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# 7 Years of the Andean Regional Office of Astronomy for Development 2014-2020

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April 15, 2023

## Abstract

The Andean Regional Office of Astronomy for Development (Andean ROAD) was established with the objective of promoting professional research, education, and public outreach in astronomy within the Andean region. A collaborative effort involving institutions from Colombia, Venezuela, Ecuador, Peru, Bolivia, and Chile, the Andean ROAD has been active since 2014 and this report highlights the progress and obstacles encountered during the program's five-year tenure from 2014 to 2020.

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# 1 EXECUTIVE SUMMARY

The Andean Regional Office of Astronomy for Development (ROAD) aimed to promote collaboration and development around astronomy within the Andean region, which includes Bolivia, Colombia, Chile, Ecuador, Peru, and Venezuela. The main objective was to strengthen communication and cooperation among regional representatives and coordinators, as well as to support the creation of new working groups. To achieve these objectives, three Task Forces were established to complete eleven distinct projects.

Task Force 1 (TF1) focused on organizing educational events and fostering collaborations among institutions in the Andean region. Three Andean Schools on Astronomy and Astrophysics were organized in Quito (2014), Bogotá (2015), and Lima (2018), with attendees and lecturers from various countries. Stable funding was a significant challenge, with each school relying on local funding, OAD sponsorship, or Andean ROAD sponsorship for accommodations. The task force also explored the potential for an Andean graduate program but made no substantial progress. The Exploration Working Groups in Astroparticle Physics and Radioastronomy established cooperation networks, secured funding for joint projects, and supported students. However, the task force's goal to create a Massive Open Online Course (MOOC) did not make significant progress.

Task Force 2 (TF2) focused on improving astronomy education and communication strategies in the Andean region. They conducted periodic coordination sessions from 2016 to 2020, led by Parque EXPLORA (Colombia) and IVIC (Venezuela). These sessions resulted in various Citizen Science campaigns, over 10 educational challenges, and the formation of a WhatsApp group called "AstroEducación Latin America."

Additionally, they developed virtual training sessions, but these did not continue after 2017. They also designed teaching material for visually impaired students, which led to the creation of three Astronomy suitcases and related materials. These resources were shared online and inspired workshops at national and international events.

Finally, TF2 organized annual meetings called "Classroom under the Stars" to gather collaborators in the node. These meetings began as face-to-face events, later transitioning to virtual meetings. The Medellin Planetarium hosts information on these meetings on their website.

Task Force 3 (TF3) aimed to enhance astronomy communication and education in the Andean region. Their first objective, Development for Planetariums (DFP), sought to create special shows for regional planetariums and science museums, highlighting ancestral traditions from indigenous tribes and founding communities in South America. Despite initial contact and plans, the special shows were not developed.

The second objective was to organize periodic meetings for the Communicating Astronomy with the Public task force, which would bring together collaborators involved in astronomy communication. Although a one-afternoon mini-workshop was held during the Latin-American Regional IAU Meeting in 2016, and Parque Explora hosted the Communicating Astronomy with the Public meeting the same year, this did not become a regular event for the Andean region.

For each project we suggested in our original proposal, we have a scorecard assessing the success of each task on a scale of 0 to 10.

The eleven projects and their scores are as follows:

- Andean School on Astronomy and Astrophysics: 6
- Andean Graduate Program: 0
- Exploration Working Group in Astroparticle Physics: 6
- Exploration Working Group in Radioastronomy: 6
- Massive Open Online Courses: 0
- Communication Network: 10
- Periodic Coordination Sessions: 2
- Virtual Training Sessions: 2
- Teaching Material for Visually Impaired Students: 6
- Development for Planetariums: 2
- Regional Communicating Astronomy with the Public: 2

With an average score of 3.5/10.0, we concluded that the first five years of the Andean ROAD mainly helped to initiate projects but did not significantly advance the originally proposed goals. In the following sections we present more details about each project. We focus on the contrast between the plans and their implementation. We finalize this report with recommendations for the future of the Andean ROAD.

