Results for abelian plasmas

J-P.B, D. de Boni, P. Faccioli and G. Garberoglio, NPA (2016)
[1503.03857]

Semi-classical expansion for heavy quark motion

- Equation for the density matrix → Langevin equation

- Langevin equation for the relative motion

$$\frac{M}{2}\ddot{\boldsymbol{r}}^i = -\gamma_{ij}\boldsymbol{v}^j - \boldsymbol{\nabla}^i V(\boldsymbol{r}) + \xi^i(\boldsymbol{r},t)$$

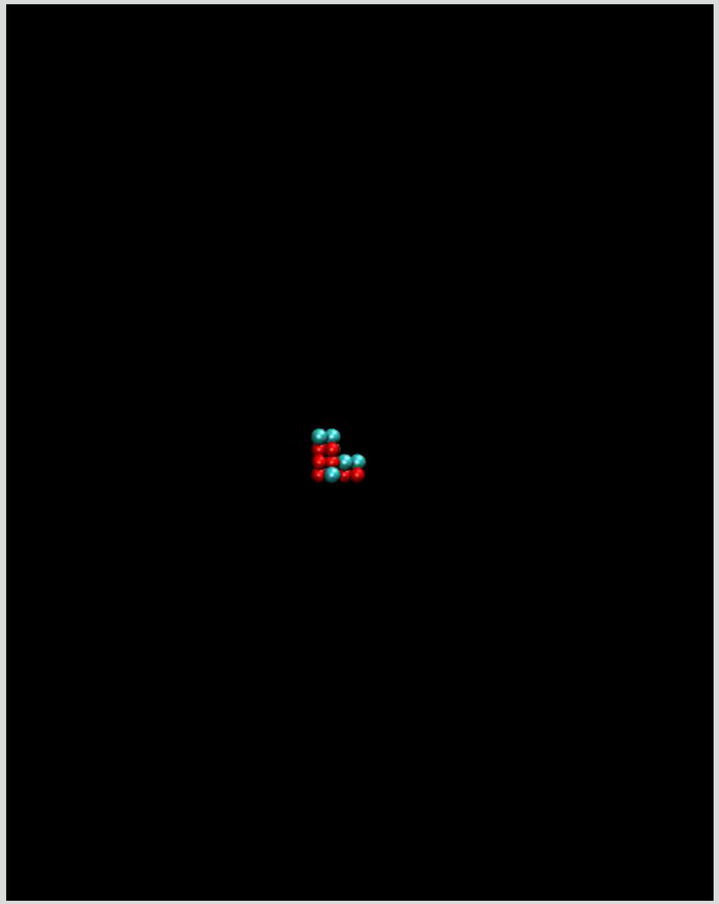
$$\gamma_{ij}(\boldsymbol{r}) = \frac{1}{2T}\eta_{ij}(\boldsymbol{r}) \qquad \langle \xi^i(\mathbf{r},t)\xi^j(\mathbf{r},t')\rangle = \eta_{ij}(\mathbf{r})\delta(t-t')$$

