

OAPA Laboratories and Facilities

Ugo Lo Cicero / Marco Barbera



Istituto Nazionale di AstroFisica

Osservatorio Astronomico di Palermo G.S. Vaiana
Palermo, Italy



Università degli Studi di Palermo

Dipartimento di Fisica e Chimica – Emilio Segrè
Palermo, Italy

OUTLINE

- **Main active projects**
- **XACT: X-ray Astronomy Calibration and Testing facility**
- **Micro-technology lab**
- **FIR/IR/VIS/UV spectroscopy**
- **Cryogenics and environmental tests**
- **Differential pressure profilometry**
- **LIFE: Light Irradiation Facility for Exochemistry**
- **Mechanical prototyping**
- **People**

Main active projects

Athena (ESA Cosmic Vision L mission)

- Design, procurement, characterization and calibration of the X-ray filters for the Athena X-IFU and WFI.

eXTP (Chinese Academy of Sciences)

- Design, characterization and calibration of the thin X-ray filters for the LAD instrument.
- Effective area calibration of the LAD modules.

MUSE (NASA MIDEX)

- Design, procurement, characterization and calibration of the multilayer reflective optics entrance filters and filter wheel optical blocking filters for the back illuminated CCD detectors

AHEAD2020 (Horizon 2020 – Consolidated Infrastructures)

- Athena low energy response: filters optimization and calibration accuracy
- Design and procurement of X-ray thin filters for a PIXE (Particle Induced X-ray Emission) prototype.

LAOF - Large Area Optical Filters (ESA TRP contract)

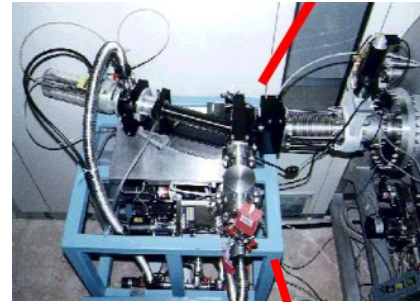
- Innovative thin filters for space applications (Si_2N_4 , PI/PI, CNT)

MITA - Micro-meteoroid Impact Tests for Athena (ESA CTP contract)

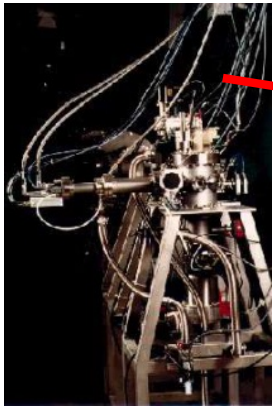
Space tweezers

- Synthesis and characterisation of organic residues as representative coating of planetary dust.

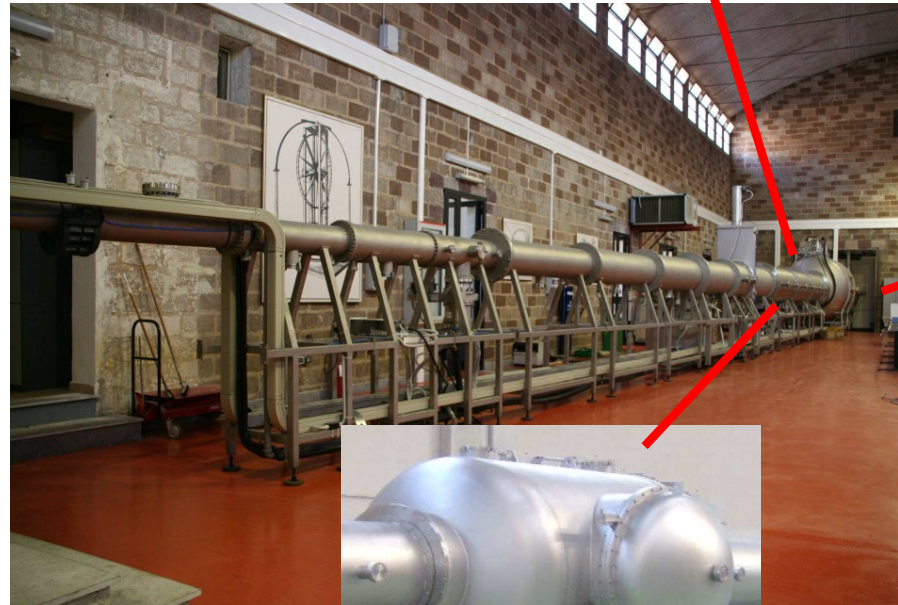
XACT facility (X-ray astronomy calibration and testing)



UV/Vis beamline
attached to the
side port of the
detector test
chamber



Multi anode electron-
impact X-ray source
(100 eV – 18 keV).
Equipped with fixed
beam double
diffraction
monochromator



Thermostated telescope
chamber: 200 cm diam.,
350 cm long. Equipped
with Alt-Azimuth mount.



