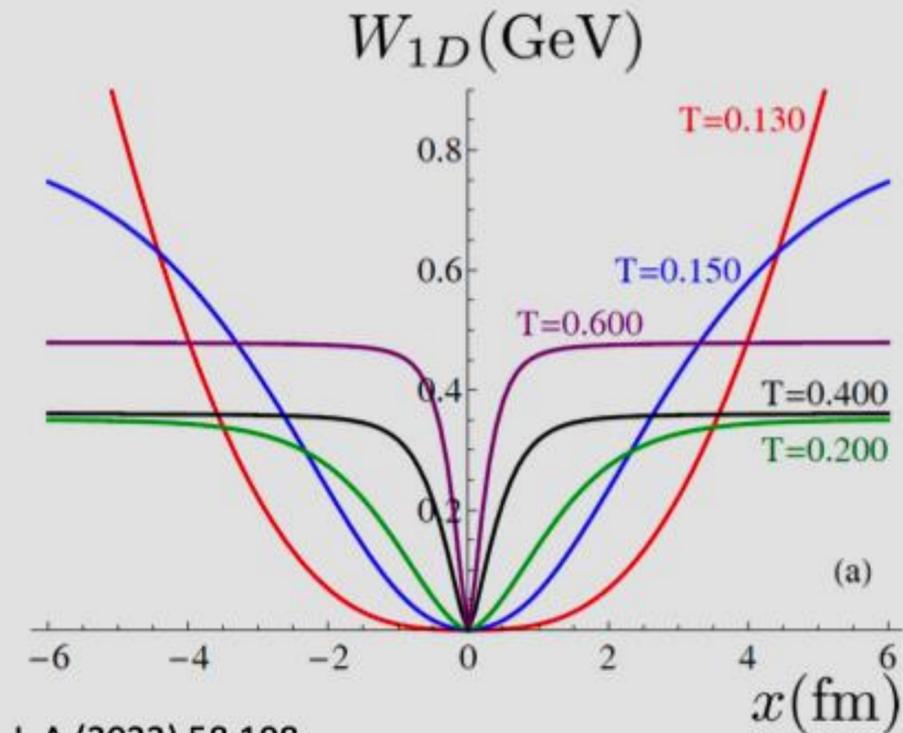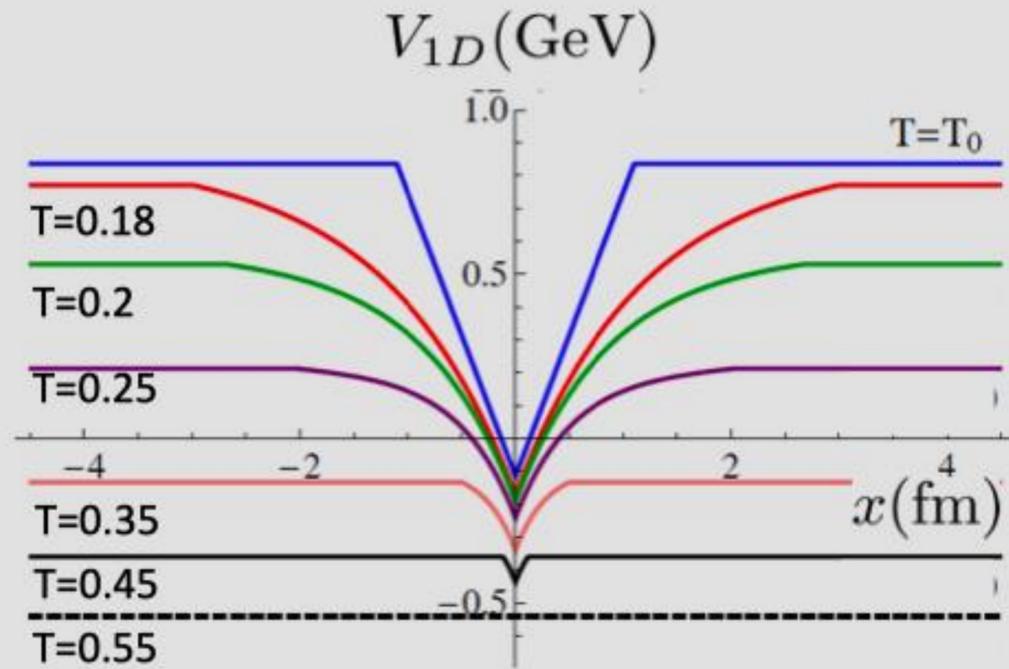# SOme illustrative results for Lecture 3
