Can a light Higgs impostor hide in composite gauge models?

Chik Him Wong

Lattice Higgs Collaboration (LHC):
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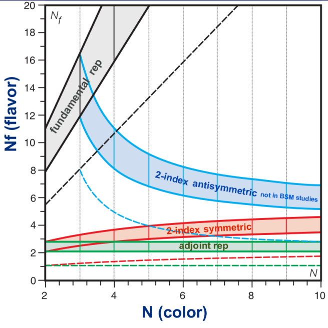
LATTICE 2013

Outline

- Introduction: Sextet model as Composite Higgs candidate
- Methodology
  - Implementation
  - Simulation Details
- Spectroscopy Analysis
  - Fitting Strategies
  - Preliminary Results on $\beta = 3.20$ $32^3 \times 64$ Lattices
- Conclusion

Introduction

- Goal: Look for a Composite Higgs model: An infrared fixed point almost exists + Confining below Electroweak scale $\Rightarrow$ models at the edge of conformal window
- After Higgs boson discovery : Light 0^{++} Higgs + reproduce detected phenomenology
- Parameter Space: N_C, N_f, Representations of $SU(N_C)$



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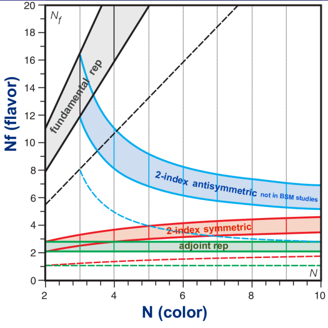

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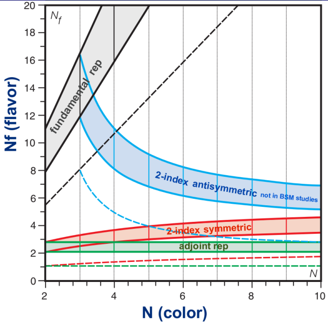

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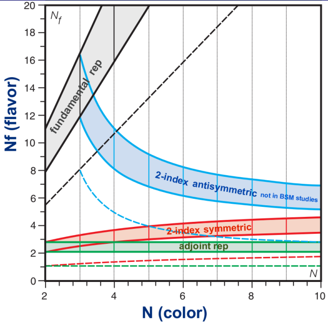

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- Yet seems to be still χSB
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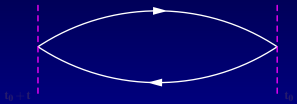
  - For fermionic operators (f_0), two diagrams are involved:



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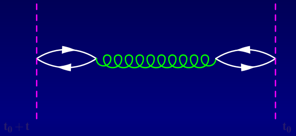

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  - Annihilation diagram requires Same-time Quark Propagator
    $\Rightarrow$ Cost of Exact Inversion is prohibitive $\rightarrow$Stochastic calculation
  - For gluonic operators(G, 0^{++} glueball),they are typically very noisy. Near Conformal Window, they can be light and coupled to the ground state
    $\Rightarrow$ a very long trajectory is needed
  - The above,possibly together with multi-hadron operators, are expected to mix in the ground state
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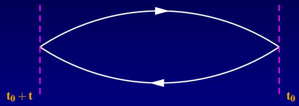

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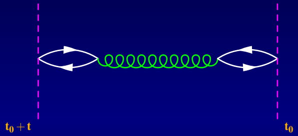

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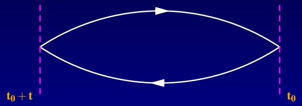

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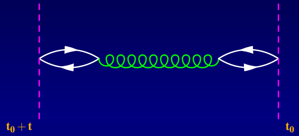

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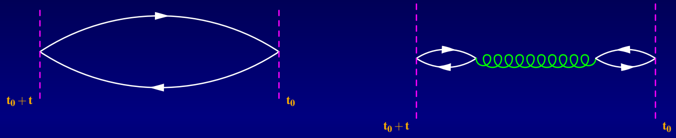

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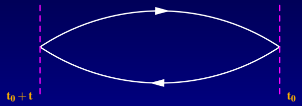

