

## Space developments at IACTec.

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### Abstract

IACTec is a technological and business space created by the Instituto de Astrofísica de Canarias (IAC) to promote collaboration between the public and private sectors. Our objective is to foster the creation of quality employment and the generation of value-added technological products with high marketing potential, both nationally and internationally. In the growing field of innovation related to the payload of microsattellites and nanosatellites, our initial focus is on Earth Observations. In this paper we present IACTec Space, our plans for the future, including the design of cameras based on the heritage of the knowledge acquired in the IAC on detectors and optics or the use of new techniques such as superresolution.

## 1 Introduction

The Instituto de Astrofísica de Canarias (IAC) is a public research consortium located in the Canary Islands. The main headquarters of the IAC is located in La Laguna with a secondary office in La Palma, the CALP. In addition to this, we have two astronomical observatories: the Observatorio del Teide in Tenerife and the Observatorio del Roque de los Muchachos in La Palma. In total, we are approximately 400 people in the IAC alone, apart from those who work for foreign institutions.

One of the most important assets of the IAC is its astronomical observatories, with almost 60 different facilities from 27 countries. This is the largest multinational collection of professional telescopes in the world. There are both solar and night time telescopes, including the world's largest telescope, GTC, and other telescopes to observe the cosmic microwave background, Cherenkov telescopes, etc.

The presence of these observatories for more than 50 years has made a crucial contribution to the development of research in the IAC, turning it into a center with a recognized



Figure 1: Image of the future IACTec headquarters.

research prestige at this time. We currently cover virtually all branches of astrophysics: solar physics, solar system and exoplanets, stellar and interstellar physics, galactic formation and evolution and cosmology.

## 2 IACTec

This same presence of observatories, telescopes and instruments has also meant that the IAC has had to make a huge effort in the instrumental area. We have been doing instrumentation applied to astrophysics for 40 years and we have acquired a great experience and knowledge. We are currently involved in more than 20 instrumental projects and we have really outstanding capabilities, characteristics and laboratories. And these are precisely the foundations of the new IAC project: IACTec. IACTec is a space for collaboration with companies to take advantage of the experience acquired in instrumentation, technology and engineering with a social base. The main motivation of IACTec is to create a business and employment network in the Canary Islands that generates alternatives to absolute dependence on tourism. A network evidently related to science and technology and with the purpose of being self-sufficient within 4-5 years. Our idea is to prioritize and promote the regional economy, but having behind the support, experience and knowledge of the IAC, which will also seek the return of all this.

There are three niches that will work within IACTec. The most obvious is that of large

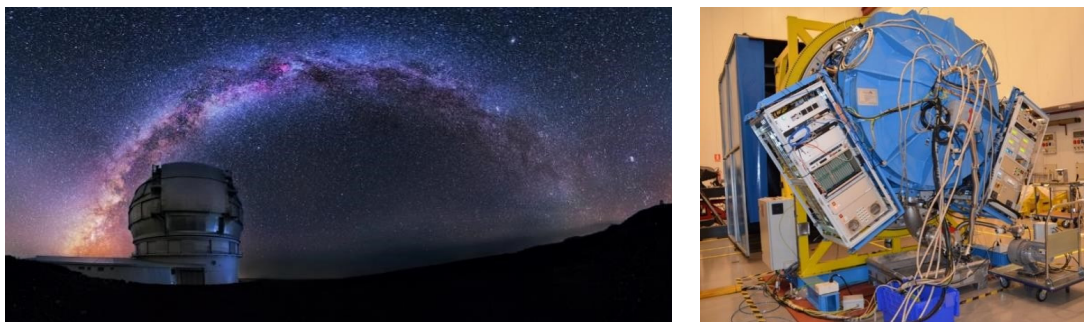


Figure 2: GTC (left) and EMIR (right), two examples of our experience with telescopes and instruments.

telescopes, including, for example, the Cherenkov Telescope Array, CTA-N, the European Solar Telescope, EST, or the New Robotic Telescope, NRT. Other important niche is medical technology, something that the IAC has been working on for several decades. And, finally, the small satellites.

These developments will be carried out in a new building located 2 km from the IAC, within a new technological park that is being built and will be ready in less than a year. In this park will be located the buildings of IACTec, Nanosciences, Parque Científico-Tecnológicos de Tenerife, the companies that want to accompany us, etc. And, to carry out the projects, we have an excellent team of engineers financed mainly by training programs of the Cabildo de Tenerife.

### 3 IACTec Space

In recent years, a kind of democracy has come to space with cheaper components and the use of commercial off-the-shelf (cots) and this has led to more and more companies or institutions have embarked on the design and manufacture of satellites of much lower-size than the big monsters that were traditionally the only projects that were sent to space. This means that there are great opportunities when it comes to small satellites, but it also makes the competition very big and wild. Therefore, before embarking on a project like this we did a very important exercise to see the niches in which the IAC could be competitive, given our previous experience.

