ACE

Advanced Composition Explorer

Mission Objective
The objective of the Advanced Composition Explorer (ACE) is to collect observations of particles of solar, interplanetary, interstellar and galactic origins, spanning the energy range from that of the solar wind (nucleon). Definitive studies will be made of the abundances of essentially all isotopes from H to Zn , with exploratory isotope studies extending to Zr.

TYPE OF MISSION	PROGRAM OFFICE	PROJECT LEAD CENTER	MANAGEMENT APPROACH	S/C CONTRACTOR	I&T CONTRACTOR
SCIENCE	SPACE SCIENCE	GSFC	OUT-OF-HOUSE	JHU/APL	JHU/APL

Payload Description
The Advanced Composition Explorer (ACE) payload includes six high resolution particle spectrometers designed to provide the optimum charge, mass, or charge-state resolution in its particular energy range. Each spectrometer has a geometry factor which is optimized for the expected flux levels, in order to provide a collecting power greater by a factor of 10 to 1000 times than that of previous or planned experiments. The payload includes three instruments of standard design to monitor energetic electrons, and H and He ions, and a magnetometer. The ACE spacecraft design is based on the Charge Composition Explorer, built at JHU/APL for the Active Magnetospheric Particle Trace Explorer (AMPTE) Program. The ACE spacecraft occupies a halo orbit about the L1 Earth-Sun libration point, with its spin axis pointed towards the Sun to within +/-20 degrees. Powered by solar cells, the spacecraft has a design life of at least five years, and returns data in daily tape recorder dumps, collected at the NASA-GSFC Multi-Satellite Operations Control Center. The average telemetry data rate is 6.7 kbps.

INSTRUMENT NAME	ACRONYM	PI AFFILIATION	PRINCIPAL INVESTIGATOR	I&T CONTRACTOR
COSMIC RAY ISOTOPE SPECTROMETER	CRIS	CIT	R. MEWALDT	CIT
ELECTRON, PROTON & ALPHA-PARTICLE MONITOR	EPAM	APL	T. KRIMINGUS	APL
MAGNETOMETERS	MAG	UNIV DEL	N. NESS	UNIV DEL
SOLAR ENERGETIC PARTICLE IONIC CHARGE ANALYZER	SEPICA	UNIV NH	E. MOBIUS	UNIV NH
SOLAR ISOTOPE SPECTROMETER	SIS	CIT	R. MEWALDT	CIT
SOLAR WIND ELECTRON, PROTON & ALPHA MONITOR	SWEPAM	LASL	D. McCOMAS	LASL
SOLAR WIND ION COMPOSITION SPECTROMETER	SWICS	UNIV MD	G. GLOECKLER	UNIV MD
SOLAR WIND ION MASS SPECTROMETER	SWIMS	UNIV MD	G. GLOECKLER	UNIV MD
ULTRA-LOW ENERGY ISOTOPE SPECTROMETER	ULEIS	UNIV MD	G. MASON	UNIV MD