The detector test
chamber opens
inside an ISO 6
cleanroom.

35 m long beamline,
 $P < 10^{-6}$ mbar
(maglev turbo pumps)

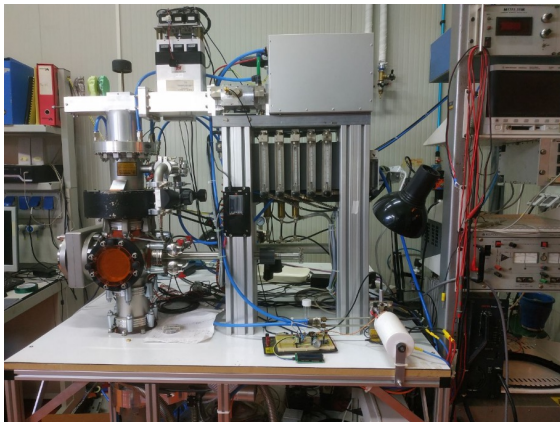
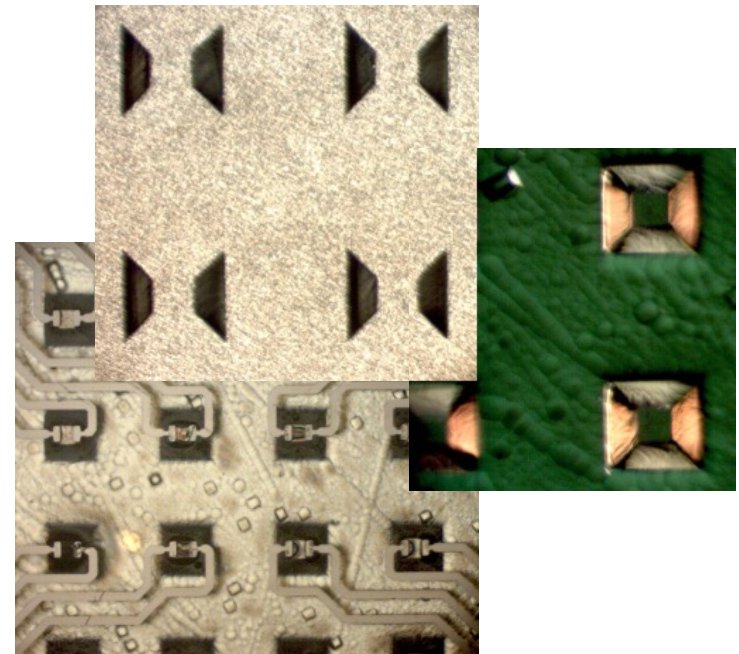
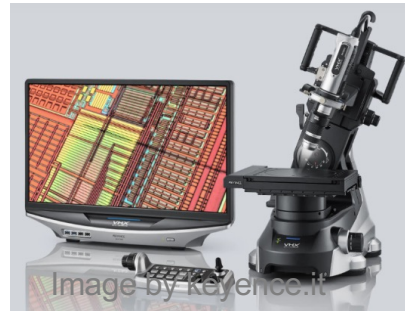
Calibration expertise at XACT

- **Chandra HRC** (operational since Aug. 1999)
 - Calibration of the UV/Ion shields
- **Newton-XMM EPIC** (operational since Dec. 1999)
 - Calibration of the thin and medium filters
- **HINODE XRT** (operational since Sept. 2006)
 - Calibration of the focal plane filters
 - Reflectivity measurements of flat mirror samples
- **Chang'E-1 LOXIA** (operational from October 2007 to March 2009)
 - Calibration of the detector Energy Resolution
 - Calibration of the detector QE vs. energy and angle of incidence
- **CORONAS-PHOTON SPHINX** (operational since January 2009 to Aprile 2010)
 - Calibration of detector Energy Resolution and pulse height linearity
 - Calibration of the detector QE vs. energy and angle of incidence
- **Athena** (in progress)
 - Uniformity characterization of filters for WFI and X-IFU instruments
- **eXTP** (in progress)
 - Effective area calibration of LAD modules
 - Uniformity characterization of filters for LAD instrument

Micro-technology laboratory

Equipment

- Cleanroom ISO 6 (25 m²).
- 3 crucibles e-beam evaporation system.
- Plasma enhanced chemical vapour deposition.
- Mask aligner.
- Lapping machine.
- Spin coater.
- Digital microscope.