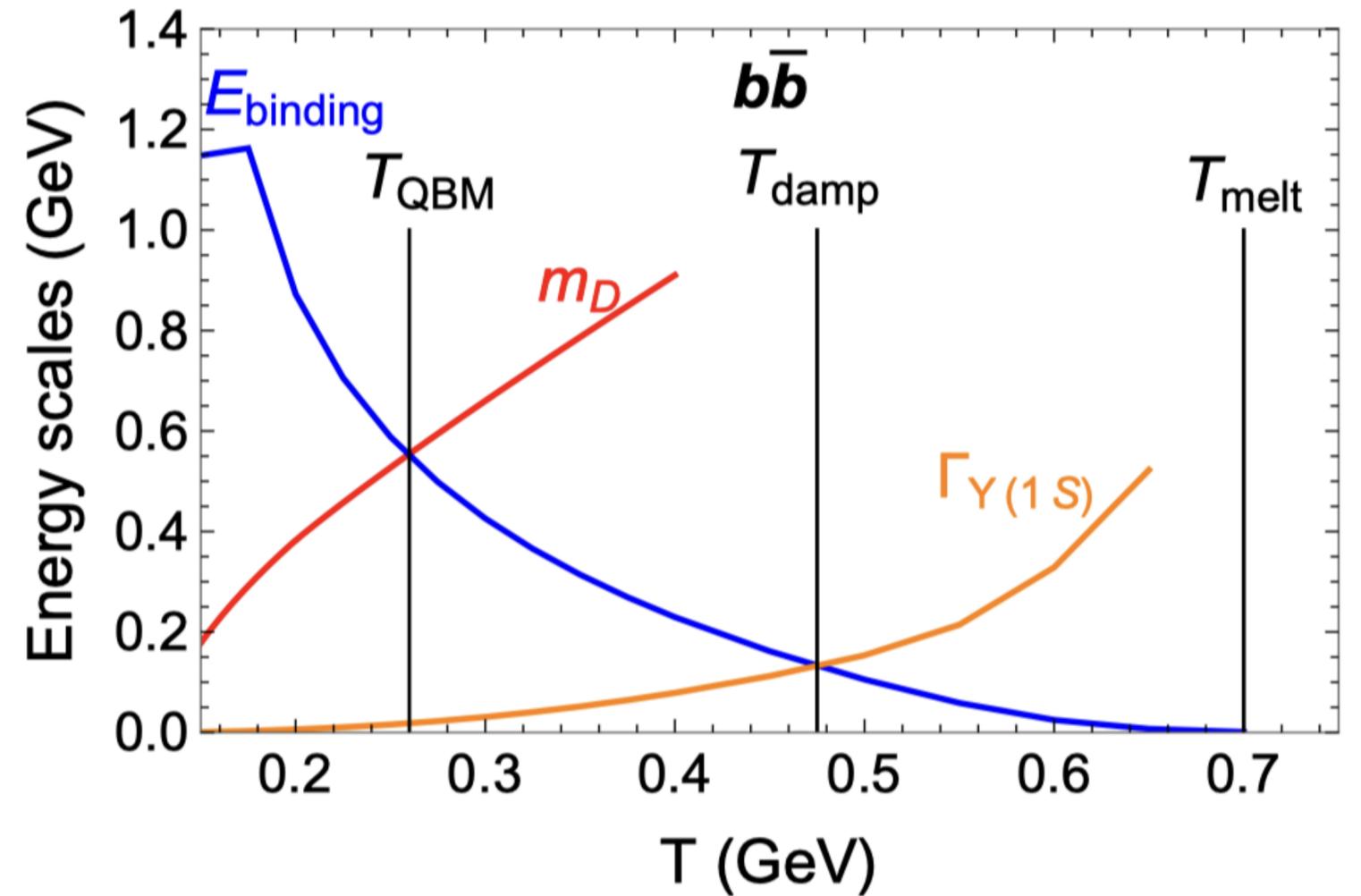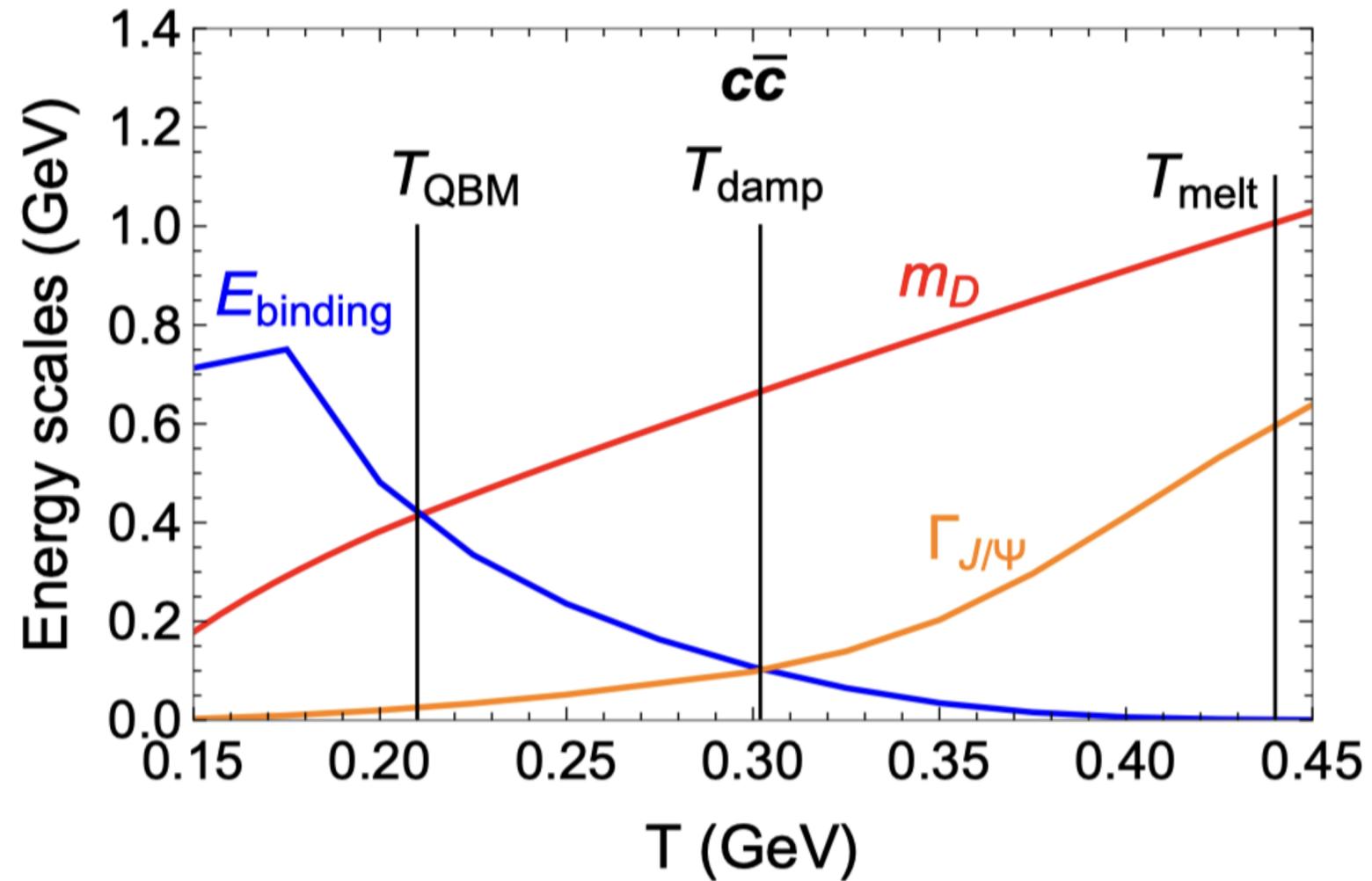
Based on 2506.19194, 2402.04488

