Foreword

The Lunar Atmosphere and Dust Environment Explorer Mission

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The Moon is our most familiar solar system object after our terrestrial home. We see it almost every night, and if we are observant, almost every day. But half of the Moon is unfamiliar; it is on the side away from the Earth and invisible except from vantage points in space. And do we really know the front side of the Moon? We see it all the time but do we know it as well as we should and do we really understand it? There is much that is important that we do not know. Are there hidden things such as the recently discovered water in the shadowed polar regions that we have not studied? Are there secrets hiding in plain sight? Surprisingly, previous missions, while discovering much about the Moon's surface and interior had left the lunar atmosphere virtually untouched. The Earth has an exosphere at very high altitudes where the atoms and molecules travel in parabolic arcs without colliding until they return to lower altitudes. The Moon too has an exosphere but here the entire atmosphere is exosphere. The arcs along which the particles travel extend from the surface to space and back to the surface. How can we study this exosphere? How can we afford to study it?

Lunar exploration need not be expensive. The Moon can be reached by the smaller rock-ets in our fleet and need not be manned by astronauts but by astrobots. Our robotic spacecraft are up to the task. The engineers and scientists at the NASA Ames Research Center in Mountain View California stepped up to the challenge. Ames had led the highly productive low cost Pioneer Venus mission of the late 1970's and 80's, and had embarked on the development of low-cost robotic spacecraft for the Constellation program. It could repeat the challenge for the Moon and hence the Lunar Atmosphere and Dust Environment Explorer Mission or LADEE was born.

This volume contains five articles describing the mission and its instruments. The first paper, by the project scientist Richard C. Elphic and his colleagues describes the mission,

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objectives, the launch vehicle, spacecraft and the mission itself. This is followed by a description of LADEE's Neutral Mass Spectrometer by Paul Mahaffy and company. This paper describes the investigation that directly targets the lunar exosphere. The exosphere can also be explored optically in the ultraviolet. In the following article Anthony Colaprete describes LADEE's Ultraviolet and Visible Spectrometer that operated from 230 nm to 810 nm scanning the atmosphere just above the surface. Not only is there atmosphere but there is also dust that putatively can be levitated above the surface, possibly by electric fields on the Moon's surface. Mihaly Horanyi leads this investigation called the Lunar Dust Experiment aimed at understanding the purported observations of levitated dust. This experiment was also very successful but in this case their discovery was not the electrostatic levitation of dust but that the dust was raised by meteoroid impacts. This is not what had been expected but clearly is the explanation that best fits the data.

The LADEE mission also carried a technology demonstration, the Lunar Laser Communication Demonstration. Don Boroson describes NASA's first step toward very high data rate communication in deep space, in the last of the five articles.

The success of this volume is due to many people; but first of all, the editor wishes to thank the authors who had the difficult job of distilling and compiling the facts such missions produce, into highly readable articles. The editor also benefited from an excellent group of referees who acted as a test readership, refining the manuscripts provided by the authors. These referees included S. Bougher, R. Elphic, R. Gladstone, G. Gronoff, J. Halekas, P. Kellogg, H. Svedham, X. Sun, R. Vondrak, and J.H. Waite.

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