DUAL PROBES TO SATURN: A NEW FRONTIERS CLASS MISSION DESIGN CONCEPT. A. Watson[1], S. Strong[2], O. Dawson[3], J. Likar[4], T. Balint[5], A. Aubrey[6], N. Bramall[7], A. Chereck[8], G. Dominguez[9], E. Hultgren[10], J. Levy[11], T. Liu[12], M. Elwood Madden[13], C. Plesko[14], D. Sigel[15], C. Soderlund[16], Y. Takahashi[7], S. Thompson[17], B.J. Thomson[5], and D. Wiese[19], [1]Department of Engineering, University of Regina (watson6a@uregina.ca), [2]Lunar and Planetary Institute, University of Texas at Austin, [3]Department of Earth and Space Sciences, University of Washington, [4]Department of Mechanical and Aerospace Engineering, Princeton University, [5]NASA Jet Propulsion Lab, Caltech, [6]Scripps Institution of Oceanography, University of California San Diego, [7]Physics Department, University of California Berkley, [8]Center for Astrodynamics Research, University of Colorado at Boulder, [9]Department of Chemistry and Biochemistry, University of California San Diego, [10]Department of Aeronautics and Astronautics, Stanford University, [11]Geological Sciences Department, Brown University, [12]College of Aerospace Engineering, University of Michigan, [13]UT-Battelle, Oak Ridge National Laboratory, [14]University of California Santa Cruz, [15]The Robotics Institute, Carnegie Mellon University, [16]Department of Earth and Space Sciences, University of California Los Angeles, [17]Department of Geological Sciences, University of Nevada at Reno, [18]Aerospace Engineering Sciences, University of Colorado at Boulder.

Introduction: Comparative planetology of the Outer Planets is one of the keys to understanding the origin and evolution of the Solar System [1,2]. Despite the spacecraft activity throughout the Solar System since NASA's inception, there are still many unanswered scientific questions regarding the Outer Planets, including Saturn. The Cassini mission has significantly increased our understanding of the Saturn system, including its formation and evolution. However, it did not cover *in situ* sampling of the atmosphere, thus major atmospheric and composition-related questions remained unanswered. In response, NASA's 2006 Solar System Exploration Roadmap proposed a New Frontiers class probe mission to Saturn [2]. In line with the recommendation to address this gap in scientific knowledge, an innovative New Frontiers class mission concept, designed to measure essential elemental abundances in the Saturnian atmosphere, has been developed as part of NASA's 18th Planetary Science Summer School Program.

Background: To date, no *in situ* measurements of the atmospheric properties of Saturn have been performed. Characterizing the heavy ion abundance (mass > ^4He) and dynamical processes of the Giant Planets is vital to understanding the origin and evolution of the Solar System and, consequentially, extra-solar systems [1,2]. In addition, constraining the heavy element abundance ratios between the Sun and the Giant Planets is crucial in further defining Solar System formation scenarios that are also relevant to extra-solar systems [3]. Since water was presumably the primary carrier of heavy elements to the Outer Planets, quantifying the O/H ratio is critical to determining the enrichment factor of the Gas Giants' composition with respect to solar values. Elemental abundance information, including water content, will be available for Jupiter following completion of the Juno spacecraft's primary mission [4], however, comparable data for Saturn will not be provided by the Cassini mission. O/H abundance will likely only be accurately ascertained deep in Saturn's well-mixed atmosphere, where high temperatures, pressures and atmospheric attenuation, combined with suitable mission architecture options, make *in situ* data collection challenging.

Design Specifications: The proposed mission concept, targeted for a 2015 launch (in line with the expected 3rd New Frontiers mission opportunity), consists of a flyby carrier spacecraft that will deliver two identical probes. One probe would be released in a prograde orbit to the equatorial region (0°) and the other in a retrograde orbit to the mid-latitude region (-45°). The entry probes shall perform *in situ* elemental abundance measurements to pressures of at least 10 bars, and before atmospheric entry characterize water content to 100 bars via microwave radiometry remote sensing. The payload of each probe consists of a microwave radiometer, gas chromatograph mass spectrometer, atmospheric structure instrument, doppler wind experiment, and nephelometer. The design of instruments included in the mission payload relies significantly on heritage from prior missions in order to decrease the overall mission cost and increase the likelihood of mission success. The concept also assumed low intensity low temperature (LILT) solar power generation with Juno design heritage solar panels, and further heritage from the Galileo probe design.

Summary: The described probe mission to Saturn would quantify the O/H ratio in Saturn's atmosphere as well as parameterize the photochemistry, cloud properties, and atmospheric structure of Saturn. These measurements are crucial since the study of atmospheric composition and dynamics of the Gas Giants is mainly limited to theoretical modeling and observations taken from Earth.

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