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Development of a power-effective muon telescope for 3D CAT scan of a volcano

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We developed a power effective assemblable muography telescope for a multi-detector tomographic observation of a volcano. New technology used in the present observation is based on the usage of a photomultiplier tube (PMT) with a Cockcroft-Walton multiplying ladder circuit and a power effective data acquisition (DAQ) system with an FPGA (Field Programmable Gate Array)-driven network system. Total power consumption including a muon telescope and a DAQ system was measured to confirm whether the telescope would be operated stable at the observation point where a commercial electric source is not available. The measured value was found to be 14 watts for a detector size of 1-m^2.Because the power consumption was improved by 85% compared to the prior work, now we can extend the observation area more when we use a realistic size of a solar panel. For the first tomographic measurement, we chose Mt. Asama as a model volcano because we have already made a muon observation point in the east (the east observation point). We constructed one more observation point in the north of Mt. Asama (the north observation point) to measure independent data from the one we can measure at the observation point in the east. During a 75-day observation we have collected about 5 million muons. The data measured at the east and north observation points are merged together to produce an image of three-dimensional density structure of Asama. The value of the density and the spatial extent of the low-density region below the crater was found to be 1.83 (1.82) +/-0.6 g/cm2 at a depth between 0 and 100 m (100-200 m) below the crater floor and 300+/-100(NS) x 150 +/-100 (WE) m2 respectively including the statistic and model-dependent systematic errors. This meeting was supported by the Earthquake Research Institute cooperative research program.