Hadronic and Electromagnetic Interactions as Probes for Strongly interacting matter

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The interactions between hadrons play a crucial role in shaping our understanding of the quantum chromodynamics (QCD) which is the theory of strong nuclear force. With the advent of the lattice QCD as well as effective field theoretical models, supplemented by phenomenological studies and many high quality data from various laboratories around the World, the study of hadronic interactions is developing into a precision science. Interestingly, the properties of the basic constituents of the underlying theory can only be indirectly inferred by studying its manifestation in the structure, the decay, the production, the spectrum and the interaction of hadrons.

To address these aspects, hadrons are explored experimentally by studying their response to high-precision probes at various energies. Electroweak probes offer versatile and well understood tools to access the internal structure of hadrons. With relatively weak coupling strength of the electromagnetic interaction, a clean separation of the probe and the system under investigation is possible. This is true for processes with photons or charged leptons in the initial or in the final states.

In this talk we shall review our recent studies on the investigation of hadron structure by analyzing the photonuclear reactions within a coupled-channels K matrix approach where the hadronic interactions are described as the exchange of known mesons and baryons. Effective Lagrangians with parameters constrained by the QCD describe various vertices involved in these interactions. This theory [1, 2] obeys unitarity and is gauge invariant. This K-matrix formalism has been very successful in providing a comprehensive description of all the available data on the photoproduction of the η and the K^+ meson off proton. The aim is to establish that different final states can be described by a single set of parameters which is the real promise of a coupled-channels theory of such reactions.

We shall also discuss the application of our effective Lagrangian method in the description of hadron-hadron reactions that lead to production of photons, dileptons and mesons in the final channel [3].

References

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