*Tracing the Ancestry of Galaxies (on the land of our ancestors)*
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# Astrophysics in Burkina Faso

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**Abstract.** On the African continent, most of the activities in Astronomy are found in South Africa where full training in Astrophysics is given in a few Universities and where most of the professional astronomers and of the research instruments (from small telescopes to the 11m SALT, in the optical) can be found. In 2007, we started a full program (undergraduate and graduate) in Astrophysics at the Université de Ouagadougou and an Observatory (ODAUO), for teaching purposes, was also built. In October 2009, we put in crates the 1m Marly telescope in La Silla, Chile which will be rebuilt in 2011-12, as a full research telescope, on mount Djaogari in Burkina Faso.

**Keywords.** telescopes, site testing, surveys, galaxies: ISM, ISM: kinematics and dynamics

## 1. History of the Astrophysics project in Burkina Faso

The project started in 2006 August when Pr Joseph Paré, then President of the Université de Ouagadougou (UdeO) and now Minister of Higher Education and Scientific Research, asked Pr Claude Carignan from the Université de Montréal (UdeM) if he would like to put together an Astronomy Department at UdeO, which would be the first such department in sub-Saharan Africa. The long-term goal would be to develop a Centre of Excellence for the whole Western Africa sub-region, which nowadays is a favored approach in many fields. Since resources are limited, the idea is not to develop departments of everything everywhere but to develop a new research activity in one country that could then deserve the whole sub-region.

The program was defined with Pr Jean Koulidiati, director of the Laboratory of Physics and Chemistry of the Environment (LPCE) and now President of the UdeO, and the Scientific Council of UdeO accepted it in 2007. However, one of the problems with teaching sciences in Africa is that usually the level of the courses is adequate but the laboratories are empty. This is why, at the end of 2007, at the same time than the astronomy program was starting inside the Physics Department, an Observatory for teaching purposes (Fig. 1), called the Observatoire d'Astrophysique de l'Université de Ouagadougou (ODAUO) was built, with the help of Luc Turbide, from UdeM.

## 2. Pedagogic project and formation of HQP

A full Astrophysics program with courses at the undergraduate and MSc levels was adopted by the Scientific Council of the Université de Ouagadougou. The first undergraduate course was given to nearly 100 students at the end of 2007 and to similar groups

**Figure 1.** (left) SBIG 3K x 2K CCD camera on the 25cm MEADE telescope of the ODAUO. (center) First image taken at the ODAUO. (right) Color image of the Orion Nebula.

at the end of 2008 and the beginning of 2010. The first MSc course (extragalactic astrophysics) was given to 20 students in February-March 2009. Two other courses (stellar evolution & stellar atmospheres) were given at the beginning of 2010 and one (cosmology) in January 2011. A first Burkinabè student started his PhD in September 2008 at the Université de Montréal and a second one in September 2009. We hope to send two more at the University of Cape Town in 2011.

To make sure that there will be Highly Qualified Personnel (HQP) to look after the research telescope once rebuilt in Burkina Faso, a technician spent 3 months at the Observatoire du mont Mégantic (OmM) in August-September 2008 in order to learn telescope's controls and an engineer will start his PhD in Astronomical Instrumentation at the Université de Provence in September 2011.

## 3. Astronomical research

In 1967, an observing station was installed on top of Mont Chiran, in France, for site testing purposes related to the construction of a 3,6m telescope which would become the Canada-France-Hawaii Telescope (CFHT) installed on the Mauna Kea, in Hawaii. In 1975, a 1m telescope built by groups in Marseille and Lyon, and called the MARLY, was installed on Mont Chiran. In was then dismantled in 1987 and moved to the Observatoire de Haute Provence (OHP) for refurbishing. In 1994, it was put back in crates, shipped to the La Silla Observatory in Chile and rebuilt for the EROS2 project that was searching for compact massive objects in the halo of the Milky Way. The project ended in 2005 and since then the telescope was not used.

While, nowadays, research can be done by data mining on the web since most of the large astronomical telescopes and satellites released publicly their data fairly quickly, it is clear that having your own research telescope is a big boost to the development of research in a country. This is why we decided to start the project of moving the Marly telescope belonging to the Université de Provence (already a partner in setting up the astrophysics program at UdeO) from Chile to Burkina Faso.

### 3.1. *Research telescope*

In the middle of 2008, we officially submitted the project to the Université de Provence and our project was accepted by the Science Council of the Observatoire Astronomique Marseille-Provence (OAMP) on 2008 December 2nd. The Université de Montréal (UdeM) agreed to pay for the moving of the telescope, the Laboratoire dAstrophysique Expérimentale (LAE) and the Laboratoire d'Astrophysique de Marseille (LAM) agreed to provide the instrumentation and the minister of Higher Education and Scientific Research, with the help of the World Bank, agreed to pay for the infrastructure. The only

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**Figure 2.** (left) Dismantling of the MARLY telescope and (right) aluminizing of the primary mirror.