## 2 TASK FORCE 1

### 2.1 ANDEAN SCHOOL ON ASTRONOMY AND ASTROPHYSICS

#### **Objective**

Organize a school for advanced undergraduate students and graduate students.

#### **Lead:**

Changes every year.

#### **Planned Implementation:**

Every year we will hold a school aimed at advanced undergraduate students and graduate students. The main subjects of the school have to be broad enough allowing a large student participation. This venue will also serve as a upstanding scenario to invite tutors from abroad and strengthen new institutional collaborations with the Andean ROAD. The first school will take place in 2014 hosted in Ecuador close to the dates for the Colombian Congress of Astronomy and Astrophysics.

## Results

Three schools were organized: the first in Quito (2014), the second in Bogotá (2015), and the third in Lima (2018).

The first school in Quito (December 8-14, 2014) was led by Prof. Nicolás Vásquez at the Escuela Politécnica Nacional. It had 35 students from Bolivia, Colombia, Ecuador, Peru, and Venezuela, and 9 lecturers from Argentina, Colombia, Mexico, and Ecuador. The main subjects were high energy astrophysics and cosmology.

The second school took place in Bogota (June 1-26, 2015) and was led by Prof. Jaime E. Forero-Romero at Universidad de los Andes. It had 18 students from Bolivia, Colombia, Chile, Ecuador, Peru, and Venezuela, and four lecturers from Germany, Israel, and the United States. The main subject was cosmology in four aspects: theory, simulations, experiment, and instrumentation.

The third school was held in Lima (November 12-16, 2018) within the third workshop "Astronomía en los Andes" and was led by Prof. Maria Isela Zevallos from the Universidad Nacional de Ingeniería. It had 55 students from Argentina, Colombia, Ecuador, Peru, and Venezuela, and three lecturers. The school offered courses on Milky Way structure and evolution, astronomical techniques in planetary sciences, and astronomy in school.

The biggest challenge for all schools was securing stable funding. Each school relied on local funding, OAD sponsorship, or Andean ROAD sponsorship for accommodations, which represented only a small percentage of the total budget. The lack of stable funding made it difficult to ensure the desired annual periodicity, and organizing each school required a significant effort from the Local Organizing Committee to secure additional funding from local organizations.

## 2.2 ANDEAN GRADUATE PROGRAM

**Objective** Determine the feasibility of creating and funding an Andean graduate program.

**Leading ROAD Institutions:** Observatorio Astronómico Nacional (Colombia); SOCHIAS ROAD Office (Chile, Oficina Nacional de Coordinación, ONC); Universidad de San Francisco de Quito (Ecuador).

**Lead:** Giovanni Pinzón, PhD; Eduardo Unda-Sanzana, PhD; Dennis Cazar Ramírez, PhD.

**Implementation:** Explore the possibility to coordinate the use of educational resources of different institutions in the region. The model for this project is the AstroMundus program in the European Union where a consortium of 5 Universities in 4 Countries offer a Master Program. This research will be done mainly through virtual meetings.

### 2.2.1 RESULTS

The project did not make any significant progress towards reaching its objective.

## 2.3 EXPLORATION WORKING GROUP IN ASTROPARTICLE PHYSICS

**Objective** Establish a cooperation network of institutions interested in Astroparticle Physics.

**Leading ROAD Institution:** Universidad Industrial de Santander (Colombia); Universidad San Francisco de Quito (Ecuador).

**Lead:** Luis Nuñez, PhD.; Dennis Cazar Ramírez, PhD.

**Implementation:** The leading institutions will organize periodic meetings to gather all the groups in the Andean Region interested in developing its research capabilities in astroparticle physics. This will be done through workshops and the installations of small research stations for the Latin American Giant Observatory (LAGO) project, which has already been kick-started in Venezuela, Colombia, Ecuador, Peru and Bolivia.

