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BAMMSAT - A PLATFORM FOR SPACE ENVIRONMENTS STUDIES ON BIOLOGICAL SYSTEMS IN CUBESATS AND CUBESAT-LIKE PAYLOADS

Abstract

Access to space environments (primarily for exposure to space radiation and/or microgravity) to study a wide range of biological systems is often restricted by long-lead times, infrequent flight opportunities and high costs using traditional space platforms. CubeSats and similar approaches offers the possibility of reduced lead-times, more frequent flight opportunities and reduced mission costs but with compromises of reduce experiment mass, volume, power and data budgets. To date there has been a limited number of relevant CubeSat flights with bioscience payloads (GeneSat-1, PharmaSat, O/OREOS and SporeSat) and these have successfully demonstrated the potential for flying bioscience and related experiments on CubeSats.

Cranfield University together with partners have been developing the BAMMsat concept – "Bioscience, Astrobiology, Medicine and Materials Science on CubeSats". This involves a hardware design adaptable for a broad range of applications and where common features are the abilities to: (i) house multiple samples, (ii) maintain the samples in an appropriate local environment, (iii) appropriately perturb the samples and (iv) monitor the samples before, during and after perturbance.

An end-to-end BAMMsat payload breadboard, compatible with a 2U payload flight model design, has been developed with the ability to house 40 discrete samples in a microfluidic system and observe these with a miniaturised fluorescence microscope and a suite of other sensors. Among the many possible BAMMsat biological payloads ranging from micro-organisms through to mammalian cells, the first steps have been achieved in demonstrating compatibility of the breadboard with the ability to fly and study human cell cultures in space. Maturing of this demonstration will open the use of CubeSat platforms for the study of human cell biology in space and including contexts associated with increasing the understanding of issues associated with long-term exposure of humans to space environments. Especially relevant are near-future CubeSat flights beyond LEO to study the effects of the interplanetary radiation environment on biological systems.

The BAMMsat concept, breadboard development, science applications and road-mapping of future developments and flight opportunities will be described in the presentation.