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Abstract

Characterization of telescope lenses using physical optics and selection of the optimal physical parameters of a reflecting telescope's optical units were done to improve the design, cost-efficiency, and quality of the 64-cm telescope (named Oof) housed at the National Institute of Physics. Characterization has been done through numerical modeling of the point spread function (PSF) in Python. The PSF code was based on the method of getting wave vectors by Richards and Wolf. The optimal PSF was established to be the PSF of a large monolithic mirror. The PSF of a single optical lens was compared to its counterpart segmented lenses. Through the comparison of maximum intensity, the normalized mean square error (NMSE) and the Linfoot's criteria of correlation quality, fidelity, and relative structural content, the study has produced results which proved that highly segmented optical components produce results with less quality compared to less-segmented optical components. It was found that as the segmentation increases, the maximum intensity decreases. Higher values of maximum intensity denote higher light gathering power. The normalized mean square error of the set-ups having one to seven layers had values greater than zero but less than one. This denotes that the PSF of those set-ups are near the PSF of the optimal set-up. Higher values of correlation quality, fidelity, and relative structural content denote higher correlation, higher signal to noise ratio, higher closeness of correspondence between the optimal set-up and the segmented set-up. The number and the size of the optical components of the segmented mirror were manipulated in order to achieve a negligible difference between that of the optimal PSF and the PSF of a segmented mirror. The equivalent single lens radius in terms of maximum intensity of the current set-up of the telescope was determined to be 234.25 mm.

If the optimal PSF is achieved, the physical parameters of the optical components generated may be applied to the optical components of the 64-cm telescope. The design that resulted from the study could be used in the future construction of a wide-aperture telescope, which could aid in the acquisition of knowledge about heavenly bodies.

評語

This project studies the possibility of using segmented mirrors to synthesize a mirror of much larger size.

This is an important technology for modern astrophysics and is worthy further studies.