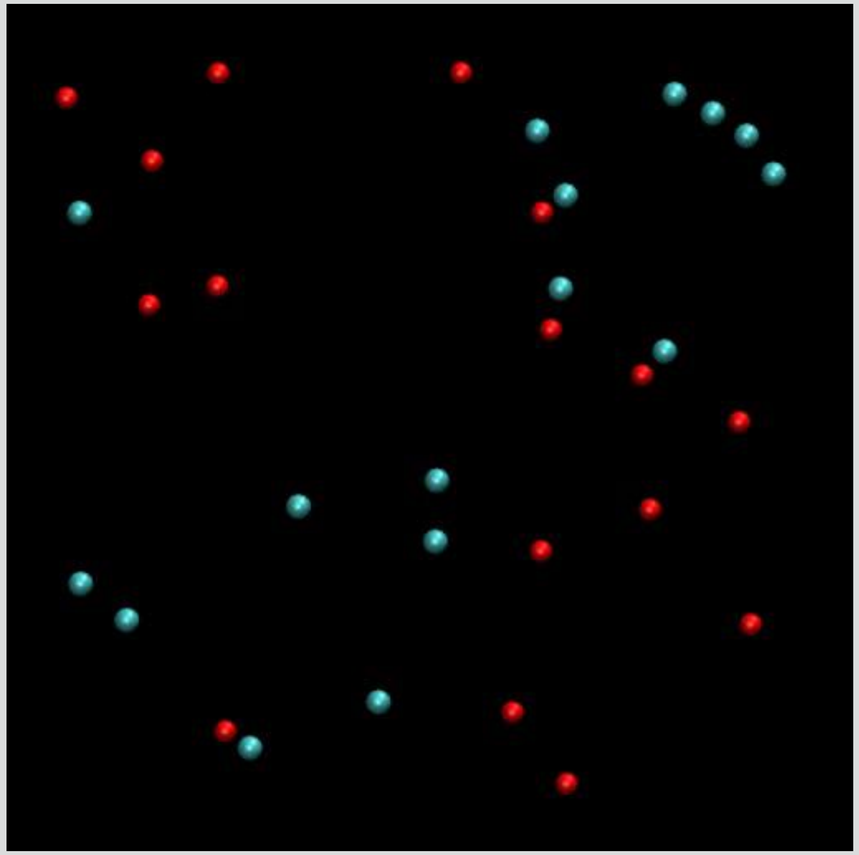
Non trivial noise

- For an isotropic plasma

$$\eta_{ij}(\boldsymbol{r}) = \delta_{ij}\eta(\boldsymbol{r}) \qquad \eta(\boldsymbol{r}) = \frac{1}{6}\left(\nabla^2 W(0) + \nabla^2 W(\boldsymbol{r})\right)$$

The semi-classical approximation allows for very detailed simulations
(abelian plasmas)





