Further investigation of massive Landau-gauge propagators in the infrared limit

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Work in collaboration with Attilio Cucchieri

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- Large-lattice results
- Conclusions

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- Infinite volume favors configurations on the first Gribov horizon, where λ_{min} of the Faddeev-Popov matrix $\mathcal{M}$ goes to zero
- In turn, $G(p^2)$ should be IR enhanced, introducing long-range effects, related to the color-confinement mechanism

Numerical Test of GZ Scenario

Before 2007:

- Gluon propagator is suppressed in the limit $p \to 0$
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Not consistent with scaling solution: $D \sim (p^2)^{2\kappa - 1}$, $G \sim (p^2)^{-\kappa - 1}$

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- Ghost propagator should not depend on T

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$$D_{L,T}(p) \;=\; C\,\frac{1\,+\,d\,p^{2\eta}}{(p^2+a)^2\,+\,b^2}$$

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Note: $D(0)^{-1/2} \;=\; \sqrt{(a^2 + b^2)/C}$ mixes m_R and m_i and depends on the normalization C

This Work: Parameters

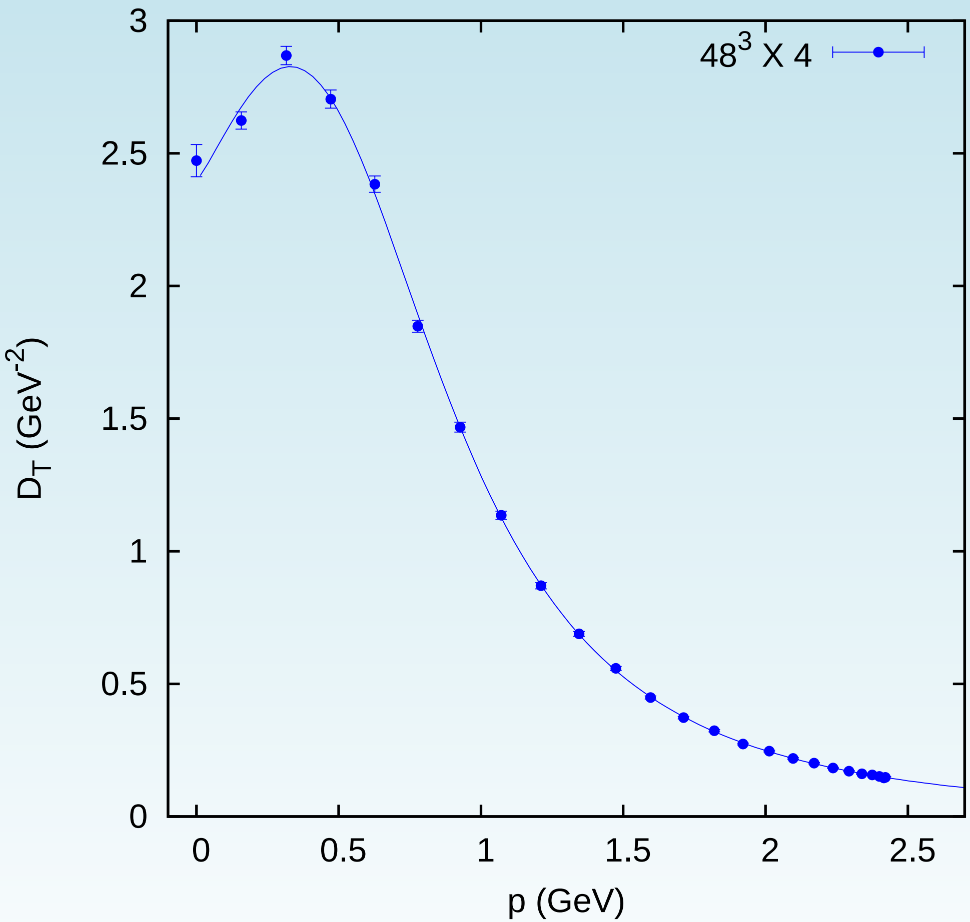
- Pure SU(2) case, standard Wilson action
- Lattice sizes: $48^3 \times 2$, $48^3 \times 4$, $48^3 \times 8$,
  $96^3 \times 2$, $96^3 \times 4$, $96^3 \times 8$,
  $192^3 \times 4$
- β values:
  $$2.2872,\ 2.299,\ 2.313,\ 2.333,\ 2.505796$$
  corresponding respectively to
  $$0.968,\ 1.0,\ 1.04,\ 1.1,\ 1.936 \times T_c$$
  at $N_t = 4$
- masses extracted from Gribov-Stingl behavior

This Work: Machine

- 1 master + 8 nodes, each with 2 CPU Intel Xeon 2.40GHz (quadcore, 8 MB cache) and 24 GB of memory
- total of 72 ($\times 2$) cores and 216 GB of memory; peak performance: about 2 Tflops
- 8 NVIDIA Tesla S1070 boards (500 Series), 960 cores and 16 GB of memory; peak performance: 2.8 Tflops in double precision or 33 Tflops in single precision
- InfiniBand 16 Gbits/s, total of 6 Tbytes HD

Results: Transverse Gluon

Transverse gluon propagator at T_c, from $\beta = 2.299$



Gribov-Stingl fit:

