Toward radiative transport with improved parton interactions

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- Introduction
- Pressure anisotropy and energy density
- gg <-> ggg with the exact matrix element
- Summary and speculations

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Introduction: radiative transport

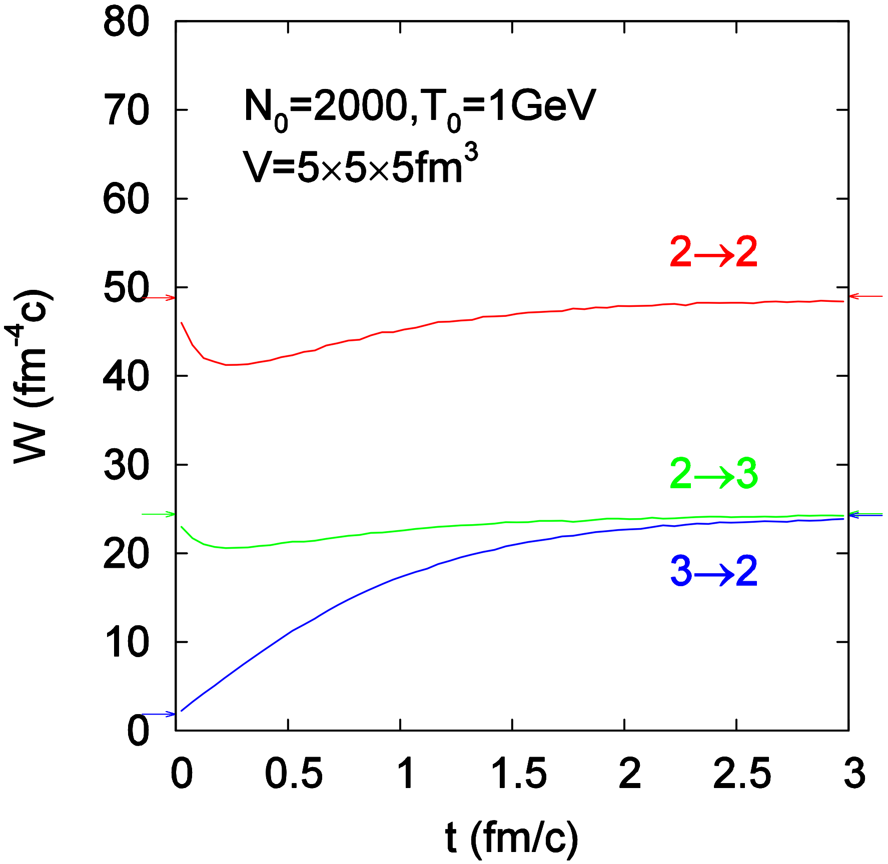
- The reaction rates

$$\sigma_{22} = \frac{9\pi\alpha_S^2}{2\mu^2}$$

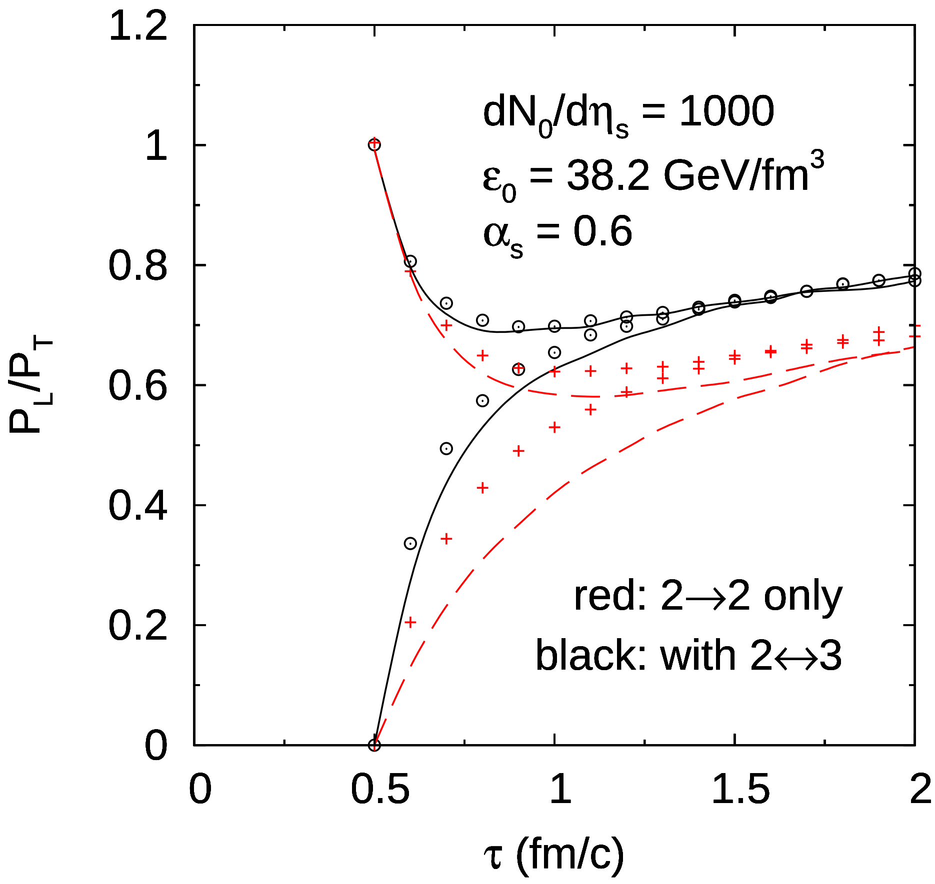