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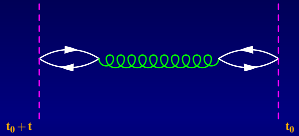

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Methodology - Implementation

- Staggered formalism:
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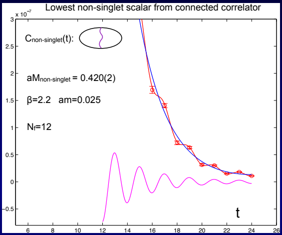
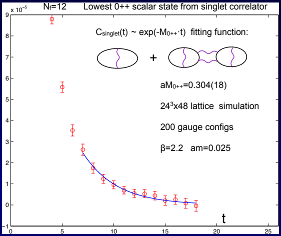
Methodology - Implementation

- Test on $N_f = 12$ Fundamental SU(3) Model
  - Known to be also close to Conformal Window
  - Runs faster and more statistics available





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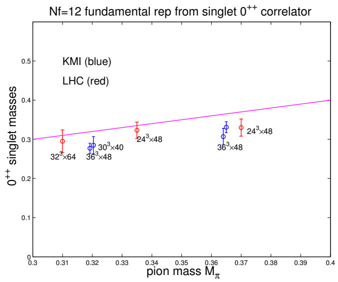

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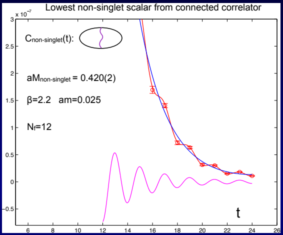

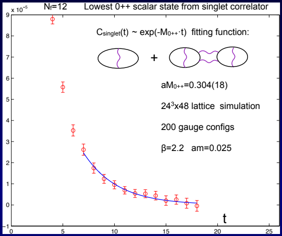

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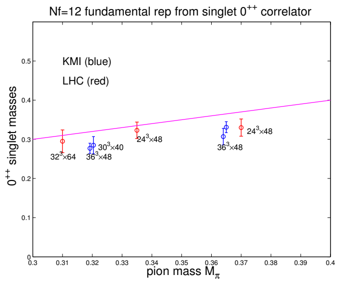

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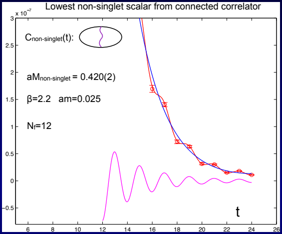

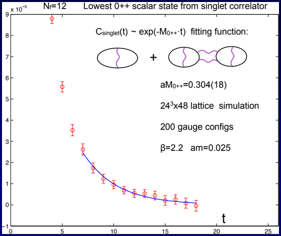

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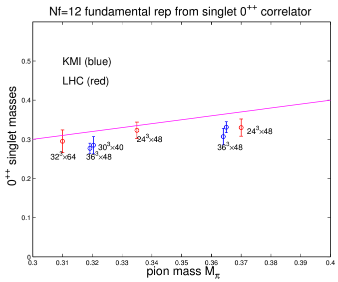

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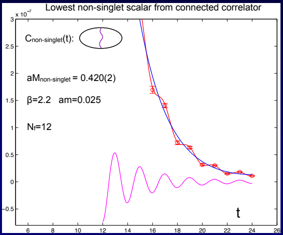

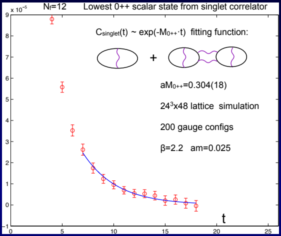

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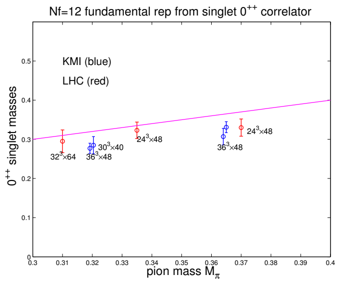