A model potential in 1D

Need to design a realistic 1D bona fide potential V + i W (based on 3D lQCD results, tuned to reproduce 3D mass spectra and decay widths)

1D potential from R. Katz, S. Delorme & PBG, Eur. Phys. J. A (2022) 58:198

Typical regimes in OQS

from arXiv: 2402.04488

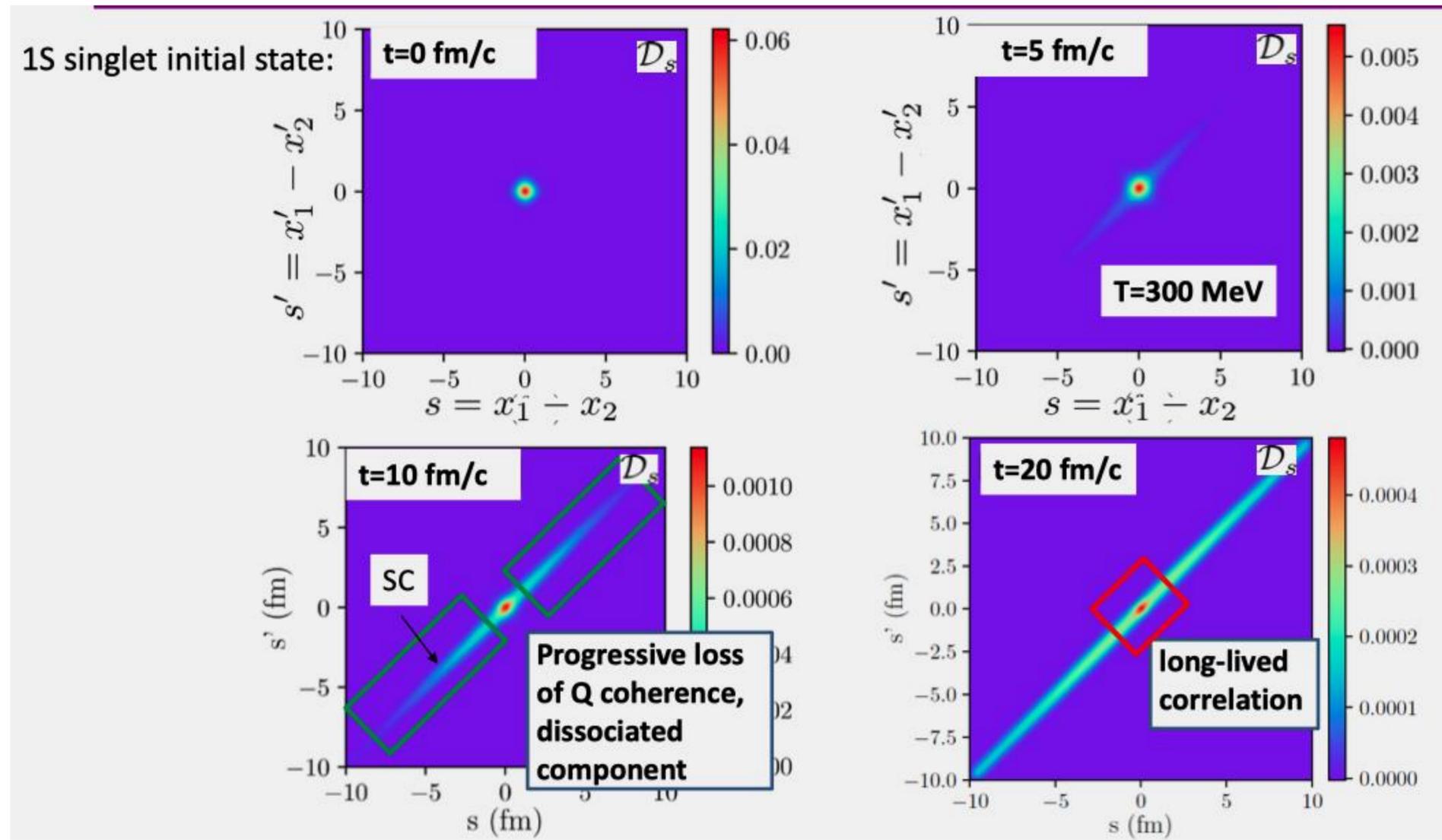# SOme tests of semi-classical approximations
(abelian case)

