Monopole-Antimonopole Correlation Functions in 4D U(1) l.g.t

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based on PLB in prep. hep-lat/0603022

Outlook

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- Motivation

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- Duality in pure U(1)

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- Lattice version and disorder parameter

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- Conclusions

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- Could be the prototype for confinement.

Continuum E.M. duality

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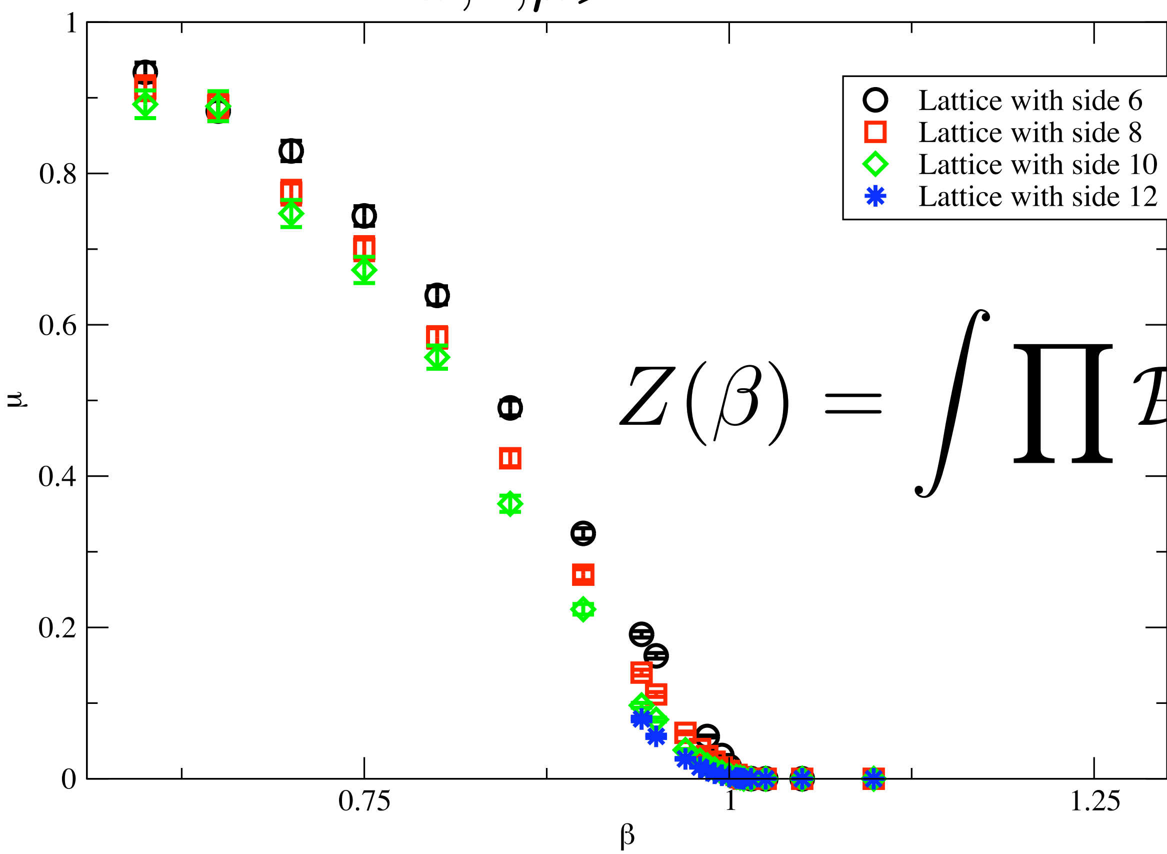

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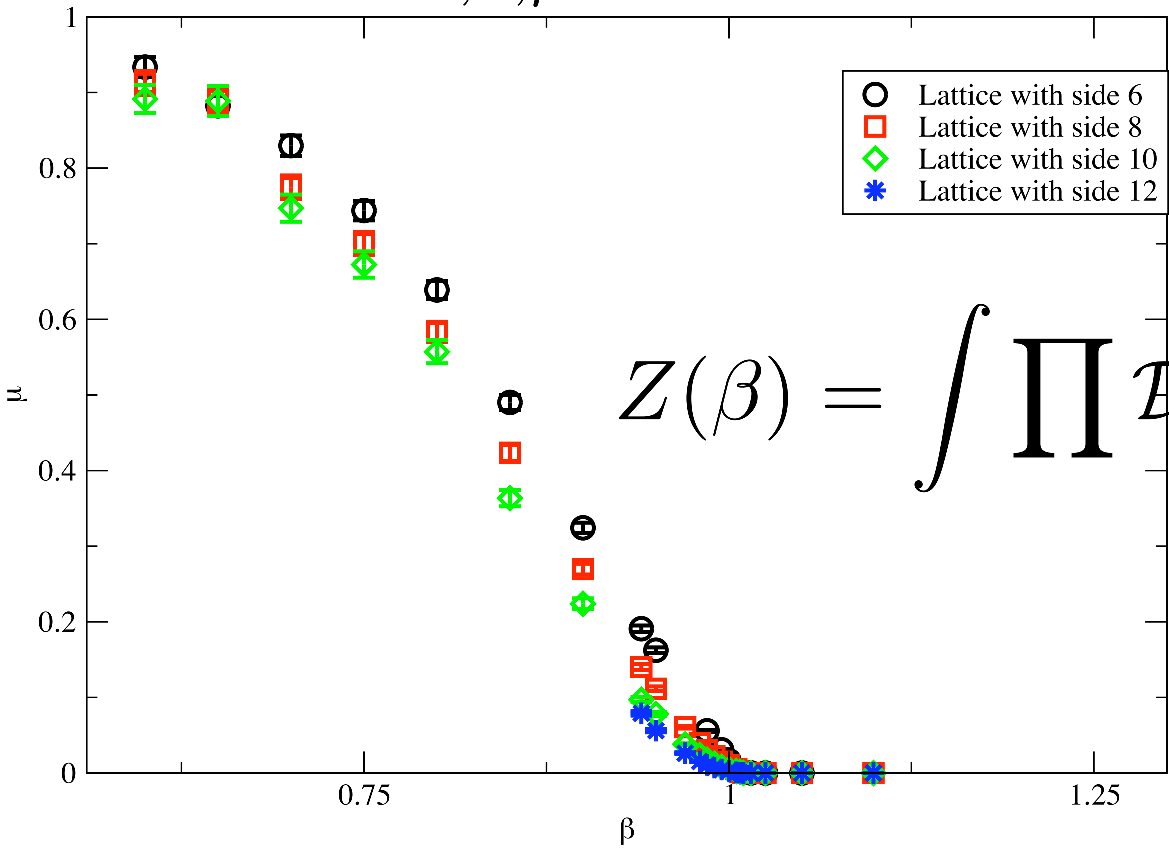

