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Jupiter as Revealed by Juno

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Abstract

The primary science goals of Juno are to improve the understanding of the origin and evolution of Jupiter, the history of our solar system and the more general theory of planetary system formation. The science objectives include the study of Jupiter interior composition and structure, deep atmosphere and polar magnetosphere. The mission has recently completed its 16th orbit marking the halfway point of the baseline mission. Juno's observations reveal numerous surprises that are changing our basic understanding of Jupiter and giant planets in general. An overview of recent results from the first half of the mission will be presented.

1. Introduction

Juno is the first mission to investigate Jupiter using a close polar orbit. The payload consists of a set of microwave antennas for deep sounding, magnetometers, gravity radio science, low and high-energy charged particle detectors, plasma wave antennas, ultraviolet imaging spectrograph, infrared imager and spectrometer and a visible camera. Juno probes significantly below the cloud decks to constrain its interior structure using measurements of Jupiter's gravity and magnetic fields and deep atmospheric composition [1]. Juno's elliptical orbit provides multiple periapsis passes very close to Jupiter, on a pole-to-pole trajectory. The very close-in polar orbits enable a unique exploration of Jupiter's polar magnetosphere [2]. Juno's payload of science investigations include an X-band and Ka-band communications subsystem for determining Jupiter's gravity field, dual magnetometers to map Jupiter's internal magnetic field, a set of microwave radiometers to probe Jupiter's deep atmosphere, a visible color camera and an infrared spectrometer/imager and ultraviolet spectrograph/imager to capture views of Jupiter. Juno also carries a suite of instruments for in-situ sampling of Jupiter's magnetosphere and investigating its powerful aurora [2].

2. Science Results

Juno provided a view of Jupiter's polar regions in both visible (JunoCam) and infrared (JIRAM) wavelengths. These images show a surprising complex organization of polar cyclones. They also revealed unexpected distributions of high-altitude hazes, widespread fine-scale discrete clouds and waves. Juno's microwave radiometer (MWR) measures brightness temperatures at wavelengths between 1 and 50 cm. The results are paradigm shifting in their indication of unexpected variability in both latitude and depth. Images of Jupiter's poles indicate cyclonic activity unique to the solar system. Juno's measurement of Jupiter's gravity field differs significantly from expectations. This has implications for the distribution of heavy elements in the interior including the existence, size, mass and structure of Jupiter's core. The observed magnetic field exhibits smallscale variations as well as a north-south asymmetry. Direct observations of the Jovian polar magnetosphere provide the first close-up observations of Jupiter's auroral regions. Energetic particle and plasma detectors measured electrons precipitating in the polar regions, exciting intense aurorae, observed simultaneously by the ultraviolet and infrared imaging spectrographs. The results from Juno's first half of its baseline mission are profound with respect to our understanding of giant planets and impact the future direction for planetary exploration.

Acknowledgements

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References

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