

# Potenziamento del laboratorio XACT per la caratterizzazione e test di materiali e componenti per lo spazio

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On behalf of the  
INAF-OAPA lab staff

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**INAF**

ISTITUTO NAZIONALE  
DI ASTROFISICA

INAF  
Osservatorio Astronomico  
di Palermo  
G.S. Vaiana



## The Lab in a nutshell

- Imagined by prof. Vaiana
- Working since 1993
- Missions:
  - Development and calibration of instrumentation to observe X-rays in extra-terrestrial environment
  - Development and design of new instrumentation

# Current involvement on space missions

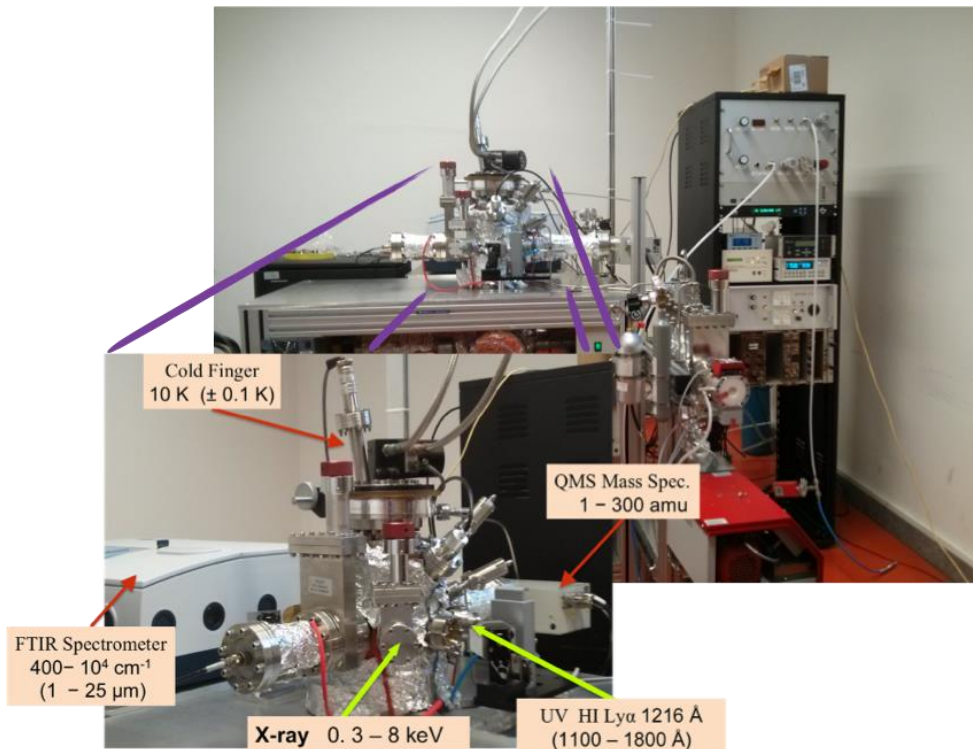
Space missions:

- **Athena**, an L-class mission of ESA. Launch expected in 2037
- **MUSE**, a MIDEX Solar mission of NASA. Launch expected in 2027.
- **Ariel**, an Infrared Exoplanet mission, already adopted in Nov 2020.  
Launch expected 2029
- **eXTP**, an X-ray Chinese mission