**Figure 3.** Shipping of the MARLY telescope from Chile to Burkina Faso.

funding still to find is for the electrification of the Observatory via photovoltaic solar energy. The Marly will be the first telescope in the world powered by a star, the Sun!!!

3.1.1. *Moving of the MARLY telescope*

In order to transfer the MARLY telescope from the Université de Provence (UdeP) to the Université de Ouagadougou (UdeO), a tripartite agreement was signed in the summer of 2009 between UdeP, UdeO and the UdeM. In mid-October 2009, a team of six (6) persons (2 from UdeO, 2 from OHP and 2 from UdeM) went to Chile and put the telescope in crates (Fig. 2 & Fig. 3). The container left the port of Valparaiso on October 31, arrived in the port of Tema, in Ghana in mid-December and in Ouagadougou at the beginning of January 2010.

3.1.2. *Choice of the site for the Observatory*

In 2008, all the regions of the country were explored in order to find the best possible site for the Observatory. Data were obtained from the Geographical Institute of Burkina Faso on the sun exposure and on the rainfalls for the last 20 years, which are the best indicators of the number of clear nights per year. While the highest summits are in the south-west, south and south-east, those regions were excluded because of the too high humidity. We finally settled for mont Djaogari in the dry north-east region, 30 km south of Dori and 250 km north-east of Ouagadougou. In 2009 October, a seeing monitor was installed on the mountain and measured seeings (image sizes) of 1 to 2 arcsec during the first 125 nights, which is very good (Fig. 4).

### 3.2. *Research projects*

Two main research projects are planned for the Marly telescope:

3.2.1. *Hα Survey of the Milky Way*

An H$\alpha$ Survey of the Milky Way (distribution and kinematics) was completed in the Southern Hemisphere (Le Coarer *et al.* 1992) using the Marseille 36 cm telescope in La Silla, Chile. The telescope was equipped with a scanning Fabry-Perot interferometer which allowed to reach surface brightness of $10^{-5}$ erg cm$^2$/s/sr. The large field-of-view of

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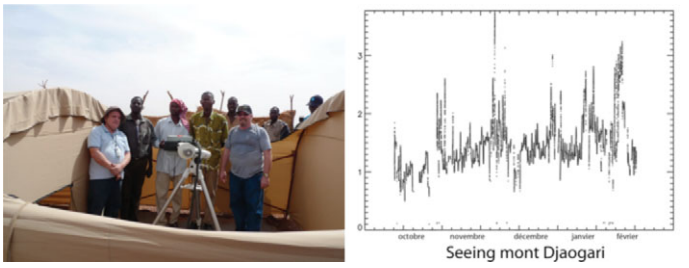


**Figure 4.** (left) Seeing monitor camera. (right) Seeing (image size) for the first 125 nights.

the Marly telescope will allow to complete this survey in the northern hemisphere. While the southern survey took nearly nine (9) years to complete, the northern counterpart should only take 2-3 years with the use of our much more sensitive photon counting camera + CCCP controller based on EMCCD technology (Daigle *et al.* 2009).

3.2.2. *Deep Detection of Diffuse Hα ($D^3$ Hα)*

The aim of this project is to detect the Diffuse Interstellar Gas (DIG) to very low levels, if possible, out to $R_{25}$. Extended DIG components have been seen in active and starburst galaxies (Veilleux *et al.* 2003), sometimes as extended as the HI disks (e.g. NGC 1068) but little is known about its extent in more normal galaxies. In 2007, 4 nights of observation (36 cm telescope) on the late-type spiral NGC 7793 (Dicaire *et al.* 2008) allowed to detect Hα and derive its kinematics out to the frontier of the HI disk down to sensitivities of a few tenths of emission measure. We intend to do the same on a large sample of normal galaxies (e.g. SINGS sample).

## 4. Conclusion: why doing Astronomy in Burkina Faso ?

Developed countries often see the help to less developed countries as sending bags of rice when they are starving and setting up alphabetization programs. It is clear that this kind of help must continue. However, if one wants those countries to really emerge (Burkina Faso was in 2009 177/182 countries on the Human Resources Index (HRI) of the United Nations Development Program), it is important (as Asia realized it last century) to develop the Human Potential and to form HQP via Higher Education programs.

Moreover, it is well known that University formation of students from less developed countries in developed countries is often a failure since most of those students never returned to their country. The result is a pure loss of human and financial resources for those countries. This is why it is essential to build in African countries the necessary infrastructures in order to be able to form the students locally. This is what the Astrophysics program at the Université de Ouagadougou, the teaching Observatory (ODAUO) and the research Observatory (MARLY) will allow in Burkina Faso.

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