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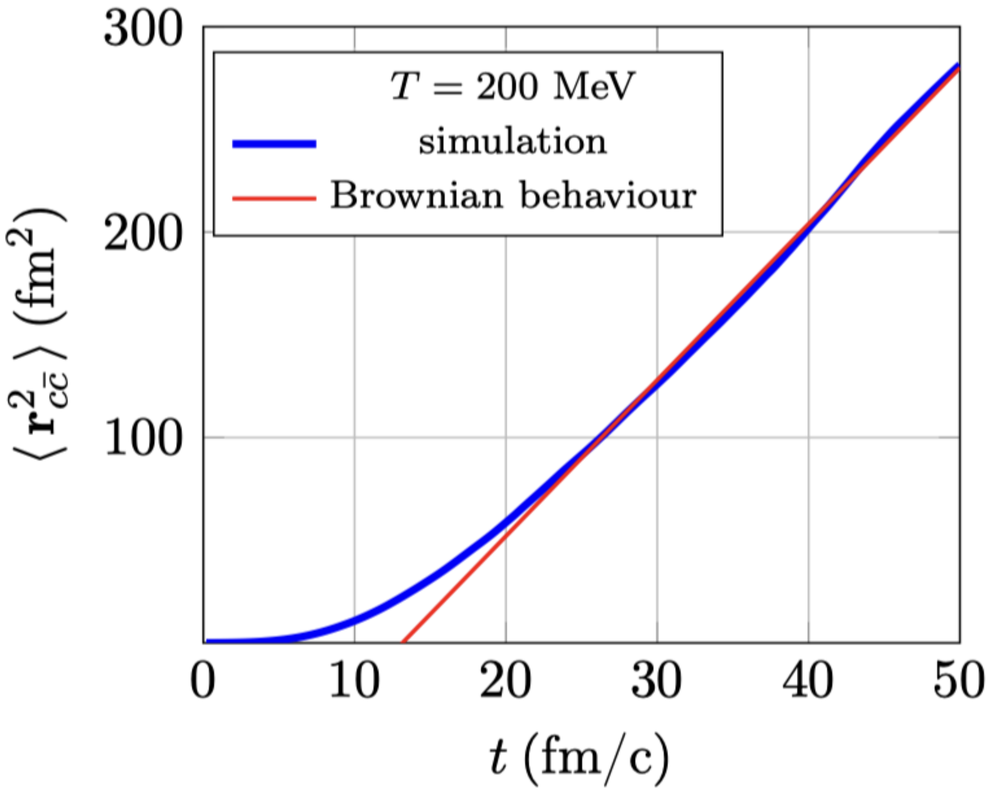
