Threshold charmonium production at JLab

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Abstract

The 12 GeV Continuous Electron Beam Accelerator Facility (CEBAF) at JLab allows studying the photoproduction of J/ψ and some higher-mass charmonium states at their thresholds, starting from 8.2 GeV. In this regime, the reaction amplitude is dominated by its real part (in contrast to the high-energy case) and contains important information on the interactions of the $c\bar{c}$ pair with the proton target at low energy. The amplitude can be related to the gluon properties of the nucleon: the gluon form factors, mass radius of the proton, the anomalous contribution to the proton mass, at the same can be used to study the possibility for $c\bar{c}N$ bound states, like the LHCb pentaquarks. We discuss the results from two JLab experiments, GlueX and J/ψ-007, aiming to extract the above information in the J/ψ production, at the same time testing the theoretical assumptions used to relate the above quantities to the measured cross sections. These studies are complemented by some observations in the GlueX experiment of higher-mass charmonium states. The proposed 22 GeV CEBAF upgrade would allow much more comprehensive studies of the above reactions, also using polarization measurements, at the same time increasing the energy reach well above the $D\bar{D}$ threshold.