Based on   2506.19194

Typical evolution of the density matrix

Reduced density matrix of a $Q\overline{Q}$ pair: $\langle x_1, x_2 | \mathcal{D} | x_1', x_2' \rangle = \mathcal{D}(x_1, x_2; x_1', x_2')$

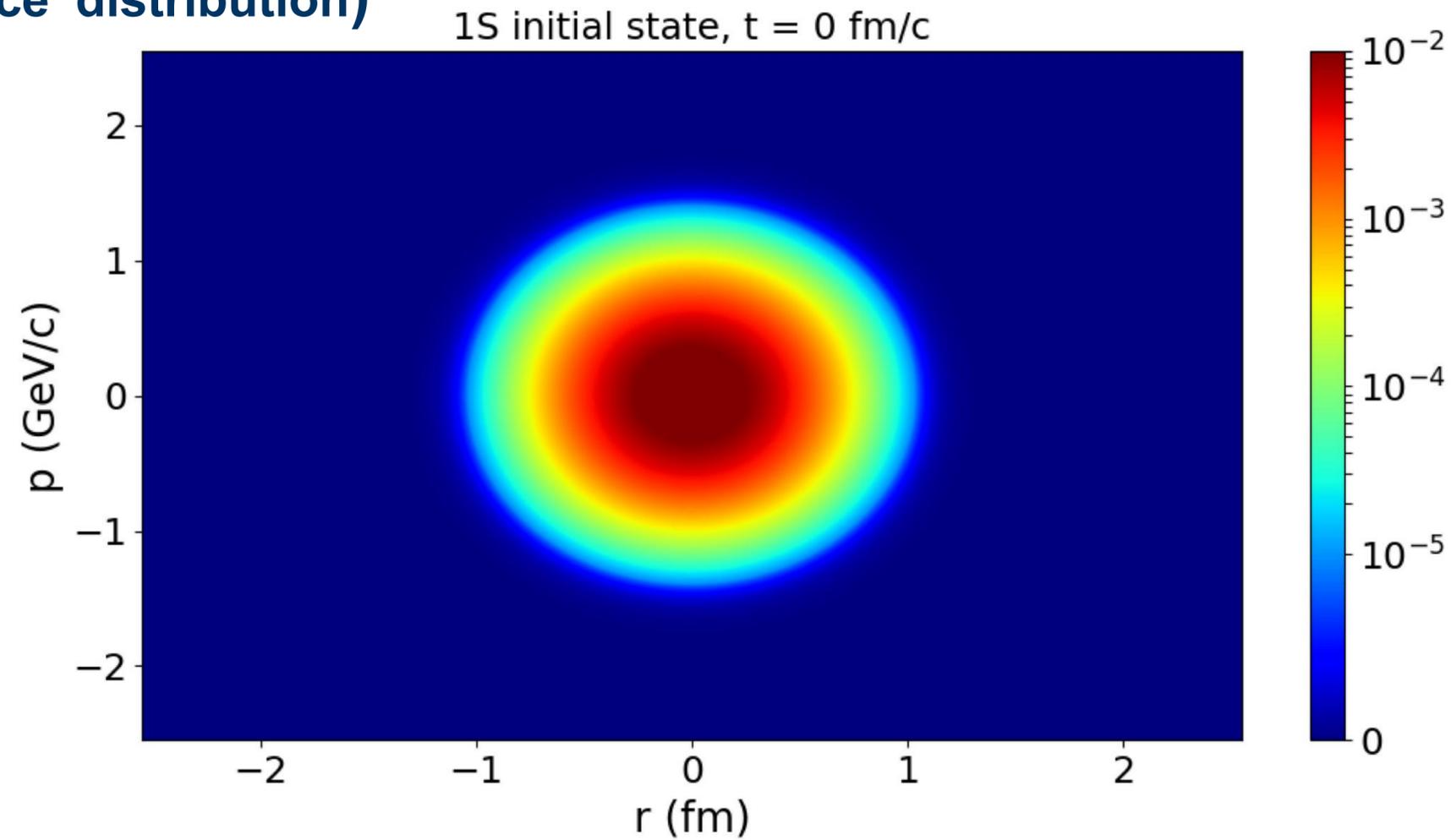$$\mathcal{D}(x_1, x_2; x_1', x_2') \mapsto \mathcal{D}(s, s')$$