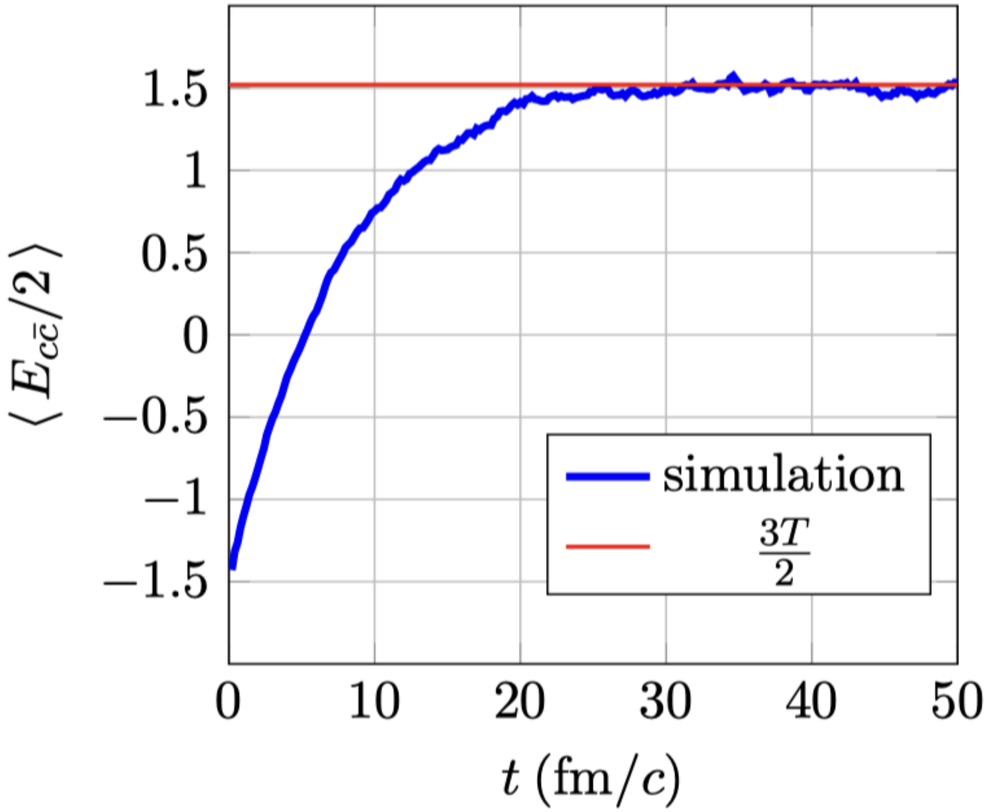
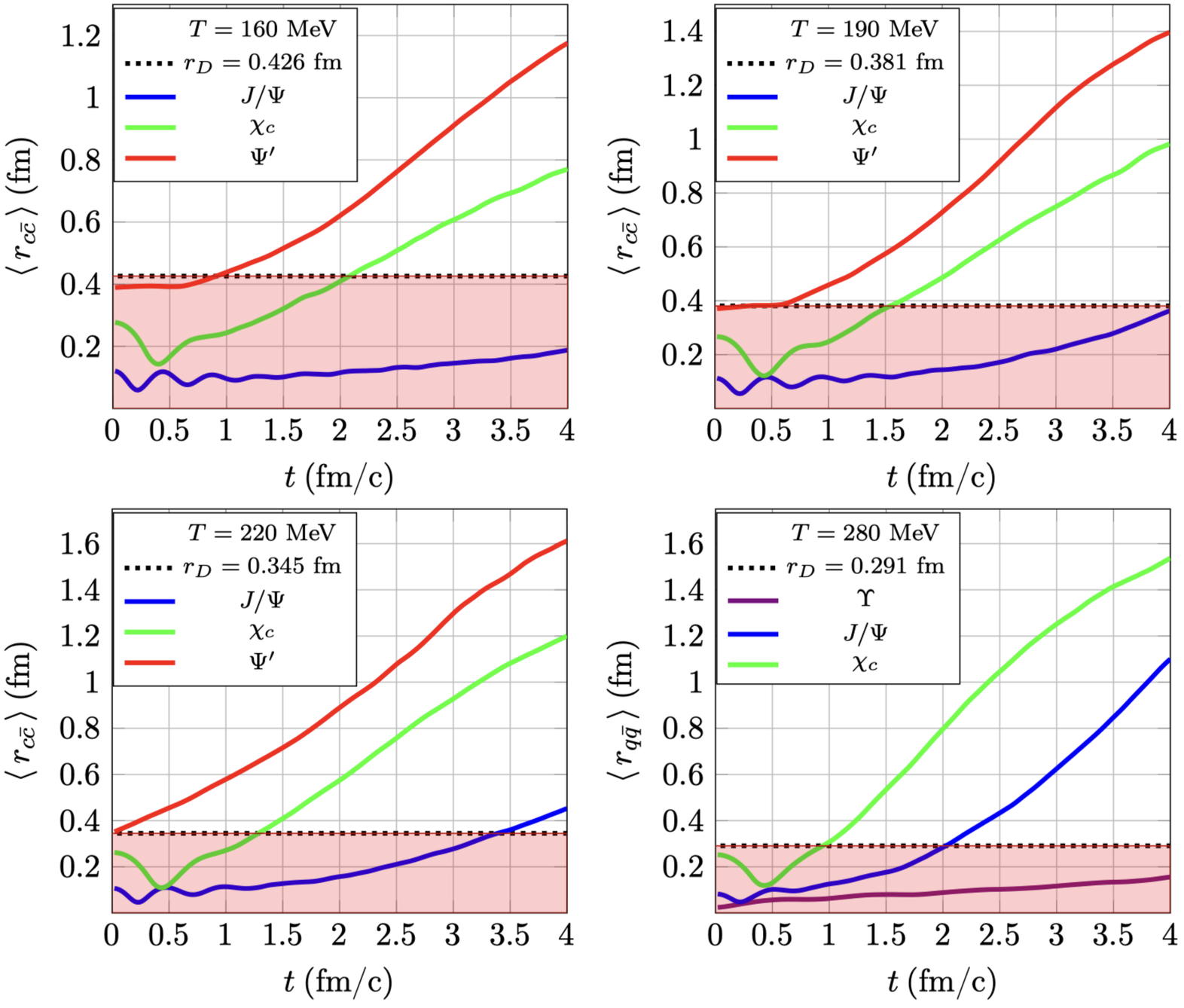
