CENTRO REGIONAL PARA LA EDUCACION EN CIENCIA Y TECNOLOGIA ESPACIAL DE AMERICA LATINA Y EL CARIBE (CRECTEALC)-CAMPUS MEXICO

Perspectives on research and education on GNSS

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Background on the origin of CRECTEALC

- Regional Centers for Education on Space Science and Technology, is an initiative of the Office for Outer Space Affairs (OOSA) of the United Nations Organization (UN).

- The UN General Assembly, on December 11, 1990, approved the creation of Regional Centers for Research and Education on Space Science and Technology, hosted by national or regional education institutions in the developing countries.

- On December 6, 1995, the UN General Assembly approved starting the formation of the regional centers and the UN will provide support to establish relationship among academic institutions working in space disciplines.

•On December 6, 1999, the General Assembly accepted and approved the UNISPACE III conference recommendation known as “The Millennium Space: Vienna declaration for space and human development”, stating that the regional centers should ensure economy and funding for their success.

•On 3-7 September 2001, the UN-OOSA, organized a specialist meeting for defining the model contents of 4 courses for space education:

•Remote perception
•Satellite meteorology
•Satellite communications
•Space science

•The background for such courses are the physics, mathematics and engineering as taught in most universities in the world.

•The contents of courses are not adapted to any particular project or institution in the world.

Actual status

Regional centers have been created :

•In India, for the Asia Pacific region

•In Morocco and Nigeria for the Africa and West Asia regions

•In Brazil and Mexico for Latin America and the Caribbean
The Brazil Campus is located in San Jose dos Campos

All centers are working under the auspices of the UN-OOSA on the development and applications of the space science and technology.

CRECTEAL-Campus Mexico

- The Campus Mexico is hosted by the Instituto Nacional de Astrofísica, Optica y Electrónica (INAOE), in Tonantzintla, Puebla.

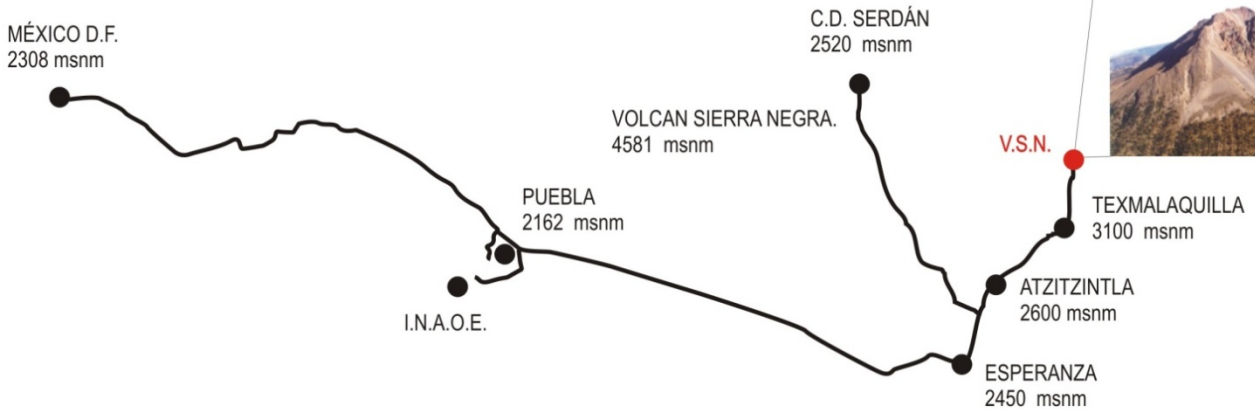
- Tonantzintla is located at 15 km from Puebla city and 120 km east from Mexico city.

- INAOE is a Research and educational center in the fields of Astrophysics, Optics, Electronics and Computer engineering.

- A complete postgraduate program in such fields grants Master and PhD degrees to students coming from all the country and from abroad.

