

# Strange meson-baryon interaction in hot and dense nuclear matter: from hadronic models to transport simulations\*

D. Cabrera<sup>†1,2</sup>, A. Ilnert<sup>1,2</sup>, L. Tolós<sup>1,3</sup>, J. Aichelin<sup>4</sup>, E. Bratkovskaya<sup>1,2</sup>, and W. Cassing<sup>5</sup>

<sup>1</sup>FIAS, Frankfurt, Germany; <sup>2</sup>ITP, Frankfurt, Germany; <sup>3</sup>ICE (IEEC/CSIC), Bellaterra, Spain; <sup>4</sup>Subatech, Nantes, France; <sup>5</sup>ITP, Giessen, Germany

## Introduction

We study the dynamics of strange pseudoscalar and vector mesons in hot and dense nuclear matter within a self-consistent coupled-channel approach based on the meson-baryon chiral Lagrangian. Our results set up the starting point for implementations in microscopic transport approaches of heavy-ion collisions, particularly at the conditions to be met in the future experiments at GSI/FAIR and NICA@Dubna. Such developments are in progress, exploiting the successful collaboration between the transport groups of Nantes and FIAS-Frankfurt.

## $\bar{K}N$ interaction in hot and dense matter

In the  $\bar{K}N$  sector we focus on the calculation of in-medium (off-shell) transition rates for the most relevant binary reactions involved in strangeness production close to threshold energies (e.g.  $\bar{K}N \rightarrow \pi\Sigma$ ), with special attention to the role of sub-threshold hyperon resonances ( $\Lambda(1405)$ ,  $\Lambda(1115)$ ,  $\Sigma(1195)$  and  $\Sigma^*(1385)$ ), isospin effects (e.g.  $\bar{K}p$  vs  $\bar{K}n$ , cf. Fig. 1) and the angular dependence of the scattering amplitudes and cross sections ( $s$  and  $p$  waves are accounted for). Together with the spectral function and the nuclear optical potential of strange mesons and hyperons, our results permit a systematic accounting of medium effects in the  $S = -1$  sector regarding the production, propagation and rescattering of light strange hadrons.

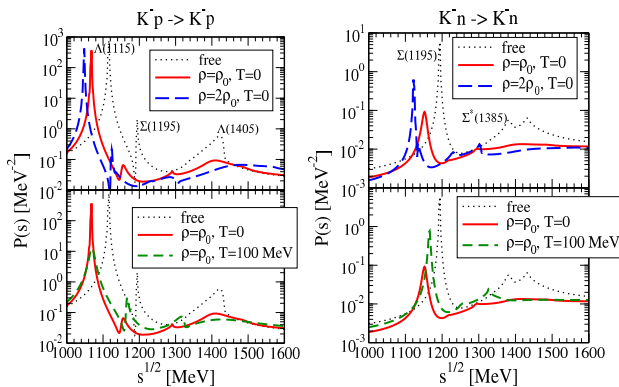


Figure 1: In-medium transition probability  $\mathcal{P}$  for the elastic  $K^-p$  (left) and  $K^-n$  (right) reactions. The peaks associated to the  $\Lambda(1115)$ ,  $\Sigma(1195)$  and  $\Lambda(1405)$  resonances are clearly visible in the vacuum case.

\* Work supported by the HIC for FAIR framework of LOEWE, GSI, HGS-HiRe and H-QM, and by BMBF project no. 05P12RFFCQ.

<sup>†</sup> cabrera@fias.uni-frankfurt.de

## Strange vector mesons: $K^*$ , $\bar{K}^*$ and $\phi$

We have also pursued recent theoretical developments regarding the dynamics of strange vector mesons ( $K^*$ ,  $\bar{K}^*$  and  $\phi$ ) in the nuclear medium, in connection with experimental activity from heavy-ion collisions and nuclear production reactions. Our work focuses on the extension to finite temperatures of previous chiral hadronic models for the vector meson selfenergy in dense matter (cf. Fig. 2), where the key mechanisms for medium modification are: (i) the excitation of strange baryon resonances in quasielastic scattering (e.g.  $\bar{K}^*N \rightarrow \bar{K}^*N$ ), which translates into resonance-hole modes that mix with the vector-meson quasiparticle peak; and (ii) the decay into hadronic modes (e.g.  $\bar{K}^* \rightarrow \bar{K}\pi$ ), where the daughter particles are also dressed and low-energy modes are Bose-enhanced.

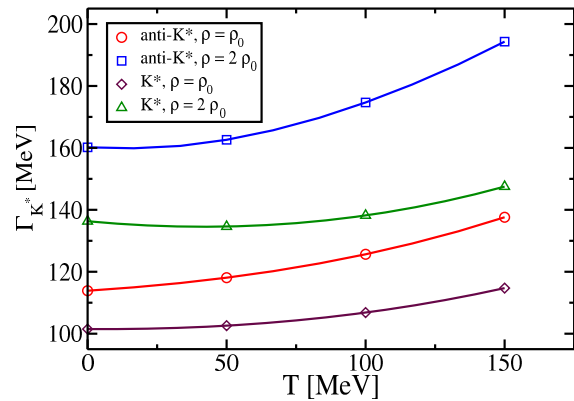


Figure 2: Temperature evolution of the  $\bar{K}^*$  ( $K^*$ ) width – or selfenergy – due to  $\bar{K}^*(K^*)\pi$  in-medium decays.

## References

- [1] D. Cabrera, L. Tolos, J. Aichelin and E. Bratkovskaya, “Anti-strange meson-baryon interaction in hot and dense nuclear matter”, *Phys. Rev. C* **90** (2014) 5, 055207.
- [2] A. Ilnert, D. Cabrera, P. Srisawad and E. Bratkovskaya, “Properties of strange vector mesons in dense and hot matter”, *Nucl. Phys. A* **927** (2014) 249.
- [3] L. Tolos, D. Cabrera, C. Garcia-Recio, R. Molina, J. Nieves, E. Oset, A. Ramos and O. Romanets *et al.*, “Heavy Mesons in Nuclear Matter and Nuclei”, *J. Phys. Conf. Ser.* **562** (2014) 1, 012010.
- [4] D. Cabrera, L. M. Abreu, E. Bratkovskaya, A. Ilnert, F. J. Llanes-Estrada, A. Ramos, L. Tolos and J. M. Torres-Rincon, “Strange and heavy mesons in hadronic matter”, *J. Phys. Conf. Ser.* **503** (2014) 012017.