$(a, b) = (0.28, 0.59)\,\mathrm{GeV}^2$

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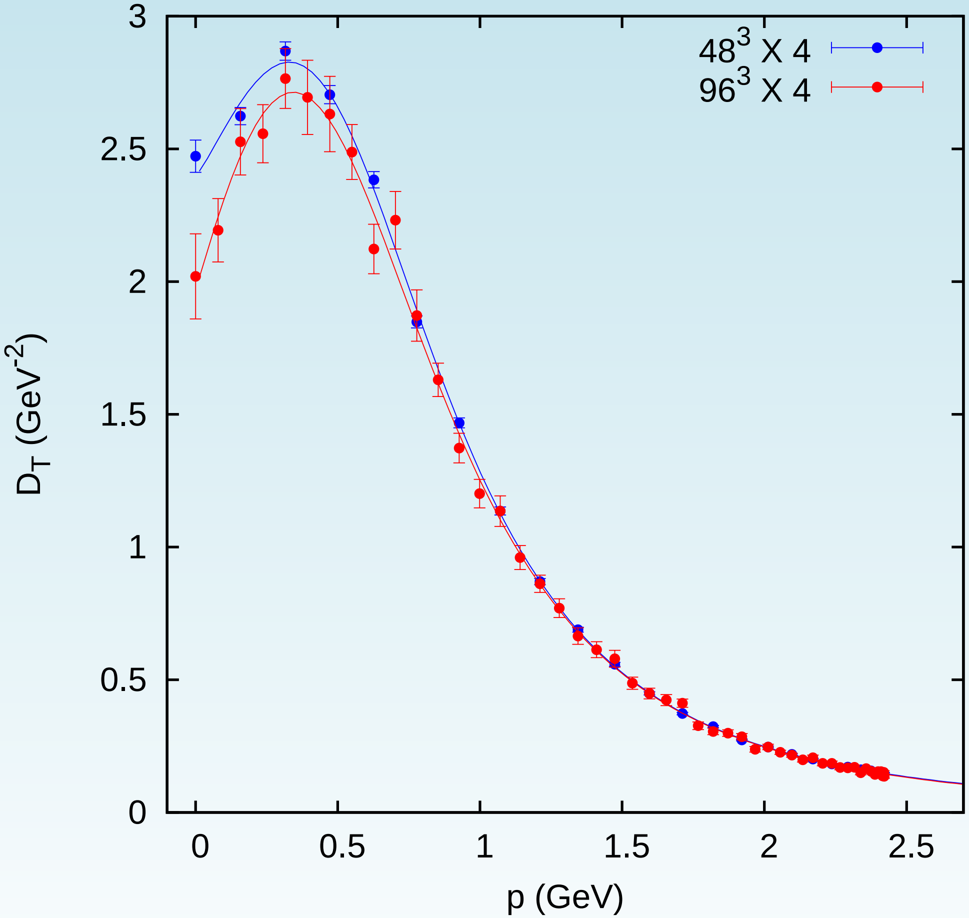

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for both: $\eta \approx 0.6$

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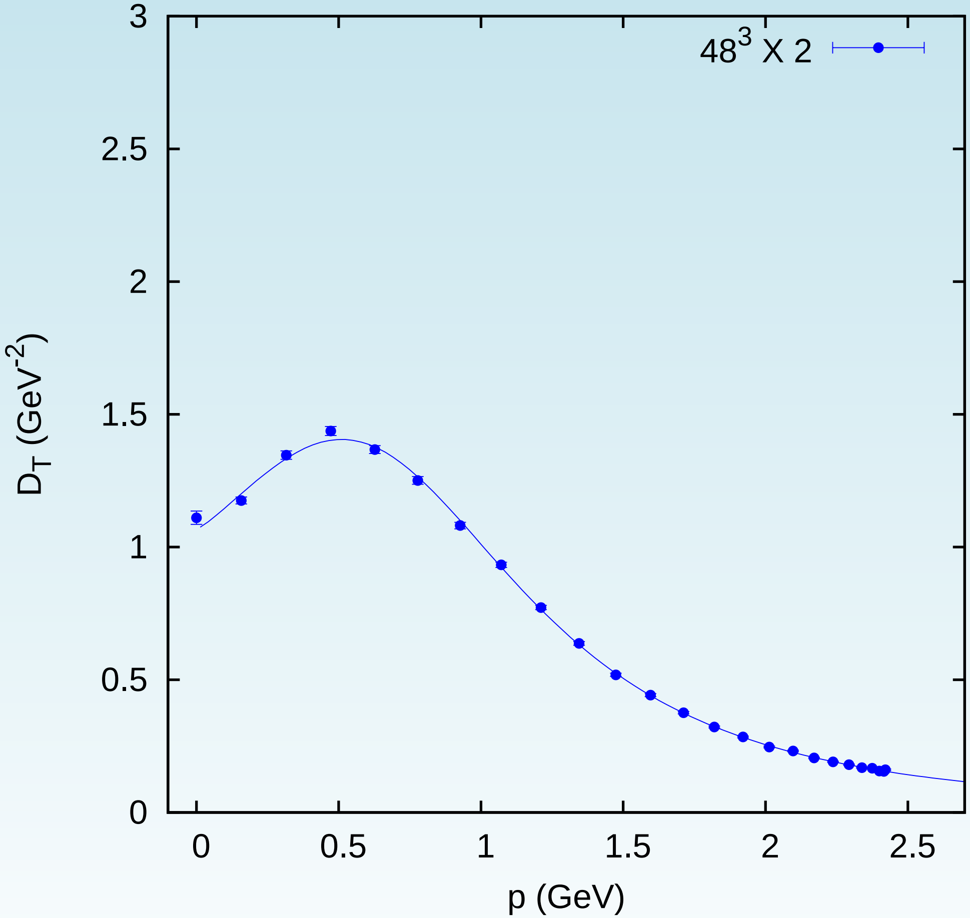
Transverse gluon propagator at $2T_c$, from $\beta = 2.299$



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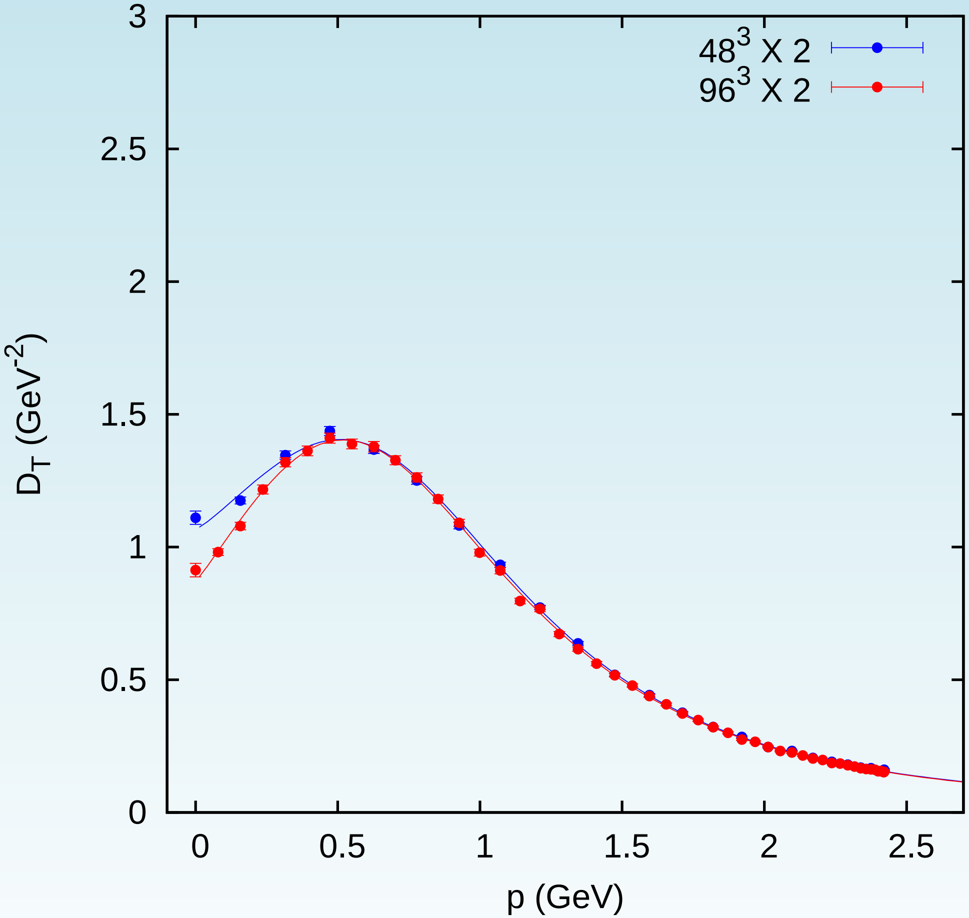


