

The Cameras that Led Hayabusa2 to Ryugu



Image of asteroid captured by camera on Hayabusa 2

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"The orbit of a planet is an ellipse with the Sun at one of the two foci."

This statement is known as Kepler's first law of planetary motion. When Johannes Kepler (1571-1630) discovered this law, astronomical observations were performed with the naked eye. At the time, it was Tycho Brahe (1546-1601), a Danish astronomer, who was said to make the most accurate observations. After Brahe's death, Kepler inherited the observation data Brahe had gathered and used it to derive the laws of planetary motion. Science is built on a foundation of highly accurate data. The cameras mounted on Japan's asteroid explorer *Hayabusa2* were also developed by scientists who seek highly-accurate data.

The three optical navigation cameras mounted*1 on *Hayabusa2* played an important role during its 300 million km trip to land on Ryugu, an asteroid*2 with a diameter of about 900 m. In addition to being used for navigation, the cameras were also used to measure the distribution of hydrous minerals*3 and organic matter on the asteroid. By observing slight differences in the intensity of light reflected off the surface, researchers could determine whether or not minerals on Ryugu contained water.

Much trial and error went into designing the cameras to make sure that only light reflected off Ryugu would enter them by blocking light from other sources in outer space. The cameras also had to withstand the powerful forces they would be subjected to during launch, and had to be resistant to the extremely high levels of radiation in space. Furthermore, if they didn't use an appropriate adhesive*4, it could evaporate*5 and contaminate the lenses.

Professor Shingo Kameda of Rikkyo University specializes in Earth and Planetary Physics, and it was he and the graduate students in his laboratory who were able to resolve these issues and build the final version of the cameras used. Kameda studies extrasolar planets, around 4,000 of which have already been discovered. His interests lie in looking for liquid water on extrasolar planets, and in studying the origin of water on Earth. High-precision observations are required for such research, which led to Kameda's development of the cameras mounted on *Hayabusa2*.

Rikkyo University's College of Science offers a course called the "JAXA Space Science and Technology Lectures," and in 2018, it hosted lectures by the Director-General of the Institute of Space and Astronautical Science*6 and by the project manager for *Hayabusa2*. Both Kameda and JAXA believe that advanced lectures like these will inspire students to play an active role in the space industry thereby bolstering JAXA and space development in Japan.

*1 Mounted means to be attached to something.

*2 Asteroids are bodies much smaller than planets that orbit our Sun.

*3 Hydrous minerals are minerals that contain water.

*4 Adhesive is another word for glue.

*5 Evaporate means to turn into a gas. When water evaporates, it becomes steam.

*6 The research institute of the Japan Aerospace Exploration Agency (JAXA).



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惑星探査機や、宇宙望遠鏡、地上望遠鏡を使った惑星大気光の観測に取り組んできた。はやぶさ 2、火星衛星探査計画 MMX に参加して、データ解析、設計検討を進めながら、太陽系外惑星大気観測装置、月惑星着陸機搭載用元素分析器の開発に力を入れている。



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