
Design and prototyping of HARMONI's light-injection module for AO calibrations

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Abstract

HARMONI is the first light visible and near-IR integral field spectrograph for the ELT. It covers a large spectral range from 450 nm to 2450 nm and can operate in two Adaptive Optics modes - SCAO (including a High Contrast capability) and LTAO - or with NoAO. The project is preparing for Final Design Reviews.

The Adaptive Optics Calibration Unit (AOCU) of HARMONI is comprised of a set of on-axis sources (covering 0.5-2.4 μm) with a deformable mirror (CalDM) to control the wavefront. It will deploy into the instrument focal plane to inject calibration light into the rest of the system. The AOCU includes six diffraction-limited sources and a resolved source, emitted by seven LED sources hosted in the electronics cabinet. To deliver this light to the rest of the system (located tens of metres away), the LED sources are coupled into multimode (MM) optical fibres which are routed through the instrument. MM fibre optic couplers are used to split the light for monitoring and for combining several light sources together. Finally, MM fibres are butt-coupled into single-mode fibres. Because of the wide range of wavelengths that need to be coupled into a single SM fibre (effectively between 600-1800 nm), we use endlessly single-mode optical fibres. This arrangement leads to large attenuations but provides huge design flexibility.

In this paper, we present the design of the AOCU, focusing on the light-injection module. We present theoretical photometric budget and evaluate experimental performance in the laboratory. We show that despite large attenuations ranging from 102-107, the scheme delivers the required beam quality (flux, geometry). Owing to the good performance and high level of flexibility of this scheme it will be used for the AOCU and is being replicated for several internal light-sources of HARMONI.

Keywords: ELT, HARMONI, Adaptive optics, calibration source, optical fibres

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