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"ISS 2 MARS" - WHAT DOES IT TAKE TO SIMULATE A MARS FLIGHT ONBOARD THE ISS ?

Abstract

The ISS may well be operated for another 8 years or so in its current mode – as LEO home base for many scientific disciplines, medium and long-term experiments, regular resupply, facility refurbishment by astronauts with real-time ground communication and a safe return capability in case of need.

However, as we approach the technical end of the ISS lifetime and proceed towards missions beyond LEO, especially towards Near Earth Objects or even Mars, thoughts are voiced to simulate such a long term mission onboard the ISS. Preparing the ISS for a long term flight simulation to Mars or an Asteroid requires specific adaptations not only of the payload to focus the scientific research programme e.g. onto human physiology, but also of the platform's subsystems: The available power level onboard a Mars ship will certainly be much lower than on ISS, also closed water and air loops for the life support system will likely be required. Reaction times of ground controlled TM/TC becomes longer, and radiation protection of astronauts and avionics becomes a much more dominant issue. Also operations must take the new flight scenario into account – there will be no visiting crews during a Mars flight, and noticeable communication gaps and delays develop over time. However, not all of the ISS subsystems and operations necessarily need to fully resemble a spaceship flying to Mars; some functions may well be simulated or excluded from the simulation, accepting thus a lower-than-perfect fidelity of the simulation.

Whether or not a long term flight simulation on ISS is feasible or not will to a large extend depend on the extra technical effort required to adapt the ISS to such a simulation. This means in turn: in order to make such a simulation mission onboard the ISS both valuable and affordable, a "minimum change – maximum fidelity simulation" approach should be applied, which optimizes between the scientifically desirable, safety-wise acceptable, technically and financially feasible, and politically acceptable adaptation effort.

This paper discusses therefore the main elements and subsystems of the ISS in the light of the past 20 years of ISS operations and utilization, compares mission simulation objectives with current capabilities and the required adaptation efforts, and proposes a set of low risk, low effort measures to prepare the ISS for a long term simulation mission. Also specific aspects of the astronaut training as a key success element are addressed.