IAF SPACE SYSTEMS SYMPOSIUM (D1)
Lessons Learned in Space Systems: Achievements, Challenges, Best Practices, Standards. (5)

Author: Dr. David Atkinson
Caltech/JPL, United States

Dr. Mark Hofstadter
Caltech/JPL, United States
Dr. Tibor S. Balint
Jet Propulsion Laboratory, United States

SETTING THE RECORD STRAIGHT: THE GALILEO PROBE MISSION WAS A SUCCESS!

Abstract

Misperceptions regarding the operational success and science accomplishments of the Galileo entry probe mission to Jupiter have acquired an inertia that threatens consideration of future Giant Planet entry probe missions. These misperceptions largely arise from the entry of the Galileo probe into a 5-micron Jupiter hotspot, an anomalously dry and cloud-free location. While local hotspot conditions prevented determination of weather-dependent global properties such as the abundance of water, the probe's measurements of parameters which are not weather dependent, including the abundance of noble gases and key isotopic ratios, have fundamentally altered our understanding of Jupiter's formation, thermal evolution, and internal structure. In addition to its scientific success, the operational success of the Galileo probe represented a resounding technological achievement.

The Galileo probe arrived at Jupiter at the location of a particularly sunny afternoon and it is recognized that in this cloud-free region the oxygen abundance as determined from the measurement of water is not representative of the planet as a whole. Furthermore, recent results from the Juno mission have shown that the mechanisms by which large-scale and local weather conditions can alter the abundance of condensable species are not understood. This limitation does not, however, detract from the importance of measuring species not significantly influenced by local weather conditions. For example, the Galileo probe's determination that the He/H2 ratio was significantly lower than was inferred from remote sensing observations and lower than the solar ratio indicate that helium rainout is occurring on Jupiter. This provides an additional heat source for the interior and significantly altered interior models for the planet.

It is inevitable that future entry probe mission concepts will be compared to the highly successful Galileo probe, the only Giant Planet entry probe mission to date. The science value and overall success or failure of an atmospheric entry probe must be evaluated based on the unique and valuable science achievable from single point in situ measurements, and should not be judged based on expectations for global in situ science results that would require a large number of entry probes distributed around the planet. In this paper we highlight Galileo probe lessons learned relevant to the design, concept of operation, instrumentation, technologies, and scientific objectives of future Giant Planet entry probe missions.