Expertise

- Thin-film deposition and patterning.
- Patterned electrodeposition.
- Patterned chemical etching.
- Design and manufacturing of semiconductor based microcalorimeter X-ray sensors.

FIR/IR/VIS/UV spectroscopy

Equipment

- UV/VIS/IR (190 ÷ 3300 nm) spectrophotometer, with in integrating sphere and motorized sample holder.
- MIR/FIR (1250 nm ÷ 330 μ m) FT spectrophotometer, with ATR and reflectance measurement accessory.
- IR microscope (1330 nm ÷ 14.3 μ m), with micro-ATR and possibility to measure in transmission or in reflection.

Expertise

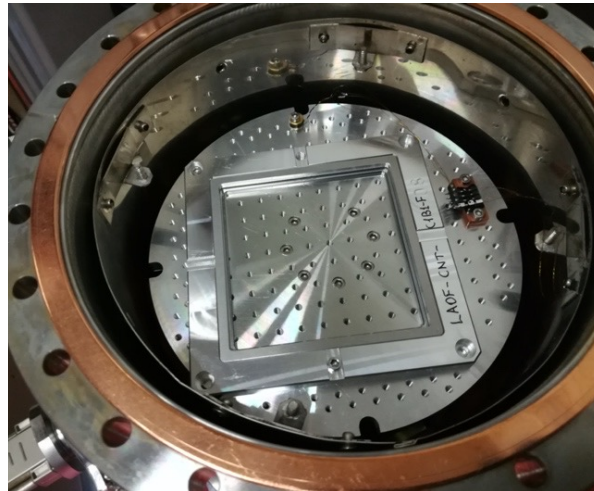
- Spectroscopic characterization of thin membranes.
- Measurement of surface reflectivity.
- Modelling refractive index curve of semi transparent materials.



Cryogenics and environmental tests

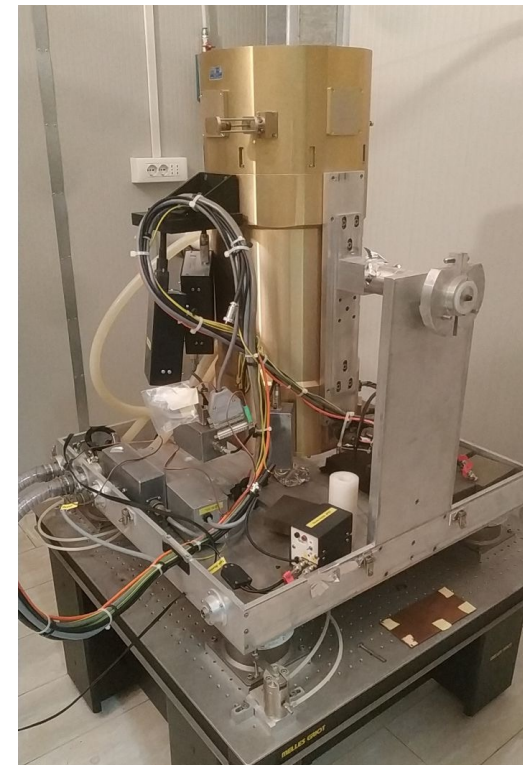
Equipment

- ADR vibration free cryostat, temperature down to 30 mK, hosted in an electrically shielded room.
- Thermo-vacuum chamber for thermal cycling, temperature down to 15 K, 160 mm diameter cold plate.
- Environmental chamber, internal dimensions: 800x700x892 mm, temperature -40°C to 180°C, humidity 10% to 98%.



