

HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)  
Joint Session on Going To and Beyond the Earth-Moon System: Human Missions to Mars, Libration  
Points and NEO's (4-D2.8)

Author: Dr. Yang Liu

Beijing Special Engineering Design and Research Institute (BSEDI), China, liuyang\_nudt@163.com

Dr. Yuntao Tan

Beijing Special Engineering Design and Research Institute (BSEDI), China, tanyuntao01@tsinghua.org.cn

Mrs. Tingting Li

Beijing Special Engineering Design and Research Institute (BSEDI), China, beautygrace803@hotmail.com

STUDY ON TECHNICAL APPROACH FOR MANNED DEEP-SPACE EXPLORATION

**Abstract**

The development trends of the major international manned deep-space exploration programs and the manned deep-space exploration technology are analyzed, the combination mode of manned lunar spaceship and the demands of launch scale are studied, and the present status of space transportation system and its future development is analyzed. Then, based on the technology of safe and reliable near-earth orbit rendezvous lunar orbit rendezvous, this paper presents 9 kinds of technical plans for manned lunar mission, such as a direct lunar-landing launch, multi-launch of near-earth orbit rendezvous multi-launch of lunar orbit rendezvous, combination of near-earth orbit rendezvous multi-launch and lunar orbit rendezvous. Also, through a comprehensive comparison on the requirements of launching capability, launch frequency, times of rendezvous and docking, project scale, technical sophistication, development difficulty and safety reliability, the paper points out the development directions of manned deep-space exploration based on the current technologies for different countries and regions. The main conclusions of this study includes as follows: Insisting on "separation of crew and cargo," "development of new, large and heavy launch vehicles," "minimizing the launching and docking times" as the fundamental criteria for the future large-scale manned deep-space exploration; Taking full advantage of the current rockets and manned space technologies to realize the integration of unmanned lunar exploration and manned space flightlike pre-research and demonstration of key technologies for the rendezvous and docking of manned lunar landing, which will be the certain choice for the countries carrying out a manned lunar landing; Utilizing the current major 20t-class large-scale launch vehicle to perform the development of 40t or 60t grade level larger launch vehicles and break down the technologies of near-earth orbit rendezvous and lunar orbit rendezvous, which will be the feasible approach to implement the limited-size manned lunar excursion in near-term; Making a breakthrough in large-scale engine technology, developing 150t-class heavy launch vehicle, configuring new-type launch vehicles which is the only way to carry out large-scale moon exploitation, lunar base construction, and deep-space exploration.