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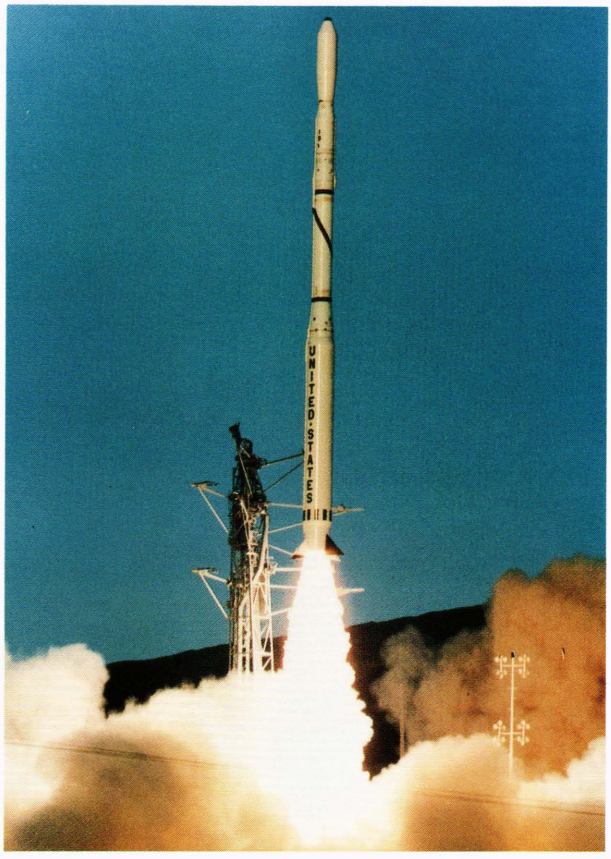
GUEST EDITOR'S INTRODUCTION

On November 13, 1986, a Scout launch vehicle lifted the Polar BEAR satellite from SLC-5 at the Vandenburg Western Test Range into a 1000-km circular polar orbit. The launch, culminating more than 26 months of intense technical effort at APL, was an unqualified success.

Polar BEAR carries a complement of interrelated Department of Defense science experiments designed to measure the properties and ionospheric structure associated with precipitations of the near-earth plasma. The origin of the plasma is the solar wind, which emanates from the sun and envelops the earth with a shower of energetic charged particles. Some of these particles are captured by the earth's magnetosphere and coalesce into electrical currents aligned with the earth's magnetic field. The currents intensify in the polar region and manifest themselves through the auroral display, a phenomena of considerable scientific interest and importance. Instrumentation on Polar BEAR produces unique images of the auroral oval and simultaneous measurements of associated field-aligned currents throughout the polar region. Such data provide considerable insight into plasma structure and dynamics. Inhomogeneities in plasma density are also technically significant because of the effect they have on radar signals and communications signals. Variations in structural density cause radio-wave scintillation and other interference phenomena that are severe problems in the polar region. The Polar BEAR experiments provide a direct measure of such phenomena and their underlying mechanisms, an immediate and more practical benefit of the mission.

Polar BEAR is the third in a series of satellite missions sponsored at APL by the Defense Nuclear Agency. The Wideband Beacon Experiment, P-76 (launched on May 22, 1976, into a 1000-km polar orbit) was the first mission to measure the distortion of RF signals produced by plasma structures. It was a complete success. On June 27, 1983, APL successfully launched the HILAT satellite into an 800-km polar orbit. The second spacecraft in the series, it carried a complement of five scientific experiments to quantify properties of the plasma directly, as well as to measure the RF scintillation associated with fluctuations in plasma density. HILAT continues to produce valuable scientific data (see the *Technical Digest*, Vol. 5, No. 2 (April–June 1984)).

Polar BEAR is, therefore, a continuation of the earlier missions and attempts to extend further our scientific knowledge and technical understanding of the near-earth plasma.



Scout-199 lifts Polar BEAR into orbit.

In reading the scientific and engineering articles in this issue of the *Technical Digest*, the reader will note that the Polar BEAR mission had a strange beginning. The Smithsonian Air and Space Museum allowed APL to exchange an earlier experimental satellite for the Oscar satellite on display. The Oscar was extensively modified and, in the transition, became Polar BEAR. Without the trade, there would have been no mission. We are all indebted to the Smithsonian for their understanding and cooperation.

The reader will also note that Polar BEAR's life has not been totally uneventful. In early May 1987, after a brief period of anomalous behavior, Polar BEAR flipped

over and stabilized in an inverted configuration. Historically, a small number of spacecraft with attitude control systems similar to Polar BEAR's have exhibited similar episodes of transient instability. The origin of this phenomena, while seemingly associated with full sun orbits, has never been totally explained. Equally peculiar is the historical observation that the instability occurs during a single period of full sun orbits and does not recur in subsequent periods. We hope that will be the case for Polar BEAR. Through a brief but intense effort, concluding on May 29, 1987, Polar BEAR was reinverted into an upright and stable configuration. Now, as before the episode, Polar BEAR continues to produce copious scientific data in fulfillment of its mission objectives.

The success of the Polar BEAR mission depended on the mutual collaboration of many independent government agencies and aerospace contractors. We are indebted to Program Manager Leon A. Wittwer of the Defense Nuclear Agency and Capt. Richard W. Roberts, USAF Space Division Project Officer, Space Test Program, for their leadership and management skill in bringing together the group of contractors and directing this complex effort.