Expertise

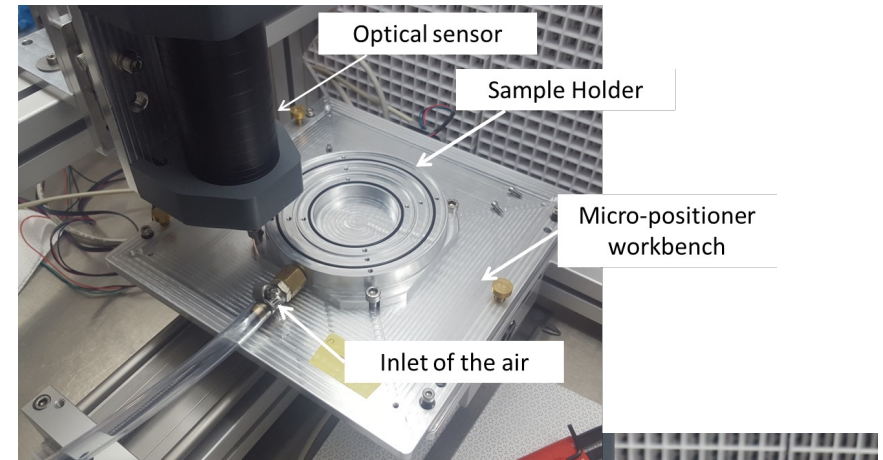
- Characterization of cryogenic sensors and cold electronics.
- Environmental cycling and tests on components for space missions.



Differential pressure profilometry

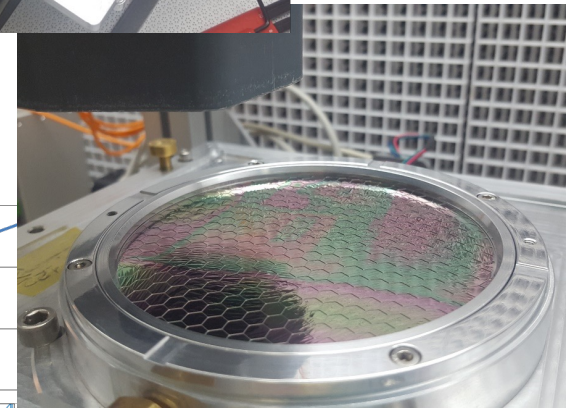
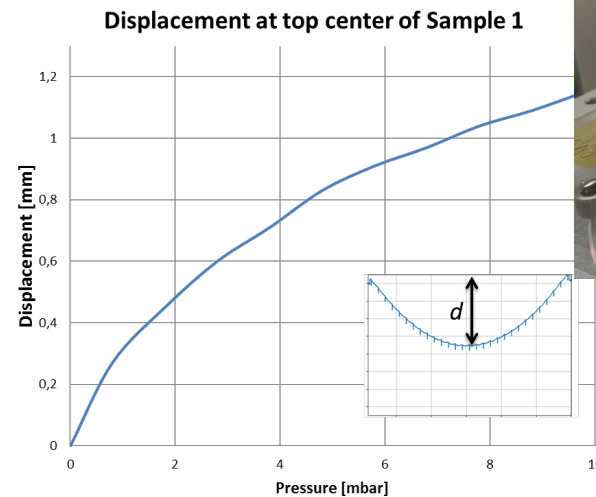
Equipment

- Micro-focused optical confocal distance sensor
- Electronically controlled pressure regulator
- Motorized XY translator



