Interplanetary Transit Simulations Using the International Space Station

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We evaluated the space life sciences utility of the International Space Station (ISS) to simulate the outbound transit portion of missions to Mars and Near Earth Asteroids (NEA) to investigate biomedical and psychological aspects of such transits, to develop and test space operation procedures compatible with communication delays and outages, and to demonstrate and validate technologies and countermeasures. Two major categories of space life sciences activities can capitalize on ISS capabilities. The first includes studies that require ISS (or a comparable facility), typically for access to prolonged weightlessness. The second includes studies that do not strictly require ISS but can exploit it to maximize their scientific return more efficiently and productively than in ground-based simulations. For these studies, ISS offers a high fidelity analog for fundamental factors on future missions, such as crew composition, mission control personnel, operational tasks and workload, real-world risk, and isolation, and can mimic the effects of distance and limited accessibility. In addition to conducting Mars- and NEA-transit simulations on 6-month ISS increments, extending the current ISS increment duration from 6 months to 9 or even 12 months will provide opportunities for enhanced and focused research relevant to long duration Mars and NEA missions. Increasing the crew duration may pose little additional risk to crewmembers beyond that currently accepted on 6-month increments, but additional medical monitoring capabilities will be required beyond those currently used for ISS operations. Finally, while presenting major logistical challenges, such a simulation followed by a post-landing simulation of Mars exploration could provide quantitative evidence of capabilities in an actual mission. Thus, the use of ISS to simulate aspects of Mars and NEA missions seems practical. If it were to be implemented without major disruption of on-going ISS activities, then planning should begin soon, in close consultation with all international partners.

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