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RF POWER LABORATORY

NATIONAL INSTITUTE OF AEROSPACE TECHNOLOGY (INTA)

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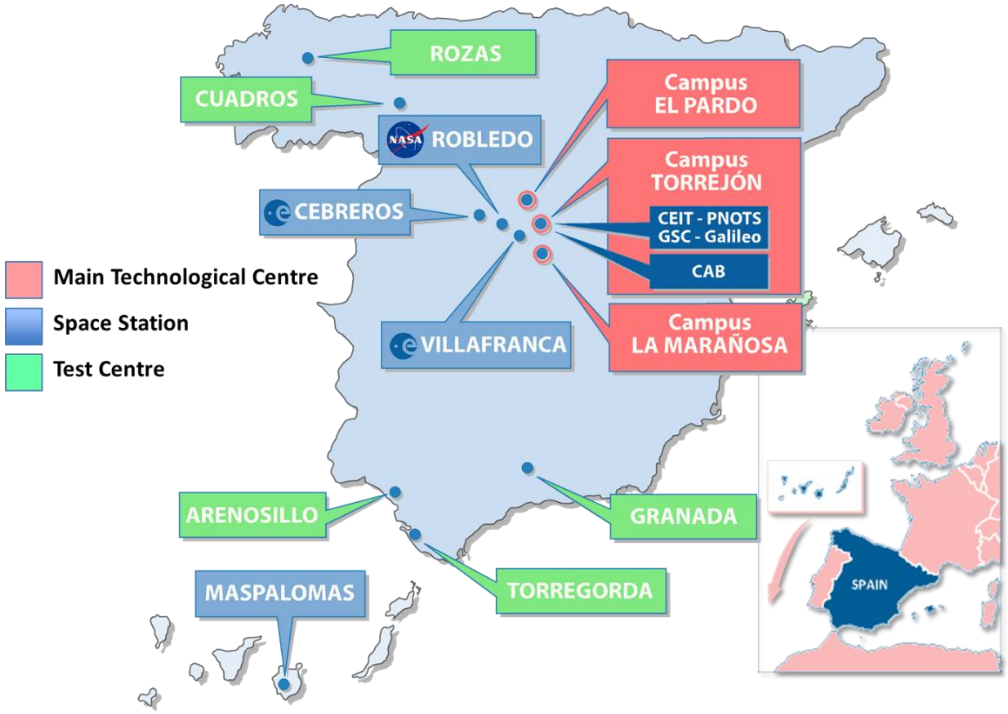
PRESENTATION

The *Spanish National Institute of Aerospace Technology (INTA)* is the public organism for research and development activities in the field of space and aeronautics. The central campus is located in Torrejón de Ardoz, close to Madrid. INTA is the most experienced and prestigious institution in the field of space engineering in Spain, and has played a leading role in many European projects during the last decades.



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INTA is located close to Madrid

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SYSTEMS AND EQUIPMENT

TEST DEPARTMENT

The *RF Power Laboratory* is enclosed within the *Systems and Equipment Test Department*, whose objectives are the space systems qualification, to develop new measurement techniques and to collaborate on research programs. It is composed of a wide set of facilities:

- *RF High-Power and PIM Tests*
- *Electromagnetic Compatibility Tests*
- *Environmental and Mechanical Tests*
- *Antenna and Cross-Section Radar Tests*
- *Radar systems and Electronic Warfare Tests*

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FIELD OF ACTIVITY

Since 2001 the *RF Power Laboratory* is devoted to carry out qualification and acceptance tests, according to the ECSS Standards, in the field of the RF high power:

- *Multipactor*
- *Corona*
- *Power Handling*
- *Passive Intermodulation (PIM)*
- *Thermal Vacuum Electrical Characterization*

ECSS standards applied

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EQUIPMENT CAPABILITIES

- RF high power *Amplifiers*, both CW and pulsed, up to 45 GHz.
- Two *VNA* systems, up to 50 GHz.
- State-of-the *Spectrum Analyzers*, up to 67 GHz.
- Doubled *LNAs*, up to 60 GHz.
- Wide set of *RF Generators*, up to 50 GHz.
- More than 40 *channels* of power measurement, up to 50 GHz.

