SPACE SCIENCE REVIEWS / Vol. 86 Nos. 1–4 1998

THE ADVANCED COMPOSITION EXPLORER MISSION

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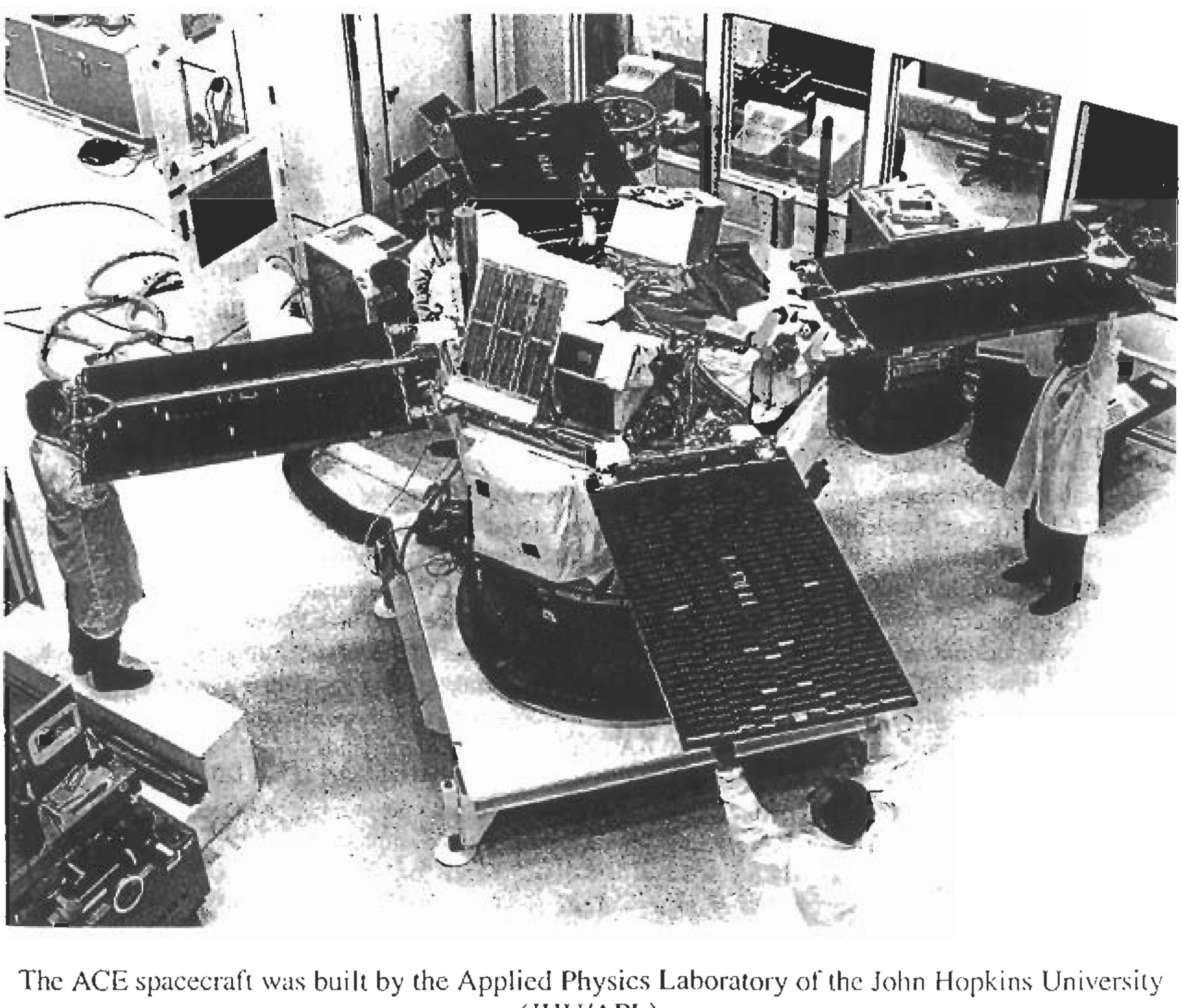

The ACE spacecraft was built by the Applied Physics Laboratory of the John Hopkins University (JHU/APL).

