

## Charm meson and charm-meson molecule in an expanding hadron gas

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We study the time evolution of the number of charm mesons after the kinetic freeze-out of the hadron gas produced by a central heavy-ion collision. The  $\pi D^* \rightarrow \pi D^*$  reaction rates have t-channel singularities that give contributions inversely proportional to the thermal width of the  $D$ . The ratio of the  $D^0$  and  $D^+$  production rate can differ significantly from those predicted using the measured  $D^*$  branching fractions.

We then study the thermal correction to the propagator of a loosely bound charm-meson molecule in a pion gas to next-to-leading order in the heavy-meson expansion. The correction comes primarily from the complex thermal energy shift of the charm-meson constituents. The remaining correction gives a tiny decrease in the binding energy of the molecule and a tiny change in its thermal width. These results are encouraging for the prospects of observing  $X(3872)$  and  $T_{cc}^+(3875)$  in the expanding hadron gas produced by heavy-ion collisions.

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