SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems (4)

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MARS ONE YEAR MISSION CRAFT: SIZING OF "AIRBREATHING" MARS EXPLORATION VEHICLE

Abstract

Traveling to Mars with a human crew poses challenges exceeding those facing the Apollo astronauts in terms of time, equipment and threatening environment. One problem is that access to Mars/Earth windows of travel are one to three years apart, not almost daily as for Apollo. When accessible, the round trip travel time for a chemical powered spacecraft is about 990 days, including a 480 day surface stay, whereas for the nuclear powered spacecraft assumed here only 370 days, including a 41 day surface stay. The former could very well doom the human crew because of the space radiation dose absorbed during the transits. Nuclear propulsion and radiation are thus strongly connected. Earth departure and arrival is not the surface of the Earth, but rendezvous in low Earth orbit with an ISS. Before astronauts depart for the Martian surface there should be a cargo craft that precedes the astronauts with life support materials to the surface as well as reconnaissance vehicles and scientific materials that are to remain on the surface. Ballistic entry into a randomly variable, unmeasured atmosphere results in non-precise landing points. For a single vehicle an uncertainty of tens of kilometers is not critical. For a human crew, with their transportation and survival resources kilometers from their landing site, this is unacceptable since long walks are not possible in current space suit concepts. An unmanned Mars orbiter cannot determine its precise location with respect to the planet. When the crewed spacecraft arrives it is vital that they establish the orbital parameters and their location with respect to geological features. Even then experience with the Soyuz capsule demonstrates how imprecise an Earth re-entry and landing location can be. In this paper, authors propose a modest L/D maneuvering cargo glider based on the Russian "Kliper" concept to assure landing within a hundred meters of each spacecraft and a crewed glider based on the high L/D (inherently stable USAF FDL-7C/D derived glider). An exploration vehicle powered by in situ manufactured CO2 and silane is proposed and sized to explore the Martian surface much faster and efficiently than with rovers or rocket-powered 'hoppers'.