(Photo courtesy of JHU/APL)

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FOREWORD

The composition of the sun is the standard of reference for studies of the origin and evolution of matter in the solar system and beyond. Yet, much of what is known about 'Solar Abundances' is derived from terrestrial, meteoritic, and lunar material rather than from samples of the sun. Fortunately, the solar wind and energetic solar particles are accessible samples of the solar atmosphere comprised of accelerated individual ions. Other accelerated ions coursing through interplanetary space are samples of the local interstellar medium and of matter from nearby regions in the Galaxy. The primary objective of the Advanced Composition Explorer (ACE) is the determination and comparison of these three distinct samples of matter. The observational challenge has been to determine the masses of individual nuclei with sufficient resolution and in adequate number to allow abundance measurements of even relatively rare isotopes.

To carry out these observations ACE includes six state-of-the-art high-resolution spectrometers that measure the elemental, isotopic, and ionic charge-state composition of nuclei from H to Ni ($1 \leq Z \leq 28$). These observations cover more than five decades in energy, from solar wind energies ($\sim$1 keV nucl^{-1}) to galactic cosmic-ray energies ($\sim$500 MeV nucl^{-1}). ACE also carries three instruments that provide the context for ion composition studies by monitoring the state of the interplanetary medium. The wide range of scientific objectives that can be addressed by studies of these three samples of matter are summarized in the first paper of this book, along with an overview of the scientific payload.

In January of 1997 a three-day workshop was held at Caltech to review the scientific goals of ACE and to identify and assess progress that has been made by other missions such as Voyager, *Ulysses*, SAMPEX, and Wind. The invited review papers from this workshop that are included in this volume provide an excellent introduction to the scientific context in which ACE began its observations. The next group of papers includes a description of the ACE spacecraft and its capabilities, followed by eight papers that provide details of the design, development, and new capabilities of the instruments on ACE.

ACE was launched from Cape Canaveral on August 25, 1997 and is now in a halo orbit about the L_1 Lagrangian point, $\sim$1.5 million km sunward of Earth. In response to long-standing interests by the Air Force Geophysical Laboratory and NOAA, Dr Stan Shawhan, then Director of NASA's Space Physics Division, requested in 1989 that the ACE team consider providing solar wind measurements in real time to aid in forecasting geomagnetic storms. In 1994 a joint NOAA/NASA agreement was reached to implement this system and on January 21, 1998, the ACE Real-Time Solar Wind System was inaugurated. These data are also available in real time to the public at http://sec.noaa.gov/ace/ACErtsw_home.html, as described in the penultimate paper in this volume.

Space Science Reviews **86:** vii–viii, 1998.

The final paper describes the ACE Science Center (ASC) at Caltech, which is responsible for preliminary processing, and for distribution and archiving of ACE data. The ASC was the dream of Dr. Thomas Garrard, a Staff Scientist at Caltech and ACE co-investigator who recognized the importance of making ACE data accessible to the broader community and accepted the challenge of making this happen. As a result, preliminary data from all nine instruments are available on the World Wide Web within days of receipt (see http://www.srl.caltech.edu/ACE/), to be followed by higher level data products produced by the instrument teams. Unfortunately, Tom Garrard suddenly passed away just two months before the ACE launch, and he was unable to share in the success of his team's efforts. This volume is dedicated to his memory.

All contributions in this volume have undergone peer review, generally by two experts, one from within and one from outside the ACE community. We would like to thank all the referees for their insightful comments that have improved both the readability and content of the articles herein.

The authors too deserve our thanks for their prodigious efforts undertaken at a very busy time for the mission. We gratefully acknowledge the help of Anne McGlynn in the editorial process.

Many individuals have contributed to the success of the ACE programs. We particularly wish to acknowledge the Explorer Program Office at NASA Headquarters, the ACE Project team at Goddard Space Flight Center, the ACE spacecraft team at the Johns Hopkins University Applied Physics Laboratory, the ACE Payload Management Office at Caltech, and the ACE Science Team, led by Principal Investigator E. C. Stone.

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