Fluctuation Properties of the Dirac Spectrum at Finite Temperature and Density ◊

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The eigenvalue spectrum of the staggered Dirac matrix on a $6^3 \times 4$ is analyzed in full QCD at finite temperature and in the presence of a chemical potential μ. We construct the nearest-neighbor spacing distribution $P(s)$ for the real eigenvalues (if $\mu = 0$) and for the complex eigenvalues (if $\mu \neq 0$). At zero chemical potential, we find the expected agreement with the Wigner distribution of random matrix theory, both in the confinement phase and in the deconfinement phase. As μ is increased, we observe a crossover from Wigner statistics to Ginibre statistics, in accordance with random matrix predictions for complex non-hermitian matrices.

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Nuclear Quark and Gluon Distributions in Coordinate Space ◊

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In coordinate space, quark and gluon distributions of the nucleon are defined as correlation functions involving two field operators separated by a light-cone distance $y^+ = 2l$. We study the nuclear modifications of these distributions. The largest effect is a strong depletion of parton distributions (shadowing) at large longitudinal distances, which starts for all parton species at $l = 2fm$, i. e. at the average nucleon-nucleon separation in nuclei. On the other hand, the nuclear radius does not play a significant role. At $l \leq 1fm$, nuclear modifications of parton distributions are small. The intrinsic structure of individual nucleons is evidently not very much affected by nuclear binding. In particular, there is no evidence for a significant increase of the quark or gluon correlation length in bound nucleons.

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Exclusive J/ψ Photoproduction and Gluon Polarization ◊

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In exclusive J/ψ production by polarized photons incident on polarized protons, a finite polarization asymmetry arises because of $c\bar{c}$ Fermi-motion and binding-energy effects. The asymmetry depends on the polarized nonforward gluon distribution of the proton and thus gives information on gluon polarization in the proton. The analyzing power, however, is rather small

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The Reaction $pp \to p\Lambda K^+$ Near Threshold ◊

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We analyze the recent total cross section data for $pp \to r\Lambda K^+$ near threshold measured at COSY. Using an effective range approximation for the on-shell $p\Lambda$ S-wave final state interaction we extract from these data the combination $\mathcal{K} = \sqrt{2|K_2|^2 + |K_t|^2} = 0.38fm^4$ of the singlet (K_s) and triplet (K_t) threshold transition amplitudes. We present an exploratory calculation of various vector and pseudoscalar meson exchange diagrams. ω-exchange alone and the combined (ρ^0, ω, K^{*+})-exchange can explain the experimental value of $\mathcal{K}$. However, the pseudoscalar meson exchanges based on a $SU(3)$ chiral Lagrangian turn out to be too large. More exclusive measurements are necessary to reveal the details of the $pp \to p\Lambda K^+$ production mechanism.

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