# Laboratorio LIFE +

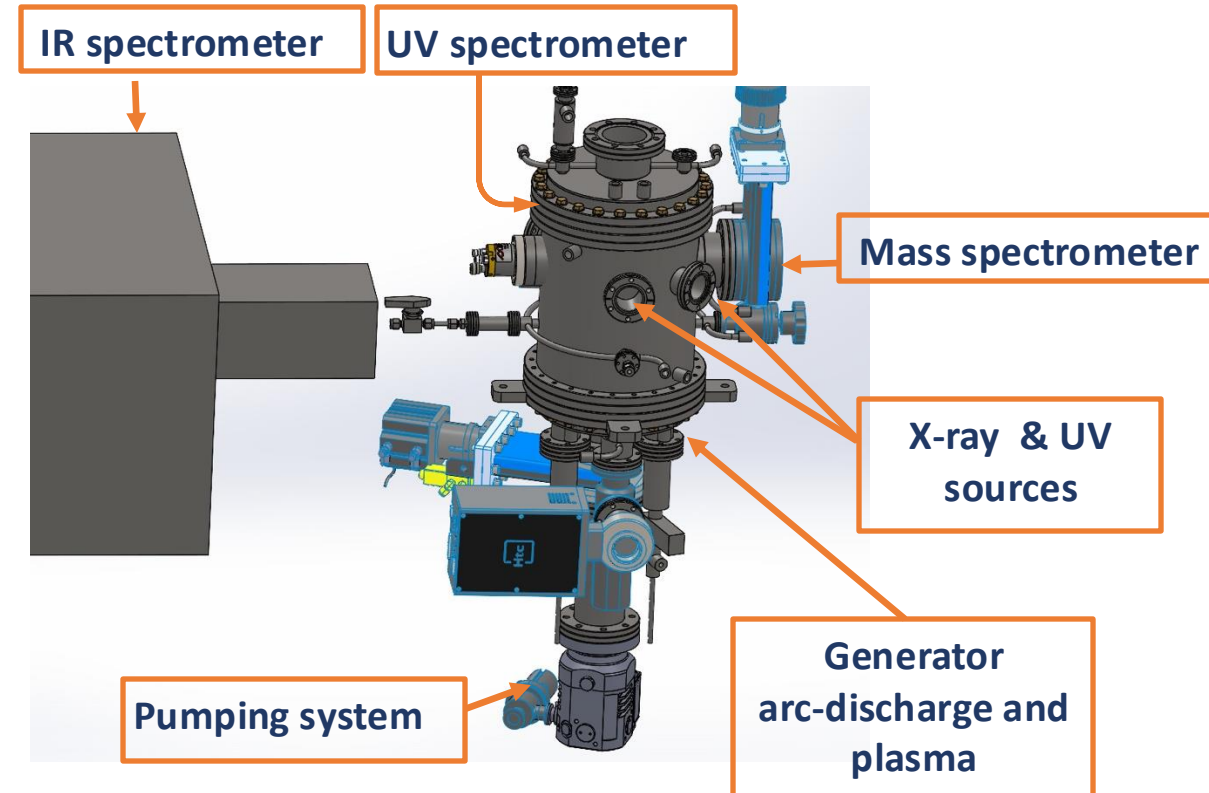
## Chemistry of the interstellar ices

- UHV ( $10^{-11}$ ) system designed to study the solid-state chemistry of the interstellar medium subject to ionizing radiation
- Study the prebiotic chemistry (astrobiology) synthesized in circumstellar conditions



## Exoplanet atmosphere simulation

- Design and fabrication of an apparatus to simulate the atmospheres for the investigation of the chemical and physical evolution of gas mixture under high-energy irradiation (UV, X-rays) and arc discharge.



# Expertise of the Team

## Characterizations

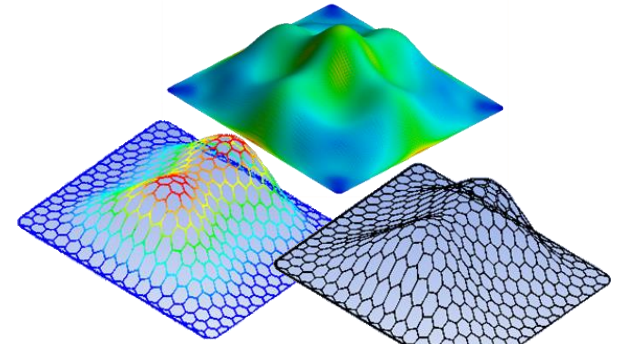
- UV/VIS/IR spectroscopy (transmission and reflectivity)
- Spatial uniformity (beamline, UV/VIS mapping)
- X-ray transmission (synchrotron radiation)
- Defect analysis (optical microscopy)
- RF attenuation
- Bulge tests
- Thermovacuum tests
- Vibrational tests and dynamic measurements

