Coherent Vector Meson Production from Deuterons ◇

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In this paper we discuss coherent photo- and leptoproduction of vector mesons from deuterons at intermediate (virtual) photon energies, $3 \leq v \leq 30 GeV$. We consider the scattering from unpolarized and polarized targets as well as processes where the polarization of the recoil deuteron is measured. Our main motivation results from the need for a quantitative analysis of the space-time structure of photon-induced processes. In this respect we suggest several possibilities to explore the characteristic longitudinal interaction length in coherent vector meson production. Furthermore, we outline methods for an investigation of color coherence effects. Besides the presentation of benchmark values for the maximal possible color coherence effect in various kinematic regions, we illustrate the anticipated phenomena within the color diffusion model. Finally we recall that the determination of vector meson-nucleon cross sections is not a closed issue. Besides being not known to a satisfying accuracy, they can be used to determine the strength of the D-state in low mass vector mesons.

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Vector Mesons in Medium ◇

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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 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. 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 moderately. For the ϕ meson we find almost no mass shift, but the width of the peak increases significantly. We use these spectra as "left hand side" of in-medium QCD sum rules and observe a remarkable degree of consistency with the operator product expansion "right hand side" 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. We also compare the resulting thermal dilepton rates of our model with CERES data. We find satisfactory agreement but we point out that the dilepton rates from completely uncorrelated quark-antiquark pairs also fit the data quite well. Considering the strongly attractive potential for the ω together with its comparably small width, we discuss the possible formation of bound ω states in nuclei. Using a Green's function approach we investigate the possibility of detecting these bound states in the $A(d,^3 He)$ pick-up reaction.

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