$$\mu^2 = \frac{3\pi\alpha_S}{V}\sum_i \frac{1}{p_i}$$

$$\sigma_{23} = 0.5\sigma_{22}$$

$$I_{32} = 12\pi^2\sigma_{23}$$



Longitudinal to transverse pressure ratio



Lines (points): exponential (condensate) initial conditions

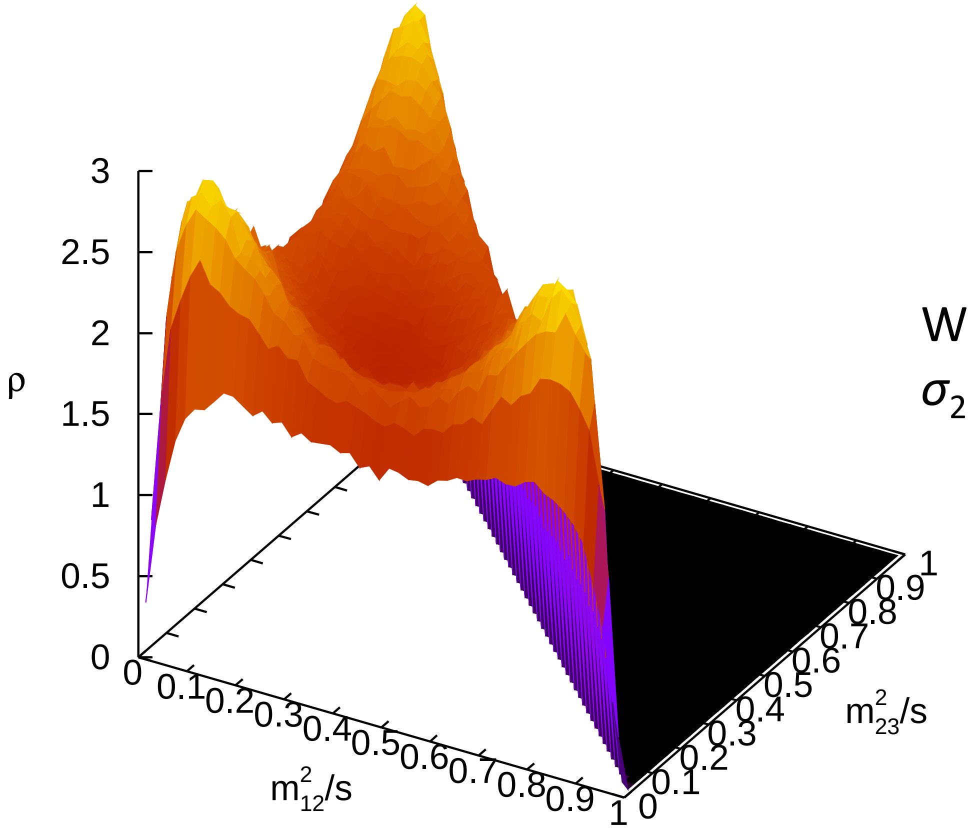
- competition between expansion and equilibration
- common asymptotic evolution
- more isotropization with inelastic processes
- not sensitive to initial momentum distribution with inelastic processes