- First of all, we are telescope manufacturers, and we do it quite well. From the IAC80, the first telescope of this type designed and built in the Canary Islands, to GTC, the largest telescope in the world, through QUIJOTE and other projects. We are used to making new and better optical and opto-mechanical designs and testing them.
- We are also experts in detectors, their use, characterization and improvements, reducing their noise and improving their efficiency and reliability.
- In addition, as astronomers, our tool is light and we are used to getting as much



Figure 3: IAC Tec Space logo.

information as possible about it and improving the data obtained. We have been improving data acquisition with our instruments for years, making algorithms for image processing and using other improvement algorithms, such as compression or super-resolution

- In the Observatorios de Canarias we are also used to transmit information, mainly from Earth to satellites or with ground-ground links, making use of optical communications.
- And, finally, the presence of the atmosphere has led us to develop instruments and techniques to compensate it and greatly improve the quality of our images: adaptive optics, cophasing, lucky imaging, etc.

The analysis of all these points led us to decide that where we could really be competitive was in the design and manufacture of payloads for Earth Observation at small satellites, combining our experience in the five points above.

To accomplish this, we have marked three different stages and two main objectives. On the one hand, DRAGO (Demonstrator for the Remote Analysis of Ground Observations) a SWIR instrument on board the ALISIO (Advanced Land-Imaging Satellite for Infrared Observations) project. ALISIO will be a 3U nanosat in LEO orbit that will help us position ourselves in the market, learn what a project of this style entails and carry out the first launch of a Canarian satellite at the end of 2019, early 2020. ALISIO will have as first objective observations in the SWIR range and as a secondary objective to test a magnetic measurement card useful for LISA. On the Other hand, IACSat-1, a long-term and more ambitious project for an optical and infrared microsatellite with a resolution close to the meter.

The first stage (2017) consisted of the creation and training of a well prepared team for the space and the first steps of the two projects. In addition, there was an important didactic and outreach activity, and the analysis and solutions for the RFI of a sub-meter resolution camera for a private collaborator. This stage ended with the conceptual design of DRAGO at ALISIO.

In a second period (2018 - 2020) we will seek to consolidate the IAC Tec team with the launch of ALISIO. This involves several phases: Preliminary Design Review (PDR), Critical Design Review (CDR) and manufacturing, Assembly-Integration-Verification (AIV), launch and follow-up. In parallel, there will be important advances in the sub-meter resolution line with its PDR and detailed design along with new projects in collaboration with companies related to small satellites payloads.

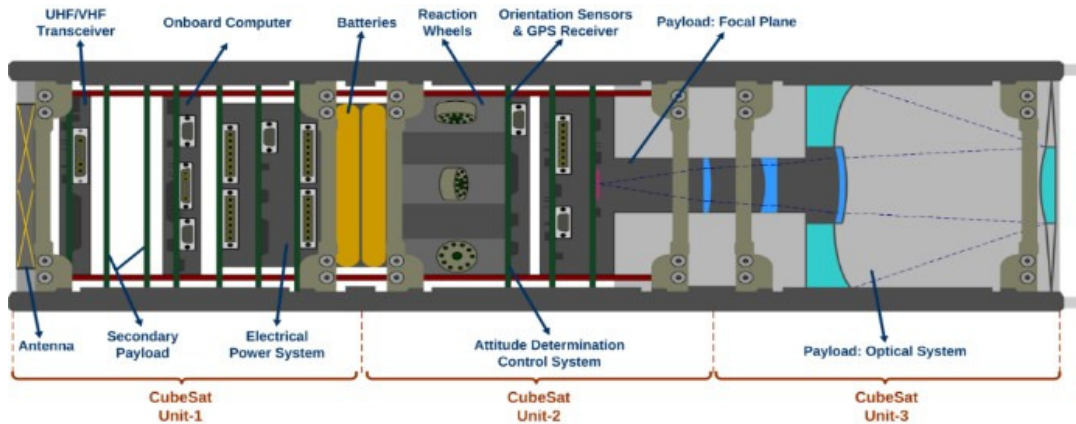


Figure 4: Scheme of ALISIO.

Finally, the third stage (2021-2022) will contemplate the stabilization of the team, with the launch of this microsatellite and with the independence and self-sufficiency of IACTec Space.

Our goals and motivation for the following five years can be summarized as:

- Create and train a multidisciplinary team in space engineering.
- Consolidate new projects to design and manufacture payloads that allow remote imaging the Earth from space with nano-satellites.
- Placement of IAC and the Canary Islands within the world map of small satellites.
- Generation of a business network in Tenerife / Canary Islands linked to space.
- Promotion of public-private collaboration in the space sector in the Canary Islands.
- Launch of the first Earth observation satellite with a sub-meter resolution with charge designed and manufactured in the Canary Islands.
- Open new windows for research.

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