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PrimEx Experiments and the Prospects of Rare Meson Decays at GlueX[1]

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There are two major challenges in contemporary physics: QCD confinement and new physics beyond the Standard Model. A study of not-so-rare and rare decays of light neutral pseudoscalar mesons π^0, η and $\eta\prime$ provides a sensitive probe to investigate both fundamental issues. A comprehensive PrimEx experimental program at Jefferson Laboratory (Jlab) is aimed at gathering high precision measurements on the two-photon decay widths and transition form factors at low Q^2 on π^0, η and $\eta\prime$ via the Primakoff effect. Completed experiments on the π^0 radiative decay width at Jlab 6 GeV, and planned measurements of η and $\eta\prime$ at Jlab 12 GeV will provide a rich laboratory to test chiral anomaly and to study the origin and dynamics of symmetry breaking in QCD confinement. On the other hand, measurements of branching ratios or upper limits for various rare and forbidden η decays are about five orders of magnitude more sensitive to high order QCD contributions or new interactions, because the lowest orders are filtered out by conserved symmetries. This circumstance presents a great opportunity to test high order chiral perturbation predictions, and to search for new sources of symmetry violations (such as C and CP) and new physics beyond the Standard Model. An experimental program to study η rare decays with the GlueX apparatus has been developed at Jlab. Simulations show that the experimental approach, which combines a state of the art $PbWO_4$ calorimeter, a 12 GeV tagged photon beam, and recoil particle measurement, will reduce the background by almost two orders of magnitude compared to other competitors in the world. The updated result from the PrimEx experiments and the prospects of rare meson decays at GlueX will be presented.

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