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The Primakoff Experimental Program at Jefferson Lab

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The system of light pseudoscalar mesons π0, η and η′ provide a unique laboratory to probe fundamental QCD symmetries at the confinement scale. While π0 and η are Goldstone bosons due to spontaneous chiral symmetry breaking, η′ is not due to an axial U(1) anomaly coupling to the gluon field. The chiral anomaly coupling to the electromagnetic field drives the two-photon decays of these mesons. This system harbors information about the effects of SU(3) symmetry and the mixing phenomena of the mesons due to isospin symmetry breaking. A study of this system will have important impact on the low-energy QCD: testing the chiral anomaly and probing the origin and dynamics of chiral symmetry breaking; offering a clean path for model independent determinations of the light quark-mass ratio and the η-η′ mixing angle; and providing inputs to calculate the hadronic light-by-light corrections to the anomalous magnetic moment of the muon. A comprehensive Primakoff experimental program has been developed at Jefferson Laboratory (JLab) to perform high precision measurements of the two-photon decay widths and the transition form factors of π0, η and η′ via the Primakoff effect. A measurement of the π0 radiative decay width was carried out at JLab 6 GeV and the published result achieved a precision of 1.5%. The data collection on the η radiative decay width measurement at JLab 12 GeV was recently completed. The future JLab 22 GeV upgrade will improve the precisions with experimental sensitivities not previously achievable. The status of this program and its physics impact will be discussed.

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