Gribov-Stingl fit:

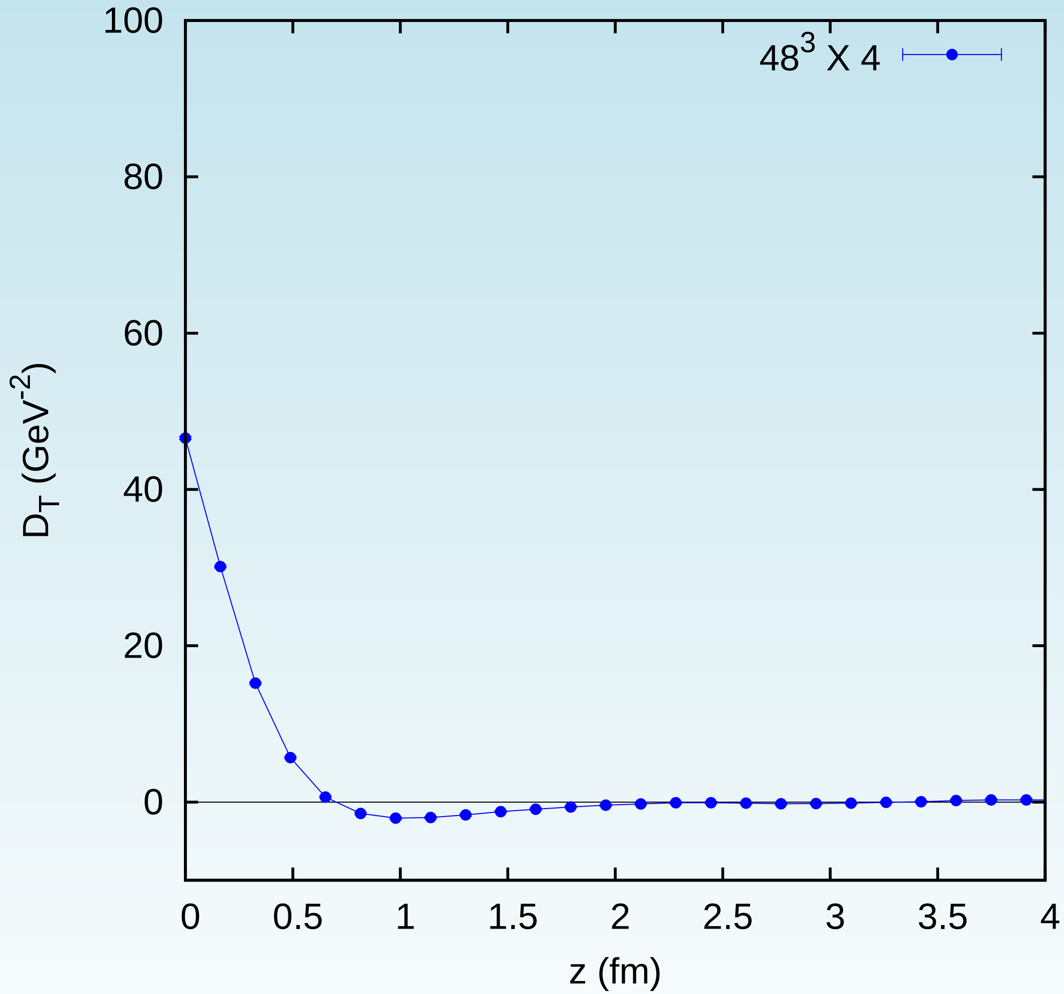
$(a, b) = (0.35, 0.98)\,\mathrm{GeV}^2$

$(a, b) = (0.44, 0.88)\,\mathrm{GeV}^2$

for both: $\eta \approx 0.6$

Results: Transverse Gluon

Real-space transverse gluon propagator at T_c, from $\beta = 2.299$



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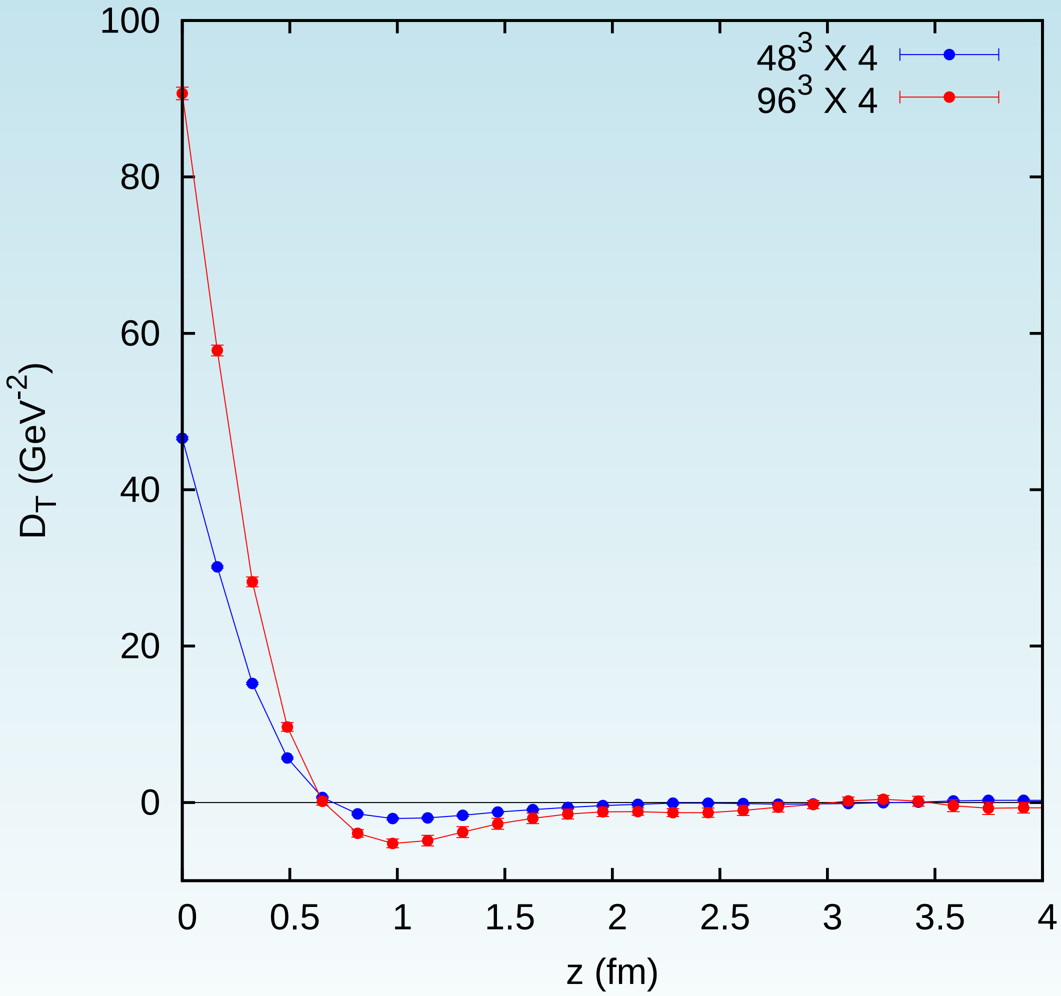

