CORRECTION AND SCOPE

# Static Compact Tensor–Matter Monte Carlo Screen

Original title · Full Compact Tensor Matter Monte Carlo Phase Screen

The compact Metropolis experiment measures static ordering. A source-resolved dynamical spectrum requires a different observable.

Manuscript · p. 1, verdict

Tower-Filtered ED Lanczos Scaling Audit for the Compact Ward-Square Spin-2 Box

Evidence · One-Hamiltonian composition requirements / Reduced finite-spin tower scaling

# Full Compact Tensor/Matter Monte Carlo Phase Screen

QATNU numerical audit

July 3, 2026

## Verdict

This audit runs an actual compact Metropolis screen on the unfactored tensor/matter Ward-square variables. The variables are compact phases $X_{ij}^{(\ell)}(x)$ for all six tensor components, all synthetic layers, and the Ward stress wall. The action uses local spatial stiffness, nearest-neighbor path locking, and local integer divergence/trace penalties. No TT projector is inserted.

The result is positive as a larger compact ordered-sector screen: an ordered region exists, local div/trace charges are suppressed by increasing the constraint stiffness, bounded-flux saturation is not observed in the ordered samples, and the harmonic target still gives two TT soft branches, $z = 1$, and $\chi_S \sim k^{-2}$. This is still a screen, not a theorem-level finite-spin phase proof.

## Compact model

The compact action sampled is

$$E = \beta \sum_{\langle xy\rangle,\ell,c} [1 - \cos(X_{\ell c}(x) - X_{\ell c}(y))] + J \sum_{x,ell,c} [1 - \cos(X_{\ell+1,c}(x) - X_{\ell c}(x))]$$

$$+\kappa \sum_{x,\ell,j} [1 - \cos((\nabla \cdot X)_j(x,\ell))] + \kappa \sum_{x,\ell} [1 - \cos(\operatorname{tr} X(x,\ell))].$$

All charges use only integer coefficients $0, \pm 1$.

## Monte Carlo screens

At fixed $L = 4$, $W = 4$, $J = 8$, and $\kappa = 20$, the beta screen shows a stable ordered side. The largest beta point has

$$|m| = 0.982097, \quad \mathrm{RMS}(\nabla \cdot X) = 0.200819, \quad \mathrm{RMS}(\operatorname{tr} X) = 0.190062.$$

The combined div/trace defect fraction is

$$0.000e + 00,$$

and bounded-flux saturation is

$$0.000e + 00.$$

At $\beta = 1.2$, the constraint-stiffness screen suppresses charges. The largest-$\kappa$ point gives

$$\mathrm{RMS}(\nabla \cdot X) = 0.163929, \quad \mathrm{RMS}(\operatorname{tr} X) = 0.156622,$$

with charge defect fraction

$$0.000e + 00.$$

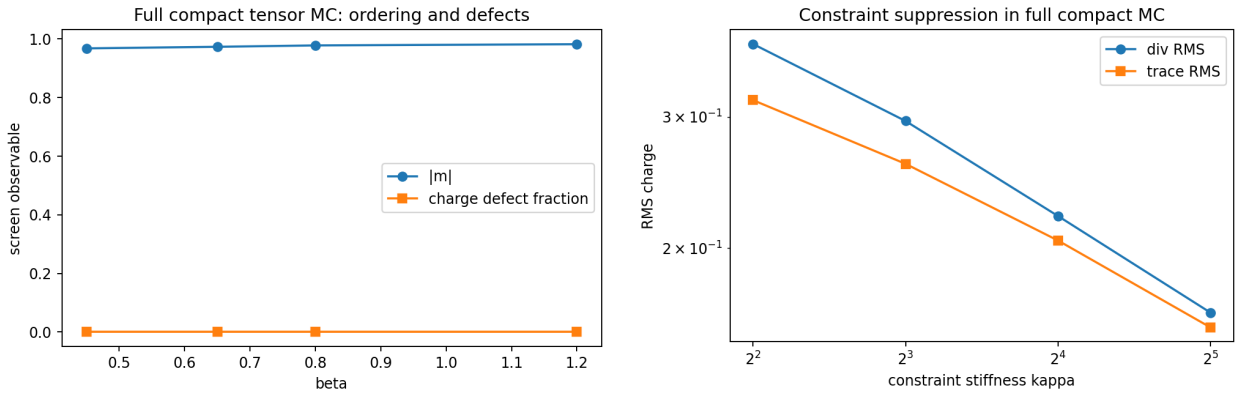


Figure 1: Compact Metropolis screens for ordering and local charge suppression.

## Finite-size pilot

A small finite-size pilot at $\beta = 1.2$, $J = 8$, $\kappa = 20$ for $L = 3, 4, 5$ shows no immediate loss of order in the tested range. At the largest size,

$$|m| = 0.982363, \quad \text{path RMS} = 0.203788, \quad \text{RMS}(\nabla \cdot X) = 0.202331.$$

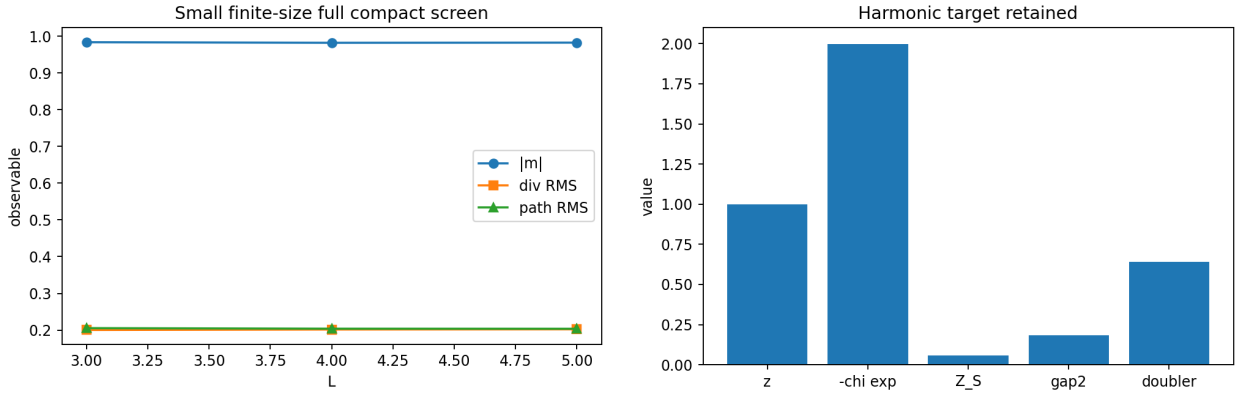


Figure 2: Small finite-size screen and harmonic target summary.

## Harmonic target retained

For the corresponding harmonic chain target, the scalar branch has

$$z = 0.999432351, \qquad \chi_S(0, k) \sim k^{-1.998835855}.$$

Tensoring with the two TT polarizations gives two low branches. The stress residue is

$$Z_S = 0.058823529,$$

the second scalar gap is

$$\Delta_2(0) = 0.184536719,$$

and the known non-origin node is gapped by

$$\omega_D = 0.639905158.$$

## Boundary

This is a compact ordered-sector phase screen for the full variable set, not a full nonperturbative proof. It does not yet implement exact finite-spin Gauss generators as hard Hilbert-space constraints, nor does it compute a many-body spectral function. It does show that the assembled local compact variables have an ordered region with suppressible charges and no immediate bounded-flux catastrophe in the audited range. The next decisive step is a hard-constraint or deconfined-gauge simulation and a direct finite-spin spectral audit.