

In-flight observation of long duration gamma-ray glows by aircraft

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The Gamma-Ray Glow is a long-lasting (several seconds to minutes) X- and gamma radiation presumably originated from high-electric field of thunderclouds. Such glows were previously observed by aircraft, balloons, and from the ground. When detected on ground with other particles, i.e. electrons and neutrons, they are usually called Thunderstorm Ground Enhancements (TGEs). Their measured spectra are often consistent with Relativistic Run-away Electron Avalanche (RREA) mechanism. That is why RREA is a commonly accepted explanation for their existence. The gamma-ray glows are observed to be interrupted by lightning discharge, which terminates the high-electric field region.

In January 2016 an Airbus A340 factory test aircraft was performing intentional flights through thunderstorms over Northern Australia. The aircraft was equipped with a dedicated in-flight lightning detection system called ILDAS (<http://ildas.nlr.nl>). The system also contained two scintillation detectors each with 38x38 mm cylinder LaBr3 crystals. While being at 12 km altitude the system detected a gamma-ray flux enhancement 30 times the background counts. It lasted for 20 seconds and was abruptly terminated by a lightning flash. The flash hit the aircraft and its parameters were recorded with 10 ns sampling time including gamma radiation. Ground-based lightning detection network WWLLN detected 4 strikes in the nearby region, all in association with the same flash. The ILDAS system recorded the time-resolved spectrum of the glow. In 6 minutes, after making a U-turn, the aircraft passed the same glow region. Smaller gamma-ray enhancement was again detected.

In this presentation we will show the mapped event timeline including airplane, gamma-ray glow, WWLLN, and cloud data. We will discuss the glow's properties, i.e. intensity and differential spectrum, and its possible origin. This result will also be compared to previously reported observations.