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Developement of the Schmidt correcting plate for a Far Ultraviolet Schmidt Camera

Tetsuya Nakamura[1*], Makoto Taguchi[1]

[1]Graduate School of Science,Rikkyo Univer

Variations in the ionosphere such as plasma bubbles and medium-scale traveling ionospheric disturbances have been observed by the ground-based observations. However, it is difficult to take a global image of these phenomena, because the spatial coverage of the ground-based observation is limited. A far ultraviolet imager (FUVI) is proposed to be installed in a geosynchronous satellite. It is expected that FUVI can take an image of OI 135.6nm night airglow and depict time and spatial extent of these phenomena. The intensity of OI 135.6nm airglow is proportional to the square of electron density in the F-layer, but its intensity is only 10R in the middle and high latitudes.
Therefore, an optical layout of a Schmidt camera which has high speed, wide field-of-view and spatial resolution of 100km is adopted for the FUVI optics. A Schmidt camera is free from spherical and coma aberrations. Since the Schmidt camera type has less reflector than an inverted Cassegrain type, it has an advantage in the FUV region where reflectivity is not high. In addition, because a telescope tube can be tightly sealed by a correcting plate, it is possible that inside of the telescope including a detector can be purged by nitrogen gas during ground tests and storage. A spherical surface is easily manufactured with an accuracy better than lambda/4 even in the FUV region, but manufacture of a pure Schmidt correcting plate is quite difficult especially for that can be used in the FUV region where wavelength of light is one-fourth of that of visible light. The material of the correcting plate is MgF2, and we started development of polishing process of a MgF2 plate by combination of diamond grinding and magneto-rheological finishing in order to establish technology to manufacture the FUV Schmidt camera. In the first experiment a plane surface on a MgF2 plate was manufactured by this process and its surface quality was tested. Then we tried to make a spherical surface with the same process as the plane surface. It is confirmed that the required surface quality was achieved by the magneto-rheological finishing but deteriorated by repeating the finishing process. In the last experiment a spherical surface was manufactured by high-accuracy grinding. The surface was as smooth as one by the magneto-rheological finishing.
The correcting plate has an aspheric surface. It is especially difficult to polish the steep slope and the deep sag of the surface. Then we are fabricating a collecting plate of 60 mm diameter which has the same slope and sag as the correcting plate of proposed FUVI and a null lens system for evaluation of the correcting plate using an optical design software. The null lens system will be combined with the correcting plate, and keeps a parallel ray in the visible region that passes the correcting plate and the null lens system as a parallel ray that can be evaluated by an interferometer. We adjusted the surface of the null lens to standard type. Then the allowed tolerance was estimated by calculating the influence of manufacturing error upon optical performance. This enables us to judge the allowance of the tolerance.
The results will be presented.

Keywords: ionosphere, Schmidt Camera, plasma bubbles,
medium-scale traveling ionospheric disturbances