CARRETERA MÉXICO PUEBLA -ESPERANZA

CROQUIS DE UBICACIÓN
DE LA CIMA DEL VOLCAN SIERRA NEGRA



Puebla-Caseta Esperanza (108km)
Caseta Esperanza-Entronque Atzitzintla (3km)
Entronque-Atzitzintla (8km)
Atzitzintla-Texmalaquilla (7km)
Texmalaquilla-Brecha Pico de Orizaba (7km)
Brecha Pico de Orizaba-Cima del Cerro la Negra (5.5km)


CUIDEMOS
LOS JARDINES

CRECTEAL-Campus Mexico

- The Campus Mexico started to work in 2004.
- A first one-year course on “Remote perception” started in September 2005.
- A second course on the same subject started in September 2006.
- A third course on “Remote perception” started in September 2007.

CRECTEAL-Campus Mexico

Up to date, 18 students coming from Mexico and from Latin America have attended such courses.

•The research activities on applications of this course are related to:

•Satellite images for applications on geographic information, cartography and urban cadastre.

•An image processing laboratory has been set-up in the past 3 years.

CRECTEAL-Campus Mexico

- **Satellite communications.**

- **The one-year satellite communications course has started in September 2006. This first course was attended by 3 Mexican, 1 Haitian and 1 Ecuadorian students.**

- **The second course started in September 2007 and attended by 4 Mexican students.**

As the students are either, computer or electronics and communications engineers, their backgrounds on physics, mathematics, and engineering are often quite different.

CRECTEAL-Campus Mexico

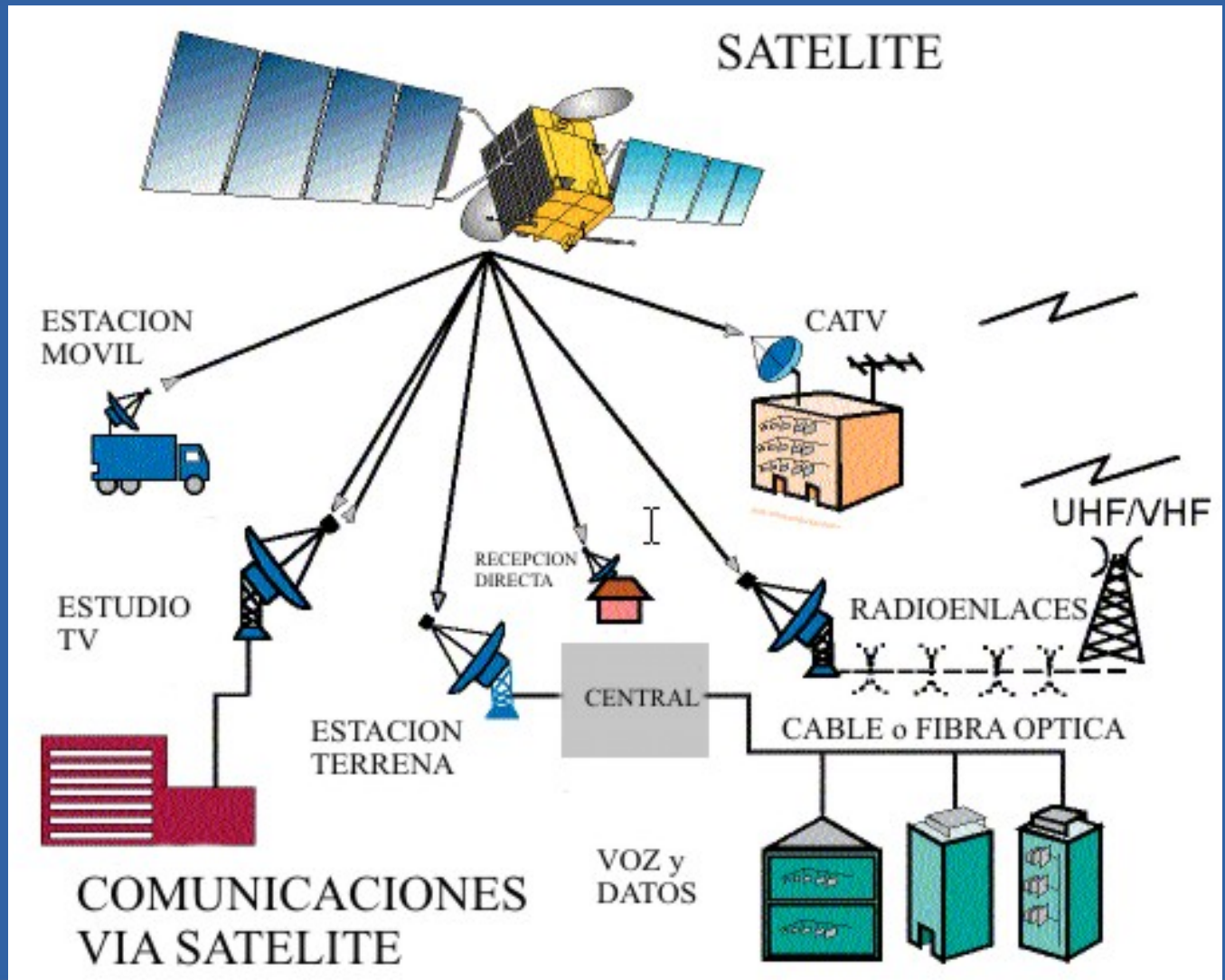
The one year course has been organized in three modules:

