

## **Apollo 15 Orbital Mass Spectrometer Experiment**

### **Instrument Overview**

The objective of Apollo 15 Orbital Mass Spectrometer (OMS), a composition experiment, was to use the measured concentrations to study the sources, sinks, and transport mechanisms of the lunar ambient atmosphere. This flight neutral magnetic mass spectrometer was similar to that flown on Apollo 16. On Apollo 17, a mass spectrometer was deployed on the lunar surface for the same purpose.

The spectrometer was deployed from the Scientific Instrument Module on the Service Module. The analyzer was mounted at the end of a retractable boom, which, when fully extended, measured 7.3 meters from the spacecraft. This distance was expected to be beyond the outgassed molecular cloud. Control of the experiment functions and the boom motion was provided by a set of command module switches that were operated by a crew member according to the mission time line or by instruction from the ground controller. The instrument weighed 11 kg, and its dimensions were approximately 30 x 32 x 23 cm. A scoop mounted on the top of the package was the gas inlet plenum. This inlet was oriented along the spacecraft velocity vector for maximum ram effect when ambient measurements were obtained, and it was oriented in the wake direction to determine background spectra and instrument outgassing. The plenum contained the spectrometer ion source, which had redundant filaments mounted on either side of the ionization chamber. Several outgassing operations during flight maintained the ion source in a reasonably outgassed state. Pre-launch experiment calibration included operation in the Molecular Beam Facility at the Langley Research Center.

### **Instrument Operation**

Use of a two-collector system in the analyzer permitted the simultaneous scanning of two mass ranges, 12 to 28 and 28 to 66 atomic mass units. Mass resolution was the order of a 1-percent valley at mass 40 atomic mass units. The mass sweep was achieved by varying the applied high voltage in a series of 590 steps over the range from 620 to 1560 volts with a dwell time of approximately 0.1 seconds. Thirty additional steps at zero volts were used to determine background counting rate and to apply internal calibration, so that 62 seconds were required to complete a mass scan. The voltage step number that determined the mass number of the ion being measured was identified by counting from step one -- a sweep start flag. Bendix electron multipliers were used as pulse amplifiers to determine the counting rate of ions passing each collector slit for each voltage step. More details of this experiment can be found in Hoffman (1972). Preliminary results are presented in Hoffman et al. (1972).

From 26 July 26 to 7 August 7 1971, the duration of the Apollo 15 flight, 90 hours of data were obtained: 40 hours while in lunar orbit and 50 hours during transearth coast.

## References

Apollo Scientific Experiments Data Handbook, NASA Technical Memorandum X-58131, JSC-09166, published by NASA Johnson Space Center, Houston, Texas, Aug. 1974, revised Apr. 1976.

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Hoffman, J. H., Lunar orbital mass spectrometer, International Journal of Mass Spectrometry and Ion Physics, Volume 8, Issue 4, pp. 403-416, 1972. DOI: 10.1016/0020-7381(72)83026-2.

Yeager, P. R., A. Smith, J. J. Jackson, and J. H. Hoffman, Absolute Calibration of Apollo Lunar Orbital Mass Spectrometer. Journal of Vacuum Science and Technology, Volume 10, Number 2, pp. 348 – 354, 1973. DOI: 10.1116/1.1317064.

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