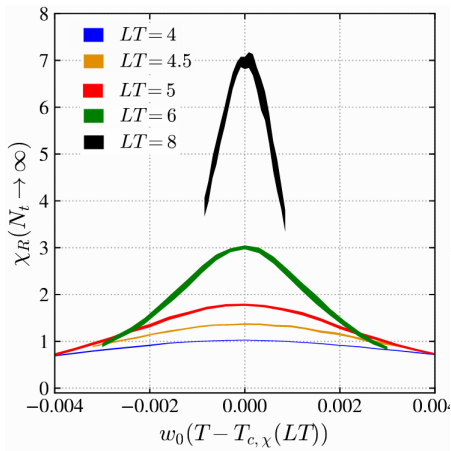
Observables: Polyakov loop and its susceptibility

$$P = \frac{1}{N_s^3} \sum_{\vec{x}} P_{\vec{x}} = \frac{1}{N_s^3} \sum_{\vec{x}} \text{tr} \left[\prod_{\tau} U_4(\vec{x}, \tau) \right] \quad \chi = N_s^3 (\langle |P|^2 \rangle - \langle |P| \rangle^2)$$

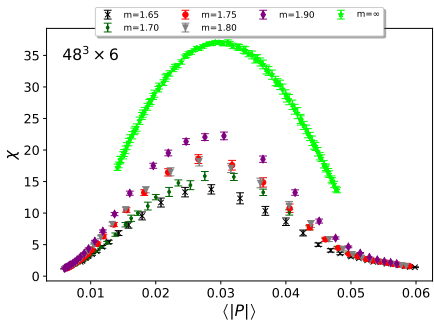
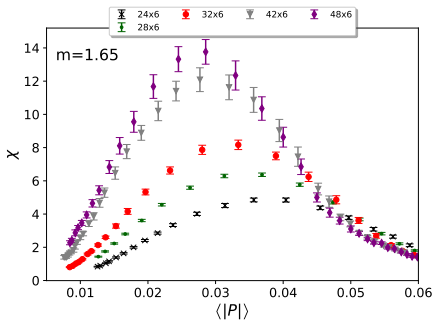


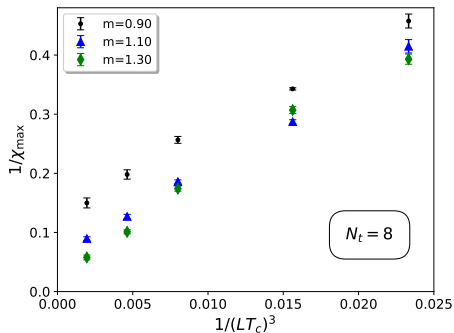
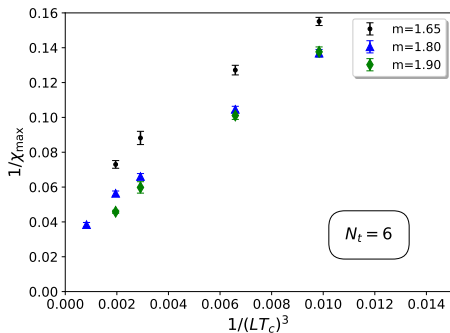
Precise peak determination

- Cubic spline of $\langle |P| \rangle(\beta)$ and $\chi(\beta) \implies \chi(\langle |P| \rangle)$
- Simpler form allows us to perform precise low order polynomial fits

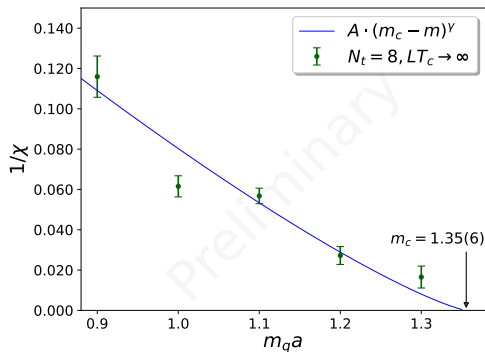
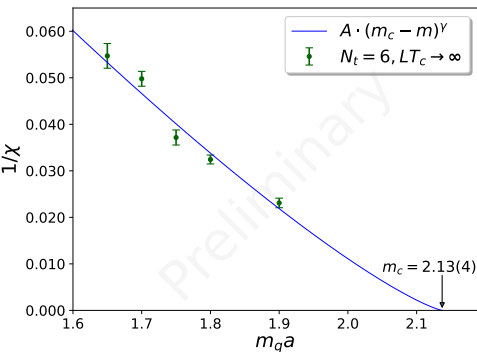


L.h.s.: Quenched case *Borsányi: [2202.05234]*



Volume scaling of χ_{\max}^{-1} Infinite volume limit for $N_t = 6$ and $N_t = 8$

- $N_t = 6$: 28^3 , 32^3 , 42^3 , 48^3 , (64^3)
- $N_t = 8$: 32^3 , 40^3 , 48^3 , 64^3



Critical region

- χ_{\max}^{-1} follows a power law near the transition
- m_q represents symmetry breaking field

$$\chi_{\max}^{-1}(LT_c \rightarrow \infty) = A \cdot (m_c - m)^\gamma$$

	$w_0 \cdot T_c$	m_{PS}/T_c
$N_t = 6$	0.2531(2)	19.2271(9)
$N_t = 8$	0.2477(4)	20.2090(4)