Physics issues in η' decays

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Studies of hadronic, radiative, and (semi–)leptonic decays of the η' allow to shed light on a broad field of fundamental physics questions:

Isospin symmetry breaking decays $\eta' \to 3\,\pi$ allow to extract the light quark mass difference $\mathrm{m}_d - \mathrm{m}_u$[1], complementarily to estimates from pseudoscalar meson masses, where symmetry breaking via the electromagnetic interaction cannot be neglected, and to meson production processes, where the information might be distorted by the hadronic environment. Differential distributions in hadronic decays allow to test predictions obtained within ChPT approaches [2], and to constrain information on the scalar meson sector via scalar–pseudoscalar–pseudoscalar couplings [3]. Precision measurements on radiative decay widths will both improve our knowledge on the pseudoscalar mixing, and on the manifestation of QCD anomalies, e.g. with experimental evidence for the box anomaly claimed and disclaimed in the past in the non–resonant $\eta' \to \pi^+\pi^-\gamma$ decay [4]. In addition, radiative decay rates constrain a possible gluonium admixture of the η' wave function [5]. The structure of the η' is further probed in semileptonic decays $\eta' \to l^+l^-\gamma$, that allow to extract the η' transition form factor from the lepton invariant mass distribution.

The combination of the high quality proton beam at COSY and the 4π detector arrangement of the WASA facility will provide a suitable tool to address these physics issues in future. The Presently available experimental information is reviewed, and prospects for η' decay physics with WASA at COSY are presented.

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