## Modeling

- Wide band transmission of radiation
- Photon shot noise
- Mechanical FEM analysis
- Thermal FEM analysis

## Manufacturing

- Design and Mechanical fabrication
- Film thin deposition
- Micro-photolithography
- Lift-off and chemical etching
- Lapping and polishing



# Technology transfer

## Hail-net for agriculture applications

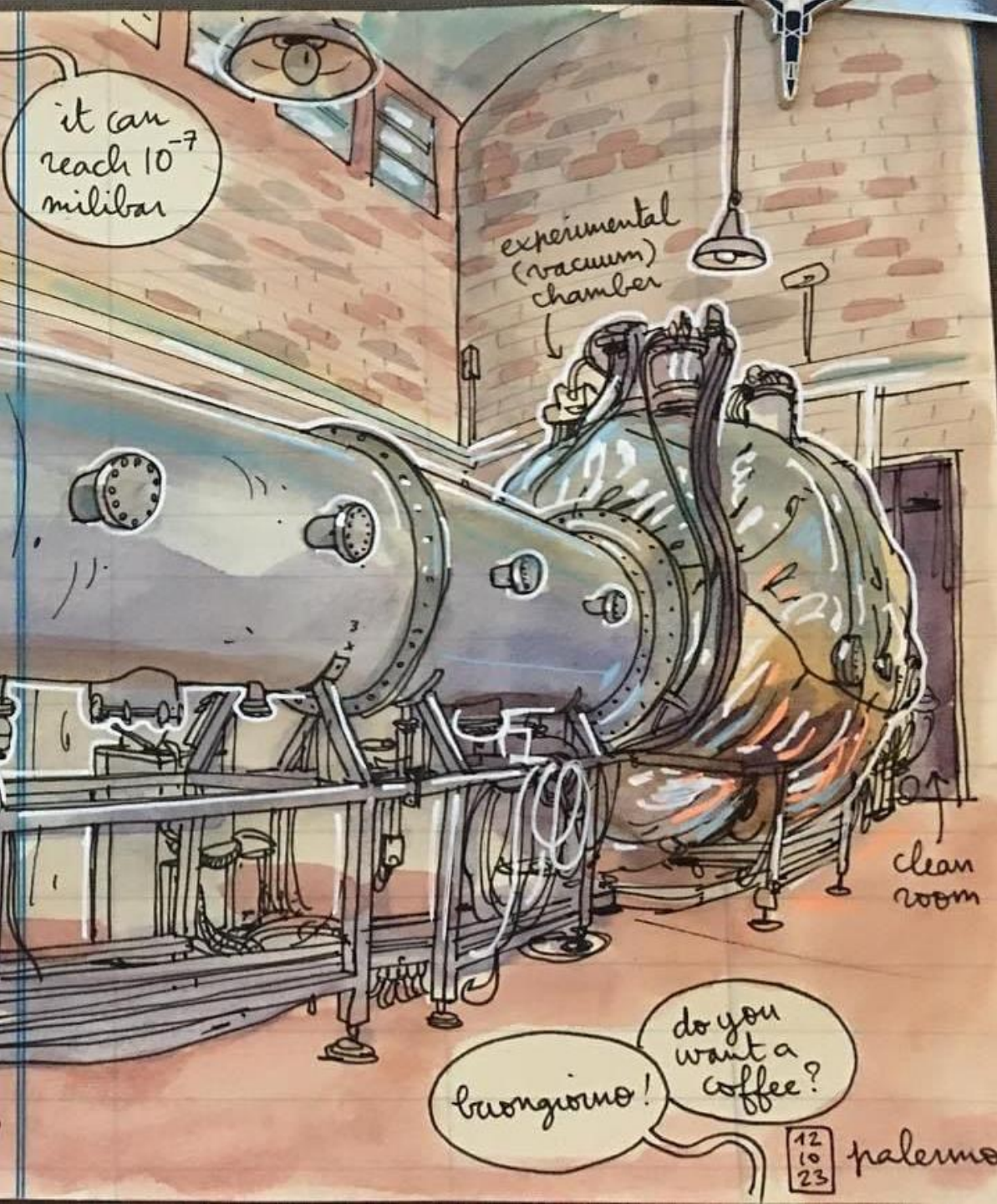


Spectroscopic analysis to understand both which portion of spectra is responsible for a high production of fruits/vegetables, and which kind of phenomena speed up the growing

## Ballons for remote-sensing applications



Development of remote-sensing helikite to monitor large area with heavier payloads than a drone can support for several applications (i.e. fire prevention...)

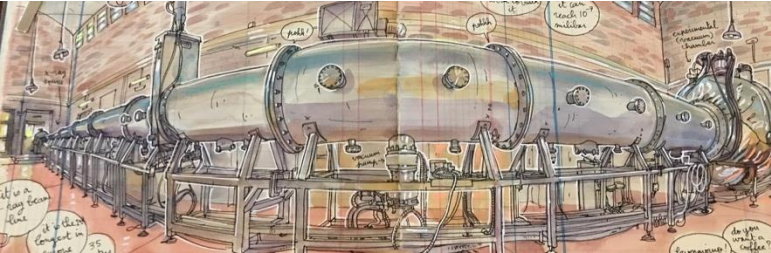


## The proposal in a nutshell

- A laboratory accessible to all INAF activities focused on the characterization and testing of materials, components, and subsystems for current and future missions
- Objectives include:
  - ✓ the development of the XACT beamline;
  - ✓ enhancing the range of characterization and testing capabilities;
  - ✓ expanding the cleanroom to ensure high levels of cleanliness.