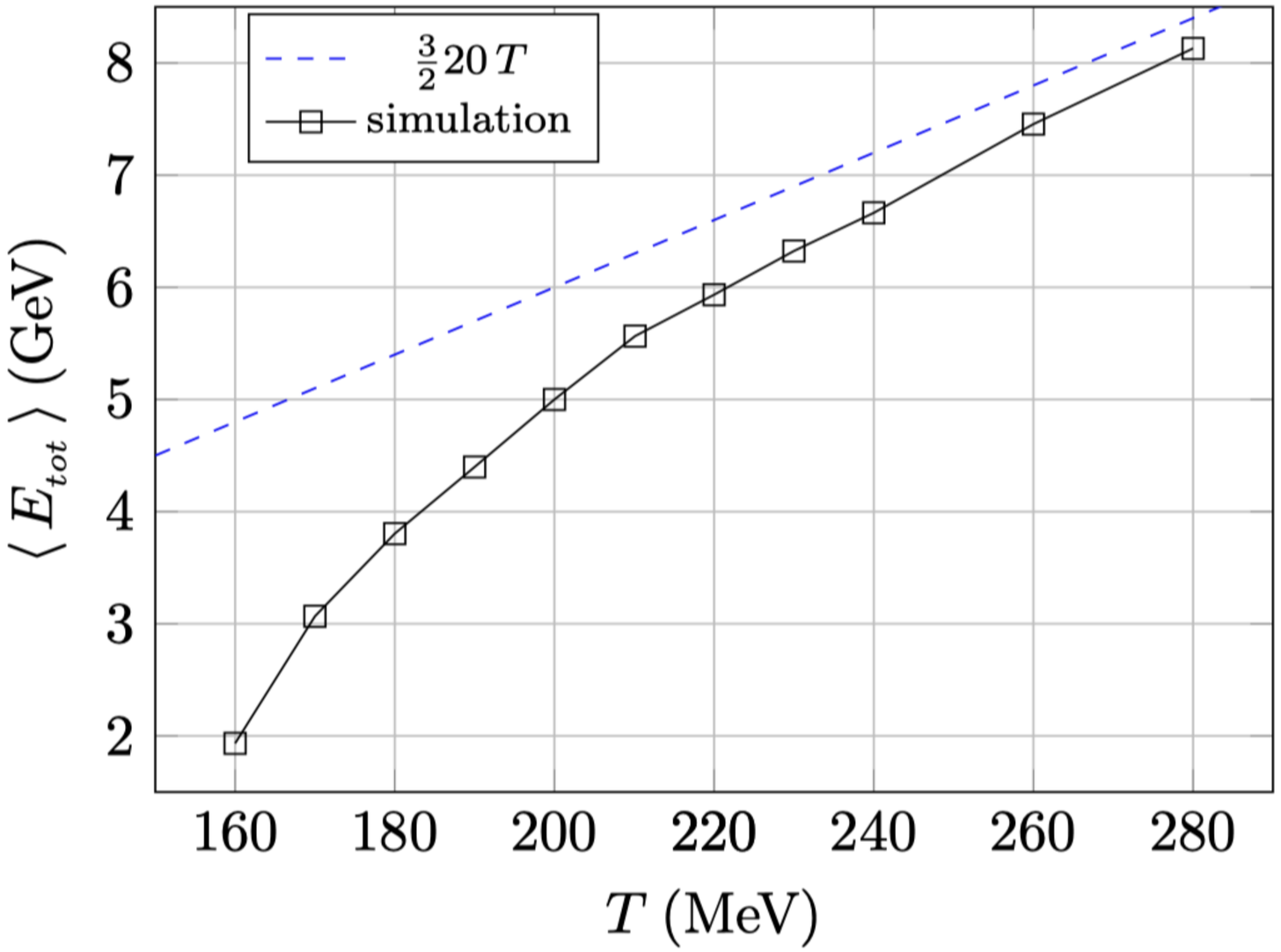
Evolution of a single pair

