OUTSTANDING SCIENCE IN THE NEPTUNE SYSTEM FROM AN AEROCAPTURED NASA "VISION MISSION". T. R. Spilker[1], L. J. Spilker[1], and A. P. Ingersoll[2], [1]Jet Propulsion Laboratory, California Institute of Technology, Mail Stop 301-165, 4800 Oak Grove Drive, Pasadena, CA 91109-8099, [2]California Institute of Technology.

Introduction: In 2003 NASA released its "Vision Mission Studies" NRA (NRA-03-OSS-01-VM) soliciting proposals to study any one of 17 "Vision Missions" described in the NRA. The authors, along with a team of scientists and engineers, sucessfully proposed a study of the "Neptune Orbiter With Probes" (NOP) option, a mission that performs Cassini-level science in the Neptune system without fission-based electric power or propulsion. The Study Team includes a Science Team composed of experienced planetary scientists, many of whom helped draft the Neptune discussions in the 2003 Solar System Exploration Decadal Survey [1] (SSEDS), and an Implementation Team with experienced engineers and technologists from multiple NASA Centers and JPL.

Mission Science: Although the NRA required only that the mission must address the question, "What is the elemental composition and internal structure of Neptune?" the Study Team felt that the lengthy voyage to Neptune would require that such a mission perform detailed, Cassini-level investigation of all aspects of the Neptune system, including its interaction with the heliosphere. Science objectives are largely taken from the 2003 SSEDS [1] and the Neptune community white paper [2] that supported the SSEDS.

High-Level Science Objectives. Seven broad questions summarize the mission's high-level science objectives:

1. What is the elemental composition and internal structure of Neptune?
2. What processes control the three-dimensional distribution and temporal variation of gaseous composition, clouds, temperatures, and winds in Neptune's atmosphere?
3. What is happening on the unexplored portion of Triton?
4. What processes control the orbital history, surface morphology, and internal structure of Triton?
5. What are the composition of Triton and the global distrubution of volatiles?
6. What are the composition, size, and dynamical properties of ring particles and small satellites, and how do they interact to control structure and evolution?
7. What processes control the structure, composition, density, and dynamics of the magnetosphere, and how does the magnetosphere interact with other elements of the Neptune system?

Mission Description: The key characteristics of our mission concept include various combinations of Solar Electric Propulsion and gravity assists to reach Neptune in 12 years or less, aerocapture into an eccentric Neptune orbit for a Triton-driven orbital tour of at least three years duration, and a well designed set of science objectives guiding a very capable science payload including multiple Neptune entry probes.

Study Results to Date: Significant pathfinding work done in 2002-03 by NASA's Aerocapture Systems Analysis Team allowed focusing quickly on principal issues. By the end of May 2004 the Science Team had drafted a thorough and coherent set of science objectives, leading to our first series of design sessions with JPL's "Team X" in early June. The initial design options studied in those sessions produced flight system designs that all fit easily on soon-to-be-operational launch vehicles. Since then, students working in Caltech's Laboratory for Space Mission Design have studied the potential benefits of incorporating new technologies into those initial designs. Early this year another series of Team X sessions will incorporate the most beneficial technologies into the best design options. Also, high-fidelity orbital mechanics work produced an example *fully integrated* system tour design capable of addressing all the science objectives in two years, verifying the feasibility of such a tour and leaving schedule margin for optimizing investigations.

The poster will discuss the mission's science and measurement objectives and payload, and will summarize study results to date.

References:

[1] National Research Council Space Studies Board, *New Frontiers in the Solar System: An Integrated Exploration Strategy*, Michael J.S. Belton Ed., National Academies Press, Washington, D.C., 2003. Also at http://www.nap.edu/catalog/10432.html. [2] Hammel, H.B. et al., "Exploration of the Neptune System," In *The Future of Solar System Exploration*, M. V. Sykes, Ed. The Astronomical Society of the Pacific, San Francisco, 2002.

This work was performed at the Jet Propulsion Laboratory and its parent institution, the California Institute of Technology, under contract to NASA's Office of Space Science.