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MULTIPACTION AND CORONA

- *Multipactor* and *Corona* testing.
- Local and global *Detection Methods*
  - Nulling
  - Harmonics
  - Envelope
  - Photo detection
  - Electron probe
  - High precision pressure gauge
- Various methods of *Electron Seeding*
  - Sr-90 radioactive source
  - Electron gun
  - Ultra-violet light sources
- Ability to test on *Different Atmospheres*
  - Terrestrial, nitrogen, Martian, helium, etc.

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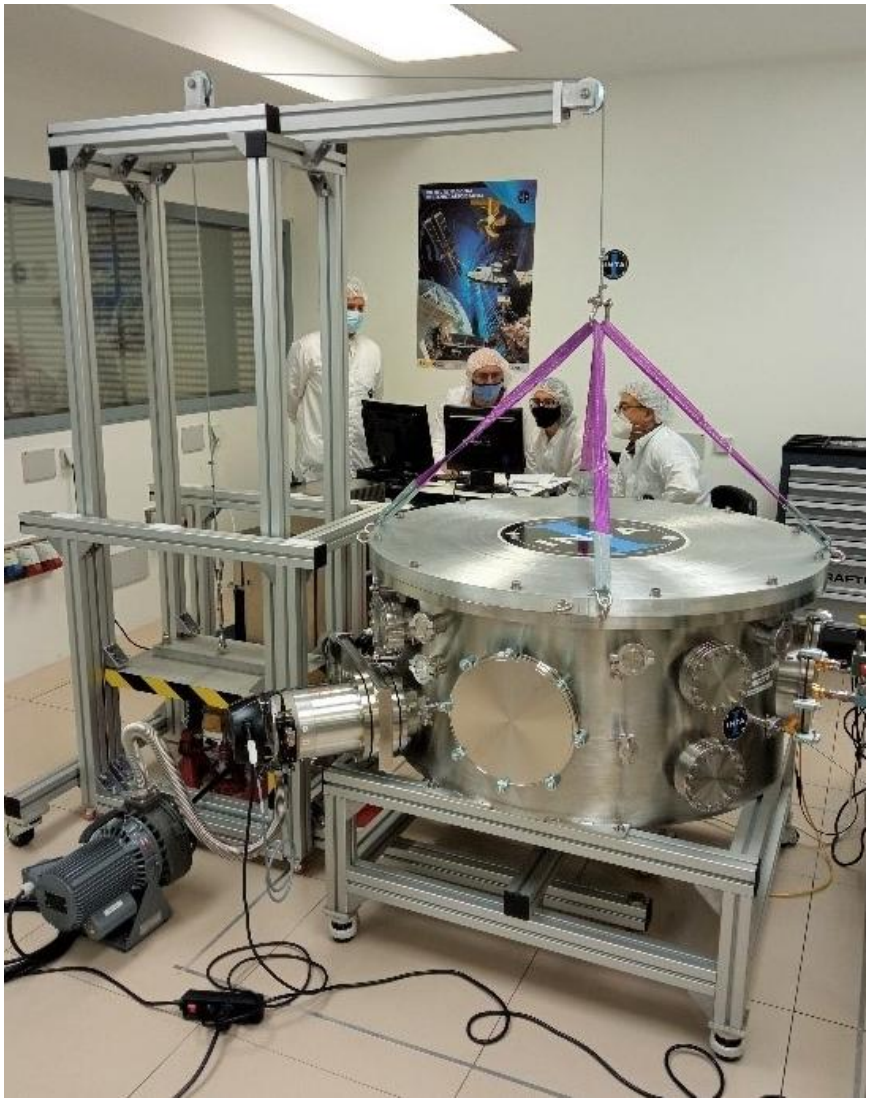