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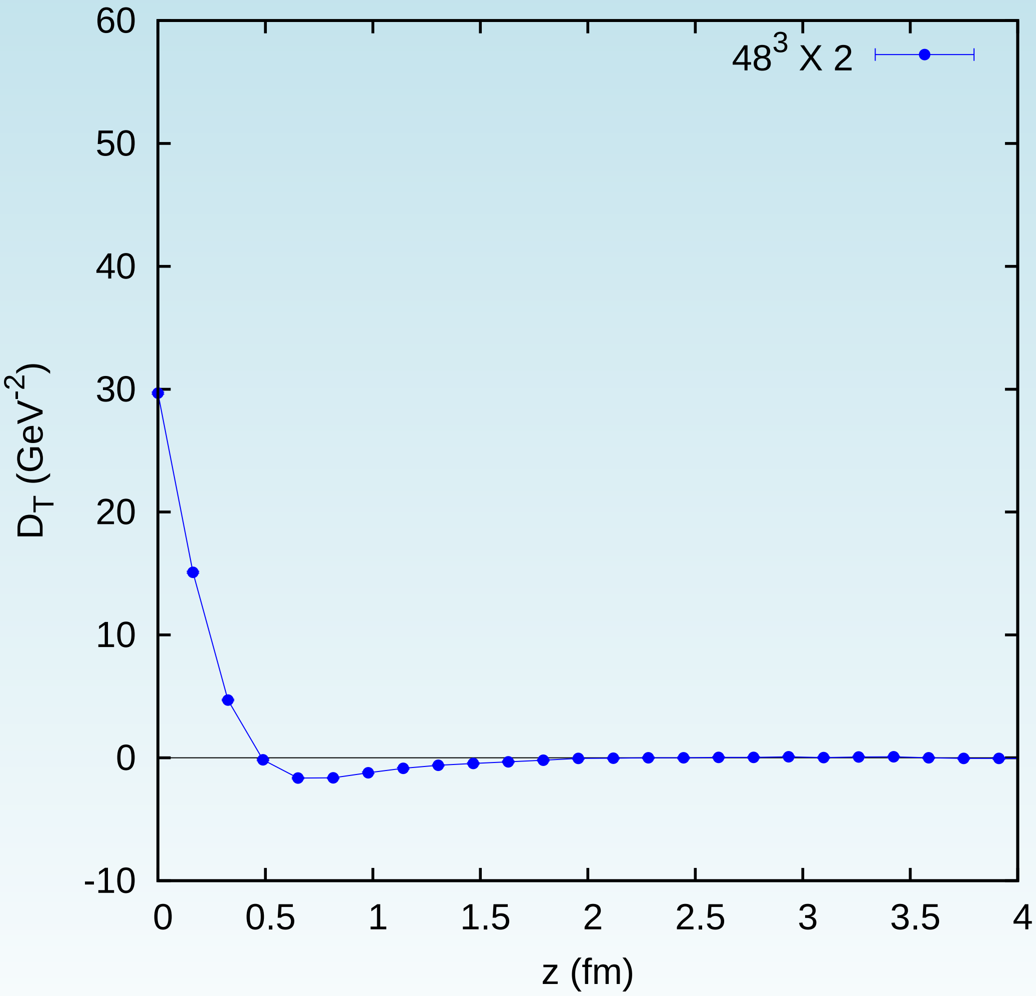

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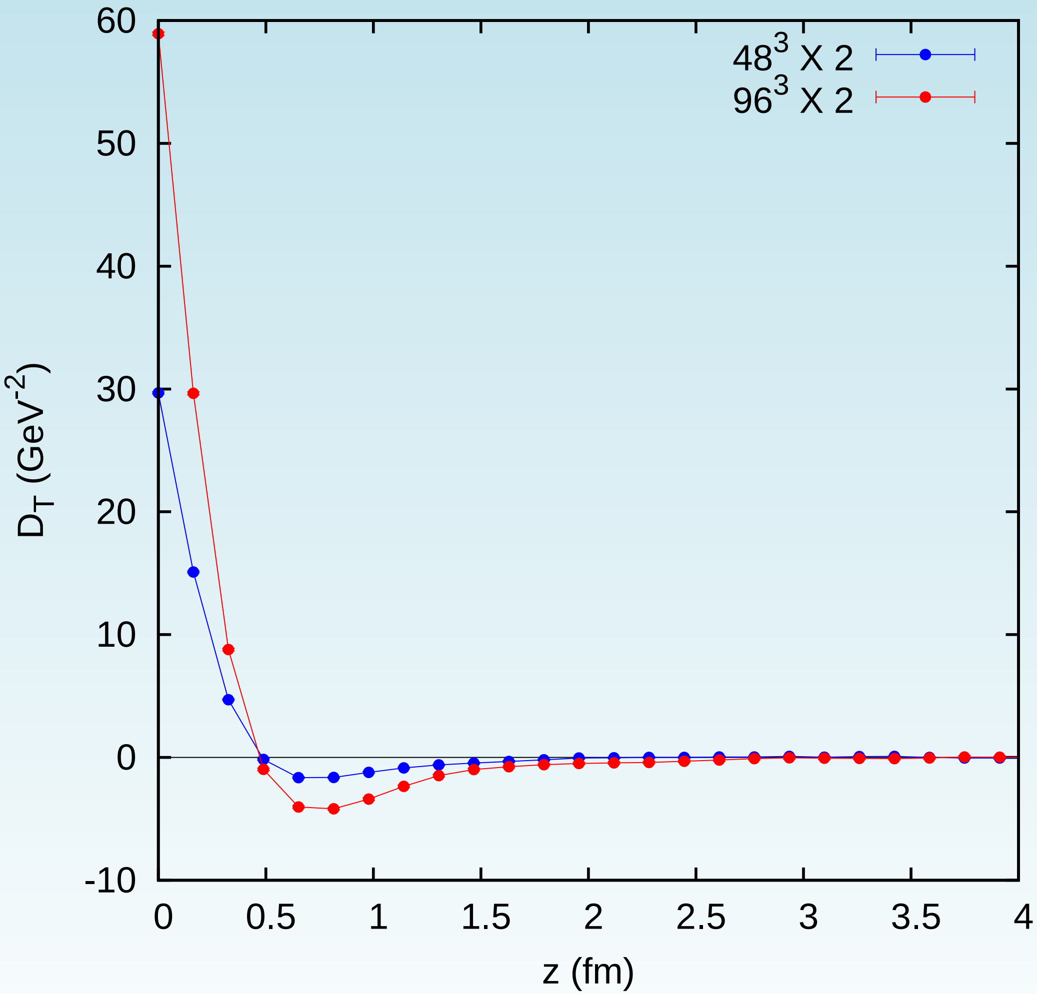