Exact matrix element for gg↔ggg

$$\left|M_{gg\to ggg}\right|^2 = \frac{g^6 N_c^3}{2(N_c^2-1)} \frac{\sum (ij)^4 \sum (ijklm)}{\prod (ij)}$$

$$(ij) = p_i \cdot p_j$$

$$(ijklm) = (ij)(jk)(kl)(lm)(mi)$$



Propagators regulated by μ^2

When α_s=0.47, μ^2=10 fm^{-2}, s=4 GeV^2, σ_{22}=0.312 fm^2, and σ_{23}=0.0523 fm^2.

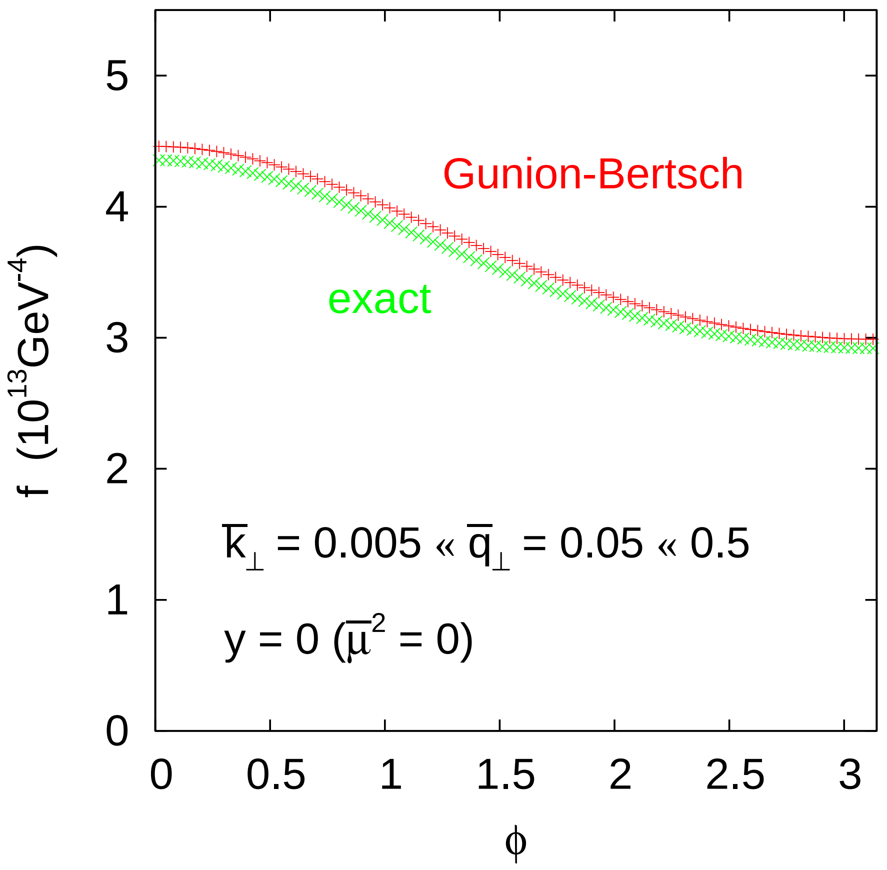
