AOGS 2006

A Performance of Alpha Ray Detector (ARD) for Mapping of Rn and Po in the Lunar Surface Onboard Japanese Lunar Mission SELENE

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Alpha Ray Detector (ARD) will be on-board SELENE, a Japanese lunar orbiter to be launched around 2006. Primary target is the alpha particles emitted by 222Rn and 210Po. It is trapped by the lunar gravity and decays with the half-life of 3.8 days emitting 5.490 MeV alpha particles. In the decay sequence of 222Rn, 210Po emits alpha particle with the energy of 5.305 MeV. Time scale of the activity is dominated by the 21-year half-life of 210Pb. Results from Apollo 15, 16, and recent Lunar Prospector mission indicate that the average amount of radon on the lunar surface is much smaller than expected, and the radon-alpha distribution suggests that radon comes out through gas emanation from fissures of the lunar surface. We developed a large-area detector of 326 cm2 for the ARD, which is 15-20 times larger than the detectors of Apollo and Lunar Prospector. Reduction of the background was achieved with the anti-coincidence by rejecting cosmic-ray tracks. It will enable (1) precise global mapping of the radioactive material on the lunar surface, (2) identification of gas emanation, (3) study of the radon gas emanation mechanism on the lunar surface and the origin of the lunar atmosphere, and (4) obtaining information on the crustal movement during the last - 50 years. The large area, low background, and long observing period will give us accurate data of high S/N and allow us detailed mapping of the alpha-particle intensity to deepen our understanding of the problems such as gas emanation mechanism and change of crustal condition on the lunar surface. We can investigate time variation of the gas emanation with the time scale between one month and one year during the mission period as well as with the time scale of years through direct comparison with the previous missions. Joint analysis with other instruments on-board SELENE will be useful. The Gamma-Ray Spectrometer will provide detailed distribution of the thorium abundance, and we can examine the correlation between the Rn/Po and Th/U distributions. Information from the Terrain Camera and the Rader Sounder will be essential to characterize the locations of gas emanation. Information on the gas emanation could be also valuable in terms of the human activities on the moon in the future. The detector fabrication is close to completion, and preflight tests and calibration activities are under way. Some of the sensors of the ARD were tested with the heavy ion beam facility HIMAC at the National Institute of Radiological Science. We confirmed that the sensor chips have expected energy resolution.