- **The first module is divided in several subjects, including signal processing, communication theory, electromagnetic theory, transmission lines and waveguides, modulation and multiplexing techniques, antenna theory.**

- **The second module is related to satellite communications theory for the space and terrestrial segments of a satellite link, the planning of a satellite link, the link budget and the administration and regulation of a satellite communication scheme.**

- **The third module studies mainly the applications of the satellite communications technology: fixed services (TV, VSAT), mobile services and the principles of GNSS.**

In this third module a short terminal project is included.

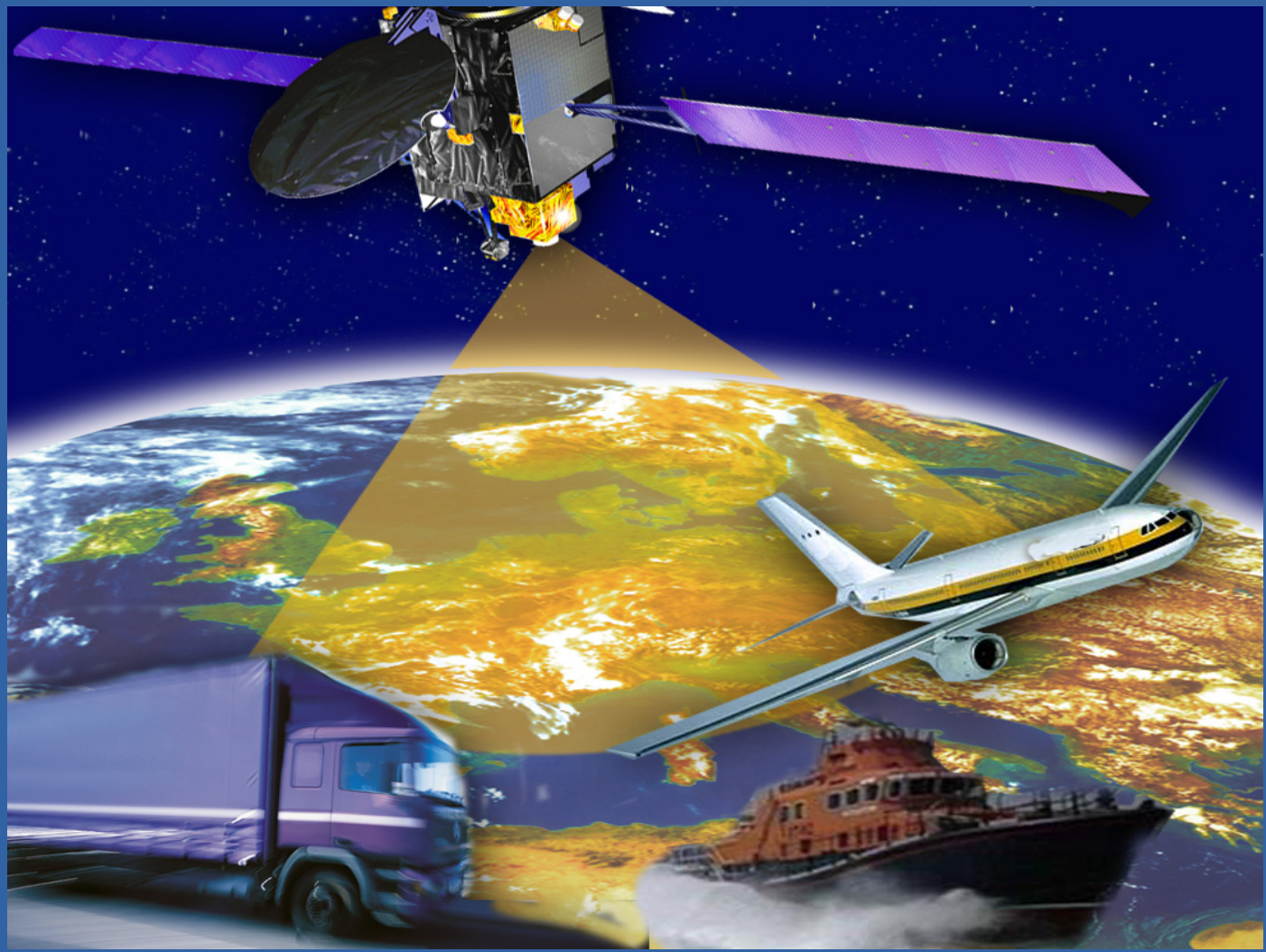

SATELITE
ESTACION MOVIL
CATV
UHF/VHF
RECEPCION DIRECTA
ESTUDIO TV
RADIOENLACES
CENTRAL
ESTACION TERRENA
CABLE o FIBRA OPTICA
VOZ y DATOS
COMUNICACIONES VIA SATELITE