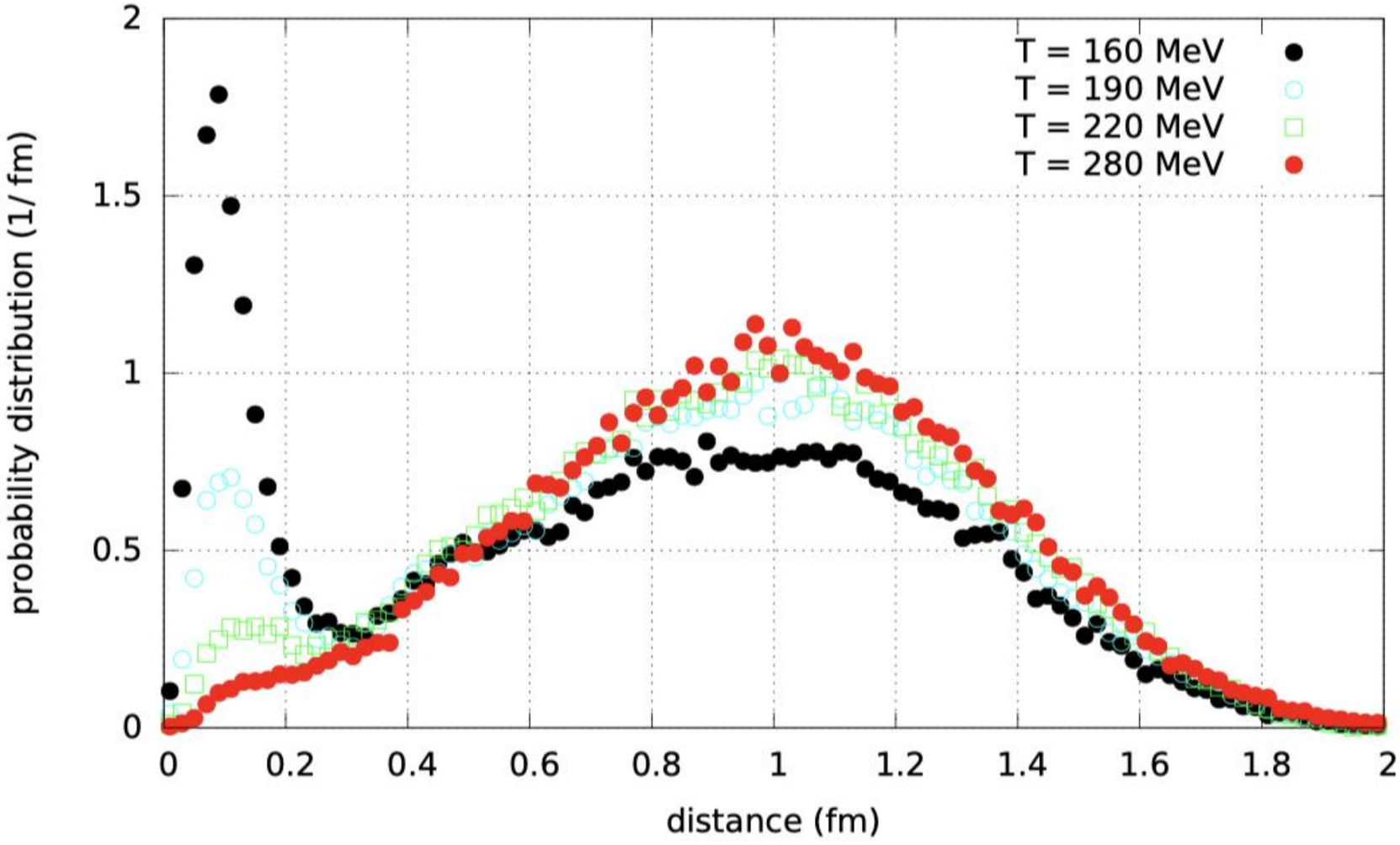





$T = 160$ MeV
$r_D = 0.426$ fm
J/Ψ
χ_c
Ψ'
$\langle r_{c\bar{c}} \rangle$ (fm)
t (fm/c)
$T = 190$ MeV
$r_D = 0.381$ fm
J/Ψ
χ_c
Ψ'
$\langle r_{c\bar{c}} \rangle$ (fm)
t (fm/c)
$T = 220$ MeV
$r_D = 0.345$ fm
J/Ψ
χ_c
Ψ'
$\langle r_{c\bar{c}} \rangle$ (fm)
t (fm/c)
$T = 280$ MeV
$r_D = 0.291$ fm
Υ
J/Ψ
χ_c
$\langle r_{q\bar{q}} \rangle$ (fm)
t (fm/c)

