

# Strange and heavy mesons in hot and dense nuclear matter: hadronic models and transport simulations for a road to FAIR\*

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## Introduction

Strange and heavy mesons probe interesting aspects of the strong interaction at extreme conditions, the different regions of the phase diagram being explored by experiments such as production reactions in nuclei, heavy-ion collisions (HICs) and the observation of macroscopic properties of neutron stars. Particularly, understanding their dynamics in the hadronic world is a crucial point to correctly analyse experimental information from HICs and perform realistic transport simulations. We study the properties of strange and heavy-flavoured mesons in a hot and dense nuclear medium within a selfconsistent coupled-channel approach based on the chiral Lagrangian.

## Strange mesons in hot/dense matter

In the strangeness sector, we have completed a new determination of the in-medium scattering amplitudes and cross sections (such as  $\bar{K}N \rightarrow \pi\Sigma$ ) in addition to the (off-shell)  $K$  and  $\bar{K}$  spectral functions and quasi-particle properties, both at finite nuclear densities and temperatures, mimicking the expected scenario at FAIR experiments (c.f. Fig. 1). Our next step in this project is to implement our results in the IQMD and PHSD models, exploiting the successful collaboration between the transport groups of Nantes and FIAS-Frankfurt.

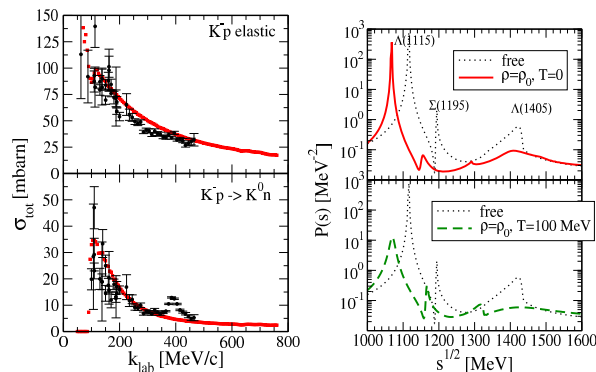


Figure 1: Left:  $K^-p$  elastic and  $K^-p \rightarrow \bar{K}^0 n$  total cross sections (red squares: model). Right: Transition probability ( $P \propto |T|^2$ ) for the  $K^-p$  elastic reaction at finite nuclear density (up) and temperature (down).

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## Heavy meson relaxation

In the heavy-flavour sector, our approach imposes partial-wave unitarity on the relevant scattering amplitudes (e.g.  $D\pi$ ,  $B\pi$ ), an essential requirement in order to extend the applicability of the low-energy theory (heavy-meson ChPT) to high temperatures  $T \simeq m_\pi$ . With a minimal set of parameters the unitarized theory dynamically generates the low lying heavy-light meson  $s$ -wave resonances ( $D_{0,1}$ ,  $B_{0,1}$ ) in good agreement with the available experimental data both in the charm and bottom sectors. Since a resonant interaction is bound to produce shorter thermalization times, accounting for this feature is important to produce a realistic estimation of the transport coefficients of heavy mesons in the hadronic phase of a heavy-ion collision (cf. Fig. 2).

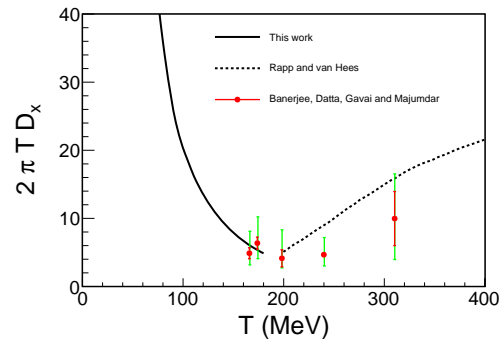


Figure 2:  $D$ -meson spatial diffusion coefficient around the crossover at  $\mu_B = 0$ .

## References

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