# In medium properties of open strange mesons

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## Introduction

We study the medium modifications of the masses of open strange ($K^*$) vector meson using the Quantum Chromodynamics (QCD) Sum Rule approach [1] as well as from the K$\pi$ loop. From the mass modifications of the $K^*$ and K mesons, the in-medium decay width of $K^* \rightarrow K\pi$ is studied. The effects of density as well as of isospin asymmetry are studied in this work. These medium effects are introduced in the QCDSR approach through the medium modifications of the light quark condensates (both strange and non-strange) and gluon condensates of the nuclear medium. The light quark condensates are related to scalar fields ($\sigma, \zeta$, and $\delta$) of the medium by comparing the explicit chiral symmetry breaking term of QCD Lagrangian to the corresponding term in chiral SU(3) model [2]. The chiral SU(3) model is based on non-linear realization of chiral symmetry and broken scale invariance of QCD. The gluon codensate is related to a scalar dilaton field ($\chi$), which is introduced in the chiral Lagrangian to imitate the scale invariance breaking of QCD. The coupled equations of motion of scalar fields ( $\sigma, \zeta$, $\delta$, and $\chi$) obtained from the chiral Lagrangian of chiral model, incorporating the medium effects through scalar and number densities of nucleons, are solved within the chiral model.

## QCD sum rule approach

The general idea of QCD sum rule is to relate the current-current correlation function [3] on the phenomenological side to the operator product expansion (OPE) side. For large space-like regions, the correlation function is written in terms of OPE having coefficients $c_i' s$ (i= 0,1,2...) and operators in powers of $(1/Q^2)$. The $c_0^V$ term in OPE is the leading term calculated in perturbative QCD, while the coefficient $c_1^V$ is given in terms of current quark masses and $c_2^V$ is expressed in terms of quark and gluon condensates which arises from the non-perturbative effects of QCD.

On the phenomenological side, the correlation function is related to spectral density $R^V_{phen}(s)$ through a dispersion relation. This spectral density separates into a resonance part and a perturbative continuum part. For better convergence, we do a Borel transform on both OPE and phenomenological side and then, by comparing the coefficients of various powers of $(1/M^2)$, we get to our finite energy sum rules (FESR). The gluon and quark condensates are introduced through coefficient $c_2^V$. These FESRs are solved to find the in-medium masses of vector K* meson.

The decay width is calculated within a phenomenological approach as well as using a light quark pair creation model, namely the $^3P_0$ model [4]. These decay widths are calculated by taking into account the medium modification to the masses of vector ($K^*$) meson and pseudoscalar (K) meson, while the medium modification for pion ($\pi$) masses is not considered.

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## References

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