



LLAMA News

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Web page: <http://www.llamaobservatory.org>

The Large Latin American Millimeter Array (LLAMA) is a collaboration between the Ministerio de Ciencia, Tecnología e Innovación Productiva (MINCyT), the Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), the Instituto Argentino de Radioastronomía (IAR), and the Instituto de Astronomía y Física del Espacio (IAFE) from Argentina, and the Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP), the Universidade de São Paulo, and the Universidade Mackenzie from Brasil.



Dear all,

This is the first Newsletter of the Large Latin American Millimetre Array (LLAMA). The purpose of LLAMA News is to provide information on the status of the project to the astronomical community, specially to those of Argentina and Brazil and their respective funding agencies and other interested colleagues.

LLAMA is a joint scientific and technological undertaking of Argentina and Brazil whose goal is to install and to operate an observing facility capable of performing observations of the Universe at millimeter and sub-millimeter wavelengths. The project is being financed by Secretaría de Articulación Científico Tecnológica from Ministerio de Ciencia, Tecnología e Innovación Productiva (MINCyT) of Argentina and Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP) from Brazil. It will be operated by IARCONICET and Universidade São Paulo (USP), on behalf of Argentina and Brazil, respectively.

The radiotelescope will be located in the Puna de Atacama in the northwestern part of Argentina at a place whose terrestrial coordinates (longitude λ and latitude φ) are $(\lambda, \varphi) = (66^\circ 28' 29.4'' \text{ W}, -24^\circ 11' 31.4'' \text{ S})$. The site, locally known as Alto Chorrillos, is located at an altitude of 4790 meters above sea level (masl) about 180 km south-east of ALMA, with atmospheric conditions similar to those for ALMA. It is within a premise of 400 hectares allocated to this project by the Government of Salta province. This place is located around 20 km, in straight line, from the town of San Antonio de los Cobres (SAC, 3800 masl). At SAC the main basecamp will be built, with laboratories and offices as well as lodging facilities to provide the infrastructure necessary for efficient operation of this remote facility.

LLAMA is a Cassegrain ALMA-type telescope, manufactured by Vertex AntennenTechnik GmbH, whose main reflector has a diameter of 12m, a target surface rms accuracy of $15 \mu\text{m}$, and a target antenna pointing accuracy of 2 arcsec. Additionally, the radiotelescope will have two Nasmyth cabins where several single and multi-pixel receivers will be installed. The Cassegrain focus will be used to install either a bolometric camera or a heterodyne array.

The radiotelescope will be in general equipped with ALMA-like receivers, covering the frequency range from 35 GHz up to above 1 THz (millimeter and submillimeter wavelengths). Although initially the instrument will work mainly as a single dish telescope, it will be used as part of a Very Large Baseline Interferometry (VLBI) network. Such network may include the Atacama Large Millimeter/Submillimeter Array (ALMA), the Atacama Pathfinder Experiment (APEX), the Atacama Submillimeter Telescope Experiment (ASTE). In this way, an increased in angular resolution of at least a factor of 10 to the one currently achieved by ALMA, would be possible. It is foreseen that LLAMA will eventually become part of the Event Horizon Telescope (EHT) and other millimeter networks.

The optical system is designed to be as versatile as possible. In this way, a maximum of four simultaneous receivers, with dual polarization each, could be used at any given time. Though the optical design of the telescope will not allow Cassegrain/Nasmyth simultaneous observations to be carried out, the system will have the capability of making a fast swap (within a few minutes) between instruments located at



the Cassegrain focus (e.g. a MKID camera or an heterodyne array at a given frequency) and those located at a Nasmyth focus.

As a single dish radiotelescope, this instrument will be suitable for studies to be carried out in continuum and atomic or molecular spectroscopy towards astronomical objects located in a broad distance range, from the Sun to red-shifted galaxies.

Besides providing to the scientific communities of Argentina and Brazil with a new radioastronomical observing facility, LLAMA will also be opened to international collaborations both as an observing facility on its own and as a test bench for new receivers, or to host guest instruments. LLAMA should be entering its commissioning phase around second half of 2017.

We hope you enjoy this edition.

E. M. Arnal and J. Lepine (LLAMA P.I. from Argentina and Brazil, respectively)

Budget related issues

Argentina: Since early June 2016 MINCyT (Argentinean financing agency for the construction phase) started transferring sizable fractions of the 2015 budget, a 4 x 4 wheel vehicle has been purchased. Orders to acquire a first ABM unit has already been placed. Orders to purchase raw material to construct the analog rack and a first version of the spectral analyzer will be put in a short while.

Brasil: The payments for the construction of the LLAMA antenna have been made regularly, financed by FAPESP, following the contract between VERTEX Antennentechnik and IAG-USP. If the cost of the Nasmyth cabins option is added to the original antenna of the first contract, 71% of the total cost has already been paid to VERTEX.

Additional funds have been used for the design of the system of mirrors and lenses that will bring the beam to the receivers, the construction of the Warm Component Assembly (WCA) for two receivers, the construction of a cryostat with room for 3 receivers, and the acquisition of a spare ACU (Antenna Control Unit).

LLAMA Site

Access to the summit: All administrative paperwork related to the construction of the access road to the summit at Alto Chorrillos (about 6 km in length) were finished. Under the assumption that the bidding process is launched by end August, the actual construction work



may start by the end of January 2017. Construction time is estimated to be three months.

Therefore, depending upon local weather conditions, the access road may be finished by end March 2017.

Infrastructure at San Antonio de los Cobres

The main LLAMA headquarters will be erected at San Antonio de los Cobres (SAC). The planned building will have a total covered surface of 1130 m².

