Measurement of the proton charge radius during the ULQ^2 experiment.

C. Legris, D. Abe, R. Danjo, T. Goke, Y. Honda, M. Kohl[A], Y. Maeda[B], S. Miura, E. Morris, T. Muto, Y. Nagano[C], R. Obara, T. Suda

ELPH, [A]Hampton University, [B]Miyazaki University, [C]Yamagata University

Since 2010, the proton charge radius has been measured using electron scattering, atomic and muonic hydrogen spectroscopy and the results of these measurements tend to fit with a 0.84-fm or 0.88-fm radius. The cause of the discrepancy is not fully understood but some inconsistent results are pointed out: different radii are determined from the same transition of the hydrogen atom (1S-3S) [1,2] and the electric form factor data obtained by the PRad and Mainz experiments using electron scattering are incompatible [3,4].

At ELPH, the ULQ^2 (Ultra-Low Q^2) experiment aims at determining the proton charge radius using low-energy electron scattering ($E_e = 10 - 60$ MeV) covering the Q^2 range from 3×10^{-4} to 8×10^{-3} (GeV/c)^2 as the proton charge radius is obtained from the slope of the proton electric form factor when the momentum transfer (Q^2) tends to 0. We are currently conducting the least model-dependent measurement of the proton charge radius with electron scattering as we are carrying out the **absolute measurement** of the electron-proton scattering cross-section using a plastic (CH_2) target and the **Rosenbluth separation** in the **extremely low Q^2 region**. The equipment of the brand-new ULQ^2 beam line has already been commissioned (see Fig. 1) and the efficiency of the detectors have already been measured. The physics runs started last April and will be carried out for 28 days to determine the proton radius with 1% accuracy.

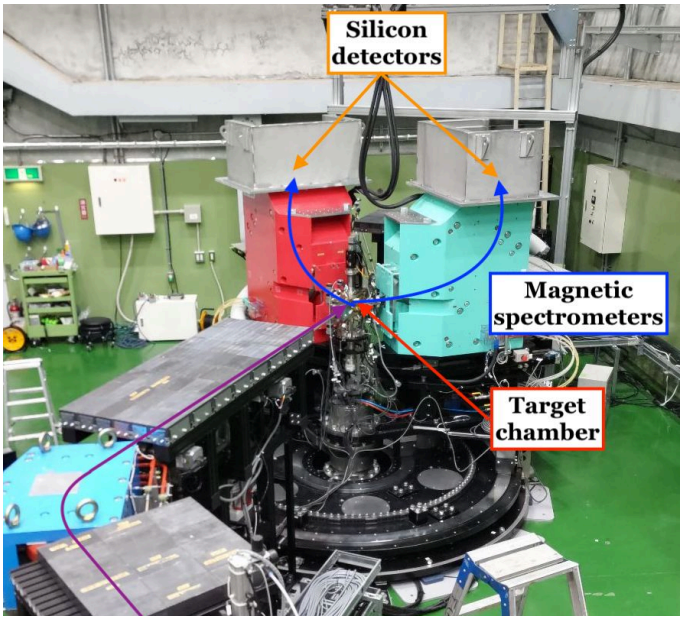

Fig. 1. Setup of the ULQ^2 experiment.

[1] A. Grinin et al., Science **370** (2020) 1061.
[2] H. Fleurbaey et al., Phys. Rev. Lett. **120** (2018) 183001.
[3] J. C. Bernauer et al., Phys. Rev. C **90** (2014) 015206.
[4] W. Xiong et al., Nature **575** (2019) 147.