

EXPLORING THE UNIVERSE, FROM GALAXY FORMATION TO EARTH-LIKE PLANETS, WITH THE GIANT MAGELLAN TELESCOPE

João Evangelista Steiner

Institute of Astronomy, Geophysics and Atmospheric Science / University of São Paulo (USP)

FAPESP Process 2011/51680-6 | Term: Dec 2014 to Nov 2024

Large telescopes are necessary to study objects of low surface brightness and large distances as well as of high spatial and spectral resolution. As our understanding of the Universe advances, we realize that essential facts are not accessible even with our largest telescopes. Among the scientific goals of the GMT project, we can mention:

- Characterize habitable exoplanets. Such systems have low mass – this requires high spatial resolution, high signal/noise and very high stability. Spectral signatures of water and free oxygen are of fundamental importance.
- Solve the enigma of dark energy and dark matter, are among the most important and demanding scientific mysteries of current times.
- Observe light of the first stars and galaxy formation
- Study galaxy assembly since the Big Bang.
- Study how massive black hole formed and evolved and how they co-evolve with galaxies.
- Study how stars and planets are formed.
- Discover and study hundreds of objects in the Kuiper Belt.

1 – Mirror casting, figuring and polishing

In a telescope construction, casting and polishing the mirror is always in the critical path. When in full operation, the GMT will have 7 mirrors (one additional for coating). Each of them will have 8.4 m in diameter. Polishing the off-axis mirrors to specified shape was initially the greatest challenge for the project. This goal has been achieved, with a figure of merit of 17 nanometers rms versus 19 specified for M1. Additional mirrors were casted: M2, M3 and M4 are in distinct figuring stages for final polishing.

All this effort has been done in the Richard F. Caris Mirror Lab of the University of Arizona.

2 – Mount procurement

On February 24, 2017, the GMTO has released a Request for Proposals (RFP) for the final (fabrication) design and construction of the telescope's main structure ('the telescope mount'). This is a major step that, together with the primary mirror will make the heart of the telescope. This process is planned to be made in three steps:

- Selection of two primary contractor candidates (3 months).
- Selection of the best cost/benefit design (6 months).
- Final contract for fabrication.

3 – Project leadership

The leadership of the GMT has been changed in the last year. The current Chair of the Board of directors is Dr. Walter Massey (University of Chicago). Among many important positions, Dr. Massey was President of the National Science Foundation – NSF.

In February 2017 GMTO hired a new President: Dr. Robert Shelton. Among other positions, he was former president of the University of Arizona.

4 – GMT Brazil Office

In order to organize the activities of the GMT efforts in São Paulo, we organized the GMT Brazil Office. This office has the organogram bellow.

The goals of the GMTBr office are:

- Organize the GMT instrumentation activities
- G-CLEF: This is the first light instrument and will focus high resolution and high stability spectroscopy; one of the main goals is to characterize habitable planets.

We are involved in developing an adaptive optics module for this instrument. The basic experiment is in operation in the optical laboratory at IAG/USP. Constructing the structure with composite materials is also in our plan.

GMACS: This is also one of the primary spectrographs for the GMT. We are organizing the system engineering team for this instrument. The optical design is also carried out by our team.

- A significant effort has been made in supporting and developing the instrumentation laboratories at IAG/USP. These laboratories will be inaugurated in March/2017.
- Coordinate the participation of São Paulo industries in the instrumentation and telescope construction. Many workshops and industry days have already been held in São Paulo and São José dos Campos with this purpose.

5 – Ground-breaking

On November 11, 2015 a ceremony was held in Cerro Las Campanas for the groundbreaking of the GMT telescope. The President of Chile Michelle Bachelet attended the ceremony as well as representatives of all partners.

6 – On-site development

The site was flattened for construction. Two towers for wind and seeing testing were erected. The initial facility construction started with a building for housing the on-site workers.

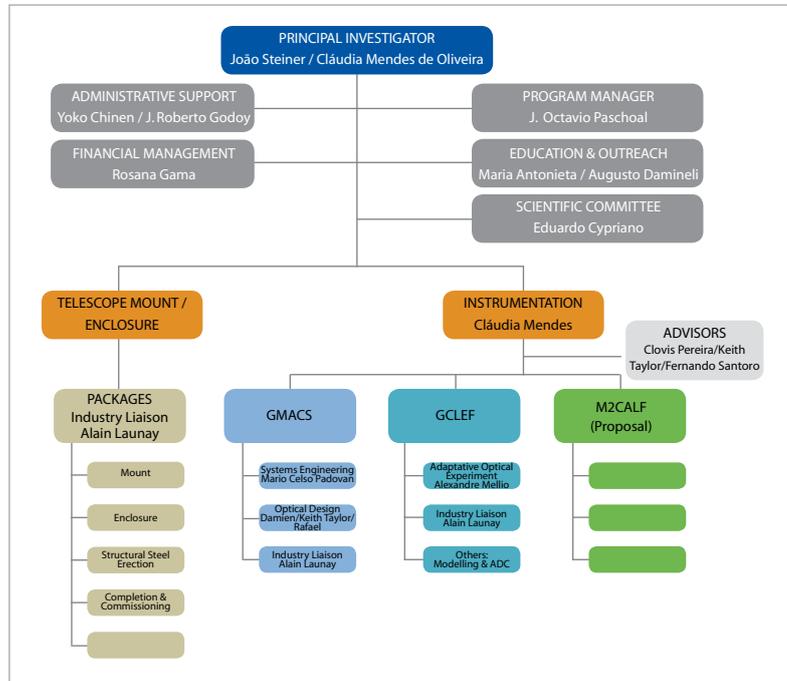


Figure 1. Organization chart of GMTBr Office



Figure 2. Site – Cerro Las Campanas, Chile

JOÃO EVANGELISTA STEINER

Instituto de Astronomia, Geofísica e Ciências Atmosféricas
Universidade de São Paulo (USP)
Departamento de Astronomia
Rua do Matão, 1226
CEP 05508-900 – São Paulo, SP – Brasil

+55-11-3091-2826
joao.steiner@iag.usp.br