The Executive Project of the entire building has been elaborated and submitted to Ministerio de Obras Públicas of the Province of Salta. The construction will be carried out in four different steps. The first one (470 m²) will be financed by Salta Province. Funds are waiting to be allocated by the Ministerio de Economía of the Salta Province. The building will be constructed on a 8000 m² premise that was ceded for a 20 year-period to CONICET (renewable for an unlimited number of years). CONICET is the argentinean agency that will provide 50% of the running costs of the facility after the Commissioning phase is over.

Were the bidding process launched by late August 2016, actual construction may start beginning February 2017. Completion of the first stage is expected to take between 10 to 12 months work, depending on weather conditions.

Energy provision to Alto Chorrillos

Administrative work to start the bidding process to provide energy to the summit is finished. REMSA, a Salta state own company, may start the bidding process late August 2016. Depending on weather conditions energy may be available at the summit by end of April 2017. This task includes: construction of gas substation (to lower main pipeline gas pressure), actual generation of energy by using gas turbines, and energy transport to summit via air lines. A backup 150 KVA diesel generator will also be provided by Salta Province.

VERTEX 12m antenna: mechanical and servo FATs

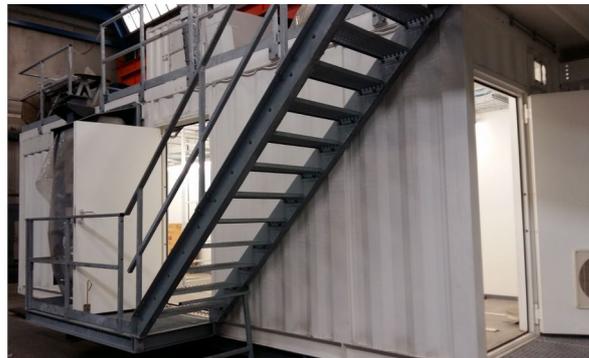
A mechanical Factory Acceptance Test (FAT) was carried out during the last days of May in Colombo, Italy. The mechanical revision included verifications on different antenna structures (pedestal, yoke, containers, both Nasmyth cabins which are already assembled to the main platform, invar cone, and minor parts that are already built).

At the same time, a servo FAT was performed at VERTEX Antennentechnik GmbH headquarters in Duisburg, Germany. Servo, electronic, and verification tests (encoder



positions, temperature and displacement sensors, etc; control of antenna movements, sub-reflector position, engine power, and other antenna parameters) were carried out.

Most of the tests were successful, but Non Conforming Reports (NCRs) were sent to VERTEX. After fixing the problems that have been detected, a new servo FAT is being planned for September-October this year with the participation of two Engineers from Argentina (J.J. Larrarte and E. Rasztocky) and one from Brazil (still to be decided).



Main platform and Nasmyth cabins in Colombo



The antenna dish, and Argentinean and Brazilian engineers at work during the FAT at Duisburg.

Temporary antenna storage

Since the beginning of the construction of the access road to the summit was delayed, it was arranged with Vertex GmbH that after completion of the antenna construction, the containers holding the different parts of the antenna will be stored in a covered place close to the Italian factory near Colombo, Italy. The antenna will be stored there till the shipping order to Argentina is given.

Data acquisition and processing

The Executive Committee decided to adopt the ALMA software for data acquisition and data



processing held in its meeting in June in Sao Paulo. The capabilities and versatility of the Common Astronomy Software Applications package (CASA) for both single dish and interferometric data makes it appropriate for data processing in LLAMA, taking into account that in the future the LLAMA telescope could be part of VLBI projects. Also the so called ALMA Observing Tool was adopted.

Dr F. Viallefond has agreed to collaborate with LLAMA's Computing group (led by Dr. G. Gimenez de Castro) to make the appropriate software modifications to the acquisition software.

First light receivers

For "first light", it was decided that the telescope will have receivers for Bands 5 (163-211 GHz, 2SB/SiS) and 9 (602-720 GHz, DSB mixer). Receivers for Bands 5 and 9 were designed in Chalmers University of Technology in Sweden and in the Netherlands Research School for Astronomy (NOVA) laboratory at Groningen, Holland, respectively. Band 5 receiver is a prototype that will be refurbished at NOVA, while receiver for Band 9 will be constructed in NOVA.

LLAMA schedule

A preliminary schedule was elaborated during the Executive Meeting held last June, with the road and foundation construction finished during the first semester of 2017, and integration and verification of receivers for bands 5 and 9 (which will be available for first light) and the holography process of the antenna during 2018.



The EC meeting in São Paulo in June 2016



CONCERTO project

During the Executive Meeting held in June Dr. Guilaine Lagache from LAM (Marseille, France) and A. Monfardini (Institut Néel, Grenoble, France) discussed with the EC the project CONCERTO, which plans to develop a KIDs (Kinetic Inductance Detectors) camera for research in Cosmology. The aim of the discussion was to analyze the possibility of installing the camera in the Cassegrain cabin in the LLAMA telescope. The team of Dr. Lagache would obtain observing time and in exchange, would make the camera available to the LLAMA users community.

The EC took a decision favorable to this agreement, considering that it would be positive for LLAMA to implement an imaging capability early during its science phase. The instrument will not interfere with the heterodyne receivers that are planned to be installed in the Nasmyth cabins. Switching between both options (imaging camera and heterodyne receiver) will be easily accomplished.

The EC expressed the interest in a long term collaboration, and in exploring the possibility of further developments, going in the direction of KIDs working at higher frequencies and of implementing an option that will allow to carry out polarimetric observations.

LLAMA at LARIM

LLAMA will be present at the Latin American Regional IAU Meeting to be held in Colombia in October in the session "VLBI at mm and submm wavelengths" and in oral presentations by Dr. J.R. Lepine and Dr. E.M. Arnal.