σ_{23}/σ_{22} ~ 0.168 < 0.5

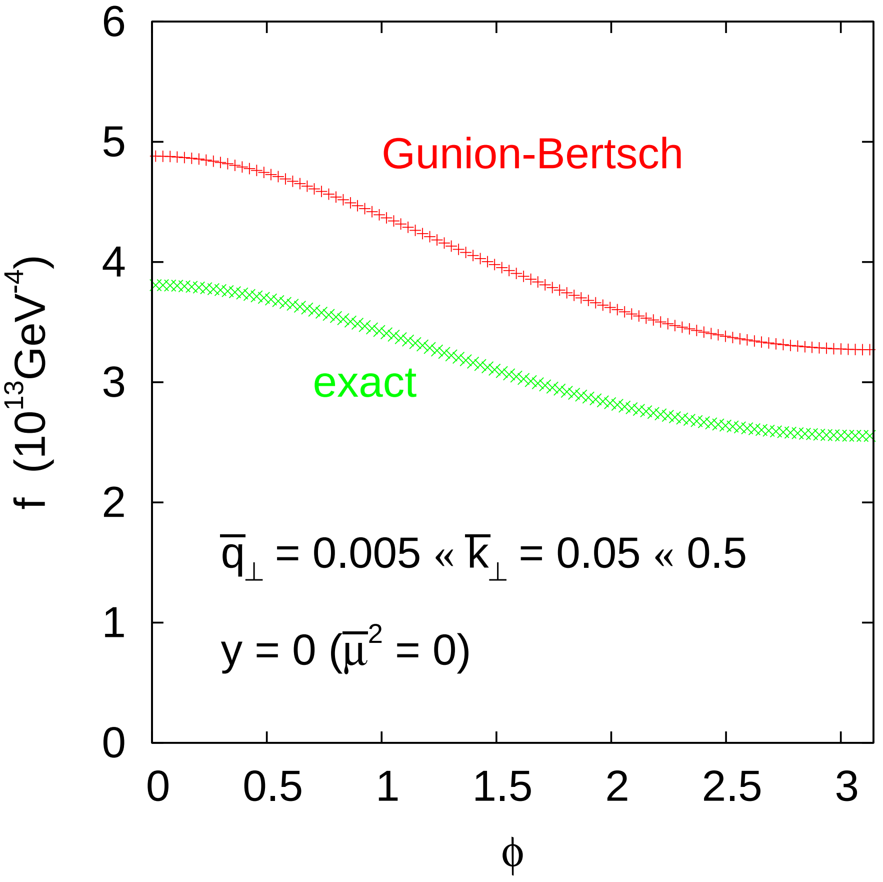
(When α_s=0.3, μ^2=6.38 fm^{-2}, s=4 GeV^2, σ_{22}=0.199 fm^2, and σ_{23}=0.0504 fm^2.)

Exact matrix element vs. Gunion-Bertsch

$$\left|M^{GB}_{gg\to ggg}\right|^2 = \frac{9g^4s^2}{2(q_\perp^2+\mu^2)^2}\,\frac{12g^2q_\perp^2}{k_\perp^2((\vec{k}_\perp-\vec{q}_\perp)^2+\mu^2)}$$