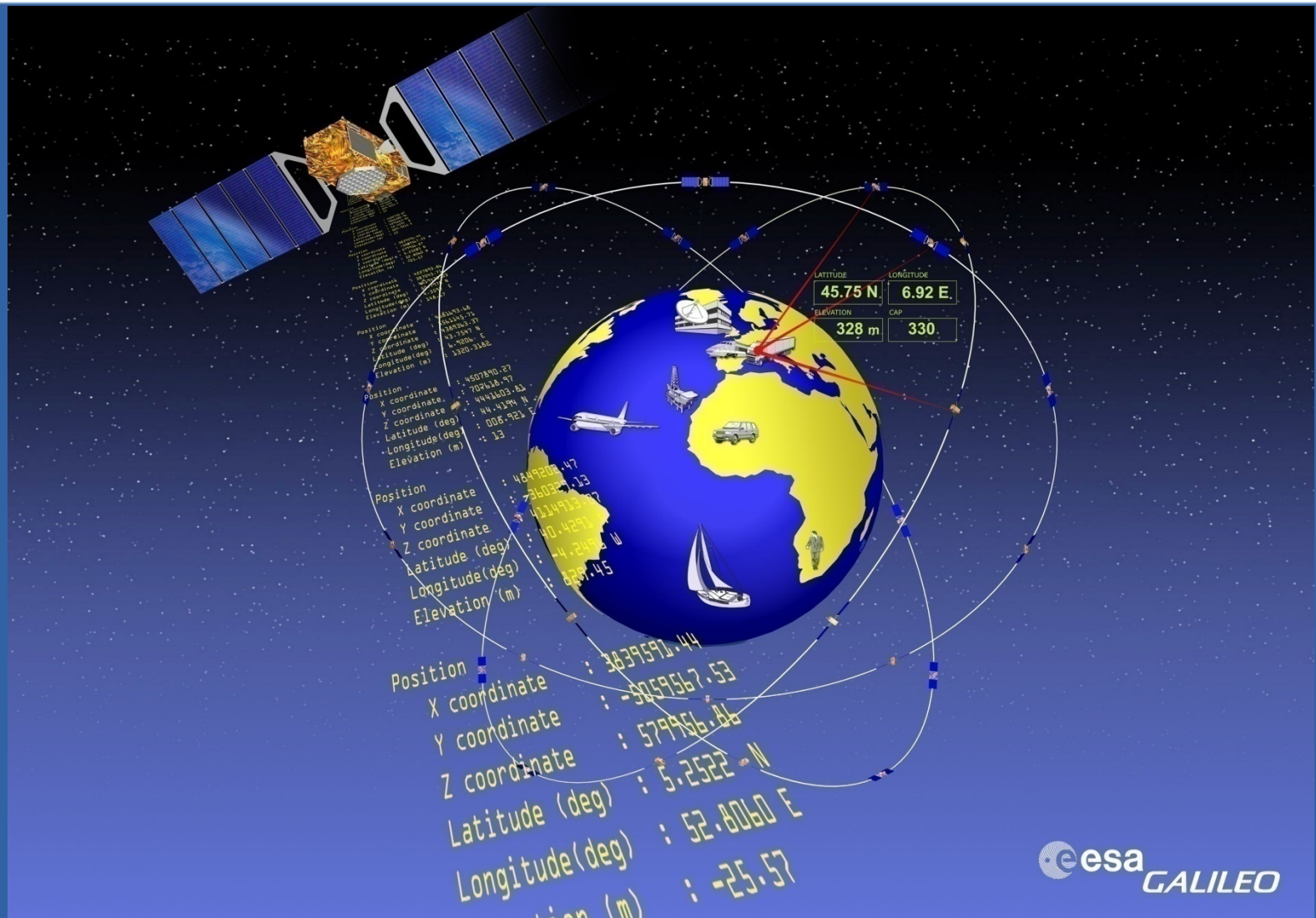
CRECTEAL-Campus Mexico

- Related to GNSS, the principles of NAVSTAR (GPS) and GALILEO are being integrated to the satellite communications course. A general description of the subject is realized.

- However as GNSS is becoming a very important subject; at CRECTEALC-Mexico, it is being considered to extended it to a more complete course.

- A more complete perspective is being analyzed in order to propose a specific postgraduate program (master and PhD) on space science and technology.




LATITUDE
45.75 N
LONGITUDE
6.92 E.
ELEVATION
328 m
CAP
330
Position
X coordinate : 3839591.44
Y coordinate : -5059567.53
Z coordinate : 579956.84
Latitude (deg) : 5.2522 N
Longitude(deg) : 52.8060 E
: -25.57
esa GALILEO

•**Research and education on satellite communications.**