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Weak first order transition

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$$\mu(t) = \frac{\prod_{i,\vec{n}} \exp\beta\cos(b_i(\vec{x}-\vec{n}) - d\theta_{i0}(\vec{n},t)) - 1}{\prod_{i,\vec{n}} \exp\beta\cos\, d\theta_{i0}(\vec{n},t)}$$

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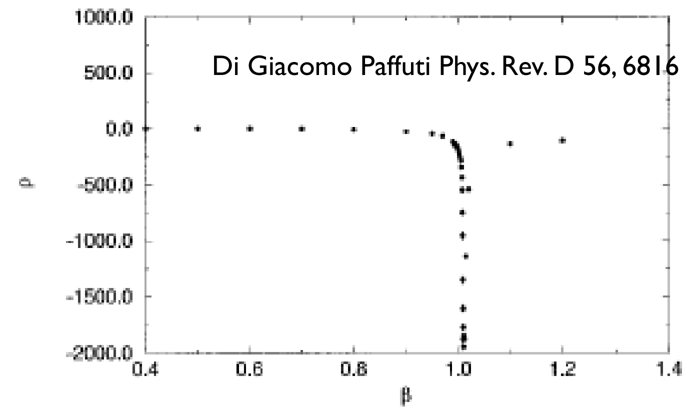

FIG. 2. ρ_∞ as a function of β. The negative peak signals the phase transition (lattice $8^3 \times 16$).

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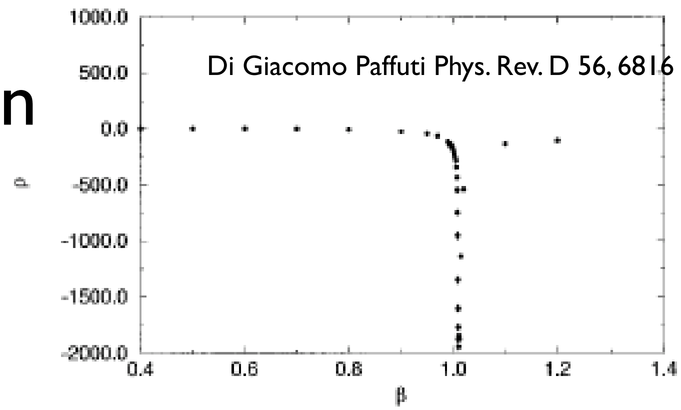

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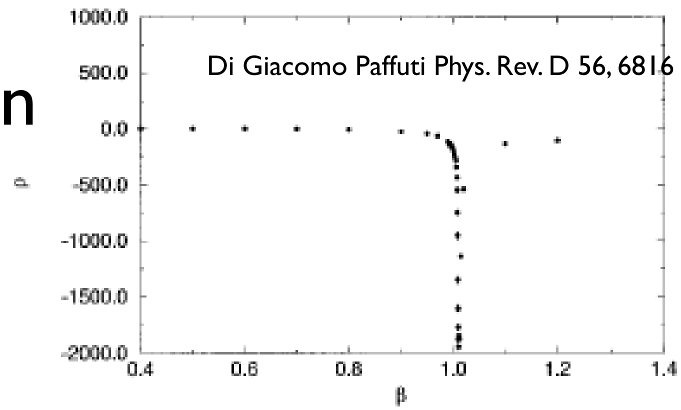

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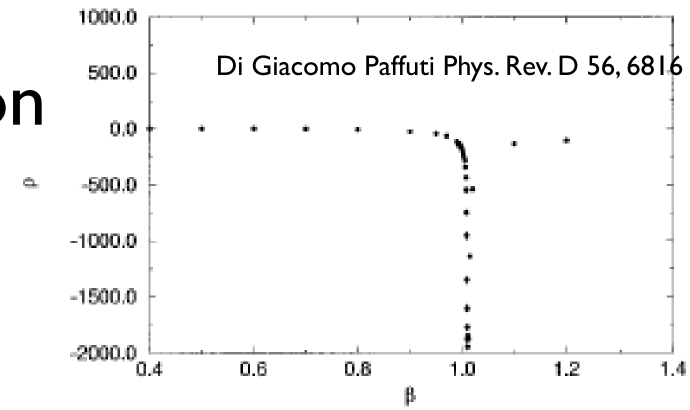

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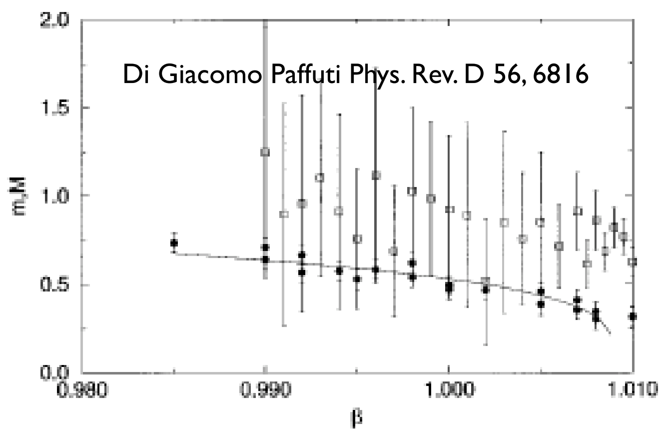

FIG. 6. Mass of the monopole M (squares) and mass of the dual photon m (circles) versus β.