singularity regulated by μ^2





Exact matrix element vs. Gunion-Bertsch

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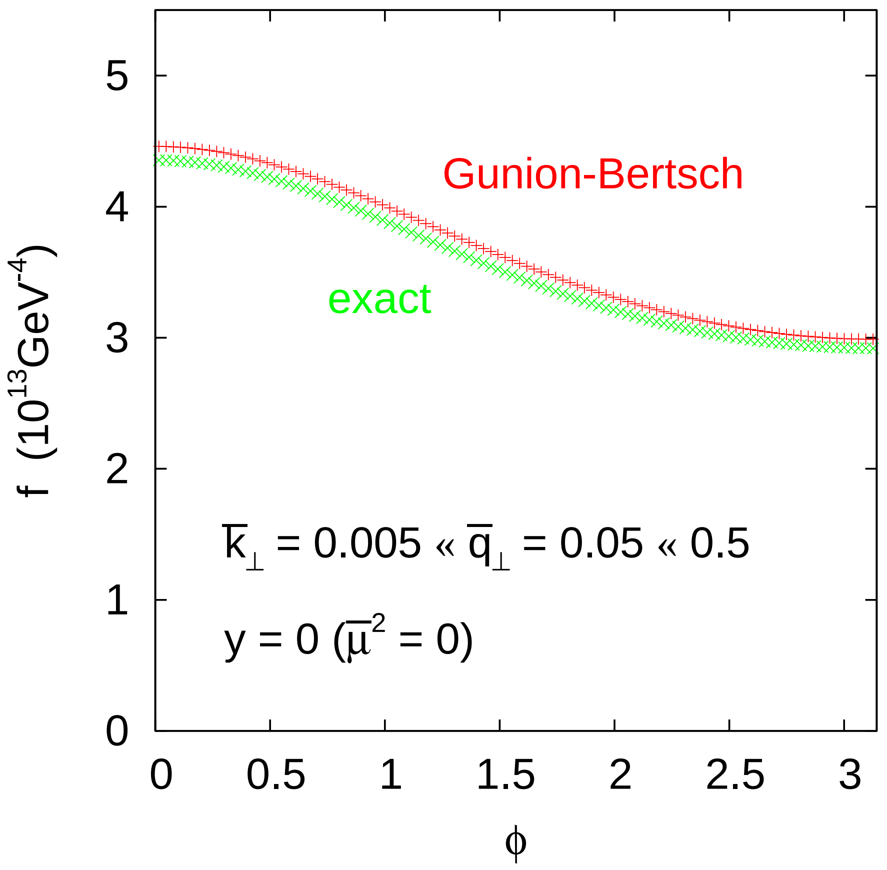
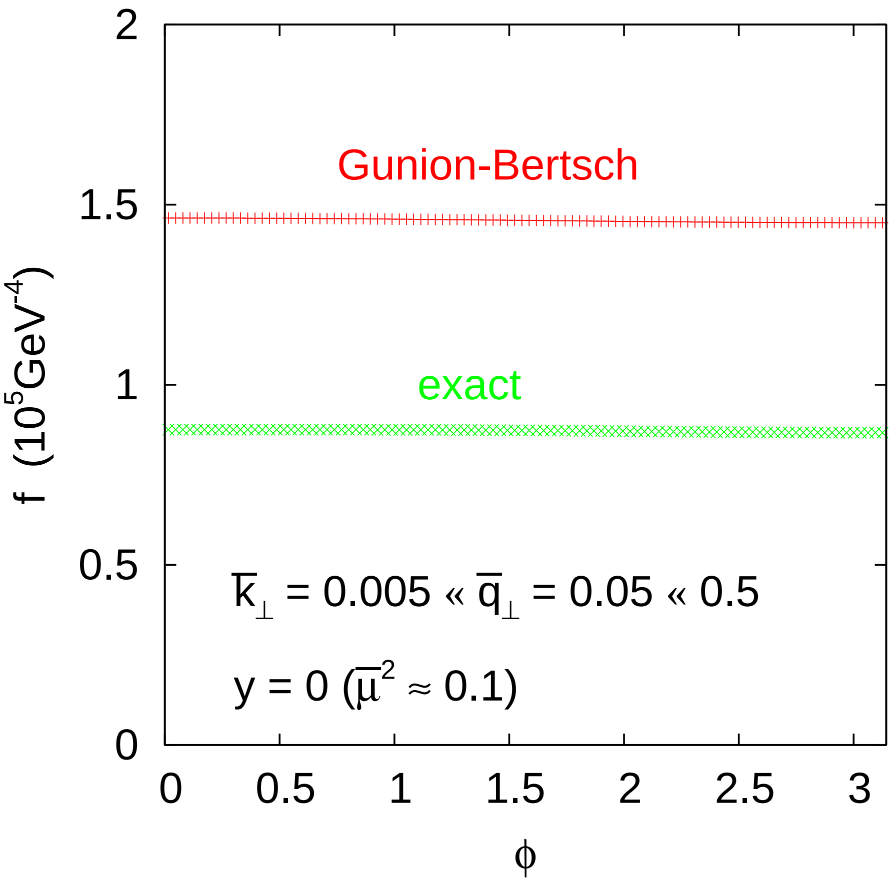
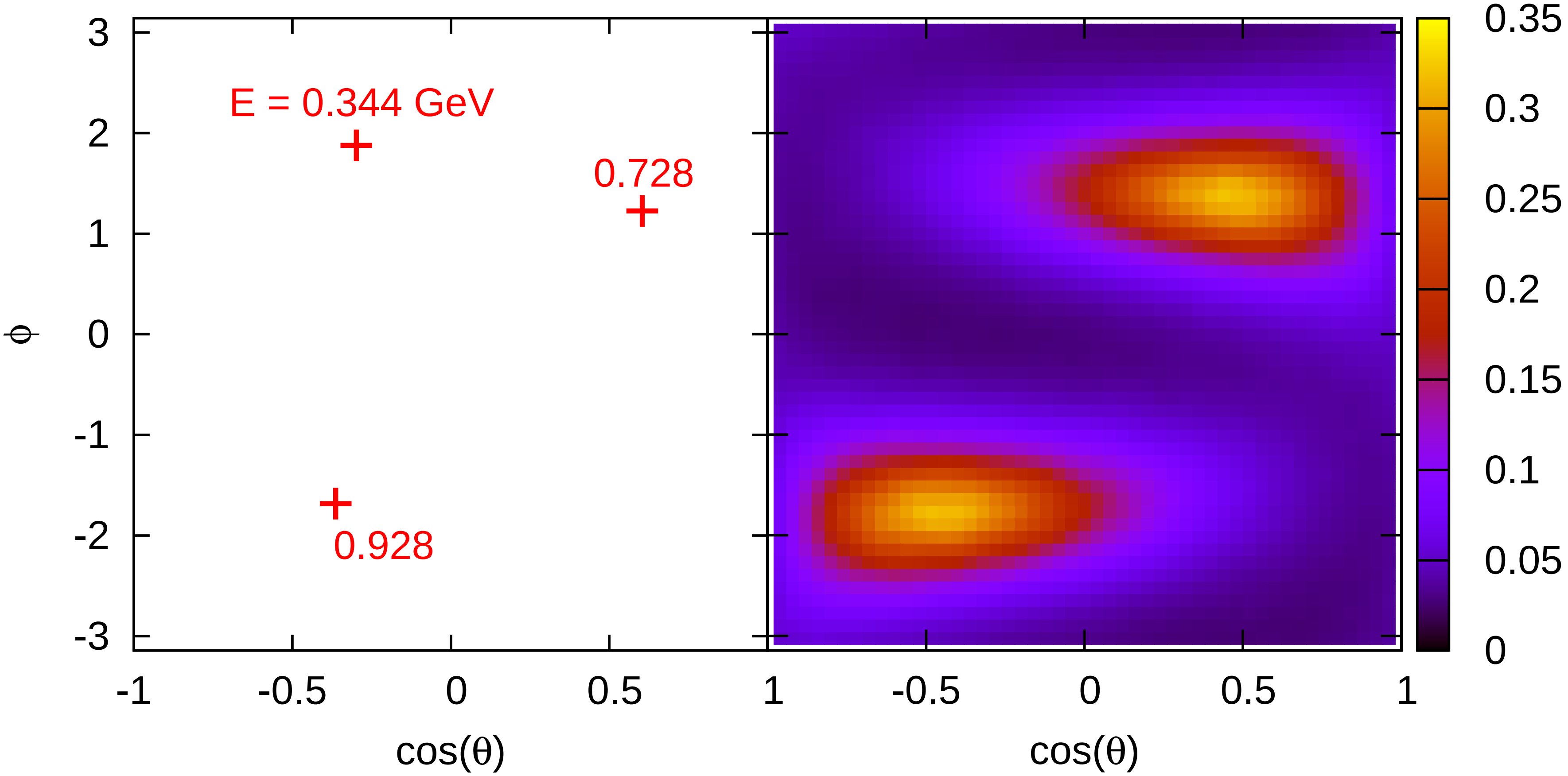
singularity regulated by μ^2