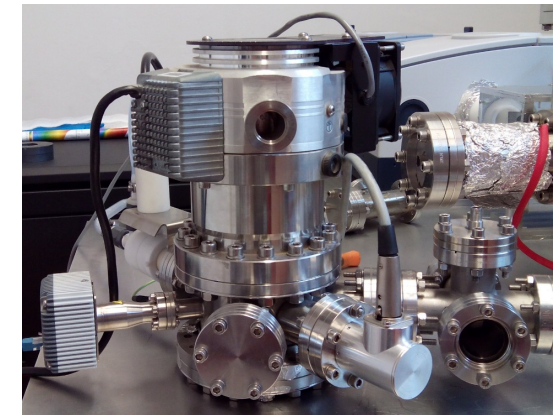
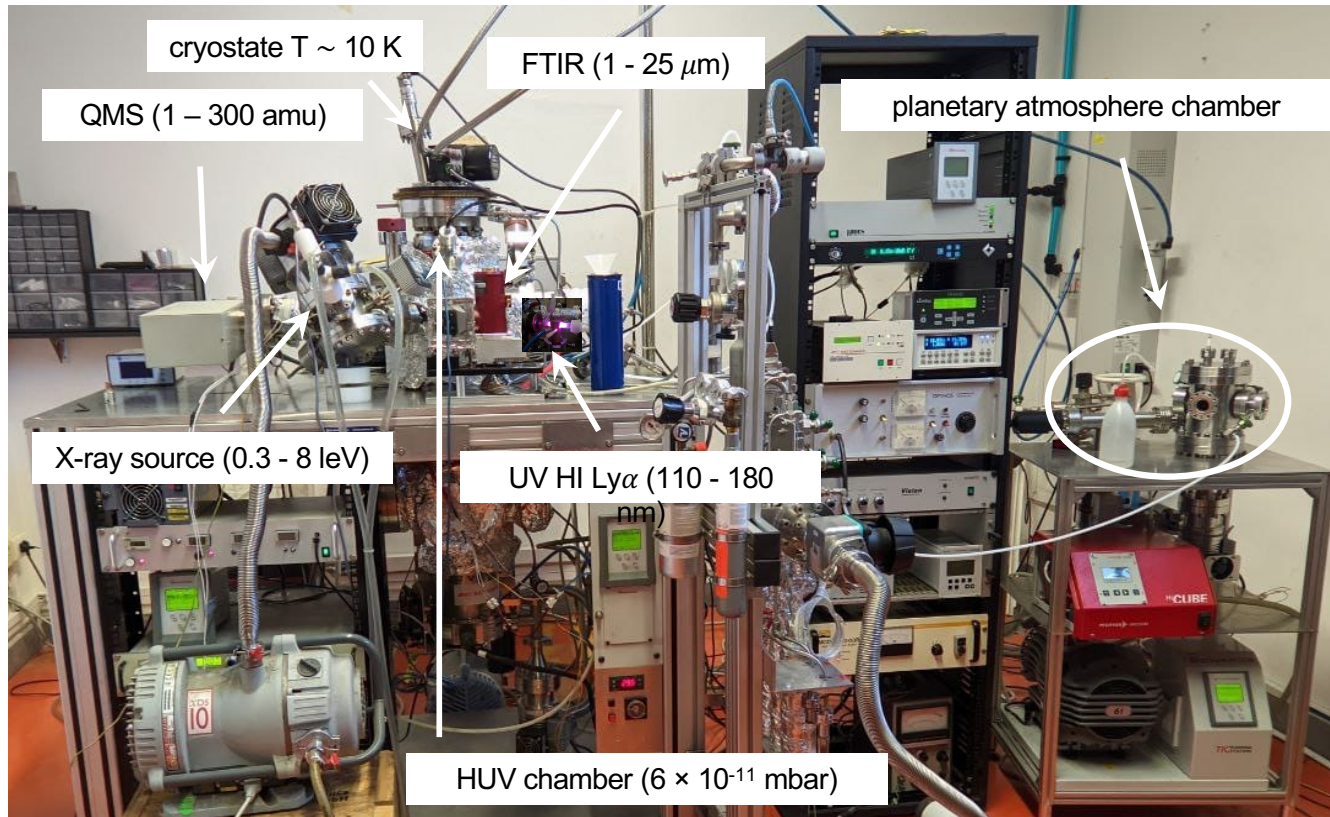
Expertise

- Mechanical characterization of thin membranes.
- Modelling mechanical properties of thin membranes.



LIFE: Light Irradiation Facility for Exochemistry

We study chemical processes that occur when ices and organics are exposed to ionizing radiation and the subsequent formation of more complex organic materials in the gas surrounding young solar-type stars



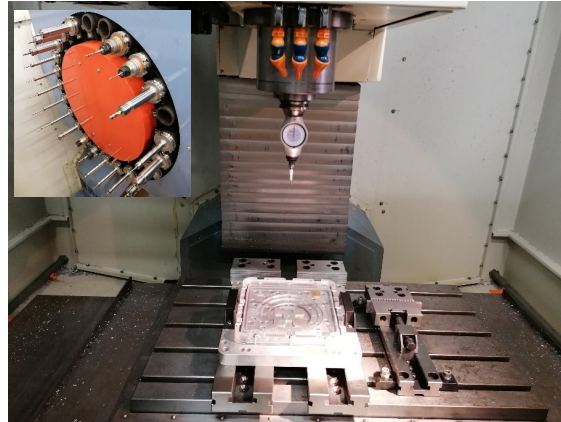
Built in house X-ray source
(electron impact)

X-ray emission from young solar-type stars is thousands of times brighter than that of today's sun with chemical implications quite unexplored; the OAPA group has pioneered the study of the formation and photoejection into the gas phase of organics in ice analogues irradiated by X-rays.