At INAOE, there exists a research microwave laboratory, associated to the Gran Telescopio Milimétrico/Large Millimeter Telescope (GTM/LMT). This is a binational scientific project between Mexico (INAOE) and USA (UMass).

•**There is a potential for generating applied projects related to remote sensing, satellite telecommunications, satellite navigation and space science and technology development, in a collaborative basis, and open to international partners.**

•**The microwave infrastructure ensures hardware and software prototyping of components and systems for satellite signals (digital television, satellite data networks, GNSS signal reception, etc).**

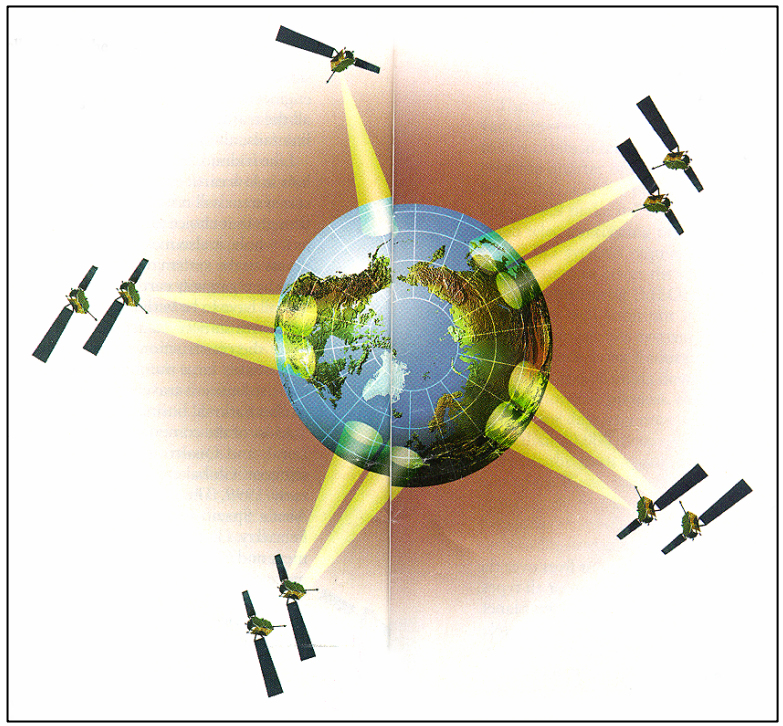
Gran Telescopio Milimétrico/Large Millimeter Telescope (GTM/LMT)

