# THE OUTER PLANETS : GETTING THERE FAST I'*

Paul A. Penzo
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California 91109

## ABSTRACT

'l'he terrestrial planets and small bodies of the inner solar system provide many opportunities for meeting the NASA criteria of faster, better, cheaper. This challenge has been met successfully with the application of new technology to small but very capable spacecraft and instruments. The challenge remains, however, for the outer solar system, where chemical propulsion falls short of permitting any real advance. Now, with promising developments of inflatable structures, and solar electric and solar thermal propulsion, the outer planets may be brought closer.

This study is a first look at how these and other new technologies can close the gap and make the outer planets more accessible in a faster, and hopefully cheaper way. Only direct missions to the planets are considered. Gravity assist, of Venus, Earth, Mars, and Jupiter, can be very effective, but they also restrict launch opportunities and make each mission, and often the spacecraft design, unique.

With the developmental expectations of inflatable power antennas, and solar electric and solar thermal propulsion systems over the next 10 years, particularly in making them lighter, faster missions will be possible. For example, the giants, Jupiter, Saturn, Uranus, and Neptune, could be reached in 1 to 5 years. This paper will present mission scenarios and discuss the impact of each new technology on Earth escape, launch vehicle requirements, flight time, arrival conditions, and mass in a parametric manner. This data can then be used to help direct new technology developments in a way that is most. beneficial to the outer planet missions of the future.

*This research performed by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration. Submitted for the Second IAA International. Conference on Low-Cost Planetary Missions to be held April 16-19, 1996 at JHU/APL.