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The GEM stability test against frequent high voltage on and off switching.

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We report the performance stability of the gas electron multiplier (GEM) against frequent high voltage on and off switching.

We have been developing a GEM, which is included in the X-ray polarimeter by utilizing a micropattern time projection chamber. Our GEMs are adopted by some coming satellite missions (e.g., Imaging X-ray Polarimetry Explore, IXPE) which have a low Earth orbit with a high inclination and pass through the South Atlantic Anomaly (SAA) region where the flux of charged particles increases by a few orders of magnitude. The detector systems must repeat powering down and up every time the satellite passes through SAA. Therefore, the GEM is required to have a stability against powering high voltage on and off repeatedly. In this study we performed the test to confirm that the GEM is robust enough for the situation.

The GEM was tested in dimethyl ether (DME) at 190 Torr, which is the same gas condition in the polarimeter. In the test, we increased the applied high voltage up to 500 V in 25 seconds and then decreased to 0 V in 30 seconds. We repeated this on/off sequence 17 thousand times with continuous irradiation of 8.0 keV X-rays produced by an X-ray generator for 20 days. We took an energy spectrum for 60 seconds once in 50 on/off sequences. As a result, the GEM operated normally and was able to detect X-rays during this test. The gain decreased only 2% and the energy resolution showed no significant change. Therefore, we confirmed the GEM has a tolerance against powering high voltage on and off repeatedly for the satellite operation.

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