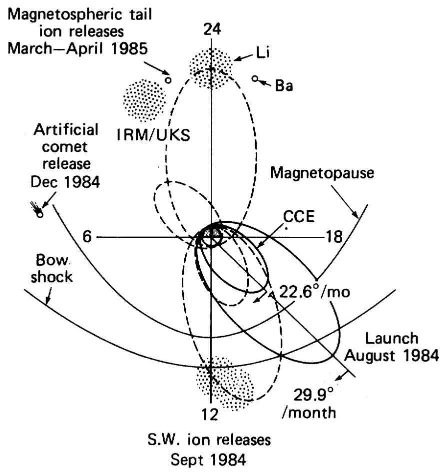
Editorial: AMPTE-Mission Overview

THE ACTIVE Magnetospheric Particle Tracer Explorers (AMPTE) program involves three separate spacecraft that were launched by a single Delta vehicle on August 16, 1984. The first spacecraft is the Ion Release Module (IRM), developed and built by the Federal Republic of Germany; the United Kingdom Subsatellite (UKS) was supplied by the United Kingdom, and the third spacecraft, the Charge Composition Explorer (CCE), was developed and built by the United States. The Delta launch vehicle placed the three satellite stack (shown in the cover of this issue) in an elliptical orbit inclined 28.8° to the earth's equator. The IRM and the UKS spacecraft were interlocked together in a single structural frame that included a solid rocket motor. This motor was fired at first perigee to increase the combined IRM/UKS spacecraft velocity and raise the orbit apogee to approximately 18 Earth radii. The CCE spacecraft, which also included a small solid rocket motor within its structure, was separated from the stack immediately after orbit injection. The CCE solid motor was fired at first apogee to reduce the orbit inclination to approximately 5° while retaining the original injection apogee of approximately 8 Earth radii. The purpose of the different orbits was to place the three spacecraft in specific regions of space to conduct a series of active experiments which consist in the injection of tracer ions by the IRM spacecraft and their eventual detection and analysis by the CCE spacecraft. The UKS orbits in close formation with the IRM and provides local diagnostic measurements during the ion releases. The IRM orbit apogee is such that the spacecraft has periodic access to the solar wind, outside the Earth's magnetosphere, during the first 6 months of the mission, while the small orbit inclination and reduced apogee of the CCE orbit place the spacecraft within the magnetosphere, in the equatorial region, where the injected ions are expected to concentrate. In addition to the ion-tracer experiments, a massive barium release in the dawn magnetosheath will create and artificial comet in the flowing solar-wind plasma.

The scientific objectives of the AMPTE mission are covered in detail in the paper by Bryant *et al.* [1] in this issue and can be categorized broadly as follows: 1) investigate the transfer of mass and energy from the solar wind to the magnetosphere and study its further transport and energization within the magnetosphere; 2) to study the interaction between artificially injected and natural space plasmas and 3) to establish the elemental and charge composition and dynamics of the charged population in the magnetosphere over a broad energy range. Additional objectives include further studies of the structure and dynamics of ambient plasmas within the magnetosphere and particularly in the boundary regions [2].

The orbital configurations at launch and during each of three



	CCE	IRM	UKS
Apogee	8.8 R_E	18.7 R_E	18.7 R_E
Period	15.6 hrs	44.3 hrs	44.3 hrs
Inclination	< 5°	28.8°	28.8°
Mass	242 kg	705 kg	77 kg
Releases		7	

Fig. 1. Orbit configurations of the three AMPTE spacecraft at launch (solid lines). These orbits will precess in the Earth-sun frame, to the positions shown by the dashed lines at the times of the solar wind, artificial comet, and magnetotail releases. The Earth's bow shock, magnetopause boundaries, and approximate orbital and spacecraft data are shown for reference.

release periods are shown in Fig. 1. The initial phase, already carried out at this time, consisted in the release of lithium tracer ions in the solar wind, near the "nose" of the magnetosphere (stagnation point) and close to the Earth-sun line. As the orbits precess in the Earth-sun frame, the artificial comet release is carried out 3 months after the solar wind releases, when the IRM spacecraft is located in the dawn magnetosheath. Approximately 3 months later, the orbits will have precessed to the earth's magnetotail region where additional lithium and barium releases will be carried out.

