



INAF Laboratories @ RSN3

State of art and new perspectives

M.E. Palumbo, J.R. Brucato

Napoli, 18-19 Oct. 2022

RSN3 laboratories: Instrumentation



RSN3 laboratories: people



A circular diagram showing the names of RSN3 laboratory personnel arranged in a spiral pattern around a central point. The names are written in various colors and fonts, representing different individuals.

Names listed clockwise from the top:

- Vito Mennella
- Giuseppe Piccioni
- Alessandra Rotundi
- John Brucato
- Maria Elisabetta Palumbo
- Ernesto Zona
- Marco Ferrari
- Riccardo Urso
- Emanuele Papini
- Giovanni Poggiali
- Alexandra Parmentier
- Pegah Darvehi
- Marianna Angrisani
- Giuseppe Massa
- Chiara Gisellu
- Adrián Kazakov
- Andrea Apuzzo
- Hervé Haudemand
- Francesco Frascella
- Alice Stephan
- Igor Bertello
- Tommaso Alberti
- Lorenzo Rossi
- Anna Musolino
- Maria Angela Corazzi
- Stefano Ferretti
- Alice Maria Piccirillo
- Stefano Orsini
- Mario Accolla
- Angelo Boccaccini
- Alessandro Mura
- Luca Colasanti
- Fabio Reale
- Antonio Jimenez Escobar
- Nelio Vertolli
- Rosella Muscolino
- Federico Landini
- Fabrizio Nuccilli
- Valeria Caracci
- Rosanna Rispoli
- Ernesto Palomba
- Vincenzo Della Corte
- Giuseppe Massone
- Maria Cristina De Sanctis
- Marco Barbera
- Cesare Cecchi-Pestellini
- Alfonso Collura
- Giovanni Strazzulla
- Raffaella Noschese
- Stefano Massetti
- Davide Loreggia
- Roberto Sordini
- Alfredo Moppolini
- Valeria Mangano
- Daniele Fulvio
- Alessandro Aronica
- Giovanni Di Cicca
- Fabrizio Capaccioni
- Luca Zangrilli
- Alberto Riva
- Stefania Stefani
- Roberto Candia
- Maurizio Pancrazzi
- Simone De Angelis
- Ugo Lo Cicero
- Gerardo Capobianco
- Carlotta Scirè
- Teresa Fornaro
- Gabriele Franzese
- Elisabetta De Angelis
- Fabio Cozzolino
- Ciprian Popa
- Giuseppe Baratta
- Silvano Fineschi
- Francesca Esposito
- Andrea Louyobapdo
- Piero Diego
- Emiliano Fiorenza
- Salvatore Varisco
- Gianalfredo Nicolini
- Ernesto Palomba
- Valeria Caracci
- Rosanna Rispoli
- Antonio Jimenez Escobar
- Fabio Reale
- Luca Colasanti
- Alessandro Mura
- Stefano Orsini
- Mario Accolla
- Angelo Boccaccini

RSN3 laboratories: people

staff

Vito Mennella Giuseppe Piccioni Alessandra Rotundi John Brucato
 Giuseppe Baratta Silvano Fineschi Maria Elisabetta Palumbo Marco Ferrari
 Ciprian Popa Francesca Esposito Angela Ciaravella Ernesto Zona Riccardo Urso
 Fabio Cozzolino Gabriele Franzese Teresa Fornaro Simone De Angelis
 Ανδρέα Λογοβάρδο Elisabetta De Angelis Carlotta Scirè Maurizio Pancrazzi
 Piero Diego Gianalfredo Nicolini Ugo Lo Cicero Cristian Carli Roberto Candia
 Emiliano Fiorenza Salvatore Varisco Gerardo Capobianco Stefania Stefani
 Ernesto Palomba Vincenzo Della Corte Alberto Riva Fabio D'Anca
 Valeria Caracci Marco Barbera Luca Zangrilli
 Rosanna Rispoli Antonio Jimenez Escobar Federico Landini Cesare Cecchi-Pestellini
 Fabio Reale Nello Vertolli Rossella Muscolino Alfonso Collura Alessandro Aronica Gaspare Di Cicca
 Luca Colasanti Alessandro Mura Stefano Orsini Anna Milillo Raffaella Noschese Giovanni Strazzulla Daniele Fulvio
 Alessandro Frigeri Mario Accolla Angelo Boccaccini Fabio Tabacchioni Stefano Massetti Valeria Mangano
 Davide Loreggia Roberto Sordini
 Διάφρερο Μορφίου
 Maria Angela Corazzi

non-staff

Emanuele Papini Giovanni Poggiali Alexandra Parmentier Pegah Darvehi Marianna Angrisani Giuseppe Massa
 Enrico Bruschini Fabrizio Dirri Gabriele Vizzini Adrian Kazakov Andrea Apuzzo Hervé Haudemand Chiara Giselli
 Chiara Giselli Francesco Frascella Alice Stephan Eliana La Francesca Igor Bertello Tommaso Alberti Lorenzo Rossi
 Maria Musolino Stefano Ferretti Alice Maria Piccirillo Anna Musolino