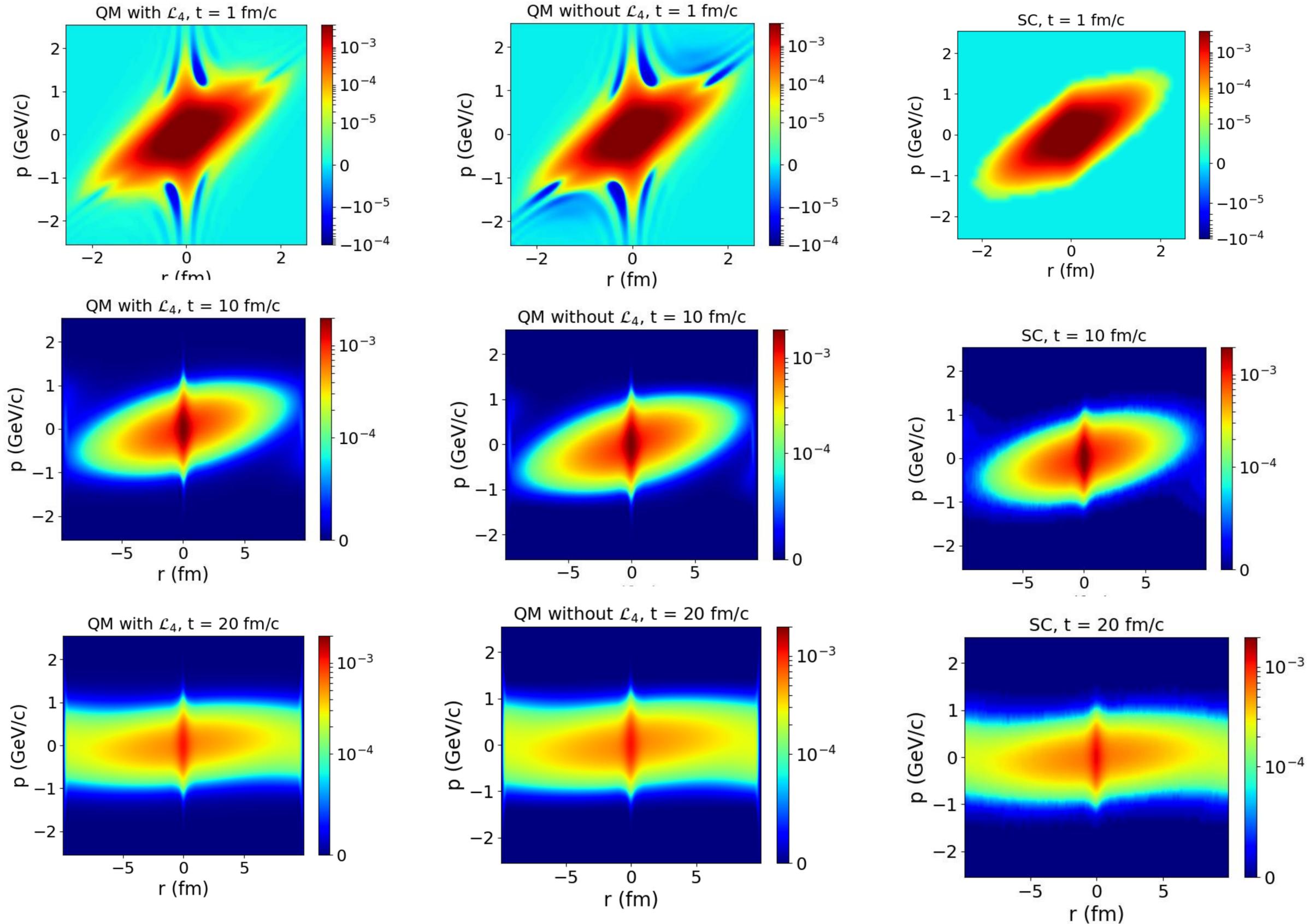$$s = x_1 - x_2 \qquad s' = x_1' - x_2'$$

Initial wave packet

$$\psi(x) = \left(\frac{1}{\pi\sigma^2}\right)^{1/4} e^{-\frac{x^2}{2\sigma^2}}$$