GTM/LMT MICROWAVE LABORATORY AT INAOE

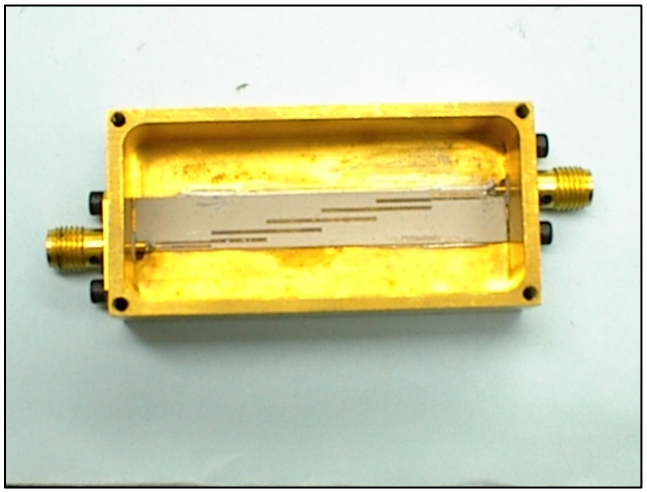
GTM/LMT MICROWAVE LABORATORY AT INAOE

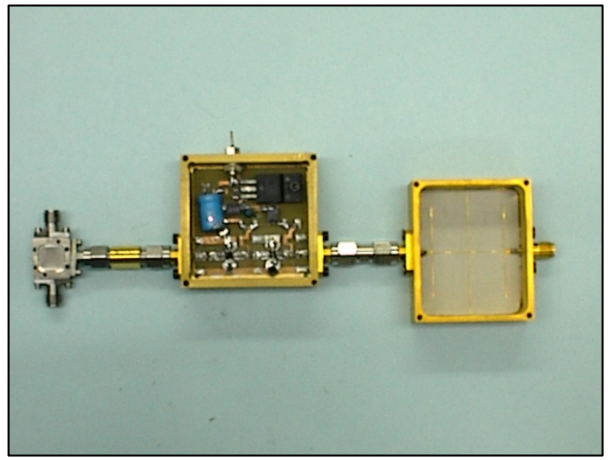
Research activities

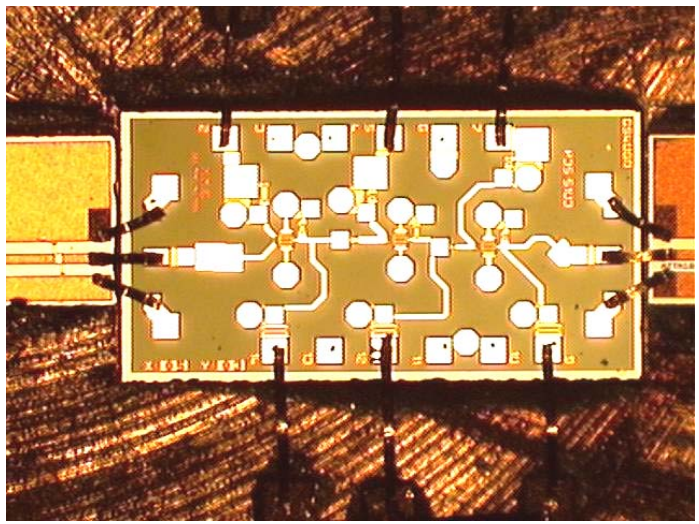
- Analog and digital satellite tv receivers.
- Microwave circuits and modules for telecommunications
- SATEX Project
- 38-40 GHz Radio link
- Radio over fiber transmission schemes