Instrument Descriptions
The ACE Cosmic Ray Isotope Spectrometer (CRIS) resolves isotopes by measuring a particles energy loss in a detector of known thickness and its residual energy loss deposited in a following detector. The CRIS includes a scintillating optical fiber hodoscope (SOFT) and four identical "telescopes" composed of large-area silicon solid-state detector arrays. Each telescope includes a stack of eight detectors (E1 to E8) with graduated thickness. The final detector (E9) identifies particles penetrating the entire telescope.
The ACE Electron, Proton and Alpha-Particle Monitor (EPAM) consists of five apertures in two telescope assemblies and an associated instrument electronics box. The EPAM detectors consist of three silicon solid-state detector systems: 1) Low Energy Magnetic Spectrometers (LEMS); 2) Low Energy Foil Spectrometers (LEFS); and 3) Composition Aperture (CA). The LEMS/LEFS provide pulse-height-analyzed single-detector measurements with active anticoincidence. The CA provides elemental composition in an energy range similar to LEMS/LEFS, plus Helium isotope resolution.
The ACE Magnetometers (MAG) consist of twin, wide-range triaxial fluxgate magnetometers mounted on deployable booms, a 12-bit resolution analog-to-digital converter system and a microprocessor controlled data processing and control unit (DPU). Two identical sensors (M1 and M2) are mounted at the end of a boom that extends beyond the Solar Panels. Each sensor assembly includes an orthogonal triaxial arrangement of ringcore fluxgate sensors plus thermal control elements. Both sensors provide a very wide range of dynamic measurements capability.
The ACE Solar Energetic Particle Ionic Charge Analyzer (SEPICA) consists of six nearly independent instrument sections, four of which are identical with respect to slit collimator geometry. Energetic particles entering the multi-slit collimator are electrostatically deflected between six sets of electrode plates. This deflection is inversely proportional to energy per charge, and is measured in a thin window proportional counter and position-sensitive silicon solid-state detector at the back of the instrument. An anticoincidence scintillator is utilized to reject penetrating high energy particles.
The ACE Solar Isotope Spectrometer (SIS) resolves isotopes using a proven technique involving measurement of a particles energy loss in a detector of known thickness and its residual energy loss depostited in a following detector. The SIS detector system design consists of two identical telescopes composed of large-area ion-implanted and Lithium-drifted (LID) silicon solid-state detectors. Each telescope consists of a hodescope system made up of a pair of two-dimensional positionsensitive detectors (M1 and M2), followed by an energy-loss stack containing eight detectors (T1 to T8) of graduated thicknesses . The final stack detector identifies particles that penetrate the entire telescope.
The ACE Solar Wind Electron, Proton, and Alpha Monitor (SWEPAM) is composed of the Los Alamos solar wind eiectron and ion analyzers from the Ulysses mission (BAM E and BAM 1), with minor modifications. Each sensor is separately powered with its own low-voltage converter, fixed-level analyzer plate voltage supply, and channel electron multiplier (CEM) high-voltage supply. Each is operated with an independent microprocessor-based electronics control system, while both pass acquired data along to the central data processing unit. Both sensors make extensive use of curved-plate electrostatic analyzers (ESAs) which are spherical sections cut off in the form of a sector.
The ACE Solar Wind Ion Composition Spectrometer (SWICS) five basic sensor elements and operating principles are: 1) ions enter the SWICS through a large area, multi-slit collimator which determines particle entrance trajectories; 2) the electrostatic deflection analyzer allows only ions within a given energy-per-charge interval to enter the TOF vs. Energy system: 3) the ions are accelerated before entering the TOF vs. Energy system to give them sufficient energy to be measured adequately by the solid-state detectors; 4) the TOF system determines ion velocity by measuring particle travel time between Start and Stop detectors; and 5) the identification of particles is completed by measuring their residual energy in a low-noise solid state detector.
The ACE Solar Wind Ion Mass Spectrometer (SWIMS) consists of a versatile deflection system followed by a TOF spectrometer with excellent mass resolution. Solar wind ions enter the wide angle, three-chamber deflection system which acts as a UV trap and energy-per-charge passband filter. The deflection analyzer accepts incident ions over an angular range of +20° from the nominal direction and passes only those with a predetermined range of energy-per-charge (E/Q). Since ions with an E/Q outside the passband are blocked from entering the mass analyzer, protons can be excluded from the system by an appropriate setting of the deflection analyzer.
The ACE Ultra-Low Energy Isotope Spectrometer (ULEIS) is composed of a time-of-flight (TOF) sensor telescope; an analog electronics box and a digital system box. The ULEIS is a mass spectrometer which identifies ions by measuring the TOF and residual kinetic energy of particles that enter the telescope cone and stop in one of the Silicon solid state detectors. Particle TOF is determined by START and STOP pulses from microchannel plate (MCP) assemblies. Secondary electron emission from solar UV is avoided by pointing the ULEIS telescope at 30 degrees to the spacecraft spin axis and including a sunshade that prevents sunlight from striking the foil directly.

Launch
8/21/97