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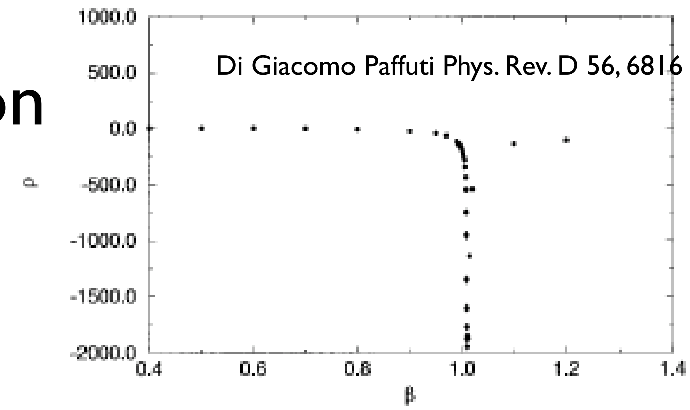

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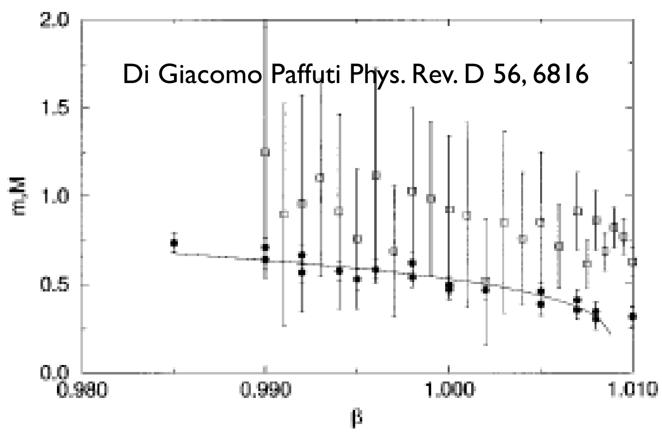

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Anything new from the known spectrum?

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$$\langle O_0(x) O_1(y) \rangle_c = 0$$

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Frohlich, Marchetti Europhys. Lett. 2, pag 933 1986

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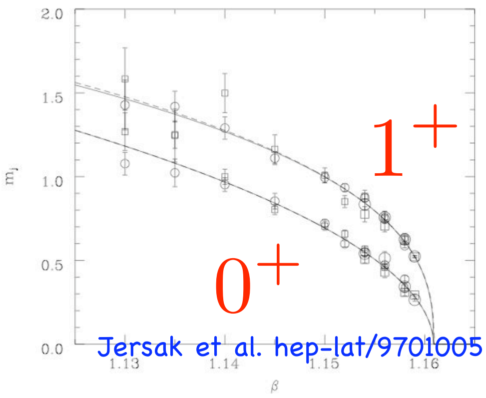
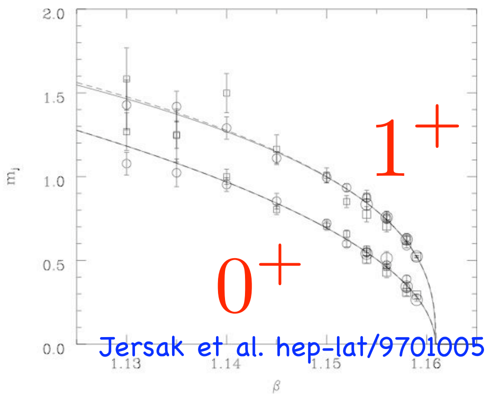


2.0
1.5
1.0
0.5
0.0
m_j
1.13
1.14
1.15
1.16
β
1^+
0^+
Jersak et al. hep-lat/9701005

Spectrum



Mjumdar Koma Koma hep-lat/0309003

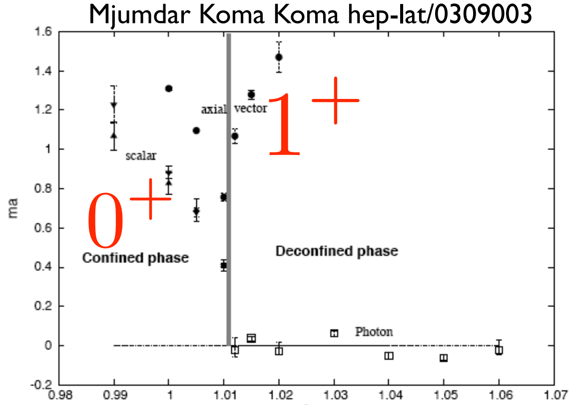


FIG. 7. Consolidated plot of glueball masses. ▲ and ▼ are the scalar glueball masses from the sets $\partial\partial^*\langle CC\rangle$ and $\partial^*\partial\langle CC\rangle$ respectively. The • corresponds to the axial vector mass with zero momentum. The □ is the photon extracted from the axial vector correlator (See fig. 6).

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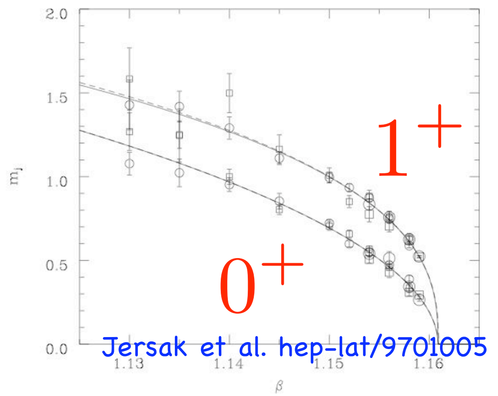