# Actual and Future Labs

XACT beamline

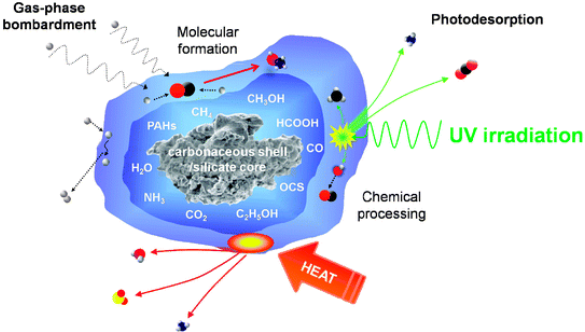


METALab

Mechanical and Environmental Testing for Astrophysics Laboratory



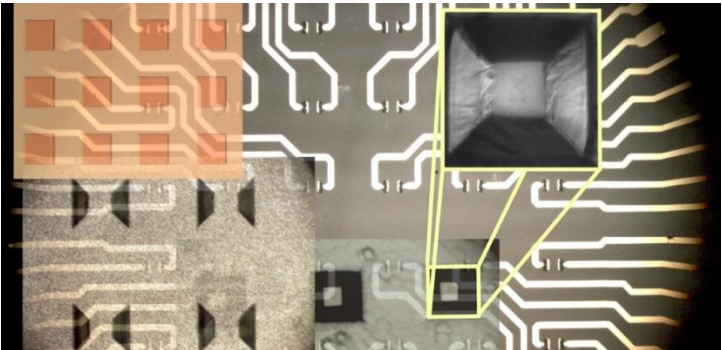
LIFE, LIFE+, Exochemistry Lab



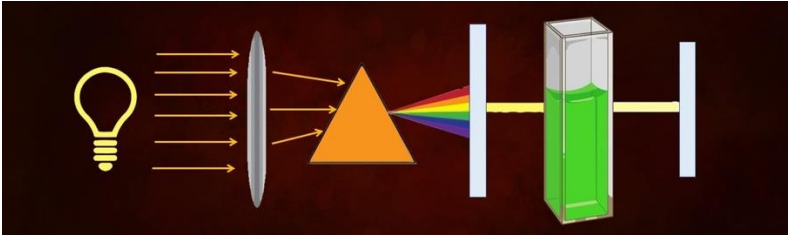
High-precision Workshop



Microtechnology Lab



Spectroscopic Lab





# Instruments and equipment at the INAF-OAPA lab

- XACT beamline
- 2 cleanrooms (ISO6)
- Thermovacuum
- Bulge test apparatus and profilometer
- CNC and traditional machines
- Plasma-Enhanced Chemical Vapor Deposition
- Mask aligner
- Digital microscope (up to 2500x)
- UV/VIS/NIR double spectrophotometer
- FT-IR spectrometer (MIR and FIR)
- IR microscopy
- LIFE (FT-IR in UHV equipped with a X-ray source, an UV lamp, and a mass spectrometer)
- Climatic Chamber
- e-beam evaporation system
- 3D printers
- Some hoods
- High-Speed Milling Machine
- Electrodynamic Shaker 8 kN
- Laser scanner vibrometer

# Instruments and equipment to be

- A high flux X-ray source
- New clean area
- GC-MS
- SEM
- Solar simulator
- Updated thermo-vacuum cycling system
- VUV spectrometer
- 3D measuring machine
- Atomic Force Microscopy
- Optical micro profilometer

✓ the development of the XACT beamline;

✓ expanding the cleanroom to ensure high levels of cleanliness.

✓ enhancing the range of characterization and testing capabilities;

✓ Enhancing measurement capabilities to boost prototyping capabilities.

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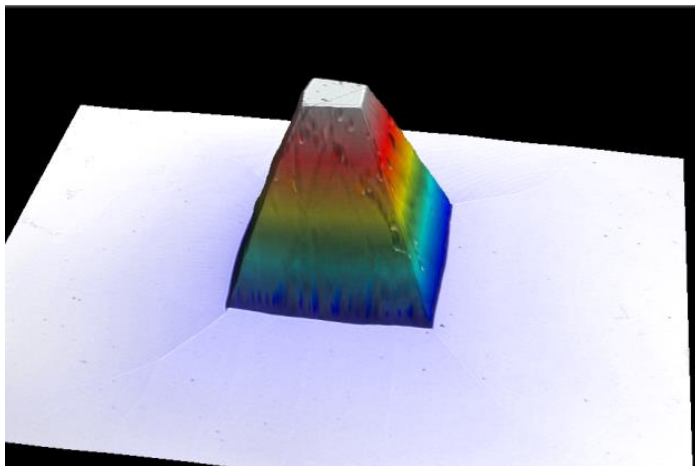
- Potenziare il prototipaggio di componenti opto-meccaniche con strumenti di misura di eccellenza. (F. D'Anca)