Mechanical prototyping

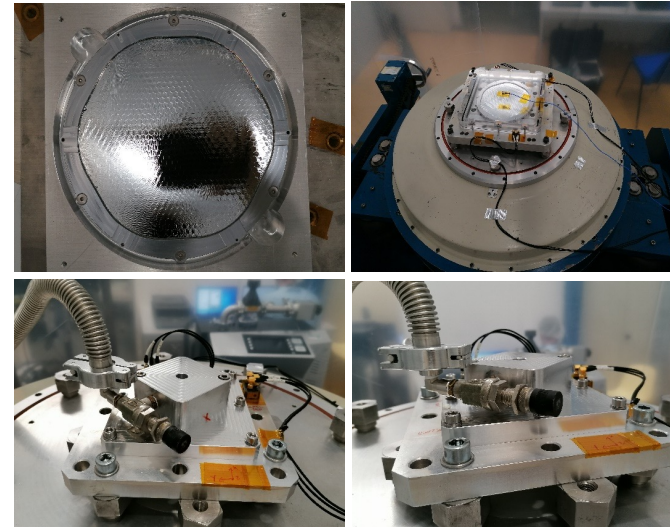


- CNC milling machine FAMUP MCX 700
- CNC lathe CMT URSUS TC
- 3 x Conventional lathe BOMAC
- Conventional milling machine BOMAC
- CAD-CAM
 - SOLIDWORKS
 - ESPRIT
- FEM
 - Structural analysis, static, random vibration and harmonic response
 - Transient structural
 - Steady-State thermal

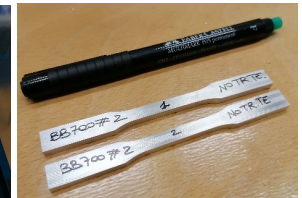


- Custom components for XACT facility as sample holders, flanges, adapters, vacuum parts.
- Frames for optical components, mechanical interfaces, sample housing in controlled environments, handling tools.
- Components for telescopes.

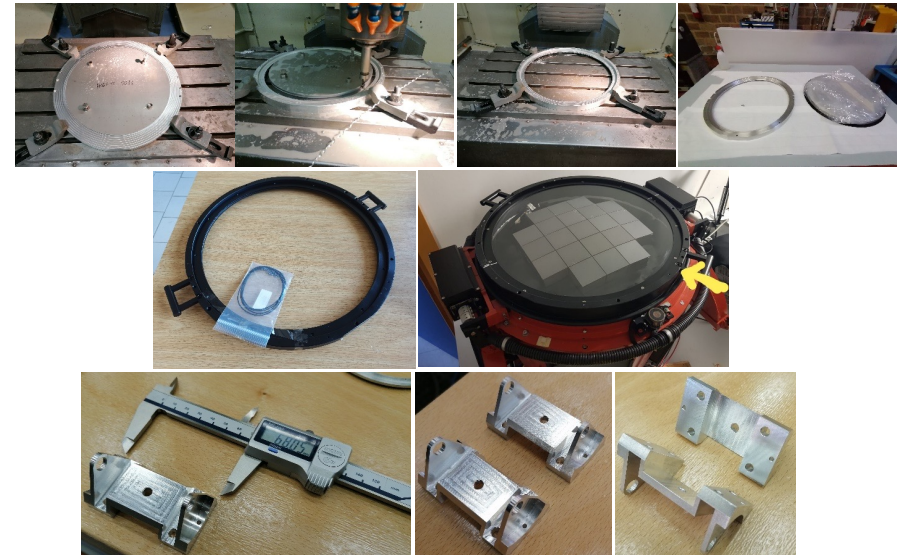
ATHENA



ARIEL



ASTRI-Horn



People



Alfonso Collura
Physicist



Marco Barbera
Physicist (UNIPA)



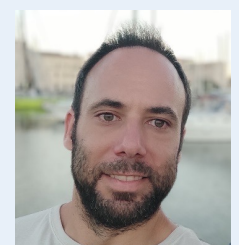
Ugo Lo Cicero
Electronic engineer



Fabio D'Anca
Mechanical engineer



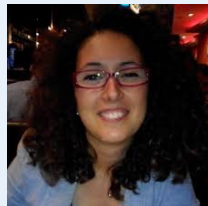
Angela Ciaravella
Physicist



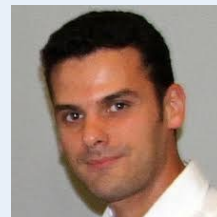
Antonio Jimenez Escobar
Chemist



Luisa Sciortino
Chemist (UNIPA)



Michela Todaro
Physicist (UNIPA)



Nicola Montinaro
Mechanical engineering (UNIPA)

Salvatore Varisco
Electronic engineer

Roberto Candia
Electronics/machine shop

Gaspare Di Cicca
Machine shop