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Development of the Alpha Ray Detector (ARD) onboard the SELENE spacecraft

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Rn atoms are trapped by the moon gravity because of their heavy mass, and then will follow ballistic trajectories until they decay to the alpha particles. Upon decay, characteristic alpha particles and heavy recoil nucleid are deposited on the surface of the moon. The surface deposit is itself unstable against radioactive decay and will be a further source of characteristic alpha particles. If we make precise measurements of these characteristic alpha particles, we can make a mapping of radioactive materials as well as can make a study of the physics of lunar surface through the escape mechanism of Rn atoms from it's surface. 210Po is a daughter product of 222Rn taking after about 20 years. Comparison of the data of the alpha particles from 210Po of the lunar surface and 222Rn in the atmosphere, we can make a study of the geological time variation of the lunar surface during about 20 years of their decay life.

Apollo 15, 16 succeeded in the observation of Rn alpha in the moon atmosphere for the first time, however the absolute flux of the alpha particles were quite low than expected. The flux was less than 1/100 times of that expected if we assume the escape rate of Rn gases from the lunar surface is similar to that of the earth. In addition, they found active areas of the alpha particles, and the locations are likely coincides with the techtronical active areas of the lunar surface. This suggest that the escape of Rn atoms from the moon surface Is not diffusion process as in the case of the earth, but likely due to the out gassing mechanism from the stressed area in the lunar surface. If the escape is indeed due to the out gassing mechanism of Rn, the data give us a possibility to provide information on the location of resource investigation such as N2, O2 and CO2 vapor. This will have important meaning as the resources for the future man's activities on the surface of the moon.

Although the observations of the Rn -alpha were carried out with the detectors on Apollo 15, 16 the flux was too low to complete a precise mapping of Rn on the lunar surface. Also, we need to consider both of spatial and time variation of Rn and its daughter -alpha activities in detail, to clarify the variation of geological condition of the lunar surface, escape mechanism of Rn gas and its relation to moon quake. In order to make precise measurements for the detailed analysis of the physics of the lunar surface; we are providing a large area Alpha Particle Spectrometers (ARD) on board the SELENE mission. The specific features of ARD compared to Apollo detectors are as follows

1) The detector has large area of about 300cm2, consisted of 48 Si-detecters with each area of 2.5cmx25cm. The size is almost 30times of Apollo detectors.

2) ARD has anti-coincidence systems by using attached 2 Si-detectors. Since most of background track. In Apollo data are due to high-energy heavy primaries in cosmic rays, we can expect to reduce at least 90 % of the background track by this anti-coincidence system. S/N of observed data is improved remarkably

3) The energy resolution of ARS is 80-100keV, and thus has a capability to separate the most important neighboring line of characteristic alpha particles from the various daughter nuclei in Rn and Tn series.

4)ARD is scheduled to observe the lunar surface almost for one year, and the total effective observation time is about 1000 times of that of Apollo, and can make precise mapping of radio active materials on the lunar surface

The ARD searches for gas release events and maps of their distributions by measuring characteristic alpha practices through the decay of 222Rn, 220Tn, 210Po and other daughter nuclei. Precise mapping of the moon surface is conducted for the first time by the observation of this ARD on board the SELENE, and will provide us and to explore the new features of lunar surface and to study the physics of moon.