JUpiter MagnetosPheric boundary ExploreR (JUMPER). R. W. Ebert[1], F. Allegrini[1,2], F. Bagenal[3], C. Beebe[1], M. A. Dayeh[1], M. I. Desai[1,2], D. George[1], J. Hanley[1], P. Mokashi[1,2], N. Murphy[4], P. W. Valek[1,2], D. Wenkert[4], A Wolf[4], and C.-w. L. Yen[4], [1]Southwest Research Institute, 6220 Culebra Rd., San Antonio, TX USA 78253 (rebert@swri.edu) [2]University of Texas at San Antonio, One UTSA Circle, San Antonio, TX USA 78249 [3]Laboratory for Atmospheric and Space Phyiscs, University of Colorado, 1234 Innovation Dr, Boulder Colorado, USA 80303 [4]Jet Propulsion Laboratory, 4800 Oak Grove Dr., Pasadena California, USA 91109.

Mission Summary: The Southwest Research Institute (SwRI), in collaboration with NASA's Jet Propulsion Laboratory (JPL) and the University of Colorado's Laboratory for Atmospheric and Space Physics (CU/LASP), has developed the Jupiter MagnetosPheric boundary ExploreR, or JUMPER, mission concept. JUMPER is a Jupiter orbiting SmallSat to explore the planet's upstream solar wind environment and magnetospheric boundaries and image its energetic neutral atom (ENA) emissions (Figure 1). Its science objectives focus on how the solar wind influences the global structure and dynamics within the magnetosphere and interacts with Jupiter's magnetospheric boundaries, amd determining the contribution of ENAs to mass loss from the Jovian space environment. These science objectives are met with an instrument payload consisting of a plasma sensor, a magnetometer, and a neutral atom imager. Measurements from these instruments will complement simultaneous observations of Jupiter's magnetosphere, radio emissions, and/or aurora from a Jupiter-orbiting spacecraft (e.g. Europa Clipper, JUICE, Io Observer, JOLT) and/or Earth-based observatories, providing simultaneous, multi-point observations to study this system. Supplemental science opportunities associated with flybys of Galilean satellites Ganymede and Callisto and multi-point observations inside Jupiter's magnetosphere are also possible. The JUMPER science objectives respond to NASA's Planetary Science Division goals outlined in the 2014 NASA Science Plan of "Explore and observe the objects in the solar system to understand how they formed and evolve" and "Advance the understanding of how the chemical and physical processes in our solar system operate, interact, and evolve."

JUMPER's science objectives drive several top-level requirements for mission design. The most important is an orbit that extends beyond Jupiter's magnetopause and bow shock on the planet's dayside (Figure 1). Mission design is also constrained by the necessity to ride share on a primary vehicle, preferably until after Jupiter orbit insertion. After separating from the primary spacecraft, JUMPER's desired orbit is achieved through a period reduction maneuver and a series of satellite flybys, mostly Ganymede, that places the spacecraft's apojove at ~150 R_J from Jupiter on the planet's dayside. The prime mission is approximately 2 years in duration with the possibility of a 1-year extension. At end-of mission, the spacecraft is de-orbited via impact with Jupiter or one of its satellites.

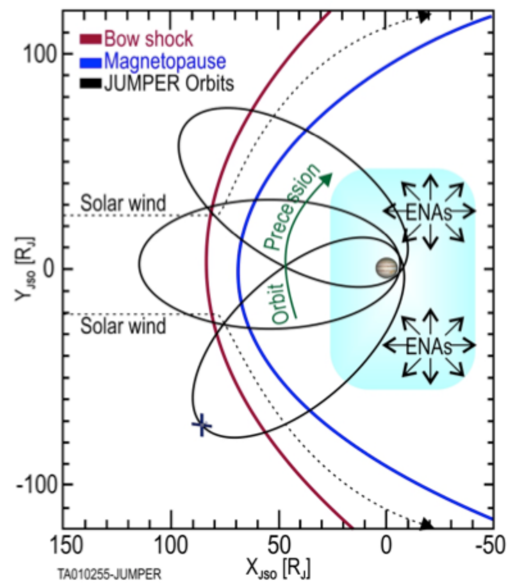

Figure 1: A representation of the desired orbit for JUMPER. The scientific rationale of this mission is to develop a low cost mission to provide measurements that address important questions related to the solar wind's influence on, and the process that lead to mass loss from, Jupiter's magnetosphere.

The JUMPER spacecraft design derives heritage from SmallSats developed by SwRI for missions such as the Cyclone Global Navigation Satellite System (CYGNSS) and the Cubesat to study Solar Particles (CuSP) . The spacecraft design consists of an evolved expendable launch vehicle secondary payload adapter (ESPA) compatible frame supporting four triple-deployed solar array panels, a propulsion system, and three science instruments positioned to accommodate their fields of view (FOVs). Embedded within the frame is an electronics vault that houses the majority of the electronics for the spacecraft avionics and payload subsystems. JUMPER uses the IRIS-2 deep space transponder and an array of patch antennas for direct-to-Earth communication through the Deep Space Network.

The JUMPER mission concept was developed in response to the expressed interest of NASA's Planetary Science Division in flying small secondary payloads on all future planetary science missions. Towards this end, NASA has recently funded a number of SmallSat mission concept studies through the Planetary Science Deep Space SmallSat Studies (PSDS3) program. The requirements for these concept studies were as follows: 1) missions could target any body in the Solar System, including Near Earth Objects, with the exception of the Earth and Sun, 2) science investigations had to be responsive to NASA's Planetary Science Division goals, 3) the spacecraft must adhere to the CubeSat form factor from 1U up to 24U (1U = 10 cm x 10 cm x 10 cm volume) or be a larger ESPA (up to 180 kg) mounted to the satellite, and 4) the mission had to be accomplished within a budget of $10 – 100 million dollars. JUMPER was selected for full mission concept development through NASA's PSDS3 program. This presentation will discusses some of the details of this mission concept study, focusing on JUMPER's science investigation, science implementation and instrument complement, mission design, spacecraft concept including mechanical, structural, and thermal design, flight avionics, power, telemetry, and launch vehicle and primary spacecraft interfaces, concept of operations and estimated mission costs.