
Giant Magellan Telescope Adaptive Optics Overview

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¹Giant Magellan Telescope – United States

Abstract

The 25.4 m diameter Giant Magellan Telescope will have four first-generation observing modes: Natural seeing, ground-layer AO, natural guide star AO, and laser tomography AO. These control modes are enabled by a suite of wavefront sensors and metrology systems that provide feedback to a segmented active primary mirror and a segmented adaptive secondary mirror.

A telescope-wide laser metrology system enables rapid optical alignment. The telescope Acquisition, Guiding, and Wavefront Sensing Subsystem provides all necessary wavefront sensing for the natural seeing and GLAO observing modes, and controls field-dependent aberrations in the diffraction-limited modes. Natural and laser guide star wavefront sensors deployed with each diffraction-limited instrument sense atmospheric and telescope wavefront errors. Together with the 4725-actuator adaptive secondary mirror, these sensors will deliver high contrast in the visible and near-infrared when using bright natural guide stars, and diffraction-limited image quality in the near-infrared over 80% of the sky.

There have been several changes made to the GMT AO design since the last conference. The Natural Guide Star Wavefront Sensor now incorporates both a pyramid wavefront sensor for high-order control and a Holographic Dispersed Fringe Sensor to increase the segment phasing dynamic range. The On-Instrument Wavefront Sensors of the GMTNIRS and GMTIFS instruments have been further developed and now include real-time phase retrieval to sense segment piston errors at high frame rate. The design of the GMagAO-X high-contrast instrument has advanced, and it will be deployed in the first generation of GMT instrumentation. We are developing laboratory optical testbeds and prototype wavefront sensors to validate active optics and AO algorithms. We are also fabricating the first off-axis adaptive secondary mirror segment to retire fabrication risk and verify its performance. We will report our progress and recent results in all these areas.

Keywords: GMT, segment phasing, wavefront sensing, deformable mirror, high contrast

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