RSN3 laboratories: Instrumentation



RSN5

Forum della Ricerca Sperimentale e Tecnologica in INAF
Bologna, 22-24 giugno 2022



RSN3 laboratory facilities

Characterization, processing and astrobiology

OAA: Arcetri Astrobiology Laboratory

OAAT: Laboratorio di Astrofisica Sperimentale (LASp)

OACN: Laboratorio di Fisica Cosmica e Planetologia

OAPA: Light Irradiation Facility for Exochemistry (LIFE)

IAPS: The Planetary Mapping and GIS laboratory (GISlab)

IAPS: Laboratorio di Planetologia (Plab)

IAPS: Sample Preparation Facility (SPF)

IAPS: Spectroscopy LABoratory (SLAB)

IAPS: Laboratorio Spettroscopia Superfici (C-Lab)

IAPS: Drill for Analogues and Visible Infrared Spectrometer (DAVIS)

Instrument development

IAPS: DISC (Dust Impact Sensor and Counter)

IAPS: DUSTER (Dust in the Upper Stratosphere Tracking Experiment and Retrieval)

IAPS: Space Materials Laboratory

OACN: Laboratorio di Fisica Cosmica e Planetologia

OAA: Life Detection Chip

Test and calibration

OACN: Martian Atmosphere and Simulation Chamber

OAPA: X-ray Astronomy Calibration and Testing (XACT)

IAPS: Solar Wind and Ionospheric Plasma Simulation (SWIPS)

IAPS: Ion and Energetic Neutral Atom beam (I-ENA)

IAPS: Laboratorio di Planetologia (Plab)

OAA: Planetary Protection

OATO: Optical Payload Systems (OPSys) Facility & Optical Lab

Laboratory Scientific Activities

Analog materials

- Silicates
- Carbonaceous materials
- Ices
- Biomolecules
- Atmospheres

Extraterrestrial samples

- Meteorites
- Interplanetary Dust Particles
- Cometary dust (Stardust/Wild2)
- Asteroids (Hayabusa2/Ryugu, Osiris-Rex/Bennu)

Analytical techniques

- X-ray - VUV - Vis – IR – mm spectroscopy
- Raman spectroscopy
- Scanning Electron Microscopy + EDX
- Mass spectrometry
- Powder diffraction (XRD)
- Liquid Chromatography Mass Spectroscopy
- Optical Tweezers
- Cartography & Geographic Information Sys.

Processing

- UV photons
- X-rays
- Fast ions (keV-MeV)
- Atoms
- Temperature
- Plasma

Complementary laboratories

Grand Accélérateur National d'Ions Lourds (GANIL), France

Interstellar Energetic Process System (IEPS) at the National Central University, Taiwan
National Synchrotron Radiation Research Center (NSRRC, Taiwan)

etc...

Laboratory Instrument Development



Small Objects

- Microbalances
- Dust Impact Sensors and Counters
- Spectrometers
- Cameras

Planetary Surface

- Spectrometers
- Dust sensors
- Cameras
- Life detection Chip
- Space tweezers

Sun & Planetary atmospheres

- Neutral and ionized particle detector
- Plasma analyzer
- Spectrometers

Future projects

INAF – Grants:

Bando per il Finanziamento della Ricerca Fondamentale 2022 in INAF

- **Large grants:** PRESTIGE (Pristine Returned Sample Testing InvestiGation and Examination) - E. Palomba
- **Grants “Laboratori Spaziali”:** Upgrade of Laboratories - G. Baratta, A. Ciaravella, S. De Angelis
- **Mini-grants:** M. Accolla, C. Carli, C. Cecchi-Pestellini, T. Fornaro, G. Franzese, D. Fulvio, A. Jimenez Escobar

Future projects

PNRR: "Rafforzamento e creazione di Infrastrutture di Ricerca"

Strengthening the Italian Leadership in ELT and SKA (STILES): funds for building an Exo–planetary Atmosphere Laboratory

PNRR: "PE - Spazio"