### 2.3.1 RESULTS

In Ecuador, the Ecuatorian Network of Cosmic Rays, Astroparticles and Space Weather was created with the participation of the Escuela Politécnica Nacional, Universidad San Francisco Quito and Escuela Superior Politécnica del Chimborazo.

An astroparticle laboratory was created at Escuela Politécnica Nacional of Quito (Ecuador). This institution has continued working within the Colaboración LAGO, which is presided by Ivan Sidelnick.

The VII School of Cosmic Rays and Astroparticles took place in Quito, and was organized by Oscar Saavedra on August 2017.

The VIII School of Cosmic Rays and Astroparticles in Bolivia organized by Martín Alfonso Subieta was to take place in 2020 but it was suspended due to the global COVID-19 pandemic.

Universidad Industrial de Santander (UIS) in Colombia has continued its work with the LAGO Collaboration throughout this period, under the leadership of Prof. Luis Nuñez.

## 2.4 EXPLORATION WORKING GROUP IN RADIOASTRONOMY

**Objective** Establish a cooperation network of institutions interested in the development of Radioastronomy.

**Leading ROAD Institution:** Escuela Colombiana de Carreras Industriales (Colombia).

**Lead:** Germán Chaparro Molano, PhD.

**Implementation:** The Leading Institution will organize periodic meetings to gather all the groups in the Andean Region interested in the development of Radioastronomy capabilities. The first meeting is planned for 2015 The Leading Institution will also organize a Training School to build up new capabilities and strengthen the ties between different groups and countries. The first school is planned for 2016.

### 2.4.1 RESULTS

A collaboration network was established between universities of Chile and Colombia. These universities are:

1. Industrial University of Santander (Bucaramanga, Colombia), Professor Julián Rodríguez .
2. ECCI University (Bogotá, Colombia), Oscar Restrepo.
3. Universidad de Antioquia (Medellín, Colombia), Professor Germán Chaparro.
4. University of Chile (Santiago, Chile), Professor Patricio Mena.
5. Catholic University of La Santísima Concepción (Concepción, Chile), Professor Ricardo Bustos

This group obtained funds for the joint projects by several funding institutions:

1. Colombian National Spectrum Agency (ANE) (20k USD) - Finished
2. Universidad Industrial de Santander (20k USD) - Finished
3. Universidad ECCI (200k USD) - Ongoing

This collaboration directly funded 2 PhD students and 2 MSc students from Colombia. Another 2 MSc students and 2 BSc students did their research projects within this collaboration.

## 2.5 MASSIVE OPEN ONLINE COURSES - MOOC

**Objective** Create a Massive Open Online Course at the introductory undergraduate level with sections for the general public.

**Leading ROAD Institution:** Universidad Industrial de Santander (Colombia).

**Lead:** Luis Nuñez, PhD

**Implementation:** We will create a Massive Online Open Course in Astronomy and Astrophysics, that could be used either as a general course for a wide audience or as an introductory course for undergraduate students of Physics programs. Planned for 14 weeks, the course will contain four major blocks: Astronomy and celestial bodies, Instrumentation in Astronomy, Current Trends in Astronomy and Astrophysics, and Data Bases and Data analysis in Astronomy. The first three blocks will be divided in two modules corresponding to two different levels: A and B. General audience could follow the level A for the three modules and physics students should follow whole content of the course. Each module, will have a 15m video, recommended reading and several assignments.

### 2.5.1 RESULTS

The project did not make any significant progress towards reaching its objective.



## 2.6 COMMUNICATION NETWORK

**Objective** Gather contact information of all TF1 colleagues in the ROAD.

**Leading ROAD Institution:** Universidad de los Andes (Colombia)

**Lead:** Jaime E. Forero-Romero, PhD

**Implementation:** Open a mailing list associated to TF1 activities.

This network will serve as a platform to exchange information concerning joint projects, fellowships, scholarships and open positions. There will also be a central web-page for the Andean ROAD showing the current ongoing projects and advances.