$(\sigma = 0.38$ **fm)**

Wigner distribution

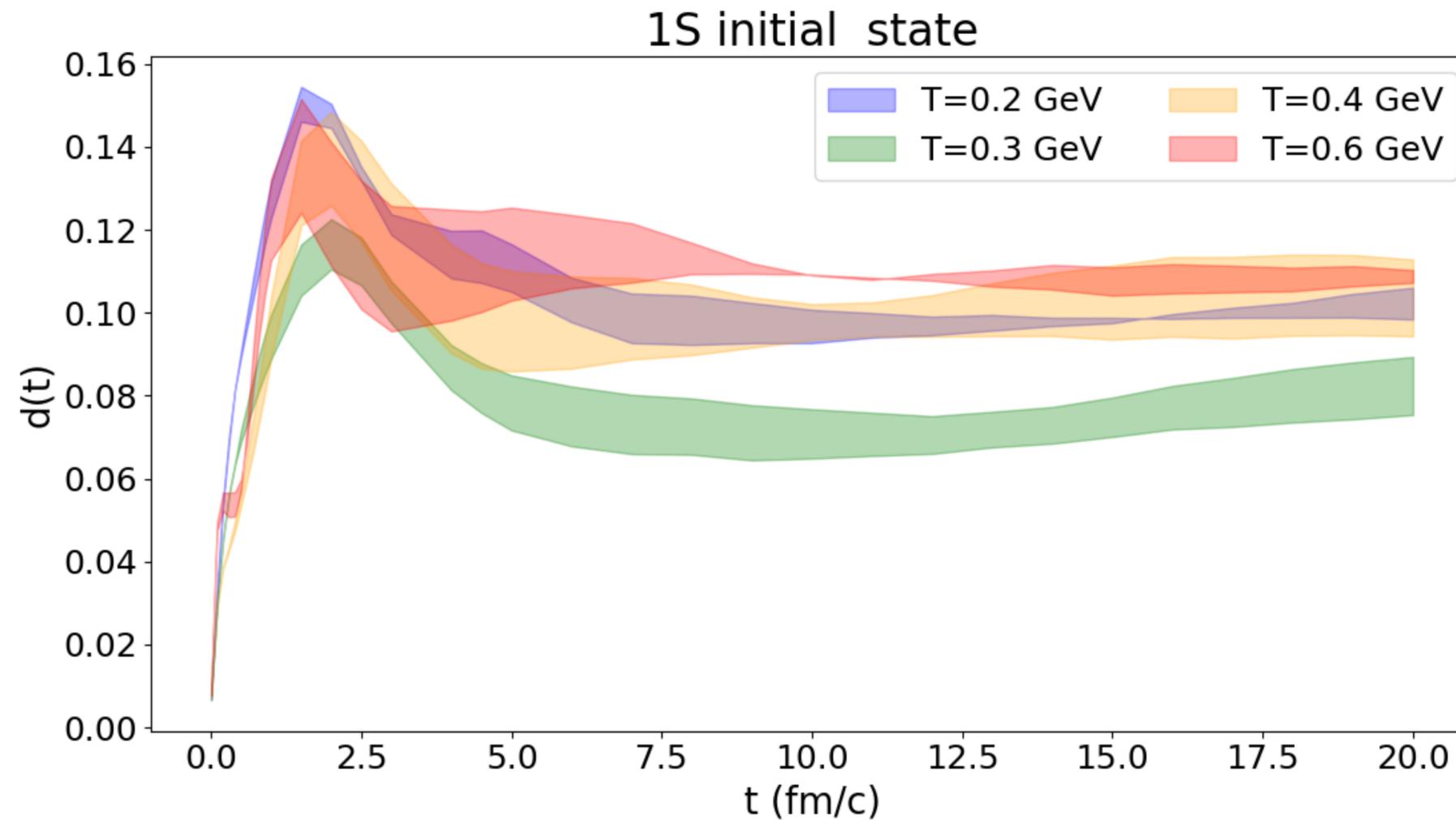**('phase space' distribution)**

Evolution in QGP with T=300 MeV
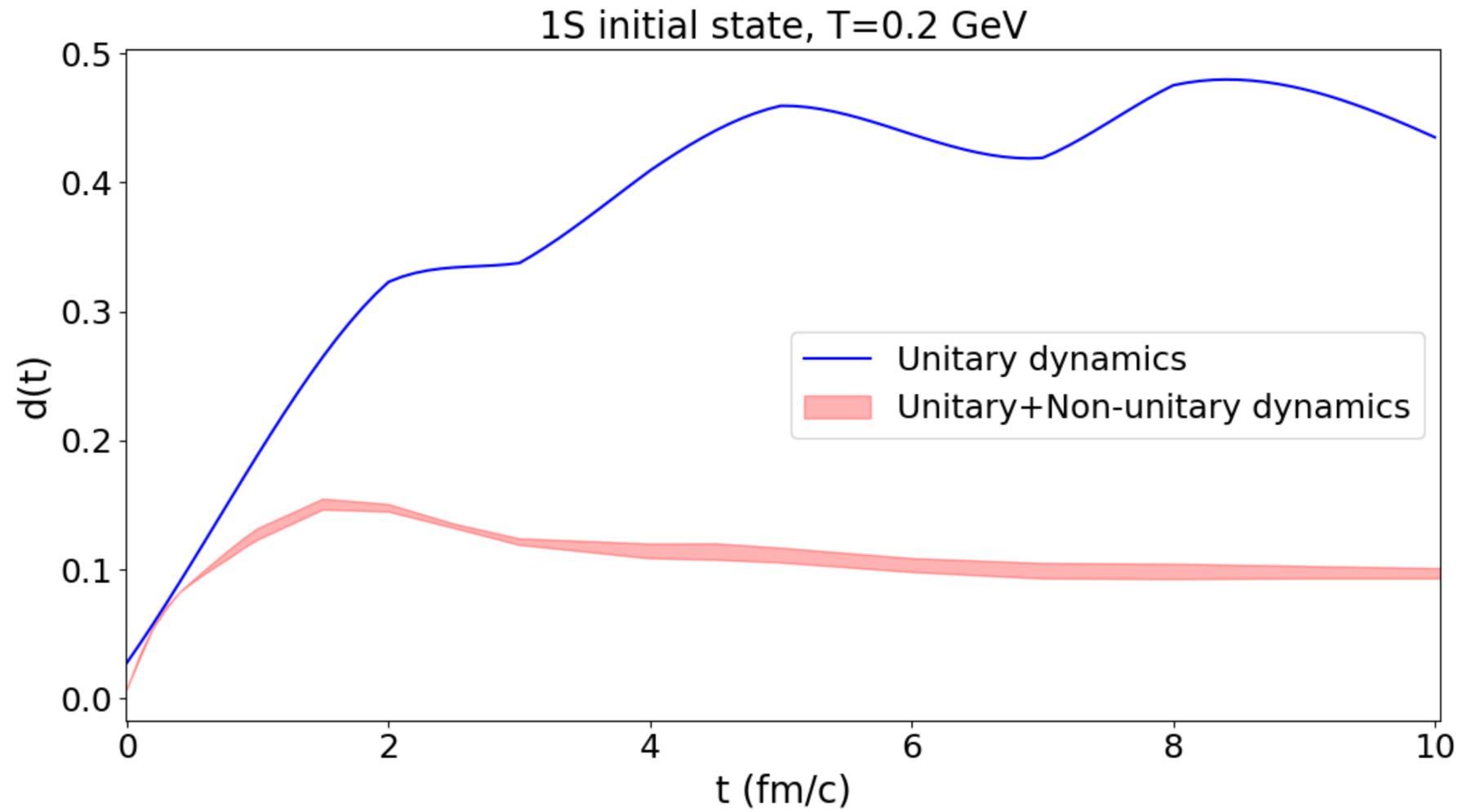
Looking at finer details