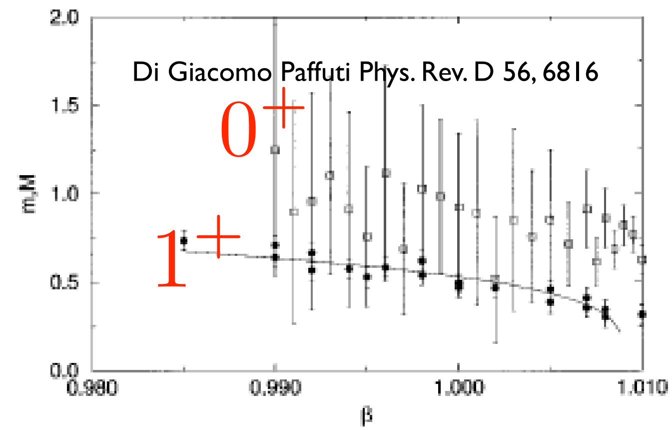

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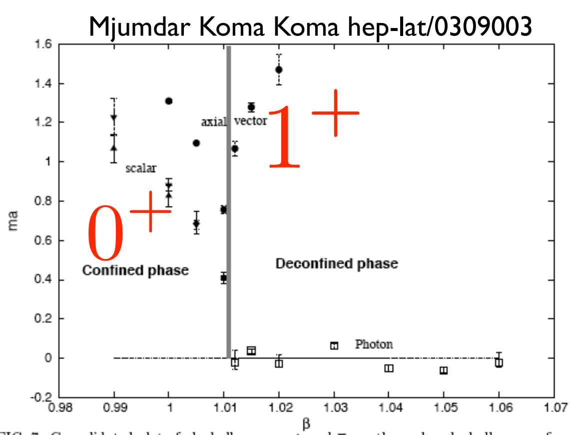

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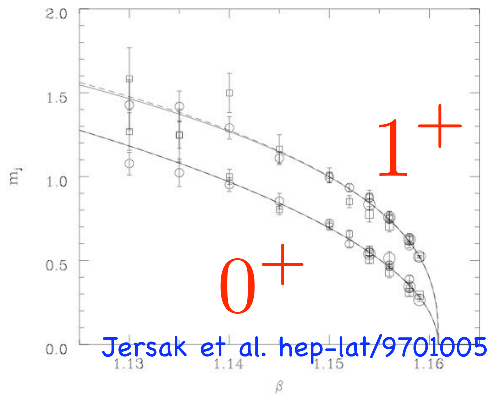

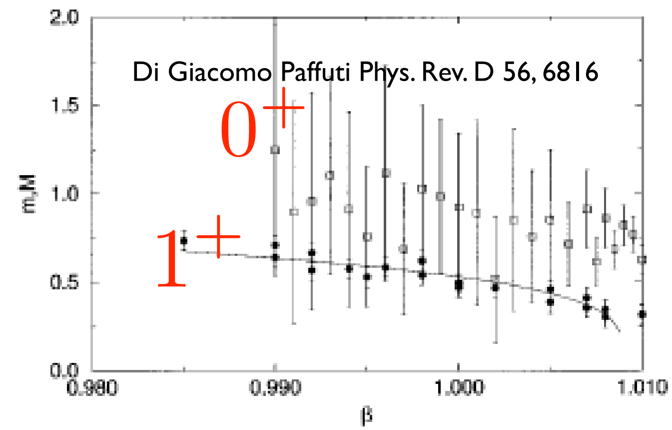

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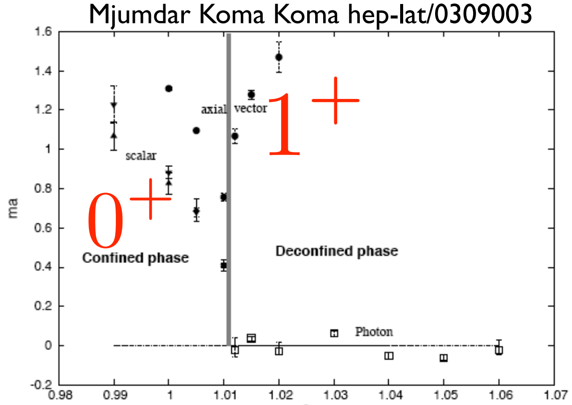

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Implicitly assume mon operator couples to new particle: magnetic superselection

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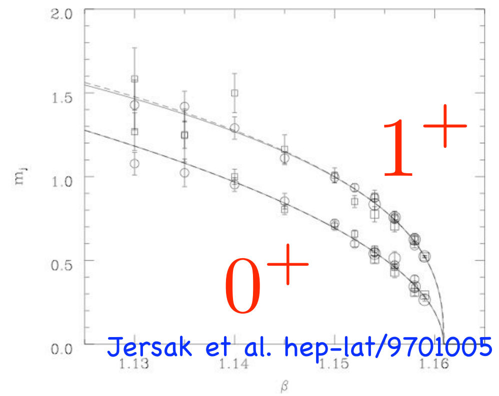

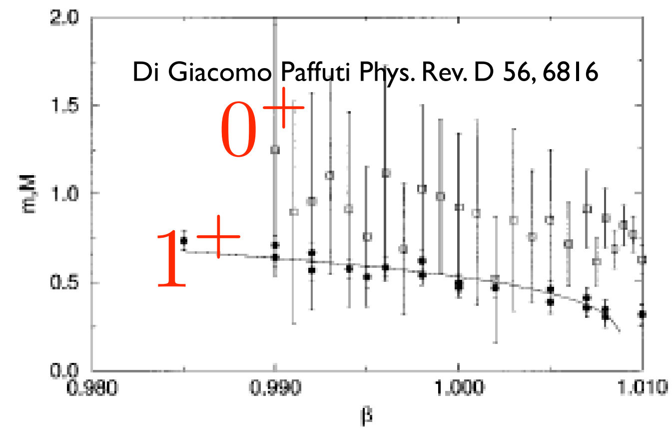

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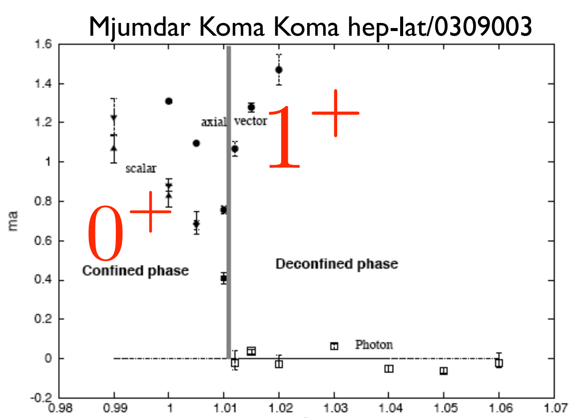

FIG. 7. Consolidated plot of glueball masses. ▲ and ▼ are the scalar glueball masses from the sets $\partial\partial^*\langle CC\rangle$ and $\partial^*\partial\langle CC\rangle$ respectively. The • corresponds to the axial vector mass with zero momentum. The □ is the photon extracted from the axial vector correlator (See fig. 6).

