RevMexAA (Serie de Conferencias), **28**, 67–68 (2007)

THE COMMISSIONING INSTRUMENT FOR THE GTC: MADE IN MEXICO

S. Cuevas,[1] B. Sánchez,[1] V. Bringas,[2] C. Espejo,[1] R. Flores,[1] O. Chapa,[1] G. Lara,[1] A. Chavoya,[2] G. Anguiano,[2] S. Arciniega,[2] A. Dorantes,[2] J. L. González,[2] J. M. Montoya,[2] R. Toral,[2] H. Hernández,[2] R. Nava[2] N. Devaney,[3] J. Castro,[3] and L. Cavaller[3]

The Gran Telescopio Canarias (GTC) is a 10.4-meter segmented telescope currently being built at the Observatorio del Roque de los Muchachos in La Palma, Spain (Alvarez & Rodríguez-Espinosa 2004). The GTC is a partnership between Spain, Mexico and the University of Florida. The Commissioning Instrument (CI) is the first instrument for the GTC. The CI is an optical instrument for imaging, pupil imaging, curvature wavefront sensing, and high-resolution Shack-Hartmann wavefront sensing. Neutral density and *BVRI* filters can be used in each mode. The CI is designed to verify the optical quality of the telescope, both at the level of individual segments and as a whole, and thereby aid the GTC in achieving its goal of excellent image quality. In particular, it is able to measure relative piston and tilt between primary mirror segments. The CI can also be used to measure stray light.

1. OPERATION

In imaging mode the CI is a focal reducer with different pupil stops. This mode is used for target acquisition, and so has a large field of view of $1' \times 1'$ as the GTC will initially work with an uncalibrated pointing model (Castro et al. 1998).

Stray light in the visible spectral region can be identified and quantified by using the imaging mode with selectable pupil stops or by using the pupil imaging mode.

The CI will verify the co-phasing of the primary mirror segments and determine and diagnose the overall optical quality of the telescope using curvature and high-resolution Shack-Hartmann wavefront sensing. Both of these methods have been used in the active optics systems on 4-meter and 8-meter class telescopes (Wilson, Franza, & Noethe 1987; Roddier & Roddier 1993). The relative piston between segments is of particular interest. This can be estimated by measuring the PSF of Shack-Hartmann lenslets placed at the image of the segment interfaces. This technique is the core of the Chanan et al. (1998) algorithm used for co-phasing the segments of the Keck telescope. A modified version of the Chanan technique will be used at the GTC (Bello, Devaney, & Castro 2000; Schumacher, Devaney, & Montoya 2002). The relative piston and tilt of each segment can also be estimated from the curvature signal using the method described by Cuevas et al. (2000).

Once the GTC commissioning phase is over, the CI could be permanently mounted at the folded Cassegrain focus for either scientific imaging or for tuning up the telescope active optics system. The CI would be an optical test bed on a real segmented telescope, and as such would be extremely useful for testing co-phasing methods and algorithms for future extremely large telescopes (Cuevas et al. 2003).

2. DEVELOPMENT AND STATUS

The Commissioning Instrument was developed by the Departmento de Instrumentacin of the Instituto de Astronomía at the UNAM in México City and by the Centro de Ingeniería y Desarrollo Industrial (CIDESI) in Querétaro under a contract with the GRANTECAN S.A. Some optical components were manufactured at the Centro de Investigaciones en Óptica (CIO) in León. The larger mechanical components were manufactured in Morelia. Other parts were fabricated by small companies in the Querétaro area and in México City. The CI has been delivered to GTC and it passed the acceptance tests in March 2004.

REFERENCES

Alvarez, P., & Rodrguez-Espinosa, J. M. 2004, Proc. SPIE, 5489, 583

Bello, C. D., Devaney, N., & Castro, J. 2000, RevMexAA, 36, 57

Castro, J., Bello, D., Jochum, L., & Devaney, N. 1998, Proc. SPIE, 3352, 386

[1]Instituto de Astronomía, Universidad Nacional Autónoma de México, Apartado Postal 70-264 Ciudad Universitaria, 04510 México, D.F., México (chavoc@astroscu.unam.mx).

[2]Centro de Ingeniería y Desarollo Industrial, Querétaro, México.

