Measurement of quantum efficiency of ultraviolet detectors for exoplanets atmospheric observation

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Many exoplanets have now been discovered, some of which are Earth-sized and likely in the habitable zone.
Russia is currently developing the World Space Observatory UV (WSO-UV), an ultraviolet telescope satellite with an aperture of 1.7 meters, to be launched in October 2025. For this project, we are developing the UV spectrograph for Exoplanets (UVSPEX), aiming to observe the atmospheres of terrestrial planets in the habitable zone around low-mass stars by transit observations.
The extreme ultraviolet (EUV) radiation received by a planet in the habitable zone of a low-mass star is much stronger than that received by the Earth from the Sun. High EUV would heat the upper atmosphere and spread it out, making it possible to detect in transit observations. However, the UV light, which is the target of this observation, is weak, so a high-sensitivity UV detector is required.
The MCP assembly, the detector used in UVSPEX, consists of three elements: a photocathode, a microchannel plate (MCP), and a phosphor screen. The light imaged on the photocathode is converted into photoelectrons. They enter each channel of the MCP and are amplified by the electric potential gradient.
The amplified electrons collide with the phosphor screen, and light is output according to their number. This allows for highly sensitive detection.
To measure the quantum efficiency of the MCP assembly, we performed two experiments: measurement of the light intensity of the light source and photon counting at the phosphor screen of the MCP assembly.
In the experiment to measure the intensity of a light source, we calibrated the sensitivity of the CCD camera using a photodiode.
In the photon counting experiment, we operate the MCP assembly, take the images of the light spot on the phosphor screen with a CMOS camera, and perform photon counting on the image. The quantum efficiency of the MCP assembly is measured from the light intensity of the light source and the photon counting results.
In this presentation, we will discuss the experimental method, results, and future works.

Keywords: exoplanets , ultraviolet detectors, quantum efficiency

