Probing Jupiter's Deep Atmosphere and Interior Structure: A Flyby Mission Proposal

S. J. Bolton (JPL), M. Allison(Goddard Institute for Space Science, NASA-GISS), J. Anderson (JPL), S. Atreya (U. Michigan), F. Bagenal (U. Colorado), J. Connerney (Goddard Space Flight Center, NASA-GSFC), D. Gautier (Paris Obs-Meudon), S. Gulkis (JPL), T. Guillot (Obs Cote D'Azur), M. Hofstadter (JPL), A. Ingersoll (Caltech), M. Janssen (JPL), M. Klein (JPL), S. Levin (JPL), J. Lunine (U. Arizona), D. McComas (Southwest Research Institute, SWRI), T. Owen (U. Hawaii), R. Thorne (UCLA)

The recent National Academy of Sciences Decadal survey for solar system exploration identified the highest priority science objectives for planetary missions in the next decade which include three key questions focused on understanding Jupiter's formation and evolution: (1) determining whether Jupiter has a core, (2) measuring the global oxygen and nitrogen abundance, and (3) exploring the Jovian polar magnetosphere. In addition to identifying science goals and objectives, the Decadal survey specifically identified a microwave remote sounding technique to be used to probe Jupiter's deep atmosphere. In this paper, we describe a simple, elegant low risk mission capable of addressing all three of these important science objectives, and that utilizes the microwave technique advocated in the Decadal report.

The mission concept uses a close polar flyby trajectory to obtain pole to pole microwave measurements of Jupiter's atmosphere at depths ranging from 1 bar to > 1000 bars. These data will be used to determine both the average water and ammonia abundances in the deep atmosphere (the primary oxygen and nitrogen reservoirs), as well as meridional variations at various depths which are sensitive to meteorology. Radio science Doppler measurements will also be collected during the flyby which will define Jupiter's gravitational moments to an accuracy sufficient to constrain core size and infer internal rotational dynamics. The flyby further serves to provide pioneering new views of Jupiter's polar atmosphere and in-situ particle environment that could radically alter our view of Jupiter's auroral processes. In addition to providing important new unique science that will discriminate among present models that describe how giant planets form and evolve, the mission is an excellent precursor to further exploration of Jupiter's system including the deep multi-probes also advocated in the decadal report.

Details of the microwave technique and retrieval analysis for determining the water and ammonia abundances as a function of latitude will be discussed. Expected results from both the gravity and microwave experiments will be presented along with the basic mission description.

The JPL contribution to this paper was performed at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.