PIPER Sprite Observations During 2007 Summer Observation Campaign

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A sprite observation campaign was conducted at Yucca Ridge, Colorado from June 24, 2007 to August 2, 2007. Among the multiple imaging devices used to detect sprites was a novel new multi-anode photometric imaging device called PIPER (Photometric Imaging of Precipitation of Electron Radiation).

The PIPER instrument contains two multi-anode photometer photomultiplier tubes, arranged in pairs: one pair operates behind a 427.8 nm optical interference filter while the other pair operates behind a 630.0 nm filter. Each multi-anode photometer pair consists of 16 linearly arranged anodes, each with a detector size of 0.8 mm x 16 mm, yielding the capability for crude spatial resolution in addition to the very high optical sensitivity and temporal resolution typical of photometers. In each photometer pair, one photometer is oriented vertically to achieve vertical spatial resolution while the other photometer is oriented horizontally to achieve horizontal spatial resolution. Interpreted together, the high-speed (25,000 measurements per second) structural evolution of the sprite at very low light levels can be inferred.

Moreover, the photometric data can be augmented with video-rate instensified camera images to produce a sequence of 16 x 16 pixel 2-D images of the sprites at the optical sensitivities and sampling rate of the photometers. This 2-D image reconstruction is accomplished by applying a total variation minimization algorithm, subject to data fidelity constraints, to the set of photometer and video data acquired for each sprite.

Several sprite events were imaged with the PIPER instrument over the course of the six week observation campaign. The PIPER photometer data for some of these sprites seems to include morphological features not captured by the intensified CCD cameras aimed at the same events. We present these examples of PIPER photometric data from sprites with these features as well as PIPER photometric data from other sprites observed. We also present the first reconstructed 2-D images of these sprites and discuss the various features imaged.