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THE CURVATURE WAVEFRONT SENSOR OF THE GUIELOA ADAPTIVE OPTICS SYSTEM

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We describe the fabrication of the 19 element lens array of the curvature wavefront sensor of Guieloa, an adaptive optics system for the 2.1-meter telescope of the Observatorio Astronómico Nacional on Sierra San Pedro Mártir. Our scheme could be scaled up to sensors with several tens of elements.

Guieloa is an adaptive optics system for the 2.1-meter telescope of the Observatorio Astronómico Nacional on Sierra San Pedro Mártir. The contribution by Watson et al. in this volume describes Guieloa in detail. The curvature wavefront sensor produces alternating intra-focal and extra-focal images of the pupil on a 19-element lens array. The light falling on each element is fed to an avalanche photodiode (APD). The alternating signal contains information on the wavefront curvature and edge gradients in the pupil, and this is used to drive the correction system.

The lens array consists of 19 BK7 planoconvex lenses cemented on a SF6 cylinder. The lenses were polished at the Centro de Investigaciones en Optica in Len, Mxico, and were cut in the Instituto de Astronomía using specially-designed grinding tools. The final assembly acts as 19 doublet lenses arranged in a three-ring symmetrical polar array (Figure 1).

The 19 foci of the lens array are close to the rear surface of the SF6 cylinder. These foci have to be precisely mated to optical fibers that lead to the APDs. We measured the locations of the foci, and machined a “cookie” in Macor ceramic at CIDESI. Holes in the cookie are aligned with the foci and then the fibers are inserted. We estimate that the fibers are centered on the foci with an accuracy of about 35 μm. The fiber ferrules were adapted from standard fiber coupler ferrules to allow denser packing. The lens array, the cookie, and the fiber ferrules have very similar coefficients of thermal expansion. The space between the lens array and the cookie is sealed with an O-ring and can be filled with optical gel.

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A mechanical mount holds the cookie in position on the lens array and secures the fibers (Figure 2). The mount is machined on 304 stainless steel which has a coefficient of thermal expansion similar to that of Macor. The mount provides a place for filters to protect the APDs during laboratory testing.

We believe that our scheme could be scaled up to wavefront sensors with several tens of elements.

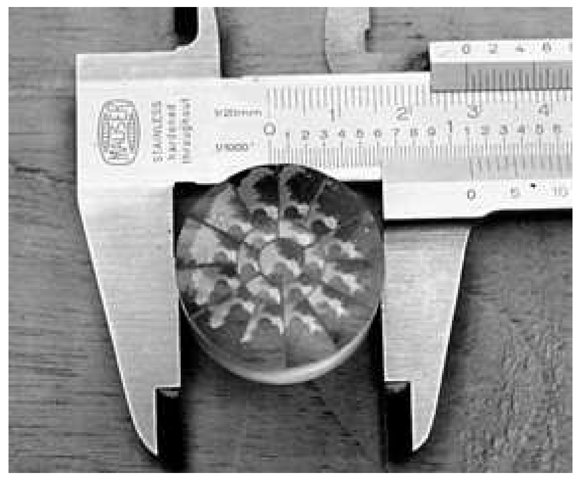

Fig. 1. The lens array. The outer diameter is 28 mm.

Fig. 2. The completed lens array in its mounting, coupled to the optical fibers.