Results: Longitudinal Gluon

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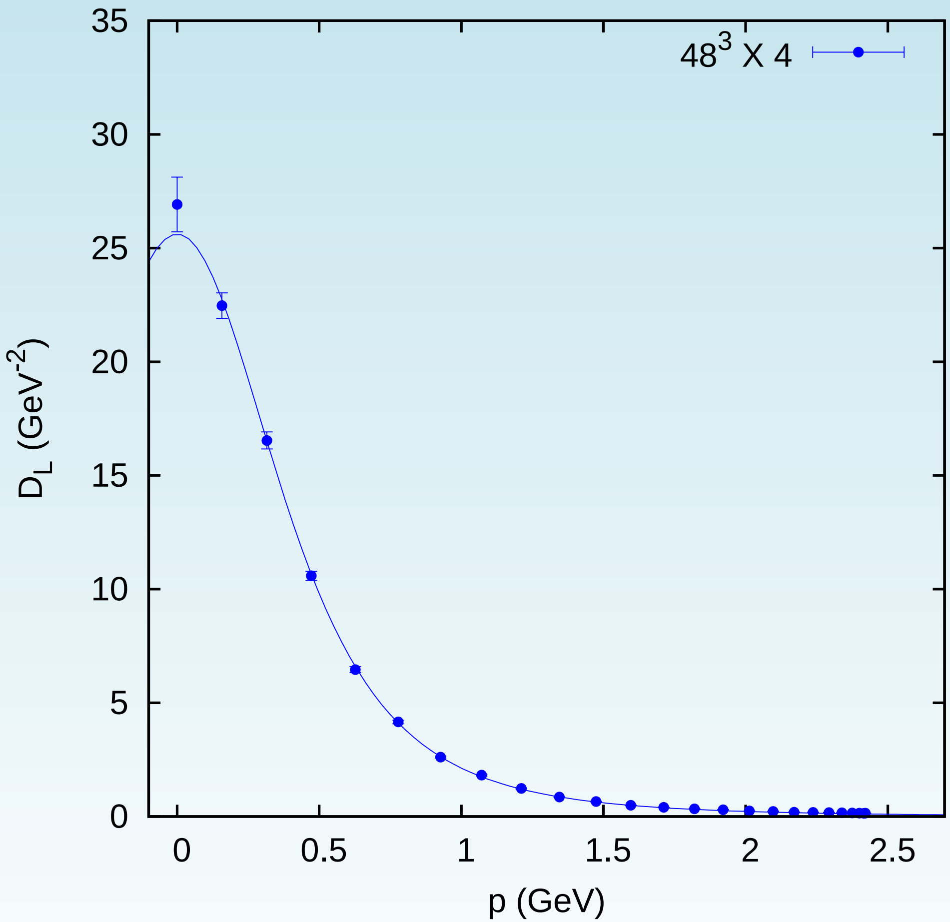

Gribov-Stingl fit:

$(a, b) = (0.39, 0.1)\,\mathrm{GeV}^2$

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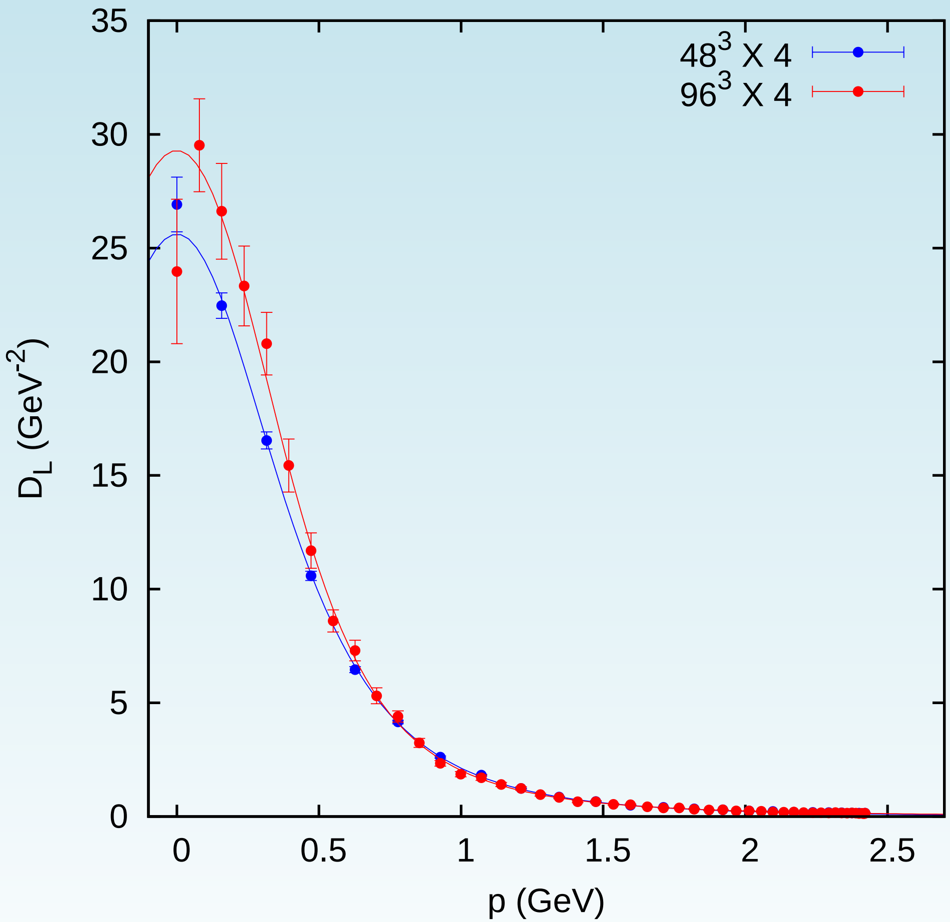

Gribov-Stingl fit:

$(a, b) = (0.39, 0.1)\,\mathrm{GeV}^2$

$(a, b) = (0.12, 0.17)\,\mathrm{GeV}^2$

oscillating η...