[3]GRANTECAN, La Laguna, Tenerife, Spain.

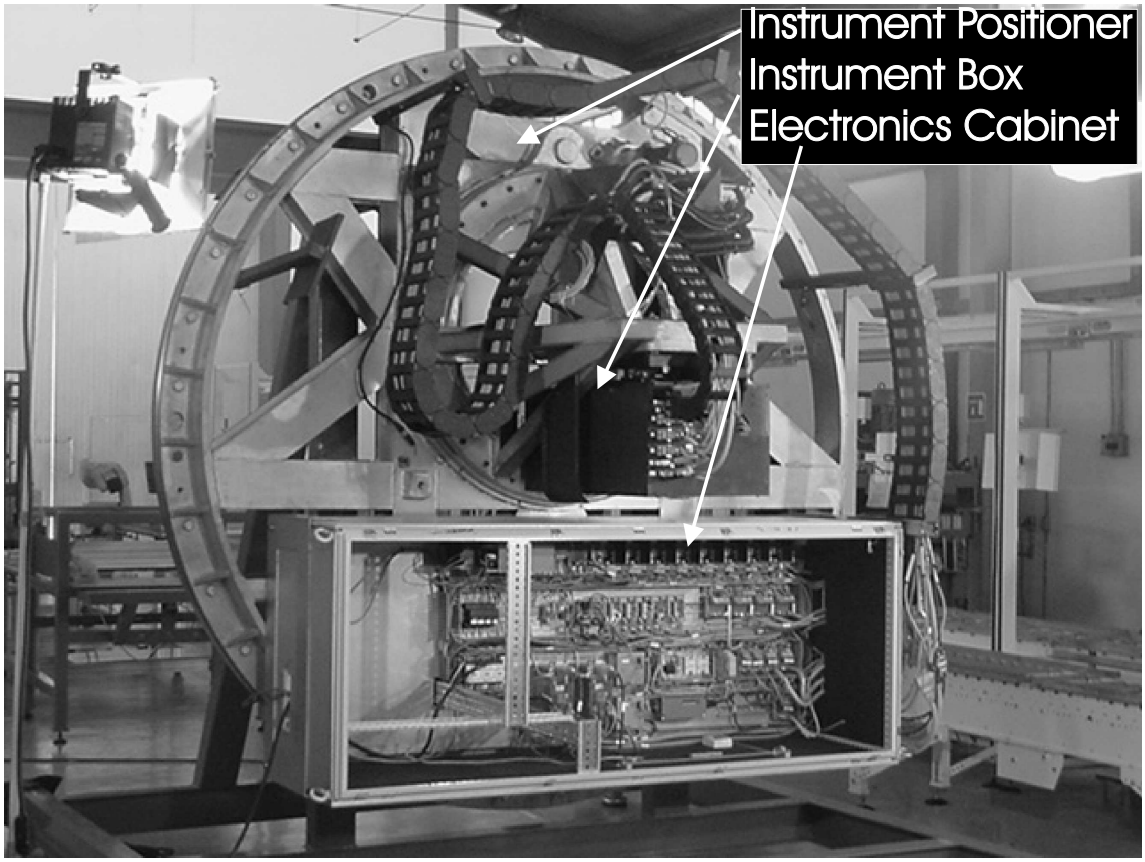

Fig. 1. The Commissioning Instrument. The instrument positioner places the instrument box inside a 20′diameter field. The instrument box contains the optics and mechanisms for the four operating modes. Note the electronics cabinet and the cable wrap from the positioner to the instrument box.

Chanan, G., et al. 1998, Appl. Opt., 37, 140
Cuevas, S., Orlov, V., Garfias, F., Voitsekhovich, V. V., & Sánchez, L., 2000, Proc. SPIE, 4003, 291
Cuevas, S., et al. 2003, Proc. SPIE 4840, 517
Roddier, C., & Roddier, F. 1993, J. Opt. Soc. Am. A, 10, 2278
Schumacher, A., Devaney, N., & Montoya, L. M. 2002, Appl. Opt., 41, 1297
Wilson, R., Franza, F., & Noethe, L. 1987, J. Mod. Opt., 34, 453