Aspects of Polyakov Loops in Partial Deconfinement

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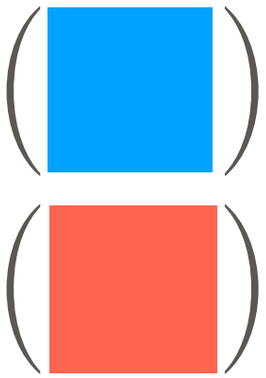
@ Poster No.16

● Partial (de)confinement



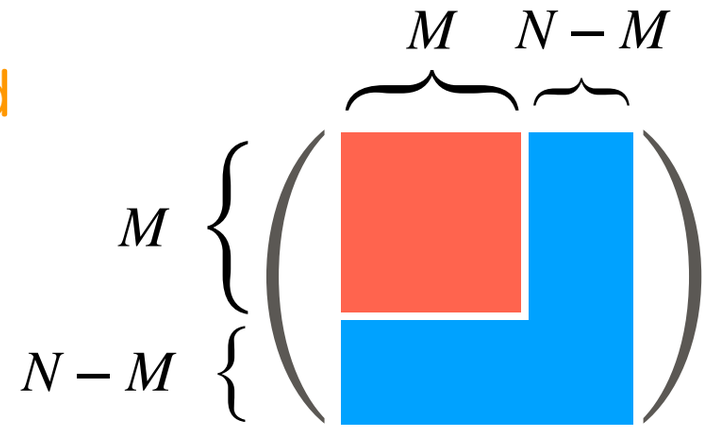
confined

deconfined

partially deconfined

: excited in part
but not all

(M/N : ratio)



A diagnosis for large-N theories: Distribution of Polyakov line phases

$$u_n(\beta) = \frac{1}{N}\mathrm{tr}\,\mathrm{P}\exp\left[\mathrm{i}\int_0^{n\beta}\mathrm{d}t\,A_t\right] = \frac{1}{N}\sum_{j=1}^{N}\mathrm{e}^{\mathrm{i}n\theta_j} = \int \mathrm{d}\,\theta\rho(\theta)\,\mathrm{e}^{\mathrm{i}n\theta}, \quad \rho(\theta) = \frac{1}{N}\sum_{j=1}^{N}\delta(\theta-\theta_j)$$

$$\rho_{\mathrm{PD}}(\theta) = \underbrace{\left(1-\frac{M}{N}\right)\rho_{\mathrm{conf}}(\theta;N)}_{\text{confined}} + \underbrace{\frac{M}{N}\cdot\rho_{\mathrm{GWW}}(\theta;N)}_{\text{deconfined}}$$

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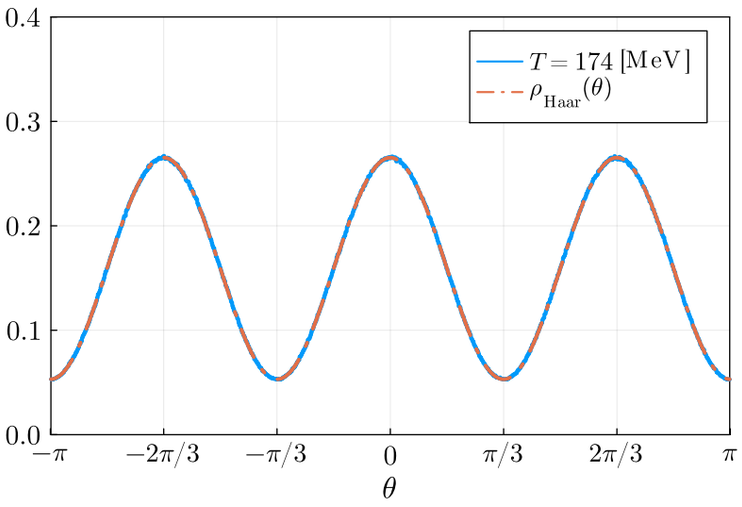
- Lattice QCD analysis from partial-deconfinement viewpoint

