Introduction: The Electron Isotope Spectrometers (EIS) on IMP-8 was designed to provide measurements of low energy isotopes from H to O ($1 \leq Z \leq 8$) over the energy range from $-2$ to $-40$ MeV/nuc, as well as low energy electrons from $-0.2$ to $-6$ MeV. These measurements supported studies of the acceleration and transport of energetic particles originating on the Sun, in interplanetary space, in the Galaxy, and in Earth's and Jupiter's magnetosphere.

IMP-8 was launched in October 1973 and still continues to provide key particles and fields measurements from orbit about the Earth. The IMP-8 EIS continued to operate flawlessly until 8/3/92, when a partial failure was suffered in a bias supply, which reduced the ability of the instrument to measure high energy particles. The EIS was subsequently turned off in 1995. A nearly identical instrument was flown on IMP-7 from 10/92 to 7/96, and many studies combined results from both instruments. For completeness, this report summarizes scientific results and publications from the entire IMP-7&8 effort, not just from the period covered by NAG5-727. The investigators on these two instruments were E.C. Stone (Principal Investigator), and R. E. Vogt and R. A. Mewaldt (Co-investigators).

Scientific Results: The EIS instruments provided new results on a wide range of topics in space physics and astrophysics. A summary of some of the topics addressed is provided on the following page. For a complete summary, see the papers in the attached bibliography.

PhD Theses: Four Caltech graduate students based their PhD thesis work on data from the IMP-7 &8 EIS instruments, and several additional graduate/undergraduate students and technical personnel received valuable training during the design, development, and calibration of these instruments. The PhD theses are listed in the attached bibliography.

Bibliography: A complete bibliography of papers and talks based on EIS data is attached.
**IMP EIS Science Highlights**

**Solar Energetic Particles**
- Discovery of heavy-ion enrichments in $^3$He-rich flares
- Measurements of $^2$H and $^3$He in solar energetic particles
- Measurements of solar flare electron spectra

**Anomalous Cosmic Rays (ACRs)**
- First measurement of the isotopic composition of ACRs
- Time variations of ACR oxygen over 20 years
- Interplanetary radial gradients with Pioneer and Voyager
- Proof that ACR oxygen is singly-charged (with COSMOS)
- Evidence for ACR hydrogen at 1 AU

**Galactic Cosmic Rays (GCRs)**
- Comparison of GCR $^2$H and $^3$He with galactic propagation models
- Composition & energy spectra of low energy $1 \leq Z \leq 8$ nuclei
- Study of neutron and $\gamma$-ray induced backgrounds in silicon detectors

**Interplanetary Particles**
- First measurement of Jovian 0.2 to 3 MeV electron spectra at 1 AU
- Discovery the particles in CIR events flow back towards the Sun
- Direct determination of interplanetary diffusion coefficients

**Magnetospheric Electrons**
- Discovery of the magnetopause energetic electron layer
- Study of energy flow at the magnetopause and geomagnetic activity
- Evidence for sub-storm associated magnetic reconnection
The Caltech Electron/Isotope Spectrometers on IMP-7 and 8; 1972–1996

PUBLICATIONS


**Thesis**


The Caltech Electron/Isotope Spectrometers
on IMP-7 and 8; 1972–1996
TALKS


