Light-Meson Transition Form Factors

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The charge distributions of composite objects are characterized by form factors. Whether describing the cross sections for electron scattering off nucleons (composed of quarks and gluons) or nuclei (composed of nucleons), form factors parametrize the deviation from the scattering amplitude off a point-like object (like an electron); to study them allows us to learn something about the constituents as well as the strong interactions that bind them together \cite{1}. The momentum dependence of the form factors can therein be understood as the Fourier transform of the charge distribution (within a certain reference frame).

Similar form factors can also be used to characterize the electromagnetic transition between different particles. In particular, we can also investigate the form factors of particles that cannot be prepared as targets in scattering experiments through the study of their decays into final states including an electron–positron pair. Of particular recent interest are the transition form factors describing the decays of light, flavor-neutral mesons ($\pi^0$, $\eta$, $\eta'$) into one real and one virtual photon; with only one single hadron involved, it is this hadron’s electromagnetic structure that can be understood in such decays.

In this working group, we want to concentrate on the decay $\eta' \rightarrow \gamma e^+e^-$. The decaying $\eta'$ can be produced in the reaction $e^-p \rightarrow e^-\eta'p$ (electroproduction), for instance at the CLAS experiment at Jefferson Lab (Virginia, USA). We want to understand the existing experimental results for such form factors \cite{2}, how they can be understood and interpreted theoretically \cite{3}, and what their implications are for a wider range of modern particle physics problems of current interest \cite{4}. Finally, we want to work on a proposal for improved experiments to measure the transition form factors.

References

\cite{1} see e.g.: F. Halzen and A. D. Martin, \textit{Quarks And Leptons: An Introductory Course In Modern Particle Physics}, New York, USA: Wiley (1984).