Under evaluation

Future projects

Space missions

- **BepiColombo:** launched October 2018 – at Mercury 2025
- **LICIACube-DART:** impact 21 Sept. 2022 on Dimorphos
- **JUICE - JUpiter ICy moons Explorer:** launch 2023 – at Jupiter 2030
- **ASCPiICS/PROBA-3:** launch 2023
- **MMX:** sample return from Phobos, launch 2025
- **MUSE – MUlti-slit Solar Explorer:** launch 2027
- **Comet Interceptor:** launch 2029
- **Ariel:** launch 2029
- **ExoMars:** launch 2030

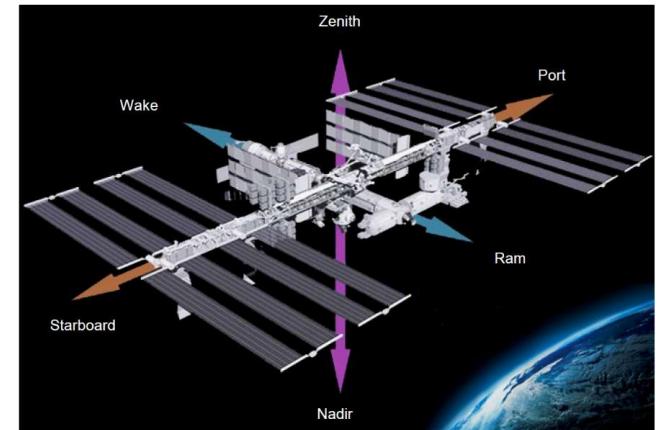
Stratospheric Balloon HEMERA

- **DUSTER**
- **CorMag**

Future projects

International Space Station

- **Material Ageing** launch 2024
- **CODEX NASA coronograph** launch 2023



Future projects

Material Ageing

Experiment on the International Space Station to study the stability of metal thin layers on polymeric substrates

Polymethyl methacrylate (PMMA)