Implicitly assume mon operator couples to new particle: magnetic superselection

contradiction with theorem

New susceptibility

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$$\rho' = \frac{\partial}{\partial t} \log \langle \mu(\vec{x}, t) \bar{\mu}(\vec{x}, 0) \rangle$$

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$$\rho' \sim \frac{AM^{1/2}t^{-3/2}e^{-Mt}\left(-M - \frac{3}{2t}\right)}{\left(\mu^2 + AM^{1/2}t^{-3/2}e^{-Mt}\right)}$$

Lattice construction

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$$\mu(t) = \frac{\prod_{i,\vec{n}} \exp \beta \cos(b_i(\vec{x} - \vec{n}) - d\theta_{i0}(\vec{n}, t)) - 1}{\prod_{i,\vec{n}} \exp \beta \cos\ d\theta_{i0}(\vec{n}, t)}$$

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$$\Delta =$$

$$\sum_{\vec{n},i} \beta \partial_t \left(\cos(b_i(\vec{n}) - d\theta_{i0}(\vec{n}, t_0)) - \cos\, d\theta_{i0}(\vec{n}, t_0)\right)$$

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$$\partial_t e^{f(t)}|_{t=t_0} = e^{f(t)}(\partial_t f)|_{t=t_0}$$

Action

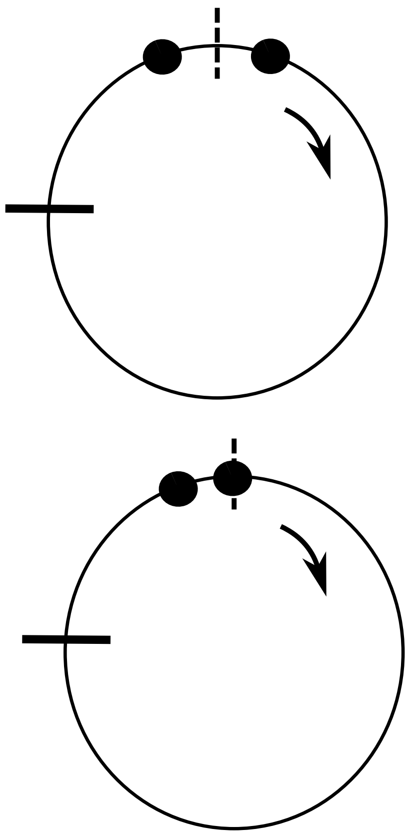
$$\partial_t \mu(t) = \mu(t)\Delta$$

Observable

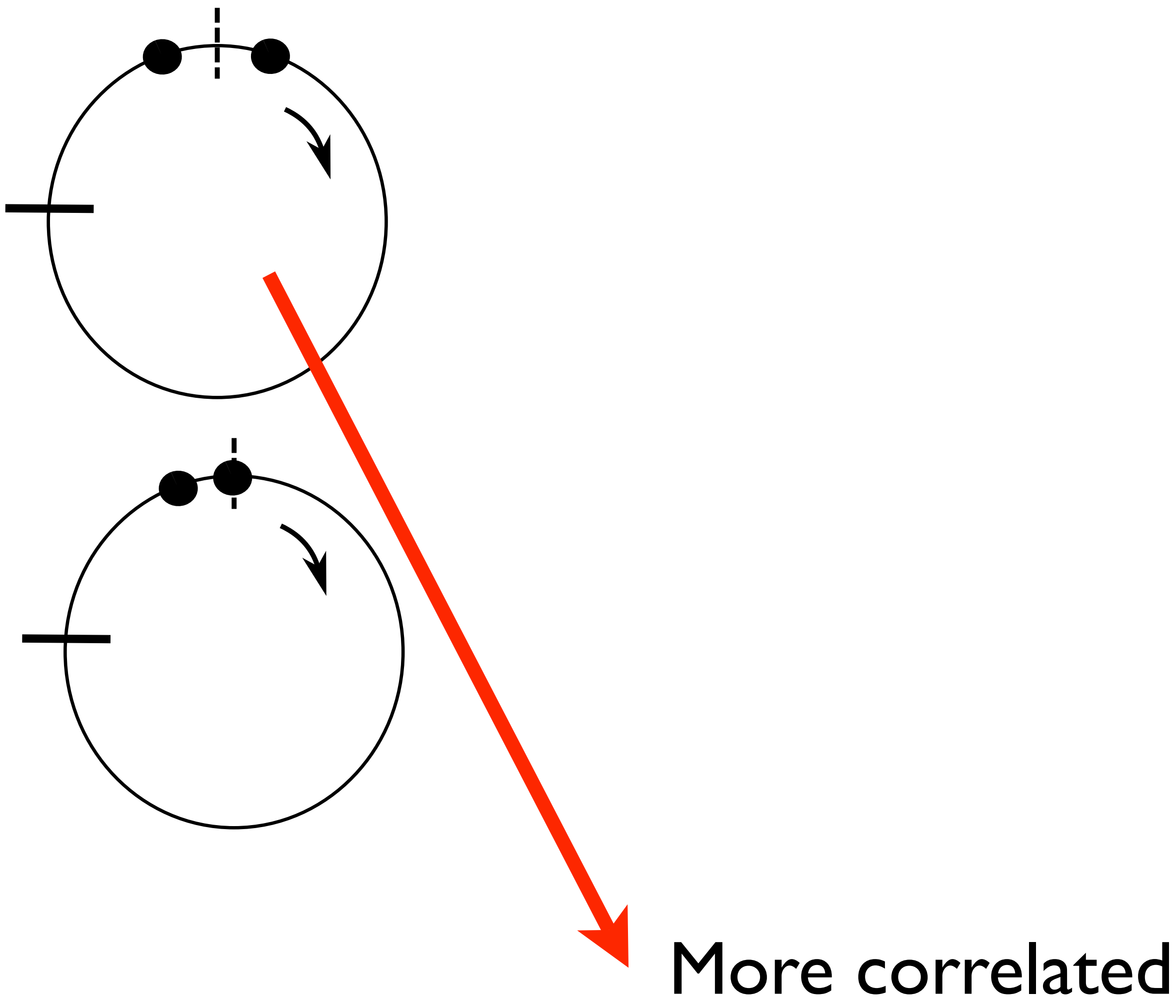
$$\Delta = \sum_{\vec{n},i} \beta \partial_t \left(\cos(b_i(\vec{n}) - d\theta_{i0}(\vec{n}, t_0)) - \cos\; d\theta_{i0}(\vec{n}, t_0)\right)$$

