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# Expected performance of the Alpha Ray Detector on-board SELENE

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Alpha Ray Detector (ARD) will be on-board SELENE, a Japanese lunar mission to be launched in 2005. The main objective of the ARD is to measure the alpha rays from 222Rn as well as 210Po and make a global mapping of the radioactive materials on the moon surface. In this paper, we report expected performance of the ARD experiment. General description of the experiment including the scientific objectives is presented in an accompanying paper(Takashima et al 2002).

The field of view of the ARD is defined by the collimator in front of the Si detectors to about +-30 degrees which corresponds to 100 x 100 km2 area on the lunar surface. SELENE will have a polar orbit with the altitude of 100 km from the lunar surface. The orbital period is about 2 hours, and the field of view of the detector scans the moon surface with the velocity of about 100 km min-1. Due to the rotation of the moon, the scan track shifts orbit by orbit, where the distance of the adjacent tracks is about 35 km on the equator.

We adopted anti-coincidence method for the ARD and expect to achieve high background rejection efficiency of about 90 %. Based on this assumption, the background counting rate due to cosmic ray particles is estimated to be about 6.3x10-5 cm-2 sec-1.The planned mission period of SELENE is around the solar minimum, which contributes to the good observing condition for the ARD.

Only significant data on the alpha-ray flux from the moon so far was obtained by the Apollo 15 and 16 missions. Based on the Apollo results, we estimated the average count rate for the ARD to be about 2 counts min-1 for the alpha rays from 222Rn and 10 counts/min for the alpha rays from 210Po. The Apollo results indicated spatial variation of the flux. The peak counting rates observed by Apollo were 10 and 2 times larger than the average counting rates for 222Rn and 210Po respectively.

The nominal observing period of SELENE is one year. After one year of data accumulation, we expect average total counts of 160 and 800 in 100 km square in the lunar equator region for 222Rn and 210Po respectively. Regions with higher latitudes will have more exposure and accumulate even higher counts. Maximum exposure will be accumulated for the polar regions which is about 55 times larger exposure than the equator region.

Based on the above estimation, we carried out Monte Carlo simulations of the ARD data. We examined source configurations such as (1) two point sources with separation of 100 km, (2) a ring with the radius of 100 km. We compared mapping algorithms of (A) simple projection to the temporal center of the field of view, (B) mapping utilizing the angular response of the ARD (equivalent to image smoothing). We confirmed (a) point source of 100 counts year-1 over the uniform distribution expected from the Apollo counting rate can well be detected, (b) two point sources with separation of 100 km can well be resolved, and (c) structures like a ring (e.g. rim of a crater) with 100 km radius can be recognized .

Thus, successful performance of the ARD experiment on-board SELENE will provide us with excellent quality and quantity of data and contribute to deepen our understanding of the moon.

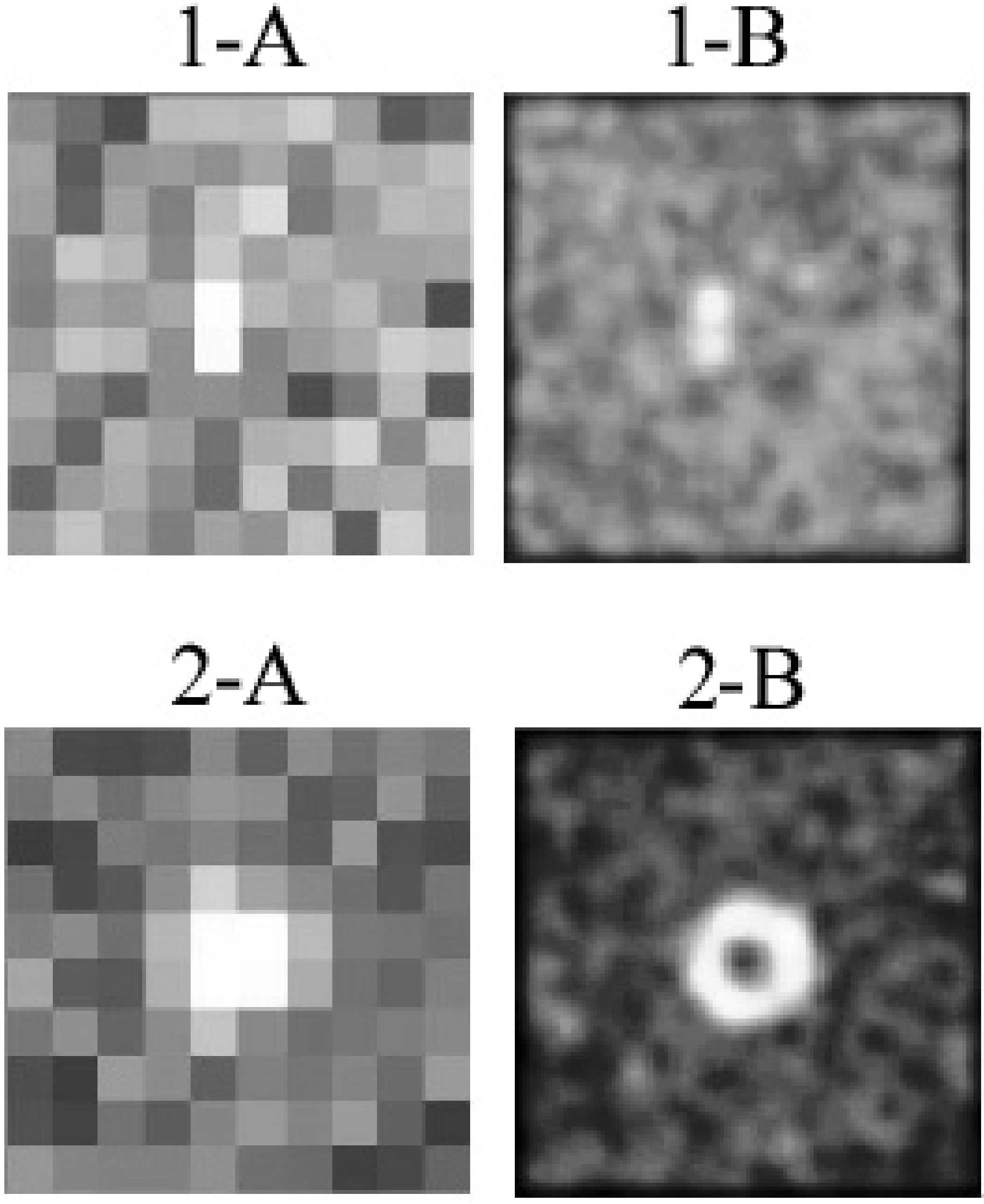


Fig.1 : The results of simulations.