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Author: Mr. Sedat Izcan
University of Nottingham, United Kingdom

Ms. Marialina Tsinidis
University of Glasgow, United Kingdom
Dr. Nishanth Pushparaj
University of Nottingham, United Kingdom
Prof. Phil Williams
University of Nottingham, United Kingdom
Dr. Chantal Cappelletti
University of Nottingham, United Kingdom

TELEOPERATED ASTROPHARMACEUTICAL PAYLOAD FOR LONG-DURATION SPACE MISSIONS: PROJECT VITA!

Abstract

The VITA (Visualizing In-space Tx-Tl Astropharmaceuticals) mission is a teleoperated Astropharmaceutical cube-payload that will launch a biological experiment to the ICE Cubes Facility (ICF) on board the International Space Station (ISS) as a selected mission for ESA Academy Experiments Programme of the European Space Agency. Project VITA aims to enable on-site, on-demand production of therapeutics for long-duration human spaceflight, addressing the critical need for transportable medicines as outlined by the International Space Exploration Coordination Group (ISECG) Global Exploration Roadmap (GER). The main scientific goal is to demonstrate efficient and effective cell-free synthesis in a flexible platform. Considering the possible increase in future human spaceflight missions to Moon and Mars, the success of VITA mission will be a turning point to further satisfy the demand for medical drugs during long duration missions. Following months of preservation, the experiment intends to demonstrate the ability to rehydrate the stacks, kickstarting the synthesis of fluorescent proteins, and real-time, in situ detection through fluorescence spectroscopy and imaging.

The aim of this paper is to present the system architecture required for teleoperated Astropharmaceutical experiment cubes and CubeSats, covering merits and drawbacks of both approaches. Considering the potential large variation of temperature of in a spaceflight mission, and the critical dependence of temperature of protein stability, the report will also focus on studies carried out for active and autonomous thermal management systems. Since this will be just a first step for in-space pharmaceutical production, it will open a new broad subject and the final part will concentrate on how to further improve the project for a possible fully automated interplanetary Astropharmaceutical production platforms.

Knowing that one of the biggest challenges for human spaceflight is related to human health and reflecting the limited access to Earth, the medical challenges must be overcome, and in-situ therapeutic production shall be proved. Hence, the initial success of VITA mission will be a pioneer step to enable deep space human missions.