Symmetric derivatives

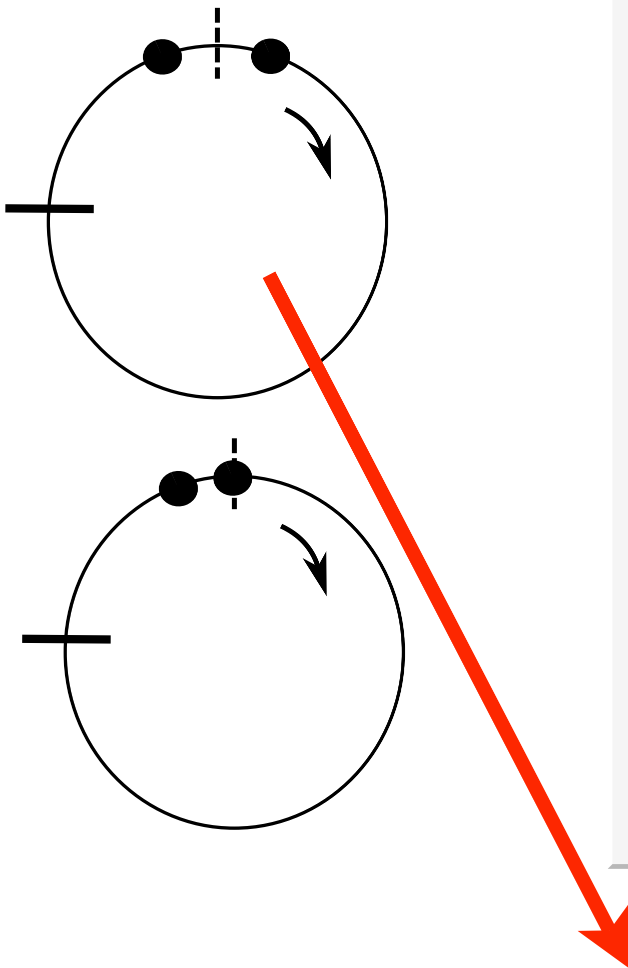
Symmetric derivatives

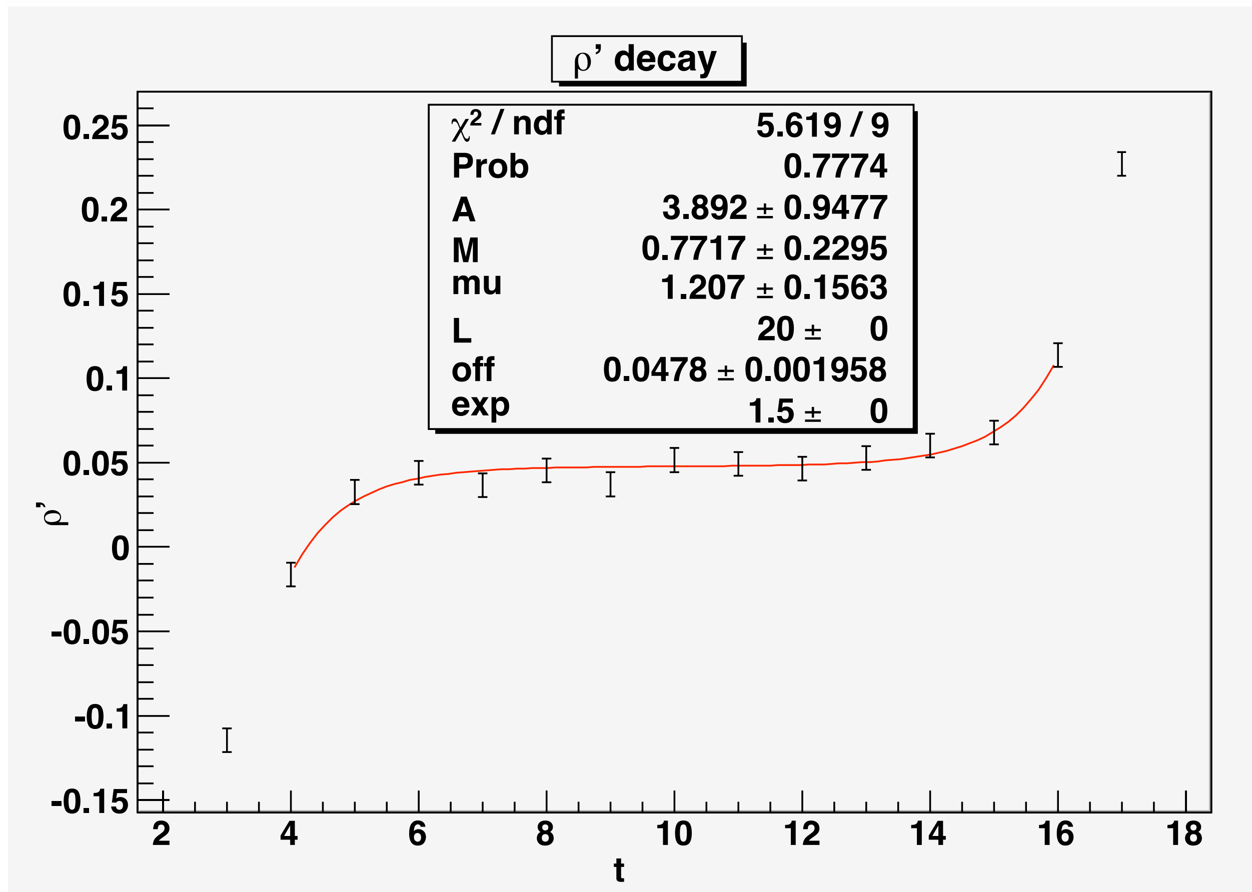


Symmetric derivatives



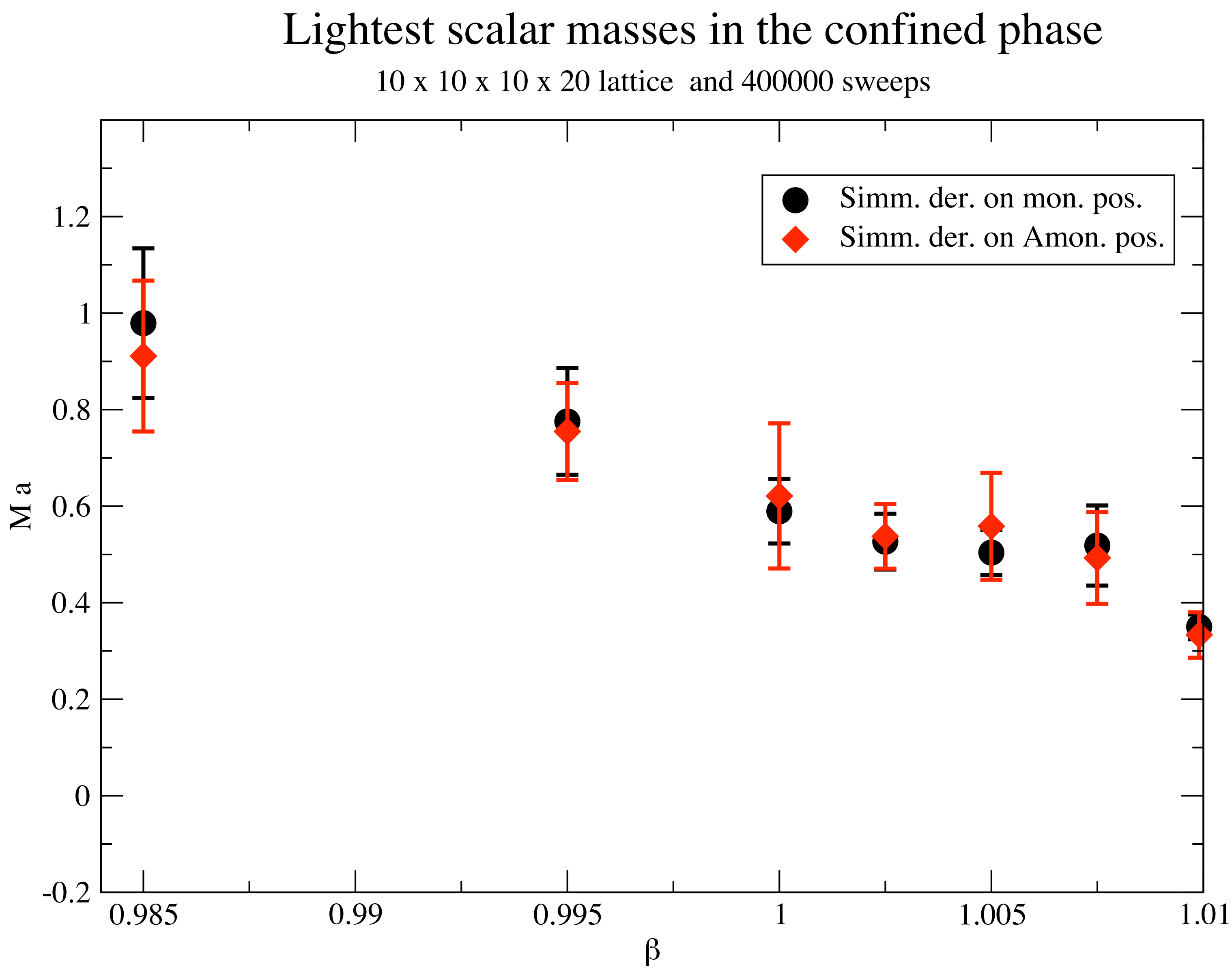
Symmetric derivatives





More correlated

Results



Lightest scalar masses in the confined phase
10 x 10 x 10 x 20 lattice and 400000 sweeps
Simm. der. on mon. pos.
Simm. der. on Amon. pos.
M a
β
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0.985
0.99
0.995
1
1.005
1.01

Compare with g. spect.

