Investigations of Supersymmetric Yang–Mills Theories

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Motivation and Methods

Motivation - rich field theory and holographic dynamics

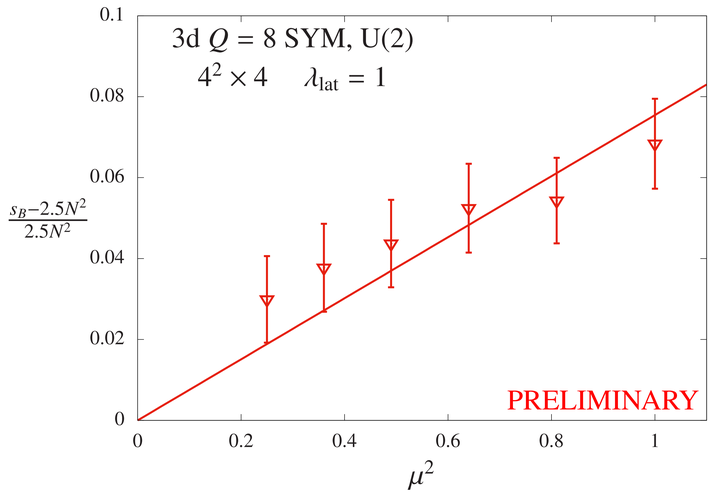
Supersymmetry broken on lattice since $\left\{Q^I_\alpha, \overline{Q}^J_{\dot\beta}\right\} = 2\delta^{IJ}\sigma^\mu_{\alpha\dot\beta}P_\mu$

By decomposing fields in reps of $\mathrm{diag}(SO_{euc}(d) \times SO_R(d))$ we can obtain $\{\mathcal{Q}, \mathcal{Q}\} = 0$ subalgebra which can be preserved on discrete spacetime

Requires enough supersymmetry for this to work - the R-symmetry must have $SO(d)$ subgroup

Work in progress: 3D 8-supercharge SYM

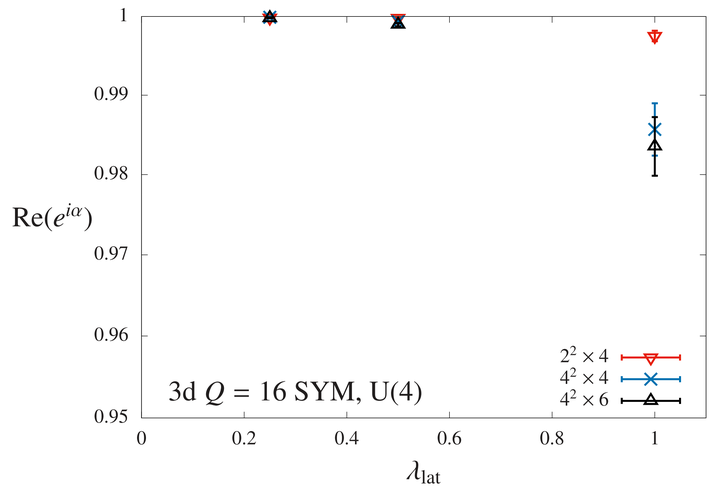
New parallel code written and tested by confirming Ward identity violations proportional to soft breaking parameter μ^2



Ward identity test passed
$\longrightarrow$ larger-scale calculation

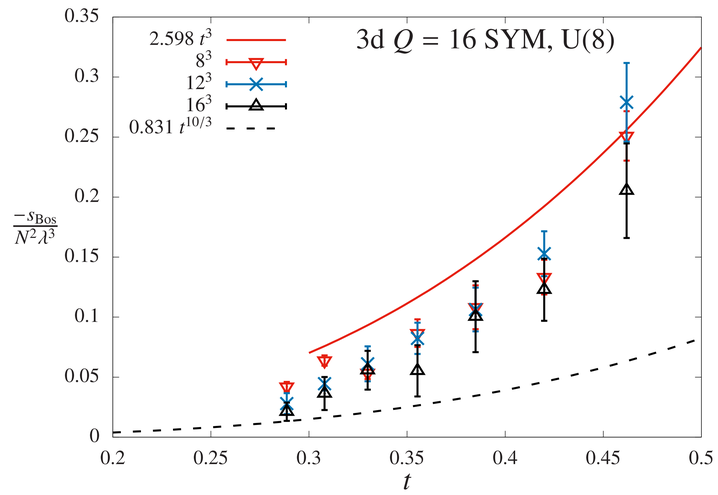
Improvements and further results for 3d 16-supercharge SYM [Phys.Rev.D 102, 106009]

Pfaffian phase α:



$\mathrm{Re}(e^{i\alpha})$ close to 1 so phase-quenched approximation valid

Improved error bars for S_{Bos}:



The bosonic action density is related to the holographic-dual black hole energy

Work in progress: Running coupling behaviour

$$k(r)g^2(N, r, L) \equiv \hat{R}^2\tilde{\chi}(N, a|\hat{R})$$

where $\tilde{\chi}$ is the Creutz ratio for square Wilson loops, L is lattice size, $N = L/a$ and $r = \hat{R}/N = \hat{R}a/L$ is fixed

kg^2 for 4D 16-supercharge SYM with $U(2)$, $\lambda = 0.5$:

r\N	8	10	12	14	16
0.3	0.0891	0.0591	0.0427	0.0491	0.0442
0.4	0.0551	0.0415	0.0233	0.0362	0.0315

Potentially consistent with continuum conformality

kg^2 for 3D 16-supercharge SYM with $U(8)$ and different temperatures t

$t = 0.31$

r\N	8	12	16
0.3	0.385	0.240	0.170
0.4	0.270	0.180	0.131

$t = 0.36$

r\N	8	12	16
0.3	0.320	0.203	0.146
0.4	0.228	0.155	0.112

$t = 0.42$

r\N	8	12	16
0.3	0.320	0.204	0.165
0.4	0.307	0.205	0.182

More data needed but kg^2 seem to be decreasing with N suggesting "backwards running"