

Dirac spectrum at the quenched SU(3) phase transition

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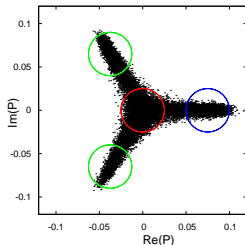
What happens to the Dirac spectrum at the transition?

- Quenched SU(3): first order phase transition at T_c
- Coexistence of two phases:
 - Confined $|\mathcal{P}| \approx 0$
 - Deconfined $|\mathcal{P}| \neq 0$

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- Three sectors for Dirac spectra:

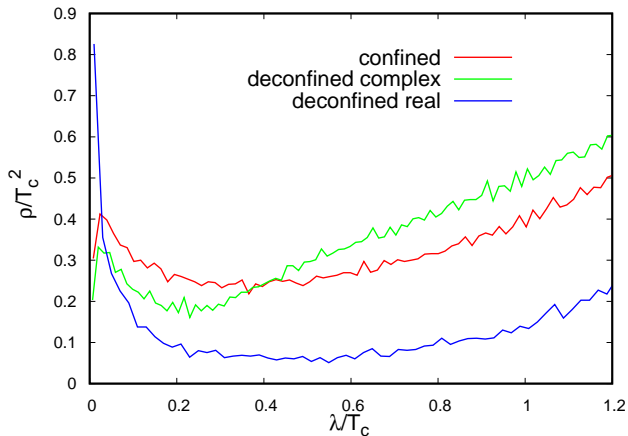
- Confined
- Deconfined real (phase: π)
- Deconfined cmplx (phase: $\pi \pm \frac{2\pi}{3} = \mp \frac{\pi}{3}$)



- Quenched SU(3), $N_t = 8$
- $\beta = \beta_c$
- \Rightarrow both phases and all Polyakov loop sectors appear
- Low-end of the overlap spectrum computed separately in
 - Confined phase
 - Deconfined phase real sector
 - Deconfined phase complex sector

Overlap spectral density

(exact zero modes not shown)



Deconfined real sector: lower density, except spike at zero

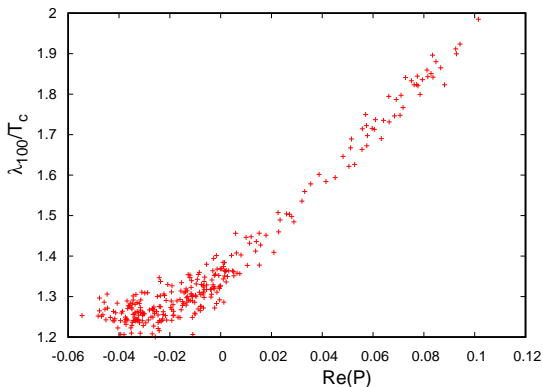
mixing topological near zero modes [Vig & Kovacs PRD 103 \(2021\) 114510](#)

Main features of the spectral density

- Spectral density depends on temporal boundary condition
- Antiperiodic b.c. π + Polyakov loop phase
- Maximal temporal twist (π) in real P-loop sector
 - \Rightarrow smallest spectral density
 - \Rightarrow preferred by dynamical quarks
- Caloron zero modes most localized in real P-loop sector
 - \Rightarrow do not mix with the bulk

Influence of the Polyakov loop on the spectrum

Scatter plot of 100th eigenvalue vs. $Re(P)$

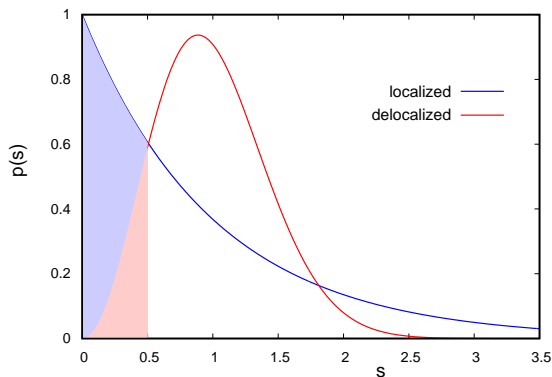


Larger real Polyakov loop \Rightarrow fewer low modes

- For $T > T_c$ low Dirac modes are localized.
- Are they also localized exactly at T_c ?

Unfolded level spacing distribution

Localized vs. delocalized

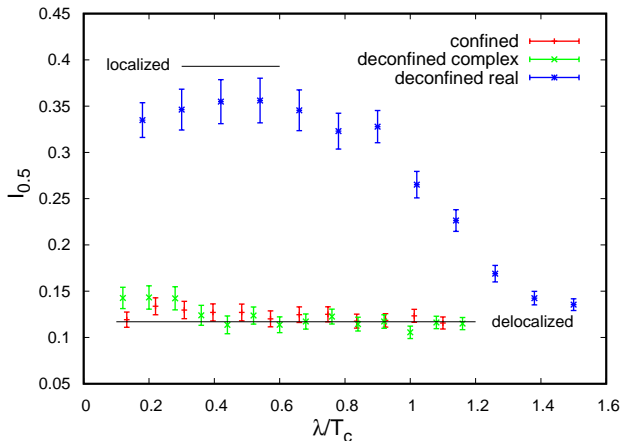


$$I_{0.5} = \int_0^{0.5} p(x) dx$$

Good quantity to distinguish localized and delocalized states.

Localization of low modes in different sectors at T_c

$$l_{0.5} = \int_0^{0.5} \rho(x) dx$$



Properties of lowest Dirac modes at T_c

- confined
 - deconfined, cmplx P-loop
 - deconfined, real P-loop
- } delocalized
- } localized

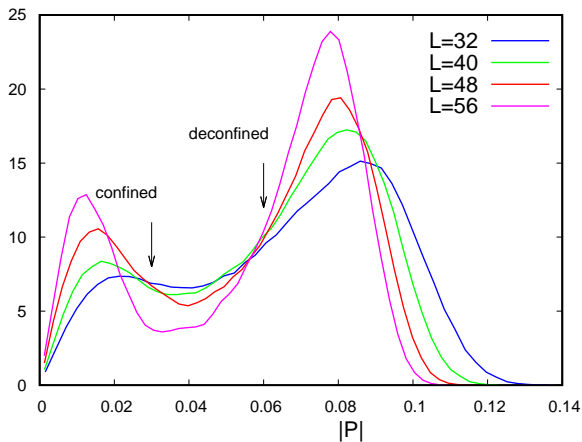
Topological near zero modes

- Deconfined, real P-loop sector: localized, separate from the bulk
- Confined and deconfined cmplx P-loop: delocalized, mix with the bulk
- Consistent with known features of caloron zero modes

backup slides

Separation of confined and deconfined phase

Distribution of the P-loop magnitude



Unfolded level spacing distribution of lowest modes

