Human Exploration of the Solar System as a Precursor to Interstellar Travel: Outlook and Realities

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Abstract

Technical speculation about the possibilities of space travel began with Konstantin E. Tsiolkovsky at the beginning of the 20th century[1], building upon notions of rockets from centuries earlier[2]. Only with the Second World War and the competition in space between the U.S. and the Soviet Union during the ensuing Cold War were sufficient funds available to develop what has become known as astronautics to the point that robotic and human spacecraft became possible. To date, the culmination of the human program has been the Apollo landings on the Moon and the building and permanent habitation of the International Space Station (ISS). At the same time there has been a recurrent backdrop of the idea of humans traveling out from the solar system to the stars, with the topic developed somewhere between science[3] and science fiction[4], given the enormity of that task[5]. Nonetheless, it seems prudent to examine the realities and requirements of the "easier" problem of human travel throughout the solar system, to inform both the longer-term possibility of human travel beyond the asteroid belt, as well as the shorter-term goal of the human exploration of the Mars system[6]. While missions to Mars can be accomplished with chemical and/or nuclear thermal propulsion[7], continuous, low-thrust missions will be required to decrease flight times to acceptable durations for more distant targets[8,9]. For human flight the duration, living space, and expendables (food, water, and air) all become part of a significant trade space, which also reflects risk postures, both with respect to radiation tolerance and contingency strategies. In the absence of some type of induced, artificial hibernation (for which no near-term technologies currently exist) mission lifetimes will likely be limited to ~5 years. Provision of supplies, if not forward positioned, recycling efficiencies and reliabilities, living volume, and the target system all then drive the required mass and, hence, required propulsion[10]. Closure of the engineering design depends upon physical characteristics of the means of propulsion, bookkept as the specific mass of that system, which must include propulsion hardware, energy generation conversion and efficiency, and radiation of waste heat[11]. Implementation is highly dependent upon materials and system reliabilities, preplaced infrastructure, and the adopted form of nuclear energy for power and propulsion. Significant structural masses will be required for such missions with assembly in space or on Earth and/or with materials brought from Earth or mined at the Moon or Near-Earth Asteroids (NEAs). The approach taken also become part of the trade space[12]. None of these issues is new. What is new is now-available space technology, the role of even newer technologies, and the development and implementation costs, all of which we have real experience over the past five decades. In the absence of disruptive, implementable, propulsion technologies, we can visit the types of requirements that may then be needed for recurrent human Mars travel[13], and for initial human forays to the asteroid belt and the planets of our solar system beyond. The experiences of actual human expeditions throughout the solar system – not unlike the initial expeditions to Antarctica – will inform us of what the possibilities for *homo ad astra* might be when the coming century dawns[6].

Keywords: Interstellar Travel, Human Space Exploration, System Engineering

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The Interstellar Probe mission would be designed to cross the solar wind termination shock and heliopause and make a significant penetration into interstellar space, thereby providing the first comprehensive in situ studies of the plasma, energetic particles, cosmic rays, fields, gas, and dust in the nearby Galaxy.Â Such an exploratory mission has been evaluated on practical scientific and engineering levels since the conference on "Missions Beyond the Solar System" held at NASA's Jet Propulsion Laboratory in 1976. 1 The socalled interstellar precursor mission, or Interstellar Probe, have continued to be discussed by individual authors, [2][3][4][5][6][7] as well as identified as a scientific priority by consensus documents in the science community. Eyes on the Solar System lets you explore the planets, their moons, asteroids, comets and the spacecraft exploring them from 1950 to 2050. Ride with the Curiosity Rover as it lands on Mars or fly by Pluto with the New Horizons spacecraft all from the comfort of your home computer. Eyes on the Solar System â€º. Overview. In Depth. Exploration. Galleries. Overview In Depth Exploration Galleries. Our Solar System News. JPL's lucky peanuts are an unofficial tradition at big mission events. What Are NASA's Lucky Peanuts? Artistic representation of a solar sail accelerated by a powerful laser grid built on Earth, according to the idea proposed by the Breakthrough Starshot Initiative.Â After having deployed the solar sail again, a hydraulic system would have the task of rotating the laser 180Â°, so that the impulse this time hits the opposite side of the sail, gradually slowing down the spacecraft until canceling the acceleration impressed during the first 1.5 years of travel. An aircraft in the nose of which the Boeing YAL-1 weapon system is installed, equipped with a laser capable of delivering power in the order of MW.Â the production of scientific instruments for the exploration of the target planetary system. are entirely missing from his cost estimate. Solar Sailing to the Outer Solar System and Interstellar Travel. Get MagellanTV here: https://try.magellantv.com/launchpad and get an exclusive offer for our viewers: an extended, month-long trial, FREE. MagellanTV has the...Â Dr. Shelhamer contributed an essay to Stellaris describing the very real biomedical challenges of sending humans on long-duration missions beyond Earth orbit. (Note: He served as NASAâ€™s Chief Scientist for human research at the Johnson Space Center and knows what he's talking about!) Mark J. Shelhamer, Sc.D. - Dr. Shelhamer started at Johns Hopkins as a postdoctoral fellow in 1990. 8. Human Exploration of The Solar System as a Precursor to Interstellar Travel: Outlook and Realities. Ralph L. McNutt Jr. Johns Hopkins University.Â Declared Consensus by participants of the Foundations of Interstellar Studies Workshop on interstellar flight, 13-15 June 2017 in the City of New York. The firmest foundation for interstellar studies is a community united by a common goal, to travel to and explore space beyond the Solar System, but committed to the mastery of their individual fields and interests. We have assembled here in the great city of New York to advance the state of interstellar studies, especially in regard to the type of engines to propel our future vessels across the stars.