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Proton Radius Measurements with electron scattering at ELPH

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The proton radius has a serious problem in the today's physics. The proton charge radius has been measured by electron scattering for more than fifty years and hydrogen spectroscopy. Since these results were consistent within experimental error, the proton radius has been believed to be 0.88 fm. However, the radius extracted from muonic hydrogen spectroscopy reported in 2010 was about 5% smaller than the value measured with electron. Despite intensive measurements and analyses, this discrepancy has not been explained reasonably yet, thus called "the proton radius puzzle".

We are going to obtain the proton radius, using elastic electron scattering with the highest accuracy at ELPH, Tohoku Univ. This experiment has two remarkable features. First, we will use low and variable energy electron beam accelerated by the 60 MeV linac in ELPH. In electron scattering, the proton radius is deduced from the charge form factor, which is related to scattering cross sections, at the limit of the momentum transfer $Q^2 \to 0$. We will measure cross section in lowest-ever Q^2 and a wide range of the scattering angle, which enables to determine reliable distribution of charge form factor for the radius. Second, we will use polyethylene (CH_2) as a target, because it is not an easy task to determine absolute cross sections. In our experiment, we will observe the scattered electron from proton (hydrogen) and carbon in the same time. The cross sections of electron-proton scattering can be determined relative to that of ^{12}C, as it is well known.

In this presentation, I will discuss the present status of the proton radius problems, and the detail of our experiment.

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