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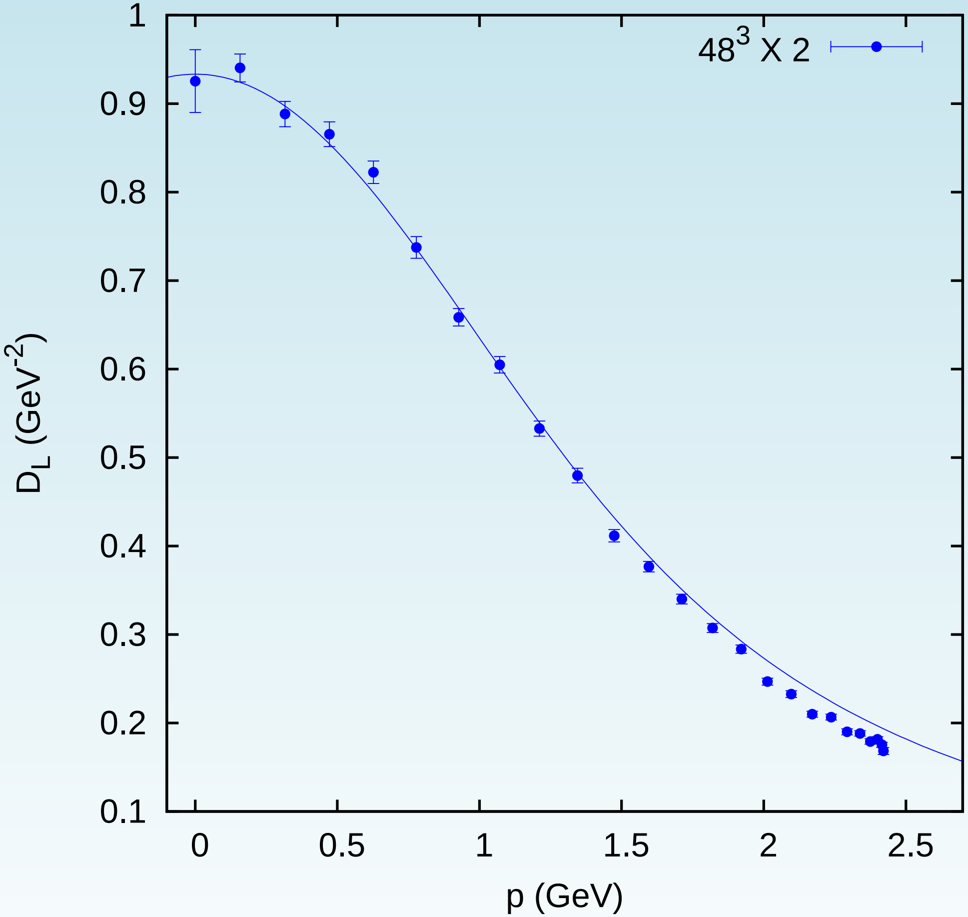

Gribov-Stingl fit:

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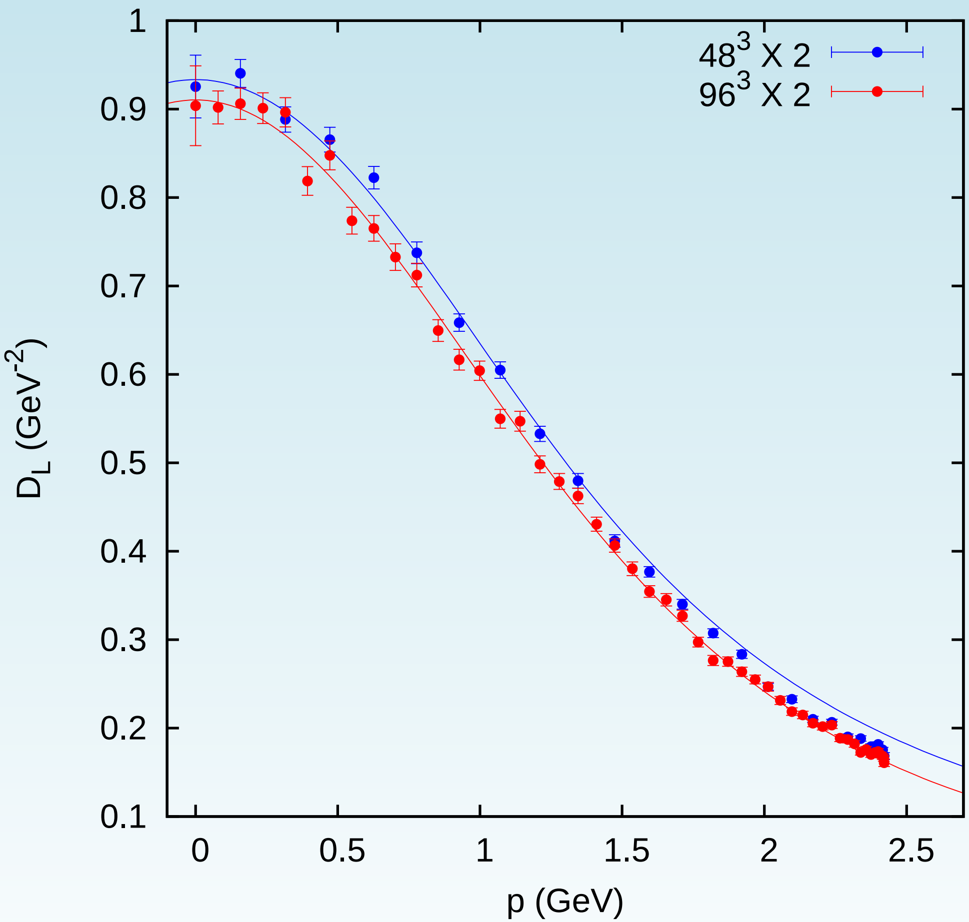

Gribov-Stingl fit:

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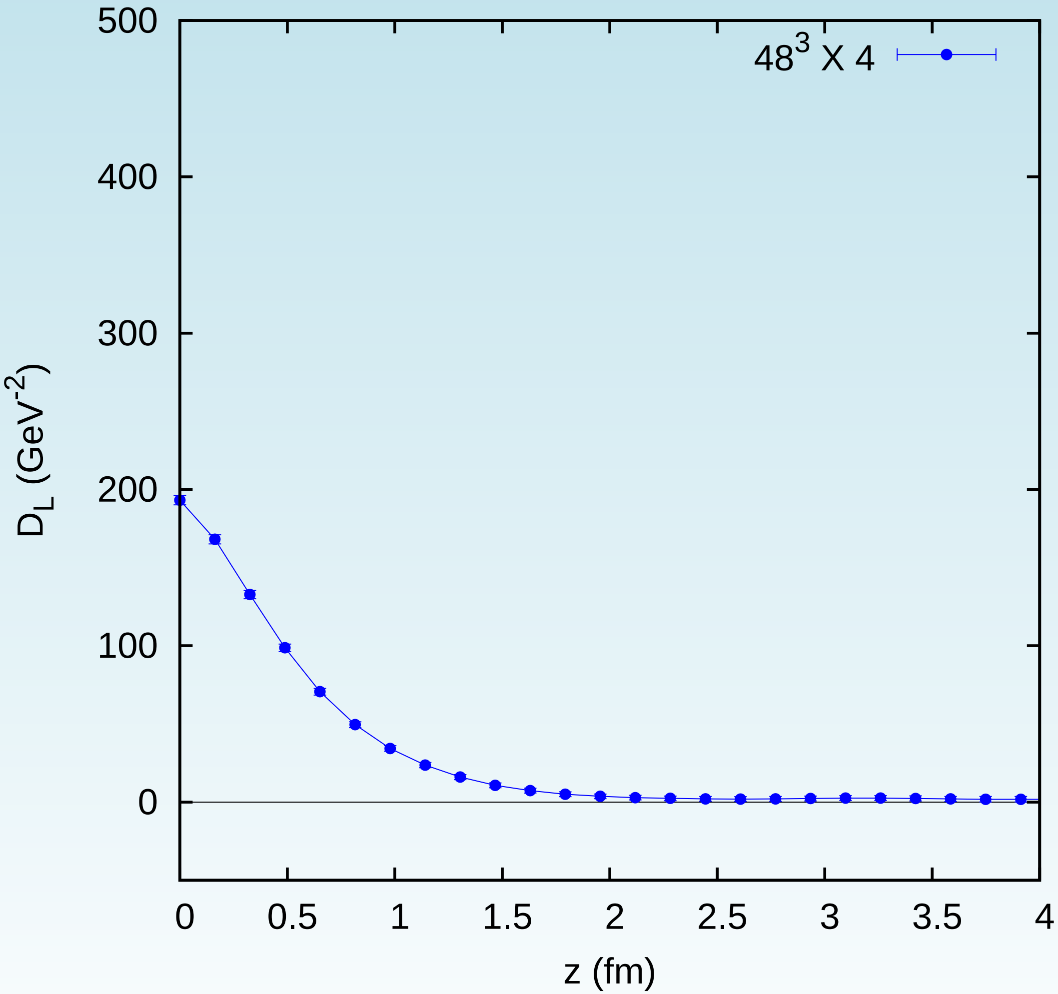
Real-space longitudinal gluon propagator at T_c, from $\beta = 2.299$



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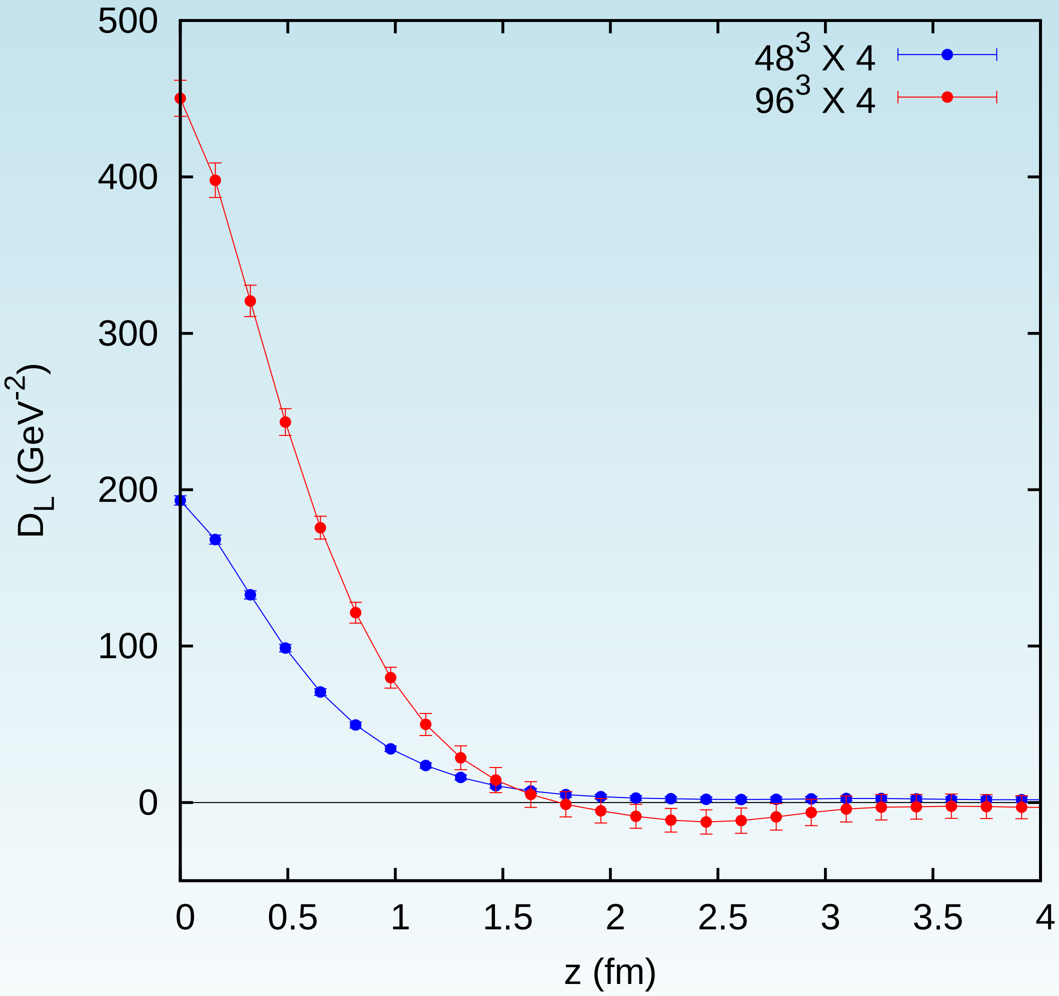