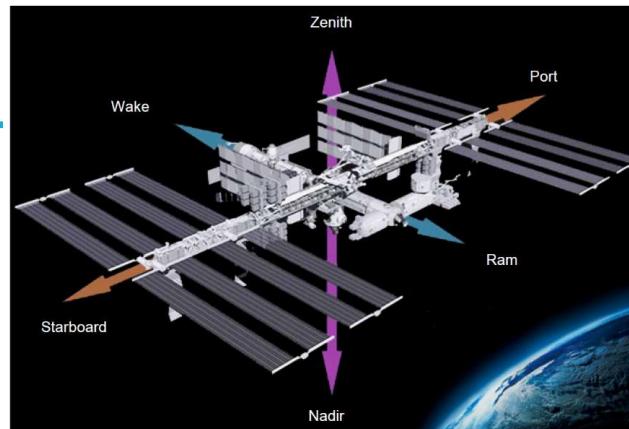
Virgin



+ 200 keV H⁺



Mezzina et al. 2022, Nanomaterials 12, 1992



Euro Material Ageing location outside the ISS



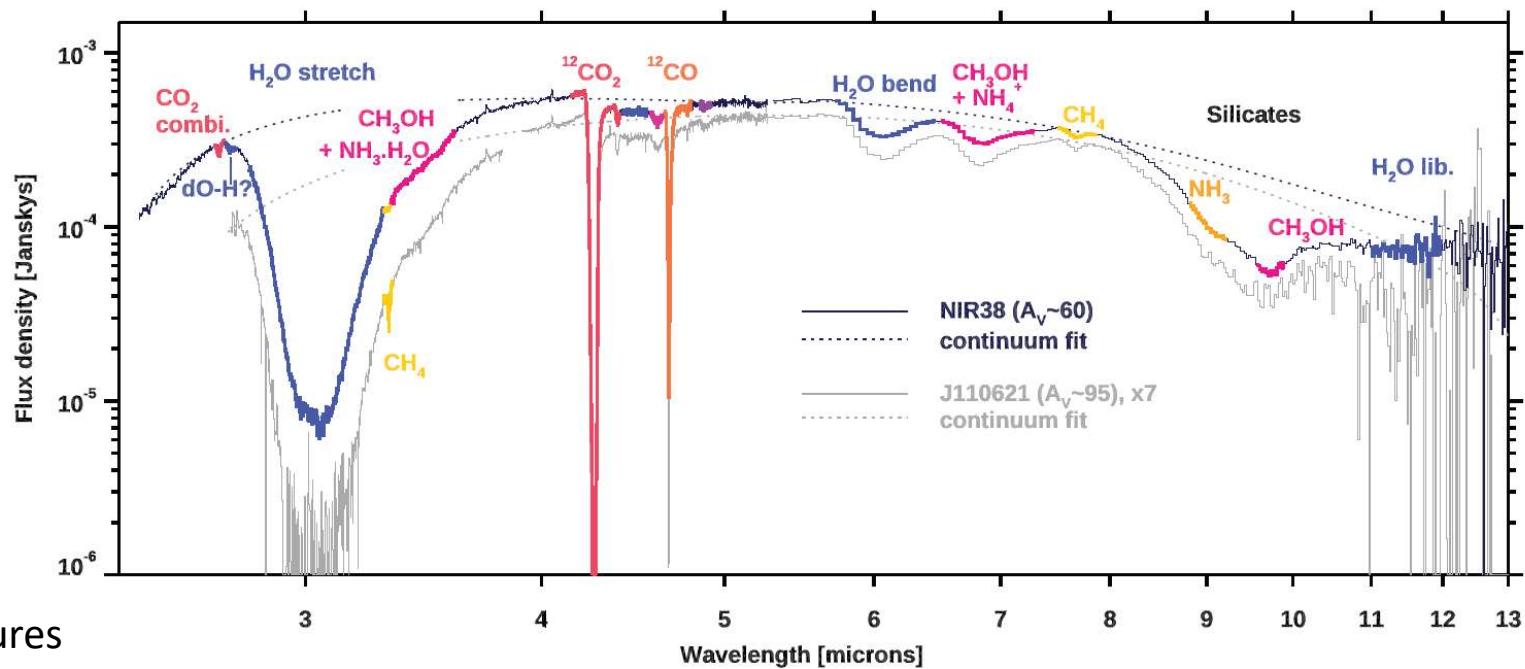
List of projects

Proposal number	Participants	Title of the proposal
AO-2020-EMA-136	DLR	ATOX Resistance of Polysilazane Coatings on Membrane Material for PV Arrays, Drag Sails and Thermal Components
AO-2020-EMA-110	BAM	Metallic glass ageing and rejuvenation in space ("Glassage")
AO-2020-EMA-106	Erich Schmid Institute	Aging of new material systems for flexible optical solar reflectors
AO-2020-EMA-115	ARCEON	Environmentally Stable and Low Thermal Expansion Composites (ESLTEC)
AO-2020-EMA-113	University of Bristol	Determination of the long-term LEO stability of novel carbon fibre reinforced plastics
AO-2020-EMA-121	NEMATX	Nematic 3D Printing of Liquid Crystal Polymers
AO-2020-EMA-105	AAC	Transparent polyimide films for thermo-optical applications
AO-2020-EMA-130	AZIMUT SPACE	BLAST-MA (Black LASer Surface Treatment – Material Ageing)
AO-2020-EMA-109	Universita di Catania	Ageing of metal/insulator patterned samples for coatings and printable electronics
AO-2020-EMA-138	LIP INAF	Ageing of Ge/Si and CZT samples for sensors and LAUE lenses of future gamma-ray astrophysics telescopes
AO-2020-EMA-127	HEVS	3D-Printed NiTi
AO-2020-EMA-134	TECHNIKER	Diamond Like Carbon (DLC) and Plasma Electrolytic Oxidation (PEO) for tribology in space
AO-2020-EMA-137	SOTON	Effects of Long duration space environment exposure on additively manufactured metals
AO-2020-EMA-139	EMPA	Materials for device applications in space: Silicon for sensing MEMS and NEMS and BMGs for the storage for mechanical energy – the impact of defects on device performance
AO-2020-EMA-128	ISTEC University Naples	Low Earth orbit environment ageing effect on Ultra-High Temperature Ceramic Matrix Composites (WINTERTIME)

Future projects

James Webb Space Telescope (JWST) observations (interstellar medium, star forming regions, Solar System, exo-planets)

IceAge: DD - ERS #1309
McClure et al.



Laboratory experiments

- Identify absorption features
- Constrain the physico-chemical environment
- Constrain the chemical evolution

Future projects

Ultra-clean laboratory where to analyse samples returned from space missions from Mars, Moon, Phobos, Asteroids and Comets



RSN3 – INAF Laboratories, Napoli 18-19 Oct. 2022

INAF is a multicentre laboratory

Pros

- Distributed expertise
- Complementary activities
- Local sci & tech impact
- Strengthens with local small PME
- Public Outreach and Education

Cons

- Small Labs sizing
- Limited interactions
- Lack of high impact Inst.
- INAF internal competitions
- Lack of common objectives

Criticalities

- Maintenance of available instrumentation
- Need for stable research staff with an interdisciplinary background to maintain the role of excellence in such a long-term program.
- Need for more technical personnel in the laboratories and funds for the maintenance of the facilities, in many cases made through ASI funding, which represent an important asset of INAF.
- To be ready to analyze samples that will be returned to Earth from Mars, Moon, asteroids, and comets.