MULCOPOWER thermal vacuum chamber, inside clean room

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The team performing a multipaction test

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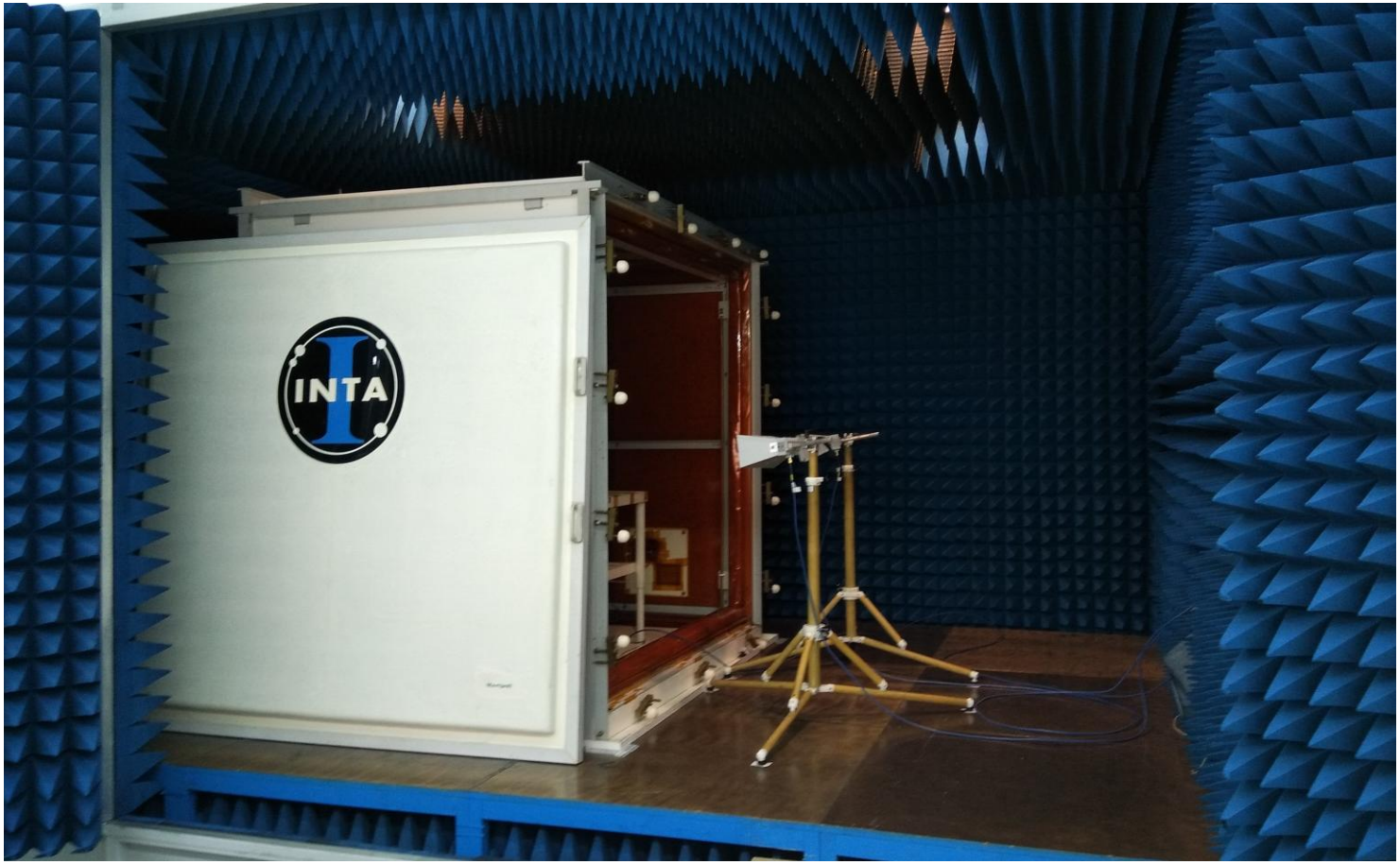
PASSIVE INTERMODULATION

