

7.5 Introduction AO Diagnostics Subsystem Functional Requirements

The AO diagnostic subsystem is a compilation of several subsystems of the NGAO system. The diagnostics system includes subsystems that perform the following functions: alignment, calibration, diagnostics, metrology, PSF monitoring, and atmospheric turbulence measurement. These tools are needed to support routine alignment and calibration and to provide the required routine metrology and diagnostics. .

7.5.1 Architectural Assumptions and Overall Requirements

The following are architectural assumptions about the diagnostics included with the AO system:

Radiometric calibration source:

A radiometric calibration source will be provided for radiometric calibration of the various instruments in NGAO. Ideally, one source would be provided for calibration of all instruments, alternatively separate calibration sources could be installed in each instrument separately. The light output from these sources will be spatial and temporally stable. Additionally, these sources will produce light consistent with the optical passband of the instruments they are intended to calibrate.

Source and atmospheric simulator:

A LGS and NGS point source simulator will be provided at the telescope focus (input of first optical relay in NGAO Cascaded Relay design). The simulator will be able to simulate both infinite conjugate sources (NGS) and finite conjugate sources (LGS). In addition, the simulator will include provisions for the simulation of atmospheric turbulence. At least two distinct atmospheric phase screens should be simulated: a ground altitude layer and a higher altitude layer at 10km.

Atmospheric profiler:

A monitor for atmospheric turbulence will be part of the NGAO system. The monitor should be mounted as close as possible to the telescope hosting the NGAO system. The atmospheric profile will use optical measurements of natural stars to infer the turbulence distribution with height over the telescope.

PSF monitoring camera:

The main NGAO optical relay will include an interface to a camera for recording images of natural sources that have been corrected by the AO system. This camera will provide point spread function for calibration of scientific data for systematic errors in the NGAO performance, Strehl variations, and angular anisoplanatism, etc.

Metrology:

The NGAO system will provide a metrology system as needed to ensure the scientific image or spectrum is not degraded by mechanical drift, image rotator errors, or residual vibrations.

7.5.2 Optical Requirements

These requirements are TBD.

7.5.3 Mechanical Requirements

Mechanical requirements are TBD.

7.5.4 Electronic/Electrical Requirements

These requirements are TBD.

7.5.5 Safety Requirements

These requirements are TBD.

7.5.6 Software Requirements

Software requirements are TBD. (See interface section 7.5.7)

7.5.7 Interface Requirements

Radiometric calibration source:

The radiometric sources will be controlled by an interface to AO non real-time control software. The science instrument's control software will also be able to control these sources whether directly or through an interface to the AO non real-time control software is TBD.

Source and atmospheric simulator:

The sources and atmospheric simulator will be controlled by an interface to AO non real-time control software.

Atmospheric profiler:

The atmospheric turbulence monitor will interface to the AO non real-time software. The AO non real-time software will be able to report the pointing of the telescope to the profiler and request that it use the most appropriate (nearby) star. The AO control

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software will relay the profile data to the AO real-time control system (RTC) to assist in tomographic estimation. The AO software will also relay the profile information to the observatory data archive for use in AO PSF estimation.

PSF monitoring camera:

The PSF camera will be controlled by the AO non real-time control software. PSF images will be relayed to the observatory data archive for use in AO PSF estimation and calibration of scientific data.

Metrology:

The metrology system will be interfaced to the AO real-time control system, the AO non real-time control system, and the science instrument's control system.

7.5.8 Reliability Requirements

Downtime:

The diagnostic system shall be designed to minimize downtime.

Operational readiness:

The diagnostics systems shall be designed for operation on a TBD basis. The system shall be designed to be deployed at night with TBD hours of preparation for setup and calibration, so that it can support both classical and semi queue scheduled modes.

Setup and preparation times:

Daytime prep time is TBD.

Nighttime setup time is TBD.

Object setup time is TBD.

7.5.9 Spares Requirements

TBD pending results of a failure analysis of system.

7.5.10 Service and Maintenance Requirement

TBD pending results of a failure analysis of system.

7.5.11 Documentation

Standard documentation provided including:

Mechanical drawings

Electrical schematics

Optical design prescription

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