Methodology - Simulation Details

- Action: Tree-level Symanzik-Improved gauge action with Staggered $N_f = 2$ Sextet SU(3) fermions
- RHMC algorithm with multiple time scales and Omelyan integrator
- Autocorrelations monitored by time histories of effective masses and correlators
- $\beta = 6/g^2 = 3.20$ and 3.25, which is in the weak coupling regime
- Lattices available:($\sim 2000 - 4000$ Trajectories each)

β	L	T	m_q
3.20	48	96	0.003
	32	64	0.003, 0.004, 0.005, 0.006, 0.007, 0.008
	28	56	0.003, 0.004, 0.005, 0.006, 0.007, 0.008
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	28	56	0.003, 0.004, 0.005, 0.006, 0.007, 0.008
	24	48	0.003, 0.004, 0.005, 0.006, 0.007, 0.008, 0.009, 0.010, 0.012, 0.014
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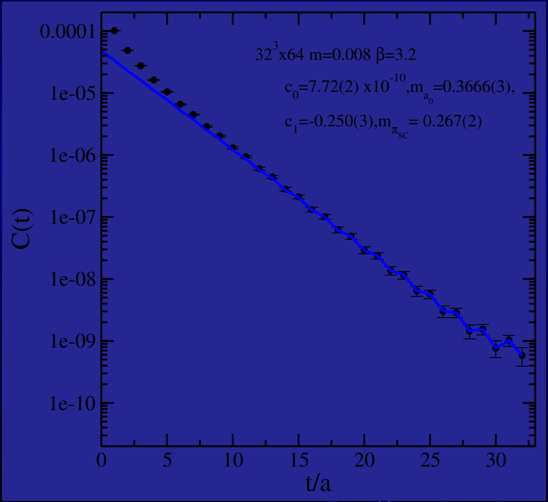

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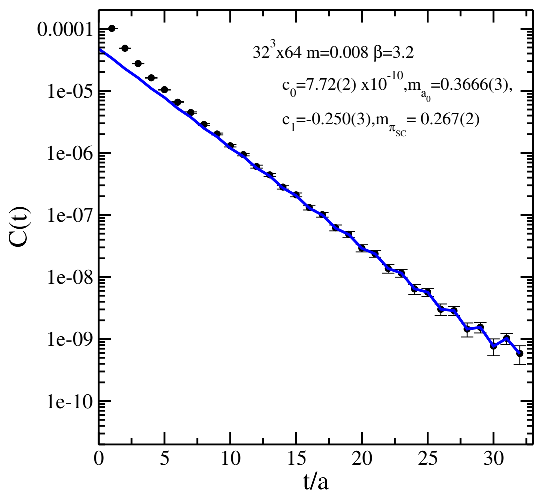

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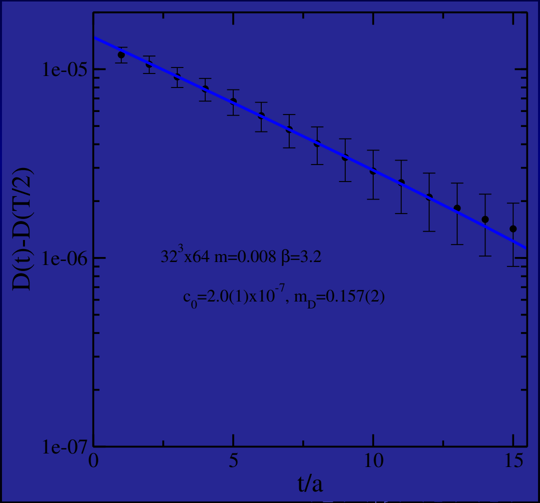

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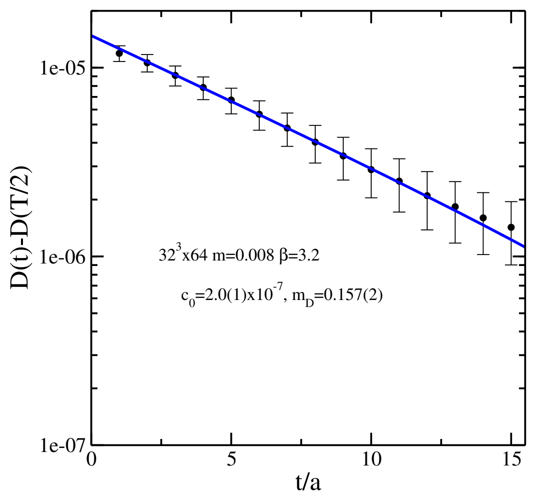

