ABSTRACT

TITLE:	Measurement and Analysis of Sprite Temporal and Spatial Morphology
AUTHOR(S):	Hensley, Bryan
PRESENTED AT:	4th Annual Natural & Behavioral Sciences Undergraduate Research Symposium, Fort Lewis College

ABSTRACT: Sprites can be described as upper-atmospheric electrical-breakdown phenomena. It is an idea that spans a century. An early theory of this process was developed by a Nobel prize-winning physicist C. T. R. Wilson. While describing the electric field of a thundercloud (Wilson 1926), Wilson claimed that the electric field that creates lightning in lower-altitude thunderstorms, quite possibly triggers an electrical breakdown in the upper-atmospheric region above the underlying thunderstorm. Even though Wilson had an early inclination of the sprite causality, it wasn't until 1989 when a group led by Dr. Winkler, of auroral researchers, from the University of Minnesota, while waiting to film a rocket launch obtained the first footage of an unusual optical event appearing at very high altitudes. The researchers obtained video recordings of an intense electrically-active thunderstorm linked to hurricane Hugo (Franz 1990). It was around this time, these optical emissions were given the name sprites due to their elusive and mischievous nature when it came to capturing this phenomenon on film. In the summers of 1993 and 1994 the dual-aircraft Sprites94 campaign was performed, yielding the first colored images of sprites while using triangulation methods to determine physical dimensions (Sentman 1995). As with the Sprites94 campaign researchers soon realized that due to different luminous formations, one term could not encompass all of these sprite occurrences. Therefore, it was proposed to use the broader term of transient luminous events (TLE's) to describe the light emissions (Lyons 1996). Under which many different formations of sprite structures can be categorized. Through more increasing observations sprites have been classified as C - sprites and carrot sprites (Westcott 1996). C-sprites typically exhibit column-arrays of light whereas carrot sprites have propagating streamers that spread out at the top in a bunch, like the leaves of a carrot. By 2000, observations of higher than video time (30-frames per second) resolution had been achieved. M. Stanley recorded sprite events at up to 4,000 frames per second in 1999 and in 2000 H.C. Stenback-Nielsen used the 1,000 frames per second camera developed by the University of Alaska to obtain optical recordings. These higher timed resolution images offered a better insight into the spatial and temporal characteristics of TLE's especially toward the onset of sprite initiation. A campaign was launched during the summer of 2008. The approach of triangulation employed one stationary and two roving observation teams. The teams deployed to various areas in New Mexico. The stationary crew set their recording equipment up at Langmuir Observatory, Socorro NM. The two roving team split up, one in Las Vegas NM area and the other the Portales NM area. Using triangulation techniques it was found that carrot sprites have top altitudes of 84.92 km and bottom altitudes of 58.28 km. C-sprites had measured top altitudes 80.02 km of and bottom altitudes of 75.03. These number were consistent with similar studies that had been produced [Lyons (1994), Westcott(1998), and Westcott(2000)] earlier.