Assessing and improving the TMT LGSF optical performance with thermal CFD modeling

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Abstract

In order to maximize the laser guide star adaptive optics system's performance, the laser launch system needs to minimize the projected spot size at the sodium layer by both minimizing the output laser beam wavefront error and focusing the beam correctly in the sky. However, with the continuously changing thermal environment, including radiation cooling and intermittent laser heating of the lenses, it is not trivial to achieve the two goals. We have recently carried out unsteady thermal computational fluid dynamics (CFD) modeling of the laser guide star facility (LGSF) for TMT to assess its thermal behavior. The temperature distribution of the lenses and lens mounts are fed into the Code V optical design software to assess the induced focus and wavefront error, while the temperature gradient of the air is used to determine the beam jitter and tube seeing. The optical baffle length, thermal resistance between the lenses and lens mounts, as well as dry air flushing, have been treated as parameters and optimized as a result. In this paper, we will present the findings.

Keywords: laser guide star facility, thermal seeing, spot size, cfd

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