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- Observations of typical data:
  - $\Rightarrow$ Full subtracted correlator can be fitted well with the ansatz:

$$\tilde{D}(t) + C(t) = c_0(\cosh(m_{f_0}(T/2 - t)) - 1) + c_1(\cosh(m_1(T/2 - t)) + (-)^t c_2 \cosh(m_{\eta_{SC}}(T/2 - t))),$$

    where $m_{f_0} \approx m_D$, $m_1 \approx m_{a_0}$ and $m_{\eta_{SC}} \approx m_{\pi_{SC}}$
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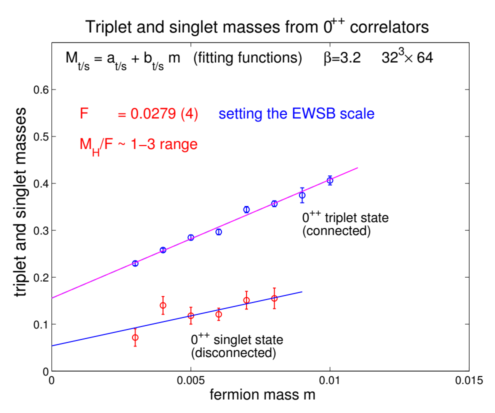
- Preliminary Results



- Finite momentum energy consistent with expected dispersion. E.g. $\beta = 0.006, m_{f_0} = 0.119(18)$, $[E_{f_0}(\vec{p} = (0,0,1))]^2 - m_{f_0}^2 - 4\sin^2(\pi/L) = 0.019(17)$
- m_{f_0} can be as light as $250 - 750$GeV
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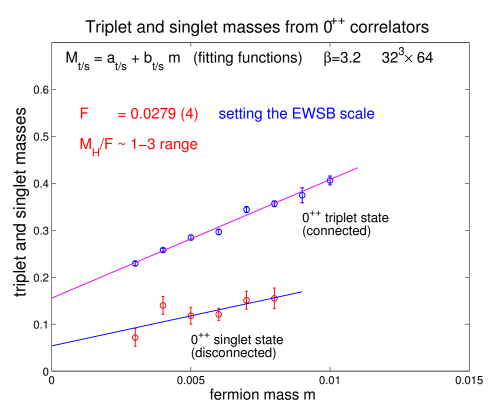

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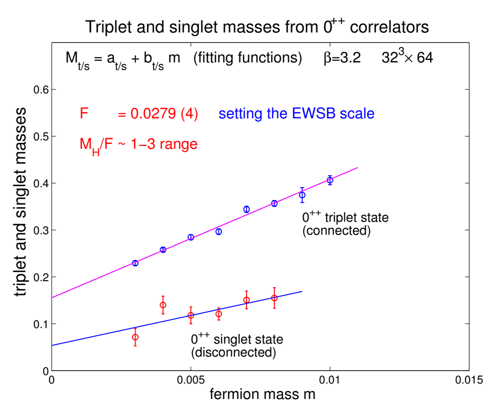

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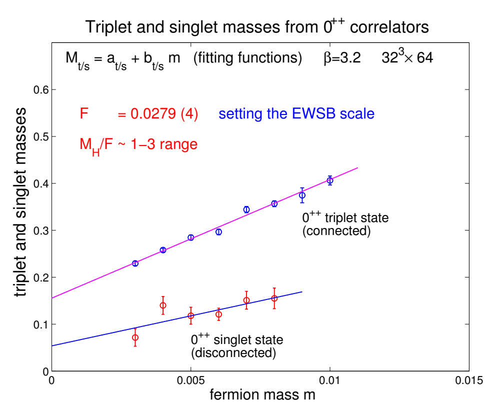

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