Current Correlation Functions, QCD Sum Rules and Vector Mesons in Baryonic Matter ◇

F. Klingl, N. Kaiser, and W. Weise

Based on an effective Lagrangian which combines chiral $SU(3)$ dynamics with vector meson dominance, we have developed a model for the forward vector meson-nucleon scattering amplitudes. We use this as an input to calculate the low energy part of the current-current correlation function in nuclear matter. Its spectrum enters directly in the "left hand side" of QCD sum rules. For the isovector channel we find a significant enhancement of the in-medium spectral density below the ρ resonance while the ρ meson mass itself changes only slightly. The situation is different in the isoscalar channel, where the mass and peak position of the ω meson move downward while its width increases less drastically than in the ρ meson case. For the ϕ meson we find almost no mass shift; the width of the peak broadens moderately. We observe a remarkable degree of consistency with the operator product expansion of QCD sum rules in all three channels. We point out, however, that these results cannot simply be interpreted, as commonly done, in terms of a universal rescaling of vector meson masses in matter.

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QCD Sum Rules and Vector Mesons in Nuclear Matter ◇

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Based on an effective Lagrangian which combines chiral $SU(3)$ dynamics with vector meson dominance, we have developed a model for the s-wave vector meson-nucleon scattering amplitudes. We use this as an input for the low energy part of the current-current correlation function in nuclear matter. Its spectrum enters directly in the "left hand side" of QCD sum rules. For the isovector channel we find a significant enhancement of the in-medium spectral density below the ρ resonance while the mass of the ρ meson itself decreases only slightly. The situation is different in the isoscalar channel. Here the mass and therefore the peak position of the ω meson decreases strongly while the width increases less drastically then in the ρ meson case. For the ϕ meson we find almost no mass shift, the width of the peak broadens due to the imaginary part of the scattering length. We find a remarkable degree of consistency with the operator product expansion of QCD sum rules in all three channels.

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Deuteron Spin Structure Functions at Small Bjorken-x ◇

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We investigate polarized deuteron structure functions at small values of the Bjorken variable, $x < 0.1$. In this region contributions from the coherent interaction of diffractively excited hadronic states with both nucleons become important. A proper treatment of this process requires an extension of the Glauber-Gribov multiple scattering theory to include spin degrees of freedom. In the kinematic domain of current fixed target experiments we observe that shadowing effects in g_1^d are approximately a factor 2–3 larger than for the unpolarized structure function F_2^d. Furthermore the tensor structure function b_1 is found to be surprisingly large at $x < 0.1$ due to coherent double scattering contributions.

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