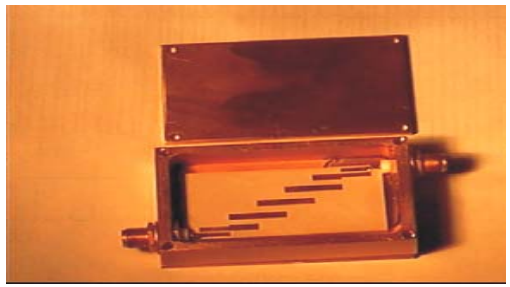
Microwave circuits and modules

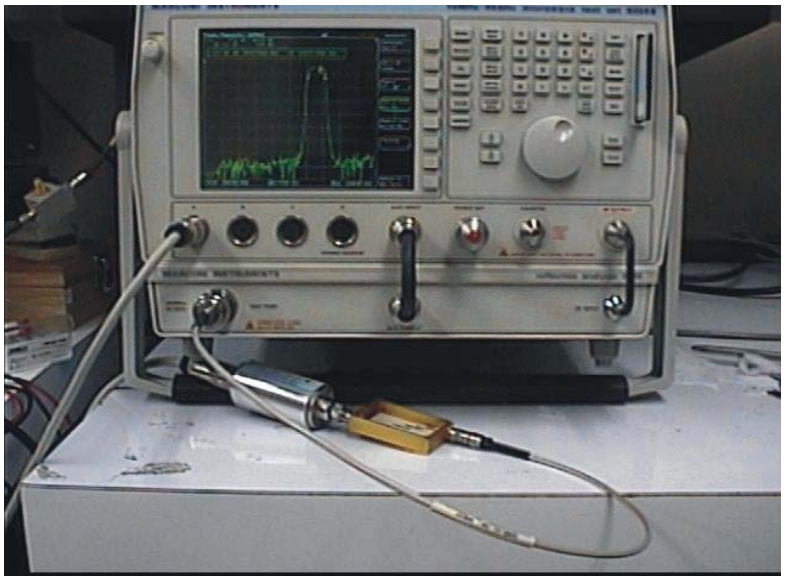






Microwave circuits and modules at INAOE





SatelliteTV

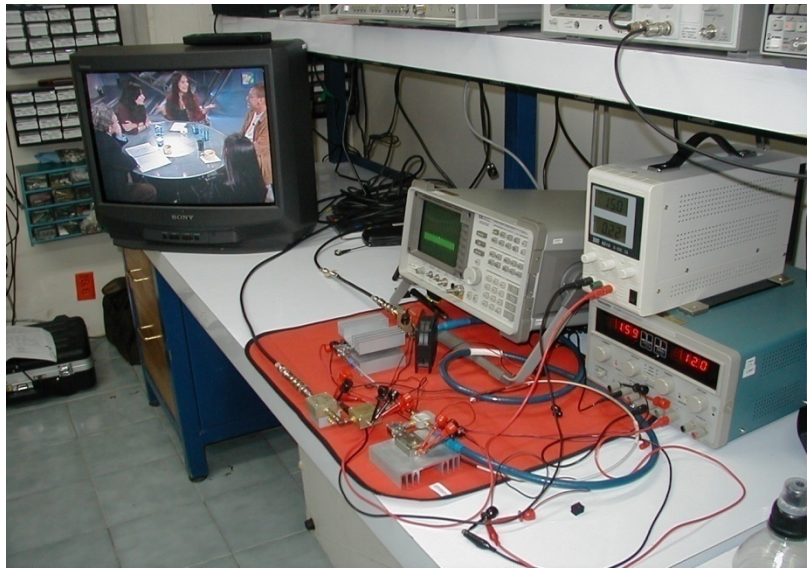
Antenna design for satellite TV reception