Of the three spacecraft, the IRM is by far the heaviest at approximately 705 kg. In addition to the scientific experiments described in this issue, it carries 16 canisters, 8 of which are filled with 5.8 kg of a copper-oxide-lithium mixture while the remaining eight are filled with a copper-oxide-barium mixture. These canisters are released in pairs by ground command and the copper-oxide thermite reactions, which vaporize the tracer elements, are initiated by internal timers triggered during the release. The UKS spacecraft, which weighs 78 kg, was implemented by utilizing the normally passive conical adapter which initially joined the IRM and CCE spacecraft at launch, and turning it into a fully instrumented scientific satellite. In addition to the advanced instrumentation described in this issue, it includes a cold nitrogen gas propulsion system which allows the spacecraft to be positioned anywhere between 100 and 6000 km from the IRM, as required by the scientific experiments. The CCE weighs 240 kg and carries the most advanced set of ion-composition instrumentation developed to date to detect and analyze the injected ions. In addition to the charged-particle experiments, it carries magnetic field and wave instruments similar to those flown in the other two spacecraft.

The instrument complement on the three AMPTE spacecraft is dedicated to make coordinated measurements which are necessary to achieve the scientific objectives. Thus the flight instruments are complemented by centrally located "science data centers" which allow interactive access to unified data bases for study. Prior to and during the releases these interactive facilities provide essential real-time displays of relevant data necessary to make rapid decisions concerning optimal conditions for the tracer ion injections. The facilities implemented in each country are described in respective papers and are included in this instrumentation issue because of the fundamental role that they play in achieving the scientific objectives of the active and survey experiments.

The AMPTE scientific team responsible for the instruments, observations and data analysis is introduced in the paper by Bryant *et al.* [1]. The outstanding contributions of the large number of engineers, mathematicians, data analysts, programmers, managers and innumerable other personnel that make a program as large and logistically complex as AMPTE a success, is evidenced throught the papers in this issue and is hereby deeply acknowledged. NASA's Goddard Space Flight Center represents the United States in the program while the Applied Physics Laboratory of The Johns Hopkins University was responsible for the development and construction of the CCE spacecraft under contract to NASA. The IRM spacecraft was developed and built by the Max-Planck Institute for Physics and Astrophysics under sponsorhip of the German Ministry for Aeronautics and Astronautics (BMFT/DFVLR; D. U. Joneleit, Project Manager). The UKS spacecraft was developed and built at the Rutherford-Appleton Laboratory, the Mullard Space Science Laboratory of the Science and Engineering Research Council, United Kingdom (K. Ward, Project Manager). Tracking and spacecraft operations support is provided by NASA/JPL's Deep Space Network, the German Space Operations Center (GSOC), and the SERC in the UK.

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[1] D. Bryant, S. M. Krimigis, and G. Haerendel, "Outline of the active magnetospheric particle tracer explorers (AMPTE) mission," *IEEE Trans. Geosci. Remote Sensing*, this issue, pp. 177-181.

[2] S. M. Krimigis, G. Haerendel, R. W. McEntire, G. Paschmann, and D. A. Bryant, "The active magnetospheric particle tracer explorers (AMPTE) program," *EOS, Trans. Amer. Geophysic. Union*, vol. 63, no. 45, pp. 843-850, Nov. 1982.

Mario H. Acuna (S'62-A'66-M'68) was born in Cordoba, Argentina, on March 21, 1940. He received the Ing. Electricista (electronics) degree from the National University of Tucuman, San Miguel de Tucuman, Argentina, in 1967, and the Ph.D. degree in space science from the Catholic University of America, Washington, DC, in 1974.

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