- Testing capability for *Radiated PIM* and *Conducted PIM* within the power and frequency capabilities stated before.
- Full range of *Low-PIM Equipment*: PIM free cables, filters, radiating antennas, PIM sources, connection gaskets, etc.
- Especially designed *PIM Thermal Chamber* for radiated testing, full nitrogen atmosphere and temperature range ±150 ºC.

Characteristic	Chamber
Anechoic PIM Chamber measures	5000 x 4200 x 3300 mm
Thermal PIM Chamber measures	1800 x 1800 x 1500 mm
Temperature Range	- 150ºC to + 150ºC
Humidity	Zero Humidity (full nitrogen atmosphere)
Frequency	10 KHz to 50 GHz



Thermal anechoic chamber, for radiated PIM testing

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CLEAN ROOM AND THERMAL VACUUM CHAMBERS

- A *Clean Room*, class ISO-8, surface 100 m2, mostly dedicated to flight components integration and tests, with the Mulcopower thermal vacuum chamber placed inside.
- A *Total of Four* thermal vacuum chambers with different sizes and temperature ranges.

Characteristic	TVC-0	TVC-1	TVC-2	MULCOPOWER TVAC
Useful Capacity	4000 x 4000 x 4000 mm	Ø 1300 mm L 1500 mm	Ø 800 mm L 1000 mm	Ø 1000 mm L 500 mm
Temperature Range	- 170ºC to + 160ºC	- 150ºC to + 150ºC	- 150ºC to + 150ºC	- 70ºC to + 90ºC
Vacuum	Better than 1 x 10^{-6} mbar	Better than 1 x 10^{-6} mbar	Better than 5 x 10^{-6} mbar	Better than 5 x 10^{-6} mbar

Cleam Room class ISO-8

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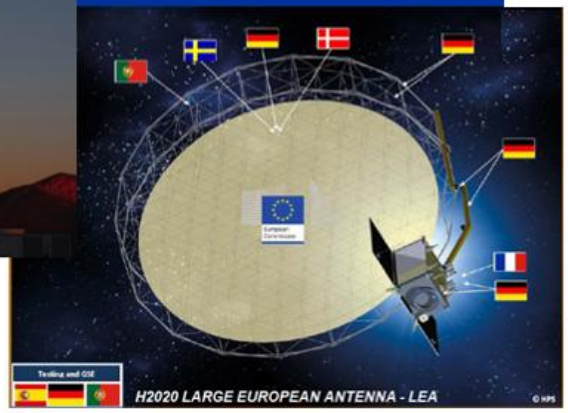
PROJECTS PARTICIPATED

➢ The RF Power Laboratory has been involved in *many projects* during the last years, amongst others:



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PROJECTS PARTICIPATED

➢ The RF Power Laboratory is member, has participated, or has presented papers, in the following research and development forums:

- ESA MULCOPIM Technical Committee
- IEC Technical Committee 46 (Passive Intermodulation)
- IEEE Transactions on Instrumentation and Measurements
- EURAMET-EMPIR "RF key quantities for 6G development", Technical Advisory Group.
- H2020 Large European Antenna
- EURAMET-EMPIR "FutureCom" Project
- EURAMET-EMPIR "RF key quantities for 6G development"
- MULCOPIM 2011, 2017, 2022, 2025
- European Technology Harmonization Program
- ESA 2025 Space Microwae Week
- Spanish Government CSIC "Retos" and "Generación del Conocimiento" Programs
- Universidad Autónoma de Madrid (UAM)
- Universidad Politécnica de Madrid (UPM)

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Thanks for your attention!

Martín García-Patrón

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