### 2.6.1 RESULTS

We created three different mailing lists, one for each Task Force. The mailing lists continue to be active and are the main communication channel across the collaboration.

## 3 TASK FORCE 2

### 3.1 PERIODIC COORDINATION SESSIONS

**Objective:** Strengthen communication strategies between teachers and coordinators from each country

**Leading ROAD Institution:** Parque EXPLORA (Colombia), IVIC (Venezuela).

**Lead:** Ángela Patricia Pérez Henao, Maritza Arias Manriquez, Enrique Torres

**Implementation:** The sessions were held for several consecutive years and their activity ended when it was reported from the OAD that it would no longer follow that figure due to the creation of the OAE. It means that it was active from 2016 to 2020 with monthly meetings, the first Monday of each month, in which teachers from the Andean countries met to share experiences of teaching Astronomy.

### 3.2 RESULTS

Citizen Science campaigns were developed at the meetings, such as the Eratosthenes Campaign and Measurement of Latitude at Equinox. More than 10 educational challenges for the school, more than 10 meetings a year, formation of a WhatsApp Group with more than 100 active members that is currently called "AstroEducación Latin America" The biggest challenge was encouraging teachers from Peru and Ecuador to be consistent with the meetings.

### 3.3 VIRTUAL TRAINING SESSIONS - VTS

**Objective:** Create virtual training and activities open to teachers and students.

**Leading ROAD Institution:** IVIC (Venezuela).

**Lead:** Enrique Torres, Juan Carlos Arias.

**Implementation.** Develop a virtual platform to hold virtual workshops on information technologies applied to astronomy and space sciences.

#### 3.3.1 RESULTS

Some meetings with the TF2 (Children and Schools) and TF3 (Public Disclosure) working groups took place with representatives of the Andean ROAD. These meetings did not have continuity after 2017.

### 3.4 TEACHING MATERIAL FOR VISUALLY IMPAIRED STUDENTS - TMVS

**Objective:** Design teaching material to work with visually impaired students.

**Leading ROAD Institution:** Planetario de Bogotá (Colombia).

**Contact:** Planetarium of Bogotá and Planetarium of Medellín (Colombia)

**Implementation:** We start by doing research on the kind of material to develop. Later on we will define the production and distribution processes.

### 3.4.1 RESULTS

The development of this material took place in several stages and received support from the OAD. The latter allowed the prototypes to be perfected, they were tested with blind people and three Astronomy suitcases were designed and made with all the senses.

Everything developed with the OAD in the framework of this project is on the page <https://www.astro4dev.org/category/astronomy-with-all-senses/>

The booklet and experience in Spanish can be found on the Medellin Planetarium page and I attach the booklet to this email <https://www.planetariomedellin.org/astronomy-with-all-senses>

Due to the pandemic, it was not possible to develop the plan to carry out training on this type of online content, although it was presented in Chile and teacher training was carried out with them. The Large Magellan Telescope through Valentina Rodriguez replicated (10 copies) the suitcase for a GMT Observatory outreach project.

We had planned to make the suitcase 2.0 for which the preparations were made but the budget that was managed with the ROAD Andino could not be obtained, some materials were removed thanks to the budget allocated by Parque Explora, but the project was left incomplete.

The Astronomy with all the Senses material has been presented and has inspired workshops in different Education and Dissemination meetings at a national level and in international events such as CAP 2016.

## 3.5 ANNUAL TF2 MEETING

**Objective:** Organize and annual meeting to gather all the collaborators in the Task Force.

**Leading ROAD Institution:** Changes every year.

**Lead:** Ángela Patricia Pérez Henao, Maritza Arias Manriquez

**Implementation:** Every year we will hold a meeting aimed at collaborators in the node. The venue will change every year. The first meeting will take place in 2015 with the theme Archeoastronomy.

