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“The Journey to Mars: What are the Engineering Challenges for Continued Human Space Exploration”?



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Abstract: Space exploration with both humans and robotic spacecraft is approaching a 56th year anniversary. The first launch represented a revolution in technological capability and achievement. The launch of the Sputnik satellite in 1957 by the Soviet Union was closely followed in 1958 by the launch of a satellite from the United States. At the present time, more than 3000 satellites are in earth orbit; monitoring our weather, carrying millions of communication messages, and sensing our climatic state. Five nations have designed rockets and robotic spacecraft which have escaped earth gravity to explore the Moon, Asteroids, and Mars. Equally important was the launch of the first human into earth orbit in 1961 by Russia followed quickly by the US. The US reached the Moon in 1968, and beginning in 1969, 12 Americans eventually walked on its surface. Altogether, more than 532 people from 36 countries have been launched into earth orbit from 3 nations: the USA, Russia (Kazakstan), and China. Four space stations have been built and operated, and two human rated vehicles have dominated Earth to Orbit transit: The US Space Shuttle and the Russian Soyuz. In the 21st century, we are on the threshold of venturing beyond Earth orbit again, possibly to the Moon, Mars, or even asteroids. But have we solved all the major engineering problems and is the decision just about destinations? What are the technological challenges which must be overcome to successfully operate in these extreme environments for extended periods of time? Over the last several years, the National Academies have evaluated, for NASA, exploration technologies from propulsion to life support. As chair of the human systems roadmaps review, the author was involved in the final published study in 2012. The results of this study and well as the opportunities for future research will be discussed.

Biography: **Dr. Bonnie J. Dunbar** is currently the M. D. Anderson Professor of Mechanical and Biomedical Engineering at the University of Houston, in Houston, TX. She also serves as the Director of the University’s “STEM Center” and the Director of the Aerospace Graduate Program. In her early career, Dr. Dunbar worked for Rockwell International Space Division, building Space Shuttle Columbia. She then entered NASA service. At NASA, Dunbar was a flight controller before being selected as a Mission Specialist astronaut where she became a veteran of 5 Space Shuttle flights. Dunbar has logged more than 50 days in space. She served as the Payload Commander on two flights, including the first Space Shuttle docking mission to the Russian Space Station Mir. In addition to her flight career, she held management positions and was a member of the Senior Executive Service. Her service included Associate Director, Technology Integration and Risk Management for the Space Life Sciences Directorate; Assistant JSC Director, University Research; Deputy Director, Flight Crew Operations; and NASA Headquarters Deputy Associate Administrator for the Office of Life and Microgravity Sciences and Applications (OLMSA). After retiring from NASA in 2005, she became President and CEO of The Seattle Museum of Flight, and, later, the Director of Higher Education and STEM for The Boeing Company. After leaving NASA, Dr. Dunbar consulted in aerospace and STEM education as the President of Dunbar International LLC, and is an internationally known public speaker. Dunbar holds BS and MS degrees in Ceramic Engineering from the University of Washington, and a PhD in Mechanical/Biomedical Engineering from the University of Houston. She is a member of the American Ceramic Society (Fellow), and the American Institute of Aeronautics and Astronautics (AIAA Fellow). She has been awarded the NASA Space Flight Medal 5 times, the NASA Exceptional Leadership Medal and the NASA Distinguished Service Medal. Dr. Dunbar was inducted into the Royal Society of Edinburgh, and in 2002 was elected to the US National Academy of Engineering. She holds 7 honorary doctoral degrees, and in 2013, she was selected into the Astronaut Hall of Fame.