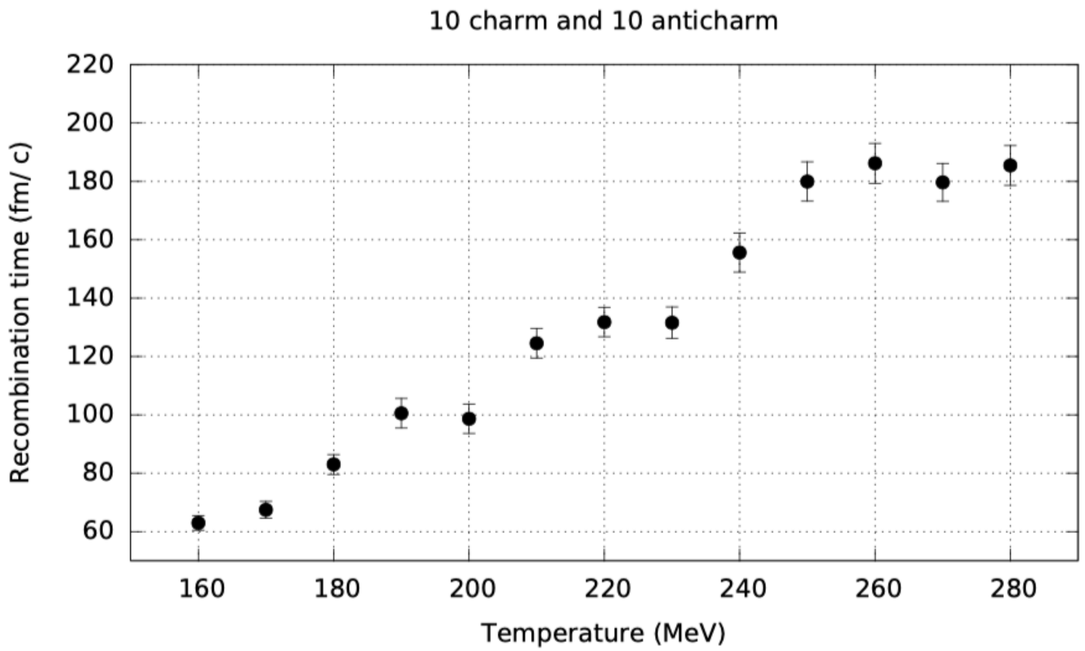
Evolution of 10 $c\bar{c}$ pairs

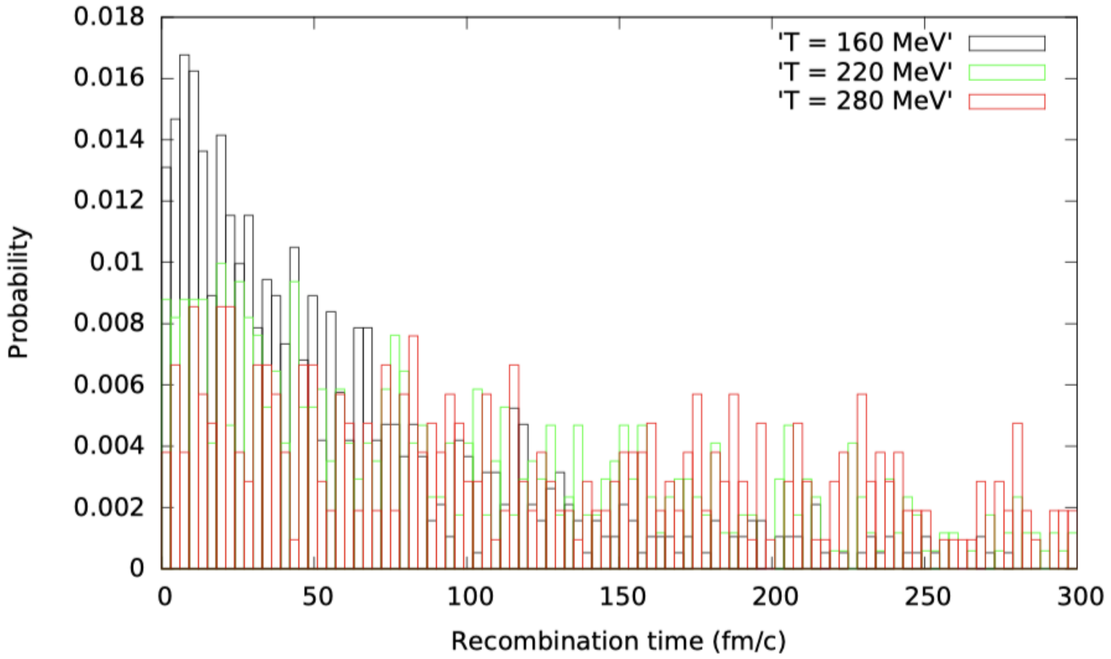




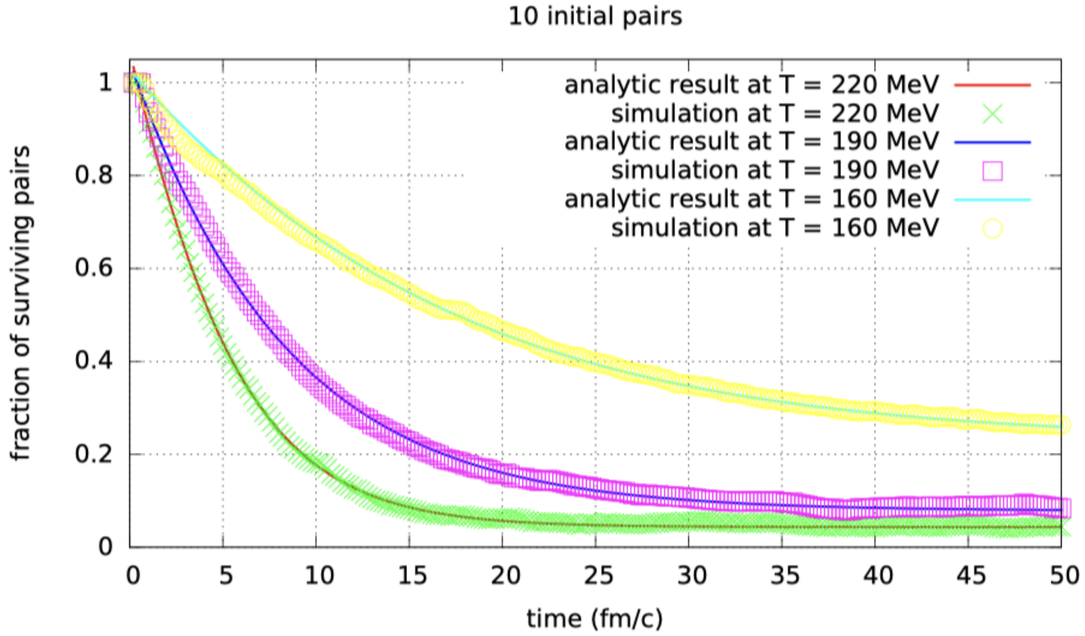
$$P_{q\bar{q}}^{\text{ideal}}(r) = \frac{3}{a}\left(\frac{r}{a}\right)^2\left(1-\left(\frac{r}{a}\right)^3\frac{1}{N}\right)^{N-1} \overset{N\gg 