### ARIEL Project

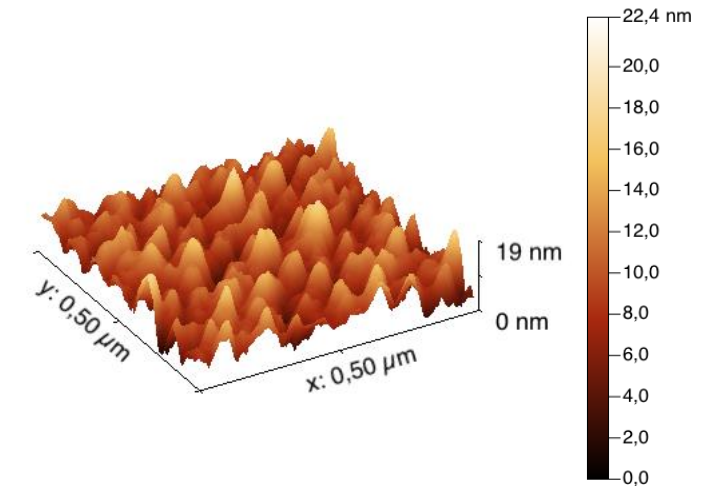
Mirror 1 - Flexure Hinges



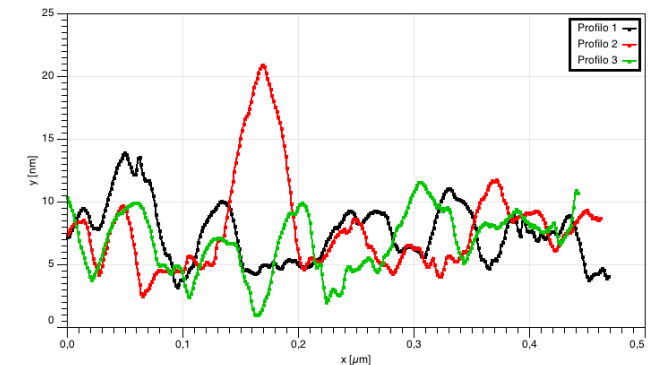
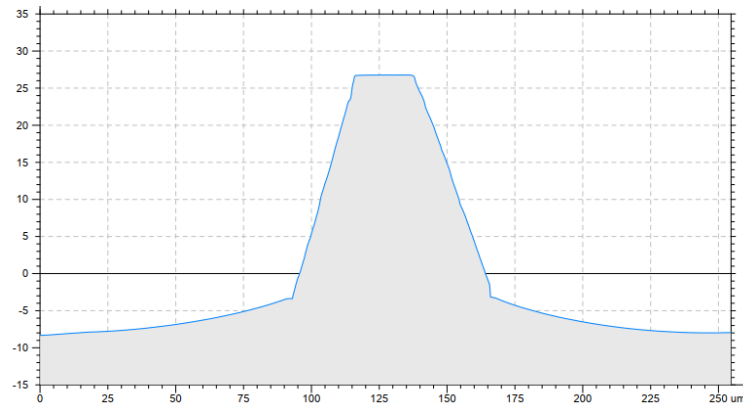
- Micro-profilometro ottico ad alta risoluzione per potenziare capacità di sviluppo tecnologico e controlli di qualità. (U. Lo Cicero)



- La microscopia a forza atomica per lo studio di fenomeni di invecchiamento e stress meccanico di materiali e componenti per lo spazio. (L.Sciortino)



### Hemispherical Support





Alfonso Collura  
Astrophysicist  
Head of the lab



Angela Ciaravella  
Astrophysicist



Alfonso Mangione  
Physicist of Materials



Salvatore Varisco  
Technician/Electronic  
Eng



Michela Todaro  
Physicist of Materials



Ugo Lo Cicero  
Electronic Eng



Antonio Jiménez-  
Escobar  
Astrochemist



Gaspare Di Cicca  
Technician



Alberto Gulizzi  
Technician



Luisa Sciortino  
Material Chemist



Fabio D'Anca  
Mechanical Eng



Elisa Guerriero  
Physicist



Claudio Saitta  
Technician



Roberto Candia  
Technician



Edoardo Alaimo  
Ph.D. student



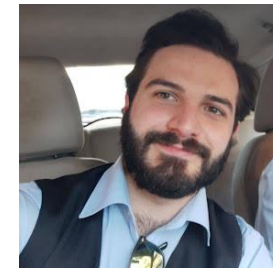
Marco Barbera  
Astrophysicist  
UniPa professor



Federico Fiorentino  
Ph.D. student



Nicola Montinaro  
Mechanical Eng  
UniPa researcher



Davide Cardinale  
Ph.D. student