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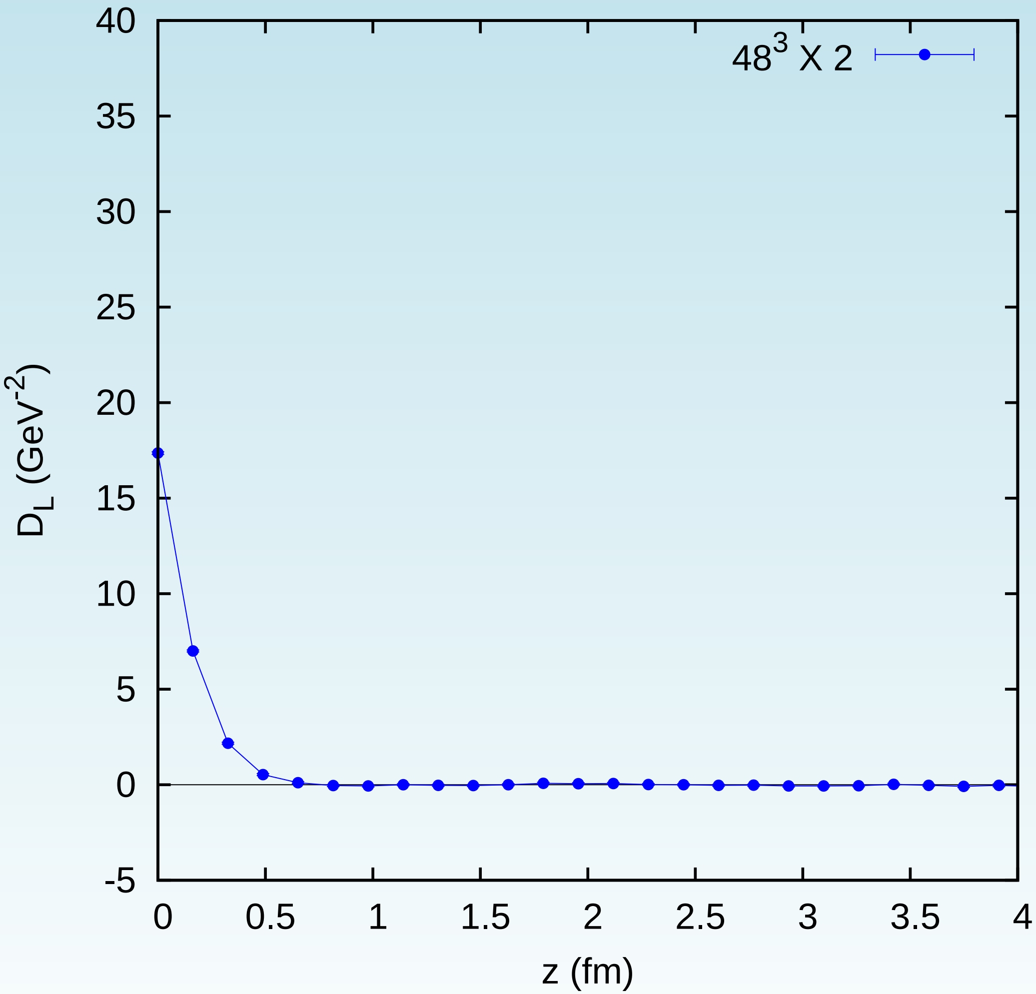

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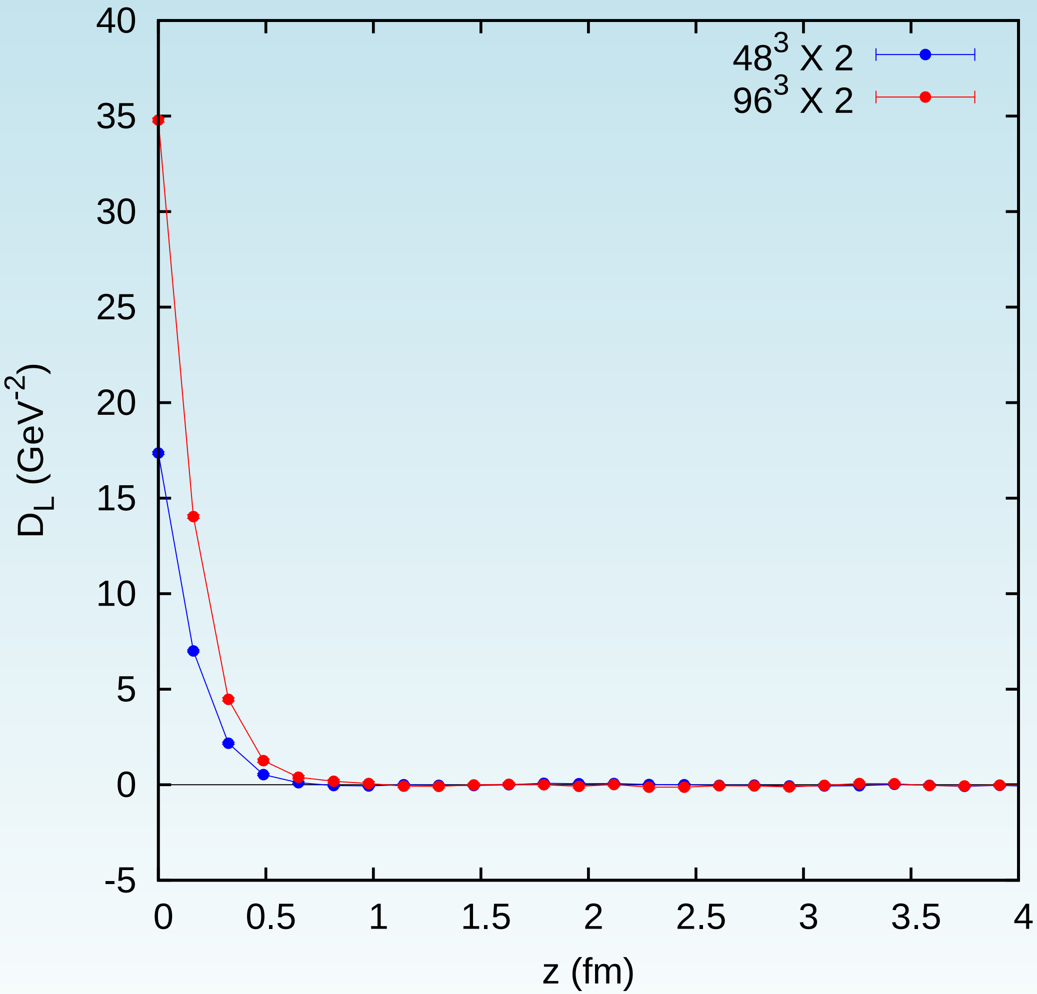

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  up to what T is the longitudinal gluon confined?