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## NRL Rocket Experiment Lights up the East Coast



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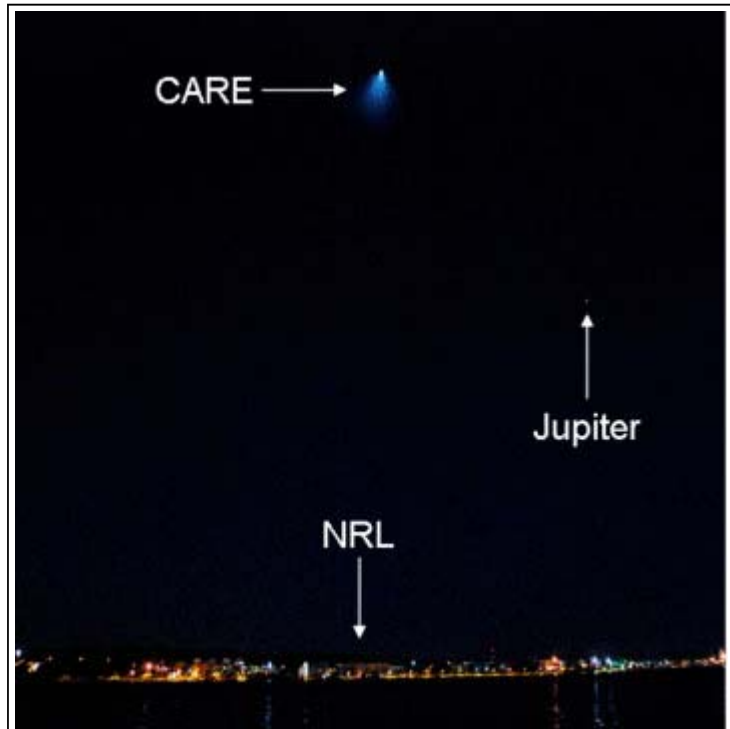
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The Naval Research Laboratory recently conducted a chemical release experiment called the Charged Aerosol Release Experiment (CARE) that was viewed along the East Coast of the United States. The bright optical display, easily seen from the ground, was produced by sunlight scattering off dust particles. A rocket launched from Wallops Island, Virginia, used a delayed firing of the fourth stage to release rocket exhaust into the upper atmosphere at 280 km altitude. The exhaust was composed of aluminum oxide

particulates as well as molecules of carbon dioxide, water vapor, and hydrogen. The launch occurred on September 19 at dusk (07:46 pm) to place the 110 kg of exhaust particles in sunlight for easy viewing by cameras on the ground, where the sun had set at that time. The large concentration of dust and exhaust material interacted with the ionosphere to produce a "dusty plasma" with high-speed "pickup ions." Ground-based radars tracked the effects on the ionosphere for over four hours providing valuable data on how rocket motors affect ionospheric densities and providing simulations of natural disturbances in the upper atmosphere.

The CARE experiment, developed by NRL's Plasma Physics Division, employed a large number of government laboratories and universities to provide scientific observations and supporting theoretic studies. The Plasma Physics Division's Charged Particle Physics Branch made measurements using a two frequency radio beacon on the rocket payload by recording signals with ground receivers in Maryland and Virginia provided by NRL, Kyoto University, University of Texas at Austin, and SCION Corporation. Along with NRL, other researchers from University of Colorado, Clemson University, Penn State, MIT Haystack, Johns Hopkins University, Air Force Research



On September 19, 2009, after sunset the CARE dust release was the brightest object in the sky over NRL as viewed from Alexandria, Virginia. The actual release was 200 km off the coast of Virginia at an altitude of 290 km. The dust cloud was produced by a solid rocket motor that remained at a fixed altitude during the engine burn. (Photograph by Dr. John Apruzese of NRL Plasma Physics Division)

Laboratory, and NOAA provided radar and optical measurements of the chemical release cloud and its effects on the ionosphere. The CARE theory effort was based in the Plasma Physics Division and Laboratory for Computational Physics and Fluid Dynamics at NRL as well as at the University of Michigan and Virginia Tech.

"The CARE launch was fully successful," stated Dr. Paul A. Bernhardt, CARE Principal Investigator. "CARE demonstrated that dust could be released from a rocket motor that was made to hover at a constant altitude. With this hovering maneuver, the maximum concentration of dust was produced over a localized region." A CARE data review was held on October 20, 2009 at MIT Haystack Observatory. During this review, the scientific results from the experiment were compared and a follow-on CARE II experiment was planned.

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