Peripheral NN-Scattering: Role of Delta-Excitation, Correlated Two-Pion and Vector-Meson Exchange ◇

N. Kaiser, S. Gerstendörfer, and W. Weise

We evaluate, within one-loop chiral perturbation theory, the two-pion exchange diagrams with single and double delta-isobar excitation contributing to elastic NN-scattering. We find that virtual Δ-excitation processes (in the static limit) produce the correct amount of isoscalar central attraction as needed in the peripheral partial waves with $L =\geq$. Furthermore we compute the two-loop diagrams involving the $\pi\pi$-interaction (so-called correlated 2π-exchange). Contrary to common believe these processes lead to negligibly small and repulsive corrections to the NN-potential. The exchange of vector mesons (ρ, ω) turns out to be important for the F-wave phase shifts above $T_{lab} = 150 MeV$. Without adjustable parameters we are able to reproduce the empirical NN phase shifts up to 350 MeV for $L \geq 3$ and up to about (50–80) MeV for the D-waves. This is therefore the characteristic window in which the NN-interaction is basically governed by chiral symmetry. Not surprisingly, the lower partial waves require non-perturbative methods and additional short-distance parametrizations of the NN-dynamics.

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Hard Leptoproduction of Charged Vector Mesons ◇

L. Mankiewicz, G. Piller, and T. Weigl

We present an analysis of twist-2, leading order QCD amplitudes for hard exclusive leptoproduction of charged vector mesons. These processes are determined by nonforward parton distribution functions which are nondiagonal in quark flavor. We derive relations between flavor diagonal and nondiagonal distribution functions based on isospin symmetry. Furthermore, we discuss general features of ρ^+ and ρ^- production cross sections, and present estimates based on a simple model for nonforward distribution functions.

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Smallest Dirac Eigenvalue Distribution from Random Matrix Theory

S.M. Nishigaki [a], P.H. Damgaard [b], and T. Wettig
[a] Institute for Theoretical Physics, University of California, Santa Barbara, CA 93106–4030, USA
[b] Niels Bohr Institute, Blegdamsvej 17, DK–2100 Copenhagen Ø, Denmark

We derive the hole probability and the distribution of the smallest eigenvalue of chiral hermitian random matrices corresponding to Dirac operators coupled to massive quarks in QCD. They are expressed in terms of the QCD partition function in the mesoscopic regime. Their universality is explicitly related to that of the microscopic massive Bessel kernel.