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## $\eta N$ scattering parameters and possible $\eta' d$ bound state from $\eta$ photoproduction on the deuteron

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Among the two-body dynamics of the meson-nucleon systems, the interaction between the eta meson ( $\eta$ ) and nucleon ( $N$ ) is not well known although it has been found to be attractive. An experiment [1] is conducted to determine the low-energy  $\eta N$  scattering parameters using a special kinematics at the Research Center for Electron Photon Science (ELPH), Tohoku University. The energy and momentum of the emitted proton ( $p$ ) are measured at 0 degrees for  $\eta$  photoproduction on the deuteron at incident energies around 0.94 GeV, which gives the low relative momentum between  $\eta$  and neutron ( $n$ ) in the final state. Low-energy  $\eta n$  scattering is likely to take place in this condition, and the scattering parameters can be determined from the differential cross section as a function of the  $\eta n$  invariant mass (corresponding to the relative  $\eta n$  momentum) [2]. We present the current status of the experiment.

Recently, a possible  $\eta' d$  bound state is theoretically investigated [3]. A structure corresponding to the state can be observed via the  $\gamma d \rightarrow \eta d$  at incident energies around 1.2 GeV. In case of backward  $\eta$  emission, the structure becomes prominent because a background contribution coming from quasi-free single-step  $\eta$  emission is highly suppressed.  $\eta$  photoproduction on the deuteron has been experimentally studied at ELPH below incident energies of 1.15 GeV. The angular differential cross sections are determined at backward  $\eta$  emission angles. We also present the preliminary results for the energy dependence and discuss a possible  $\eta' d$  bound state.

[1] T. Ishikawa et al., Acta Phys. Polon. B 48, 1801 (2017).

[2] S.X. Nakamura, H. Kamano, T. Ishikawa, Phys. Rev. C 96, 042201 (R) (2017).

[3] T. Sekihara, H. Fujioka, T. Ishikawa, Phys. Rev. C 97, 045202 (2017).

**Primary author:** ISHIKAWA, Takatsugu (Research Center for Electron Photon Science, Tohoku University)

**Presenter:** ISHIKAWA, Takatsugu (Research Center for Electron Photon Science, Tohoku University)

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