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深宇宙、月、火星を模擬した装置開発

Development of equipment simulating deep space, Moon and Mars

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Abstract

NASA has planned to return to the Moon by 2024 with a mission named Artemis. The mission will start building the Lunar Gateway and aims to be a trial for deeper space exploration. It will be an important step for landing humans on Mars. In deep space, exposure to space radiation increases as the mission duration increases. Space radiation with a low dose rate would be a constant risk for space travelers. In addition, it is important to promote life science research that not only simulates microgravity (μ*G*) in spaceflight environments but also partial-gravity environments (0.165*G* ≒ 1/3*G* and 0.378*G* ≒ 3/8*G*) such as those on the Moon and Mars, respectively. The combined effects of space radiation and partial gravity such as on the Moon and Mars are unknown. The difficulty for such research is there is no good simulating system on the ground to investigate these combined effects. Therefore, we developed the Simulator of the environments on the Moon and Mars with Neutron-irradiation and Gravity-change (SwiNG) for *in vitro* experiments using disposable closed cell culture chambers. The device simulates partial gravity using a centrifuge in a three-dimensional clinostat. Six samples are exposed at once to neutrons at a low dose rate (1 mGy/day) using ^{252}Cf in the center of the centrifuge. The system is compact including two SwiNG devices in the incubator, one with and one without radiation source, with a cooling function. This simulator is highly convenient for ground-based biological experiments because of limited access to spaceflight experiments. SwiNG can contribute significantly to research on the combined effects of space radiation and partial gravity.