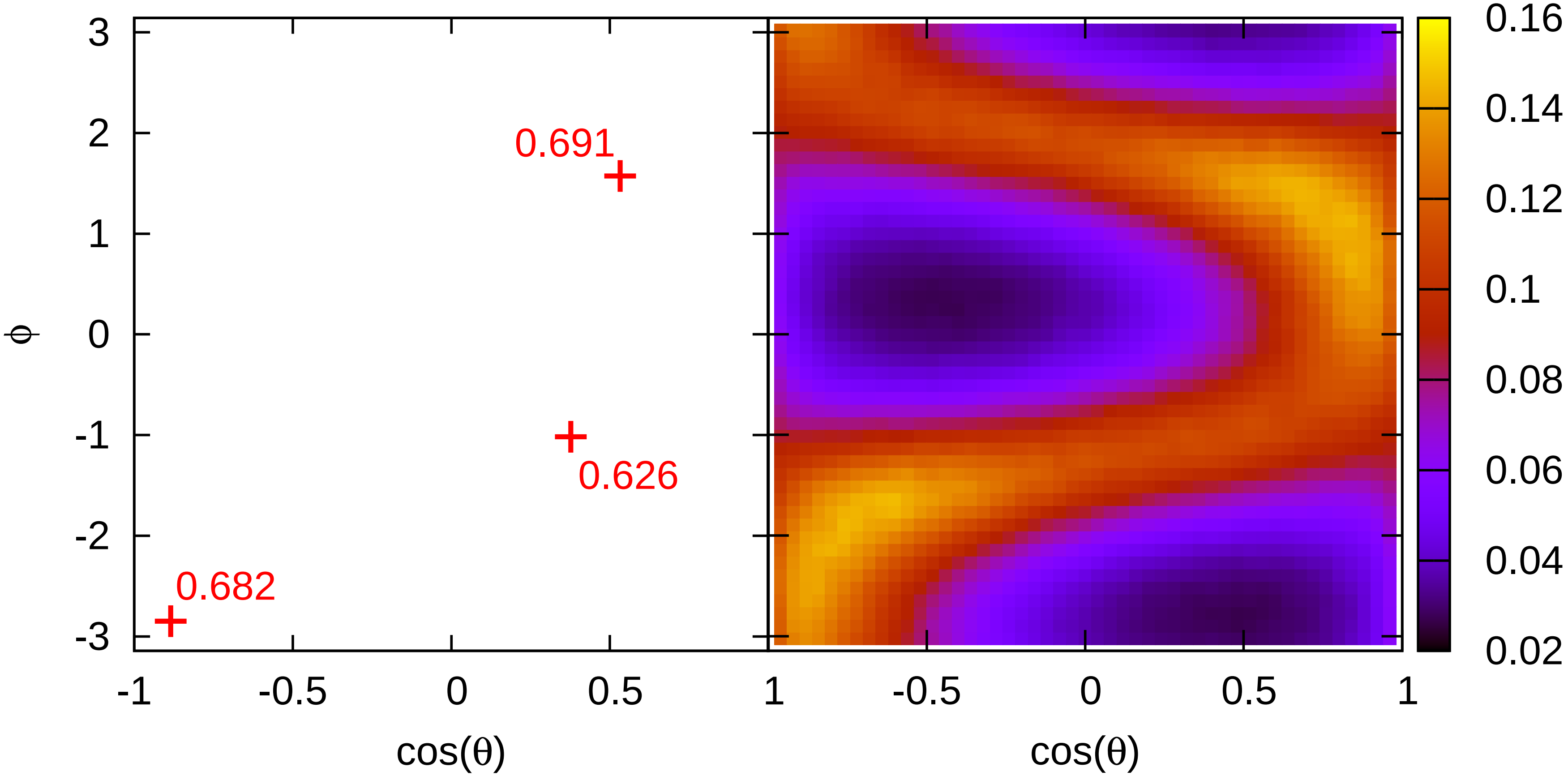
Exact matrix element for gg↔ggg

When α_s=0.47, μ^2=10 fm^{-2}, I_{32}=6.84 fm^2. Estimate with isotropic matrix element gives I_{32}=6.19 fm^2.



Exact matrix element for gg↔ggg

When α_s=0.47, μ^2=10 fm^{-2}, l_{32}=4.85 fm^2. Estimate with isotropic matrix element gives l_{32}=6.19 fm^2.



Summary and speculations

- Elastic collisions may be more important in thermalization than expected.

- Specific shear viscosity may be larger than the quantum limit.

- Formation time regularization can be approximated by screening mass regularization (replacement of the theta function by a Lorentzian).

- Exact and Gunion-Bertsch can have big differences.

- Bethe-Heitler limit may be important for bulk matter thermalization (formation time vs. mean free path).

- Elastic collisions can also be important for heavy quark equilibration (meson dissociation).