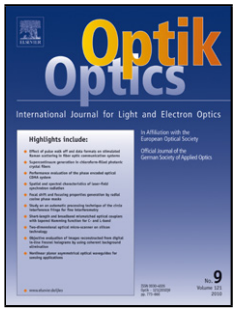

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A comparative study of the thermal performance of primary mirror at the four typical sites

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Abstract.

We propose a heat dissipation model to assess whether the material and thickness of the primary mirror of a telescope design exceed the upper constraint of the requirement in terms of the four typical sites: Dome A of Antarctica, Ali of Tibet, Mauna Kea of Hawaii and Chajnantor of Chile. It accounts for thermal conduction, heat convection, and radiation heat transfer whose effective sky temperature depends on the ambient air temperature, vapor pressure, and relative humidity. In addition, the values of the heat convection coefficient, sharply decreasing due to the low atmospheric pressure, are considered. We apply the model to analyze the thermal performance of a 2.5 m primary mirror of a wide field survey telescope (WFST). Under the conditions of the four typical sites in the world, a comparative study of WFST for two thicknesses of the primary mirror is presented via steady thermal analysis and transient thermal analysis using the proposed model. The results reveal that all RMS errors on the mirror surface of primary mirrors are smaller than 5 nm, which fulfill the performance requirements of WFST, and demonstrate that the proposed model is useful for evaluating the heat dissipation of the primary mirror on those sites.