$$d(t) = \int \frac{dr\,dp}{2\pi\hbar} \left| \mathcal{D}_{\mathrm{QM}}(t, r, p) - \mathcal{D}_{\mathrm{SC}}(t, r, p) \right|$$

1S initial state

Impact of the non-unitary dynamics
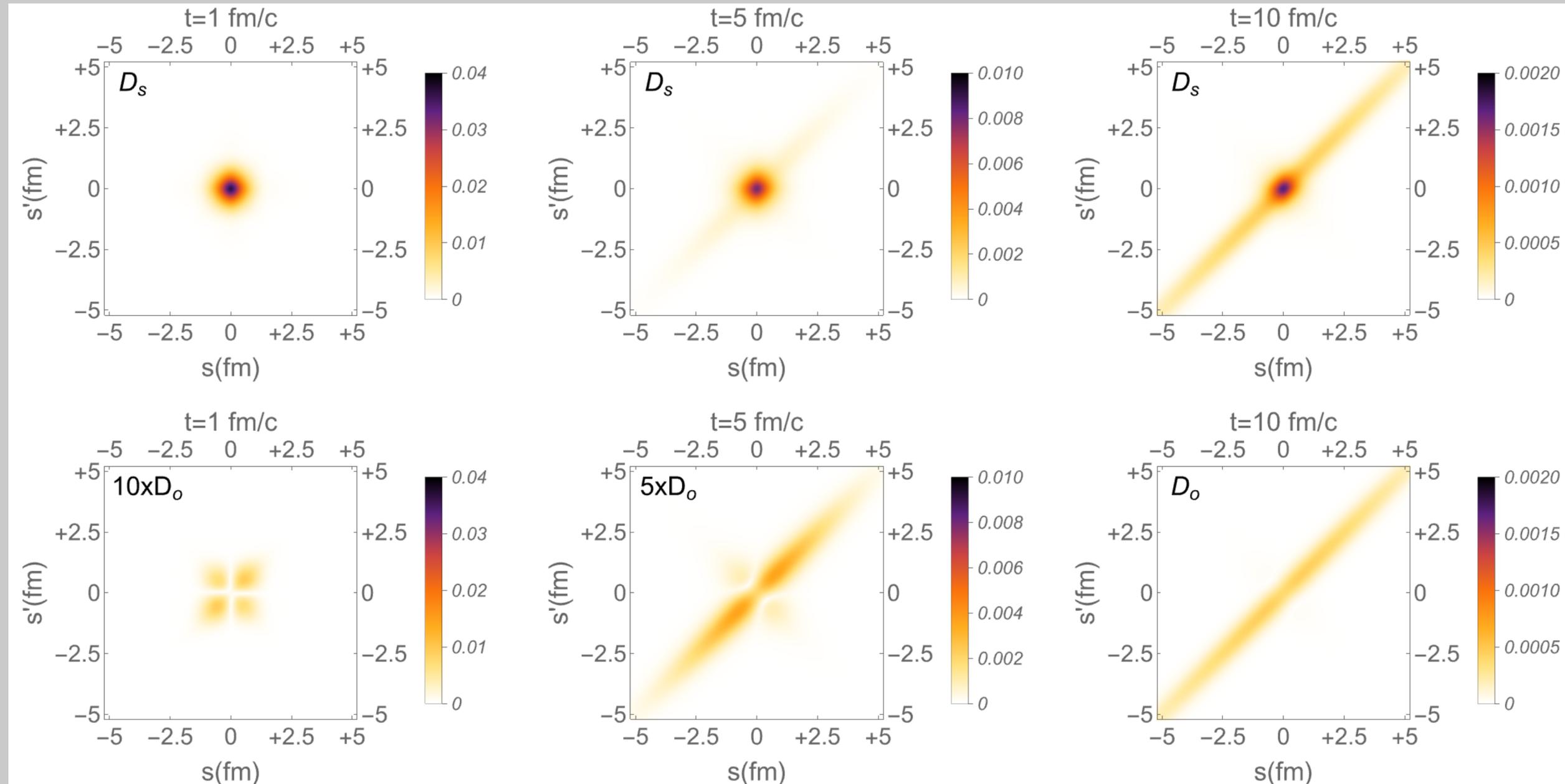

1S initial state, T=0.2 GeV

SOme results for non abelian case

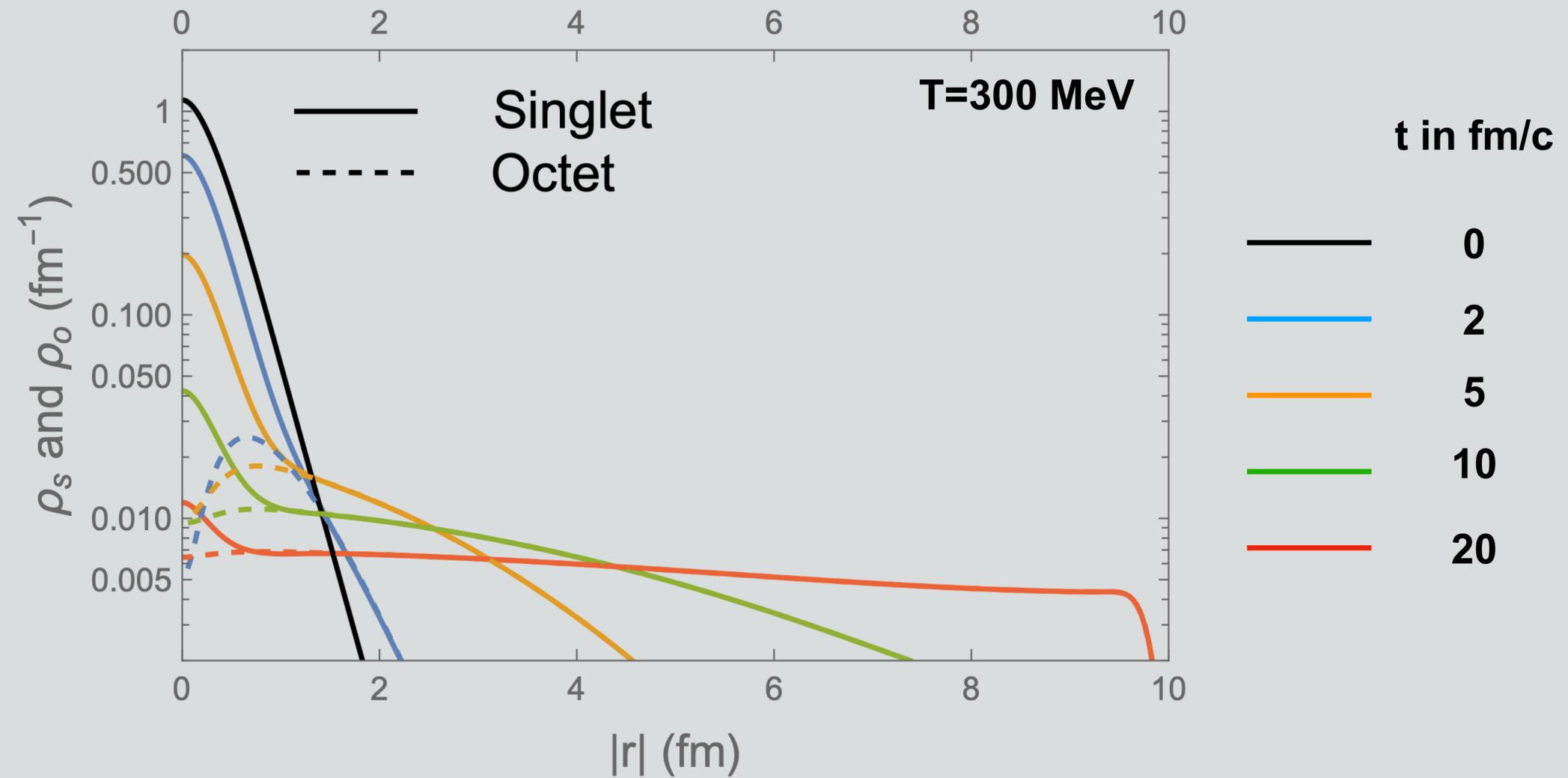**Based on   2402.04488**

Collisional decoherence

charm quark-antiquark pair at T=300 MeV

[From S.Delorme, R. Katz, T. Gousset, PB. Gossiaux, JPB (2023)]

Color equilibration

$$\rho_{s,o} = \langle r | \mathcal{D}_{s,o} | r \rangle$$

[From S.Delorme, R. Katz, T. Gousset, PB. Gossiaux, JPB (2023)]

Asymptotic state

Eigenstates $H_{Q\bar{Q}}$ | Eigenstates $\mathcal{D}_{QED}$ | Eigenstates $\mathcal{D}_s$

T = 200 MeV

T = 300 MeV

T = 400 MeV

$\psi_n(s)$ (fm$^{-1/2}$)

s (fm)

1S, 2S, 1P, 10th