Moon CubeSat Hazard Assessment (MOOCHA) – An International Earth-Moon Small Satellite Constellation and its Possibilities for Astrobiology

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Abstract

Recent developments in space exploration have reinstated the Moon as a primary target for near future space missions, The principal reasons for returning to the Moon and this time establishing a continuous presence there, include the Moon being the closest testbed and analogue for interplanetary space missions and the prospect of a scientific lunar base within the next decade. In the past, space missions have vastly improved our understanding on hazards of human spaceflights, however little is known on the magnitude of threats affecting a prospective lunar base and its instruments and crew.

The known lunar hazards to instruments and crew include radiation effects, and exposure to frequent micrometeorite impacts. The micrometeorite impact hazard has been accepted as an issue which not only will impact both the human exploration mission crew's health and safety but will additionally create long-term issues for the near-future human presence Near-Earth objects flux is determined by ground-based observations of objects large enough, typically larger than a few centimetres, as well as partly on dust and micrometeoroid flux measurements and impact flash observations on the Moon's surface[1]. Ground-based observations cannot cover polar regions, are restricted by the magnitude of the impacts, and cover roughly only half of the Moon as well as only possible with good weather conditions, and limited by atmospheric interference [1, 2].

The lunar environment has biological hazards that need thorough investigation for space travel and manned mission. These hazards can be categorized into the following main categories, radiation and microgravity. The levels of radiation on the Moon create lasting effects

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in humans and other biological organisms during long exposure durations in such environments as well impacting equipment. Microgravity has been reported to affect many aspects of biological mechanisms and behavior as the gravity will be far less than the 0.0040 g of the International Space Station (ISS)(3). For example, the ISS environment's microgravity affects the growth path and rate of microorganisms [4]. Also, it has been reported that space environment changes microorganisms to level that can make them toxic to human or dangerous for material.[5] Therefore, biological payload and instruments test in such a mission concept can provide valuable knowledge and legacy for future deep space small satellite astrobiology missions which can focus on sustainability, hazards, and long-term outer space environment exposure to organisms.

Hence, we propose a novel lunar mission concept of a constellation of microsatellites and nanosatellites – similar to the successful international QB50 project – that can both observe larger parts of cislunar and translunar space while providing scientific possibilities[6]. Microsatellite and nanosatellite missions are a cost-effective solution providing data for significant improvement of our current understanding. . In addition, the distributed constellation mission can also provide a platform to increase human capital in satellite design amongst young scientists and students worldwide.[7]

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