

The elementary analysis by the gamma ray spectroscopy in Bepi Colombo mission

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Mercury is strangest planet in a terrestrial planet. The knowledge about this planet is based on the ground observation and Mariner10, and the information on the surface substance of Mercury is not acquired. Therefore a surface substance is investigated using the gamma ray spectroscopy in a Bepi Colombo mission.

Measurement principle

1) Principle of the gamma ray spectroscopy

A galaxy cosmic ray always collided the surface substance of heavenly bodies which don't have the atmosphere or which is almost no atmosphere, such as a planet etc. As a result of the interaction of a surface substance and a cosmic ray, a neutron and a gamma ray are generated and the part is scattered and lost from the astronomical surface. And, a natural radioactive element exists in the element which constitutes the heavenly body, and a gamma ray is emitted. Penetration power of a gamma ray is high, and the part begins to scatter and lose, and leak to space with peculiar energy held. Since such a gamma ray has energy peculiar to a surface substance, if it measures from the sky, the element information on the surface of a planet can be acquired.

2) Element which can be observed by the gamma ray

The ratio of gamma ray intensity is proportional to the composition ratio of a substance, and can acquire the information on the amount of existence simultaneously with element identification. It is thought that O, Al, Mg, Si, Fe, Ti, Na, Ca, etc. which are a main element exist in the planet surface enough, and identification is comparatively easy. And, since K, Th, U, etc. which are a natural radioactive element emit the gamma ray which collapsed according to each half-life and had peculiar energy, it can observe similarly. If water exists on the planet surface, since it will act as a moderator of the neutron generated by the cosmic ray, according to the amount of existence of water, or a depth distribution, it has big influence on flux. And, if the gamma ray of 2.223 MeV directly emitted by neutron capture of a hydrogen atom is detectable, a possibility that water exists will become very high.

3) The Ge semiconductor detector for gamma ray detection

For identifying a planet surface element quantitatively by the gamma ray spectroscopy, energy resolution and detection efficiency are important. Although Ge detector has small detection efficiency compared with a NaI(Tl) detector, the energy resolution is excellent and is 0.20% at 662keV. But at the time of operation, you have to cool it even to liquid nitrogen temperature with a freezer For identification of a sample by which many and unspecified nuclides are intermingled since the Ge detector which has high resolution is advantageous, above-mentioned elements are specified as this plan using this Ge detector

4) Neutron detection

Although neutron is not applicable to each element identification, the sensitive neutron flux is very sensitive to an element. For this reason, it is advantageous to detection of a substance with big neutron absorption cross-section, such as, Gd, Sm, etc., and a moderator such as hydrogen and carbon. And it is useful to distinction with the standard soil on the surface of Mercury, and the mafic soil which was rich in iron etc. For example, iron gamma ray measurement is based on the 7.6MeV line gamma ray of neutron capture, combination with the gamma ray spectroscopy is effective. And, if hydrogen exists in the Mercury polar region, it is detectable by measurement of a super-thermal neutron or a thermal neutron.