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Development of an imager with high time resolution optical photon counter

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Astrophysical sub-millisecond time-scale transient phenomena, such as fast radio burst and giant radio pulses from the Crab pulsar, have been observed in radio wavebands, although their origins are still unknown. To reveal them, a photon detector with high sensitivity and high time resolution is required. Recently, we have developed Imager of MPPC-based Optical photoN counter from Yamagata (IMONY), an observation system using a Geiger-mode avalanche photodiode (GAPD) as a sensor. The sensor is composed of 64 pixels, each of which is a combination of a GAPD and a quenching resistor, and its pixel sizes are 100, 150, and 200 um. The signal of each pixel is read out independently, and the sensor can detect a single photon. In a readout board, the output signal from the sensor is amplified and converted into the timing pulse by onboard comparators. Then, using a Global Navigation Satellite System (GNSS) and a Field Programmable Gate Array (FPGA), our system gives time stamp for each detected photon with a resolution of 100 ns. FPGA transfers the acquired data to a PC via Ethernet. We have conducted performance verification by observing the Crab pulsar which emits pulses with a period of 34 ms. This observation was made with two telescopes in Japan: the 1.5 m Kanata Telescope and the 3.8 m Seimei Telescope. We will present this system details and configuration with selected results.

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