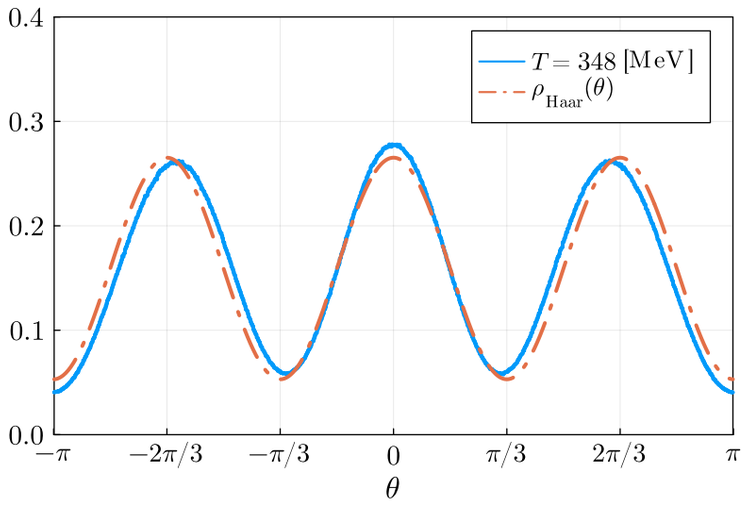
Collab. w/ Hanada, Ohata, Shimada [PTEP 2024 4, 041B02; PTEP 2024 4, 043B02]

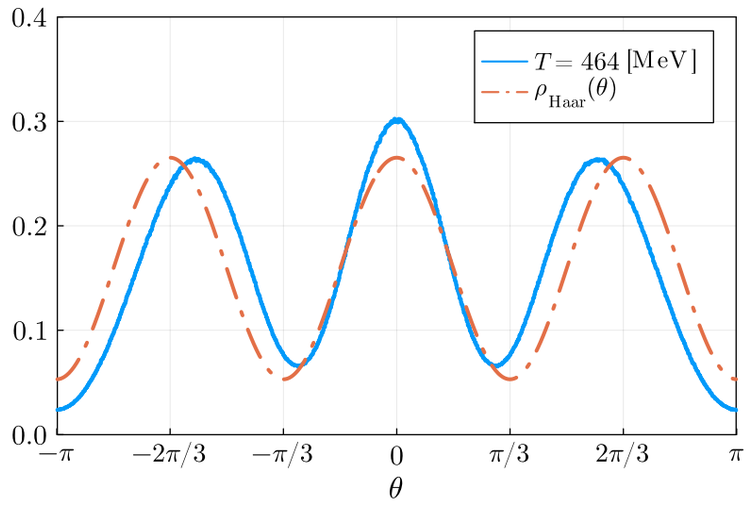
Idea: Similar mechanism possibly occurs even at finite N.

Phase structure is proved by the deviation from Haar random distribution!

$$\rho_{\mathrm{Haar}}(\theta;N)=\frac{1}{2\pi}\left(1-(-1)^N\frac{2}{N}\cos(N\theta)\right)$$







The deviation can be quantified by SU(3) characters $\chi_\lambda(\{\theta_j\})$ (Polyakov loops in rep. λ)

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● Partial (de)confinement in terms of representations Collab. w/ Shimada in progress

- Convenient as they are commonly used for manifestly gauge-inv. descriptions.
- Role & physical meaning of characters?

→ Let's go back to large-N models.

Unitary matrix models

$U \mapsto \left\{ e^{i\theta_j} \right\}$: unitary matrix

("position")

②

$\Leftrightarrow$

Random partition

λ : Irreps. (Young diagram)

("momentum")

λ_j : partition ← bosonic

$h_j := \lambda_j - j + \frac{1}{2}$ ← fermionic ①

Fourier partner on group mfd.
character $s_\lambda(U)$: "plane wave"

- Collective modes for large-N saddle-pt. analysis

$\rho(\theta)$: density of eigenphases

$\tilde{\rho}(h)$: density of boxes in YD ③