### 3.5.1 RESULTS

Each year the Planetarium of Medellín and the TF2 group organize an Astronomy Teaching and Didactics Meeting, Classroom under the stars. One (1) face-to-face meeting was held in Medellin with 120 participants from different countries of the Andean node, later 4 face-to-face national meetings were held and later they went virtual with Andean impact. The 2020 meeting had the financial support of the OAD, with the loan of an OAD Zoom account

and with the budget it was possible to print the reports, and from there two more Classroom meetings under the stars have been held as Latin American meetings.

Annex reports of Classroom under the stars 2020, I did not send the report to Ramasamy because the printing of the reports took a long time.

The information on Classroom under the stars is on the Medellin Planetarium page:  
<https://www.planetariomedellin.org/programate/aula-bajo-las-estrellas-2022>

## 4 TASK FORCE 3

### 4.1 DEVELOPMENT FOR PLANETARIUMS - DFP

**Objective:** Develop special shows for planetariums in the region.

**Leading ROAD Institution:** Parque EXPLORA (Colombia).

**Contact:** Carlos Molina.

**Implementation:** We want to develop special shows to be projected at planetariums and science museums from the region, highlighting ancestral traditions from indigenous tribes and founding communities from South America. These shows would be shared between the Local and Regional Networks of Planetariums, such as “Asociación de Planetarios del Cono Sur”, and the growing “Red de Planetarios de Colombia”.

#### 4.1.1 RESULTS

Representatives of Parque Explora (Medellín, Colombia) got in touch with Chilean colleagues to develop ideas to create shows for planetariums in the Andean region. There was a plan to implement a pilot plan in 2017-2018 for a digital planetarium to be located in San Pedro de Atacama. Unfortunately this did not come to fruition. The Escuela Politécnica Nacional in Quito had an initial approach with the Planetarium in Quito. Only initial contacts were arranged, and the none of the special shows were developed.

### 4.2 COMMUNICATING ASTRONOMY WITH THE PUBLIC

**Objective:** Organize periodic meetings to gather all the collaborators in the Task Force, "Communicating Astronomy with the Public".

**Leading ROAD Institution:** SOCHIAS ROAD office (Chile, Oficina Nacional de Coordinación, ONC).

**Contact:** Farid Char.

**Implementation:** We want to hold regular meetings that can serve as an exchange platform for people involved in communicating astronomy to the public; this includes science museums, planetariums, mass media and associated industries. We also want to use this opportunity to showcase efforts in the other two task forces. This meeting will be held parallel to large professional meetings. We envision this event as a "Communicating Astronomy with the Public" meeting for the region. We expect to hold the first one during the next Latin-American Regional IAU Meeting in 2016.

#### 4.2.1 RESULTS

A one-afternoon mini-workshop was implemented during the Latin-American Regional IAU Meeting (LARIM) in 2016. Parque Explora hosted the Communicating Astronomy with the Public meeting in 2016. Colleagues from the Andean ROAD attended, but we did not

manage to replicate this as a regular meeting for the Andean Region.

## 5 CONCLUSIONS AND FINAL RECOMMENDATIONS

Our four recommendations for future iterations of the Andean ROAD.

- **Select a maximum of three projects as a goal for the next five years.** This will allow the limited amount of human, material and financial resources to be focused and more efficient in reaching their goal.
- **Rotate the leadership positions every year.** This will allow every member of the collaboration to directly experience the challenges and opportunities faced by the Andean ROAD.
- **Develop a task force fully devoted to raising financial capital.** This will allow the Andean ROAD to mitigate the risk of not having enough financial means to take projects from start to completion.
- **Develop partnerships with organizations whose primary goal is human development.** In their first years the Andean ROAD was mostly around developing astronomy. New partnerships will help the Andean ROAD to instead use astronomy for development in a broader sense.