1}{\simeq} \frac{3}{a}\left(\frac{r}{a}\right)^2 e^{-(r/a)^3}$$

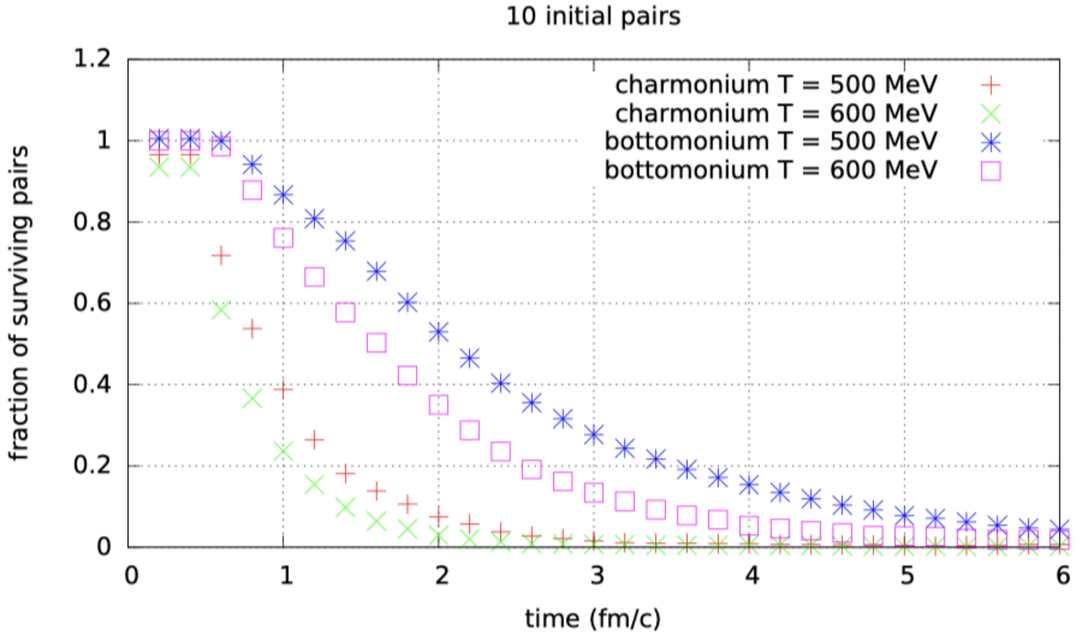
Recombination time





Recombination





$$\frac{\mathrm{d}N(t)}{\mathrm{d}t} = -\lambda_D N(t) + \lambda_R N_q(t) N_{\bar{q}}(t)$$