

MEMORANDUM OF UNDERSTANDING

BETWEEN

DEPARTAMENTO DE ASTRONOMIA

UNIVERSIDAD DE CHILE

AND

TMT OBSERVATORY CORPORATION

Establishment of An Adaptive Optics Testbed at Observatorio de Cerro Calán, Chile

In Santiago, Chile, on 8 December 2009, between the Department of Astronomy at Universidad de Chile, represented by its Director Dr. Mario Hamuy, and the TMT Observatory Corporation, hereinafter "TMT", represented by the Project Manager of the Thirty Meter Telescope, Dr. Gary H. Sanders.

Whereas:

1. The Thirty Meter Telescope consists of a large diffraction limited aperture telescope capable of high-resolution spectroscopy and imaging in the optical, near and mid infrared bands.
2. TMT plans to achieve the diffraction limited aperture by means of using state-of-the-art Laser Guide Star (LGS) Wavefront Sensor (WFS) correction system. This is the Narrow Field Infrared Adaptive Optics System (NFIRAOS). NFIRAOS consist of a Multi_Conjugate Adaptive Optics (MCAO) solution that includes two deformable mirrors (DM), uses six Laser Guide Stars and three tip/tilt infrared Natural Guide Stars (NGS) wavefront sensors.
3. In order to assure the high performance required for the wavefront correction, TMT needs to test various optical devices that are being considered to be included in the optical path of NFIRAOS, including deformable mirrors.
4. The Department of Astronomy of Universidad de Chile, located at Cerro Calán Observatory, is a leading research institute in the field of astronomy in Chile. Its research covers the optical, near to far infrared and sub-millimeter through microwave spectral bands.
5. The Department of Astronomy of Universidad de Chile has among its priorities that of developing technology for application in astronomical facilities, and among the current projects has undertaken the mission to participate in the design and construction of the Band 1 and Band 5 receiver system for a large radio astronomy project currently under construction in Chile.
6. Universidad de Chile and TMT entered into the agreement of scientific cooperation in the field of astronomy dated in Santiago (Chile) on June 14th, 2007.
7. The Department of Astronomy at Universidad de Chile has expressed to TMT its motivation to develop an Adaptive Optics Testbed in Chile to help in the testing and support of Adaptive Optics components and systems for large aperture telescopes.

8. In view of the clear synergy and correspondence between the interests of TMT and that of the Department of Astronomy of Universidad de Chile evidenced in the precedent points the parties agree to collaborate in establishing an Adaptive Optics Testbed at the Observatorio Cerro Calán as follows.

Contributions and responsibilities:

First: Scope of works.

The works to be performed for TMT at the Adaptive Optics Testbed, as well as the description of the tests, reports and communication channels, are covered in detail in the Statement of Work (SOW) Document that is attached hereto as an integral part of this MOU. TMT doesn't impose a clause of exclusivity on the Adaptive Optics Testbed at the Observatorio Cerro Calán.

Second: Material contributions

By means of this MOU, the Department of Astronomy at Universidad de Chile and the TMT Observatory Corporation agree to perform the following material contributions:

On the side of the Department of Astronomy at Universidad de Chile

- i) Contributes with the appointment and salary for a Postdoc, Dr. Dani Guzman, with a Ph.D. in the field of Adaptive Optics. The Department of Astronomy at Universidad de Chile will cover the salary of Dr. Guzman in the first stage of this agreement for up to 2 years.
- ii) Contributes with the physical infrastructure for the Adaptive Optics Testbed. This consists of a total available surface area of approximately 47 m² for the laboratory space divided in six sections.
- iii) The section of the building dedicated to the adaptive optics testbed will be equipped with an air conditioning system.
- iv) Contributes with the funds needed for the refurbishing and basic office furniture needed for the Adaptive Optics laboratory space.
- v) The lab space is provided with all the necessary utilities including: water supply, electrical distribution, telephone and Ethernet connection points.

On the side of the TMT Observatory Corporation: This will contribute with all the necessary equipment needed to equip the Adaptive Optics Testbed to fulfill its mission as defined in the Statement of Work document; this includes the following equipment:

- i) Optical Metrology Instrument: A high-resolution interferometer or similar equipment, as described in appendix A of the SOW
- ii) Optical bench with active support legs for vibration isolation, including the air compressor needed for the air legs.
- iii) Funding for the construction/purchase of an Environmental Chamber needed to conduct specific tests at controlled environmental conditions, accessories included.
- iv) Clear air tent to help maintain a relatively high clean air environment around the optical setups of the Adaptive Optics Testbed.
- v) Two computers for the control intended one for instrument control and another for data analysis as well as digital storage media.

- vi) Various optical components that are needed for the mounting of the various optical devices (lenses, mirrors, lenslet arrays, etc...) as well as for routing of the optical path and a basic set of tools needed in the setup of all the optical systems.
- vii) TMT will also supply videoconference equipment to be installed in the Adaptive Optics Laboratory space for easy communications and attending meetings as well as to discuss tests and results.
- viii) TMT will also provide reasonable funding for an annual international trip for Dr. Dani Guzman to visit the TMT headquarters in Pasadena (CA) or any other site in the interest of this collaboration.

The amount of the contributions by the TMT Observatory Corporation listed above to fulfill its responsibilities as part of this collaboration are in the order of One Hundred and Eighty Thousands US dollars.

Third: On the reports of the progress of the work subject of this MOU

A comprehensive list of tests to be developed on behalf of TMT at the Adaptive Optics Testbed at Observatorio Cerro Calán, as well as the frequency and level of reports has been included in the SOW that is integral part of this MOU.

Fourth: Concerning the intellectual property rights for publications and of technical products of the Adaptive Optics Testbed in association with the TMT Observatory Corporation

TMT operates under the rules of 'fundamental research' meaning that, with the exception of proprietary supplier data, all of the intellectual property it generates is public. Any publications arising from the use of the Adaptive Optics Testbed and on results of measurements and/or concepts directly associated with the TMT project should be done only considering the opinion and with the consent of Dr. Brent Ellerbroeck, TMT's Adaptive Optics Group Leader. Publications also shall consider the standard format and acknowledgment practices that are standard for the TMT project.

Fifth: On the duration of the current MOU and on the donation of equipment supplied by TMT

This memorandum of understanding formalizes the collaboration between the Department of Astronomy at Universidad de Chile and TMT for a period of two years at the end of which the possibilities to extend the collaboration could be reviewed by the parties involved. In a first stage the optical equipment contributed by TMT will be imported to Chile under the regime of temporary admission for a period of time of one year at the end of which TMT would consider the possibility to donate all the instruments to Universidad de Chile for its permanent use at the Adaptive Optics Testbed of Cerro Calan Observatory.

Sixth: Points of contact

The contact personnel responsible for the operations and the technical outcome of the collaboration subject of this MOU are the following persons:

On the side of TMT: Dr. Brent Ellerbroeck, Instrumentation Department Head

On the side of the Adaptive Optics Testbed: Ph.D (c) Dani Guzman

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The signatories agree to bring this MOU to the attention of their respective governing bodies and take all necessary steps to facilitate its favorable conclusion.



Dr. Mario Hamuy
Director of Astronomy Department
Universidad de Chile



Digitally signed by Gary H
Sanders
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Dr. Gary H. Sanders
TMT Project Manager
Thirty Meter Telescope Observatory Corp.