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Demonstration of the 25 ps single-photon time resolution of an RPC-based gaseous photodetector

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Photosensitive gaseous detectors with a simple photoelectron multiplication mechanism of a resistive plate chamber are expected to have both a large photo coverage and an excellent time resolution and to be low-cost. To demonstrate the time resolution, we built a prototype detector with a LaB6 photocathode. We successfully detected single-photon signals. We performed a waveform fitting to precisely measure the timing of the signals, and measured the time resolution to be 25 ± 0.2 ps at the gain of 3.3×10^6 .

We also studied the photon feedback event that is additional avalanches caused by UV photons from the primary avalanche. Because the photon feedback doubles or triples the output charge, it was clearly seen in the charge distribution of the signals. We extracted the probability of the photon feedback by fitting the charge distribution. Using this result, we determined the photon feedback probability to be 0.3 under assumption of a Poisson model. Photon feedback probability can be larger with a photocathode that has a better quantum efficiency, and it can be a major challenge in practical application of the gaseous photodetectors.

In this presentation, we will discuss the details of the above measurements and prospects of the future R&D of this photodetector.

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