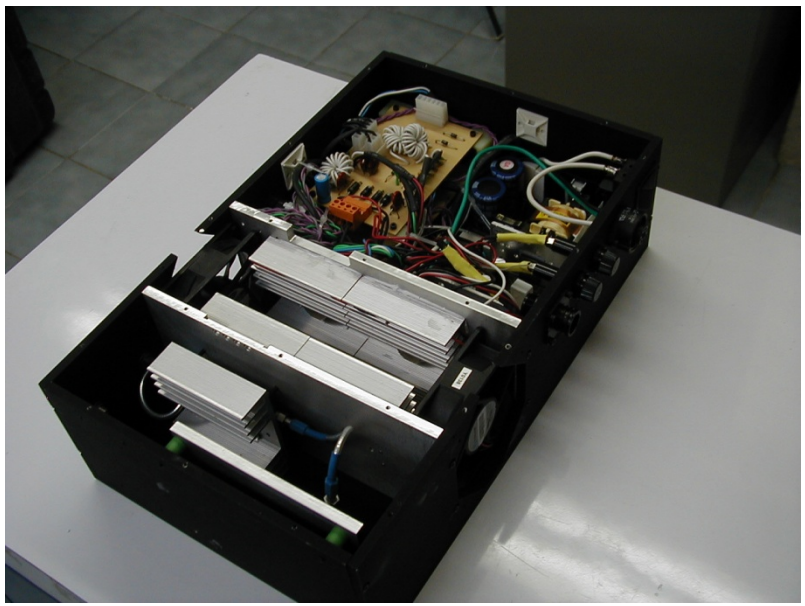
Antenna design for satellite TV reception

Satellite TV reception

Mexican inter-institutional SATEX project

- Low-orbit experimental microsatellite
- Ground station transmitter at 23. 5 GHz
- Satellite technology development





CRECTEAL-Campus Mexico

•Research and education on satellite communications.

In the frame of the microwave infrastructure, a “satellite communications laboratory” has been started.

The CRECTEALC students are working on their terminal projects using these facilities, depending on the availability of the infrastructure and equipments.

However, a very important issue is to set-up a specific space science and technology laboratory for CRECTEALC students and associated researchers and lecturers for working on specific projects (satellite communications, GNSS, satellite remote perception, etc).

CRECTEAL-Campus Mexico

- **Activities on GNSS for education and academic collaboration.**

- **CRECTEALC is associated to the Galileo Information Center for Latin America (GICA). This association is allowing that researchers and lecturers learn and teach about the GALILEO project and also participate in academic and professional meetings sponsored by GICA.**

- **Last December, CRECTEAL-Mexico has participated in the GALILEO Summer School, in Santa Maria, Brazil. The GALILEO Navigation and integrity subject was lectured by C. Gutierrez and an overview of GALILEO architecture was lectured by J. Gonzalez.**

- **Next September, CRECTEALC-Mexico will organize a GALILEO Autumn School, at INAOE, in Tonantzintla, Puebla, Mexico.**


Navegación, exactitud, in
sistema satelital Galileo
Celso Gutierrez Martine
INAOE/CRECTEALC
MEXICO

•**CRECTEAL-Campus Mexico**

•**Perspectives of GNSS development on satellite technology and applications:**

CRECTEALC-México has started to work on cartography of rural and urban areas and urban cadastre. For such applications, a well equipped laboratory for image processing from satellites has been set-up. Such a capability will easy to work on GNSS-based projects.

CRECTEALC-Mexico is also starting to work on hardware of satellite technology. Microwave and satellite infrastructure can promote collaborative work for GNSS hardware on depending of specific applications.

At CRECTEAL-Mexico, there is a special interest in studying GNSS signals as the potential applications may promote international collaborations for developing projects either related to applications or development of satellite technology.

CRECTEAL-Campus Mexico

- The courses at CRECTEAL-Mexico are open to students and professionals from Latin America and the Caribbean.

- The web page is www.crectealc.org

For the remote perception course: jagonzalez@inaoep.mx

- For the satellite communications course: cgutz@inaoep.mx

- Students are logged at INAOE and work full-time.

- Scholarships are possible as the International Affairs Ministry of Mexico receives applications of Latin America and Caribbean students. The web page is www.sre.gob.mx