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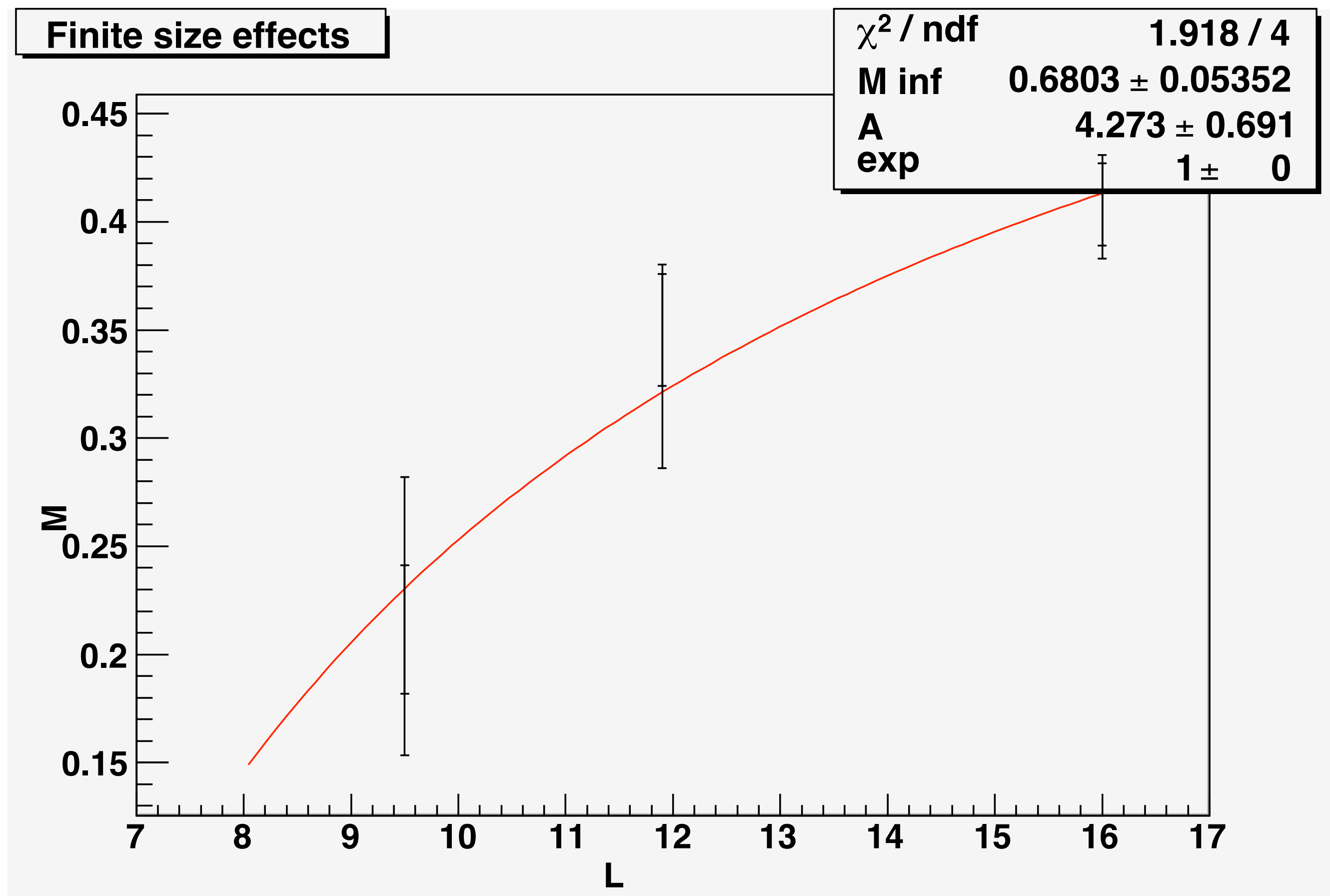
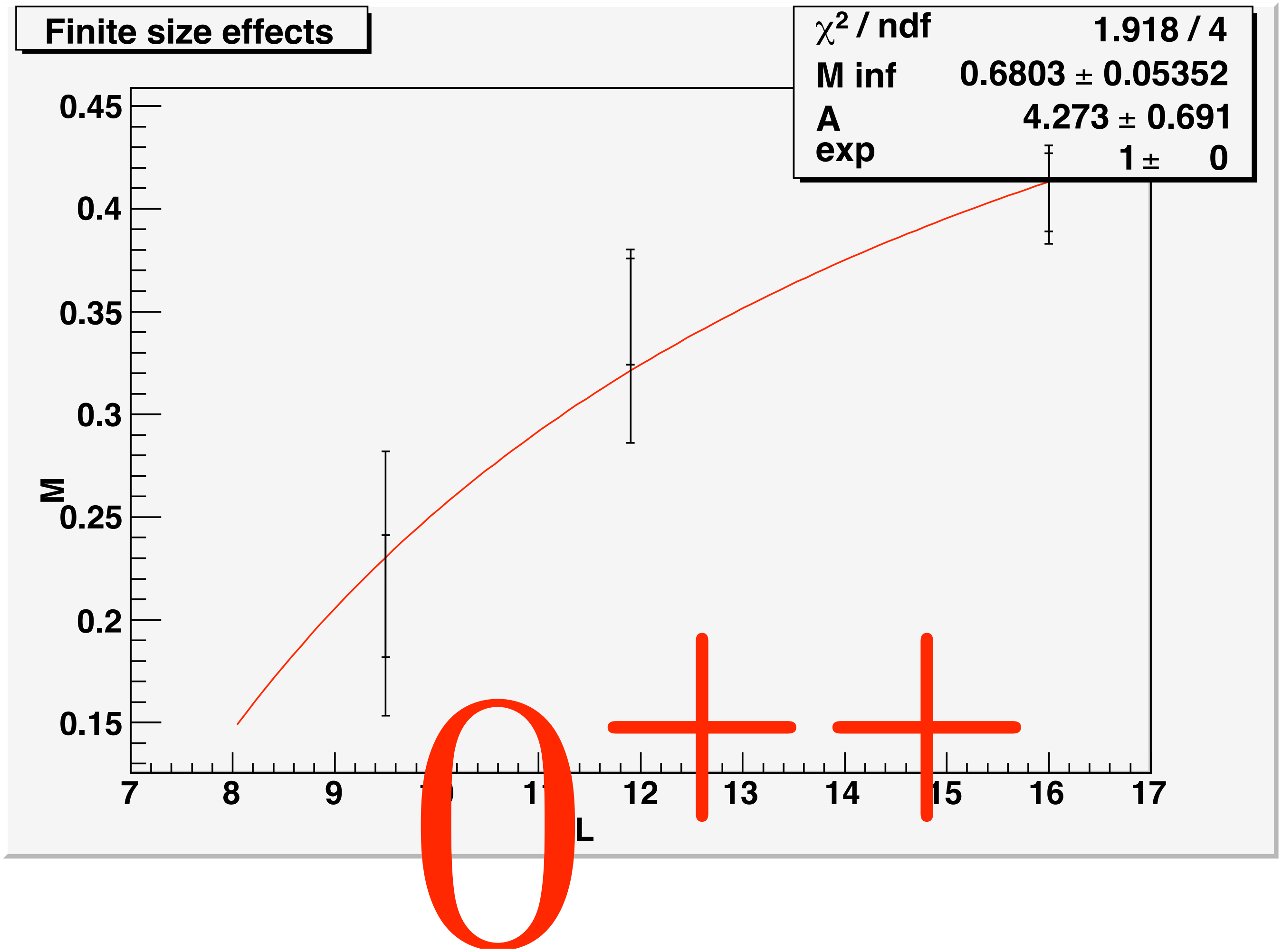


Compare with g. spect.



Conclusions

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- Introduce a new susceptibility for the monopole creation operator

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