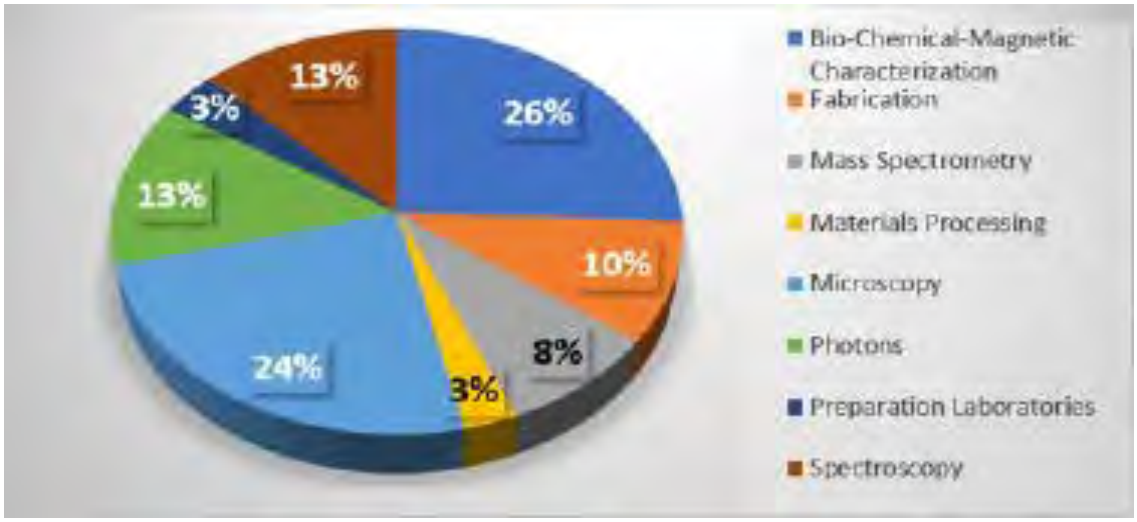
Annex – MRFs

Table 1. The list of MRFs open to User Direct Access 2023

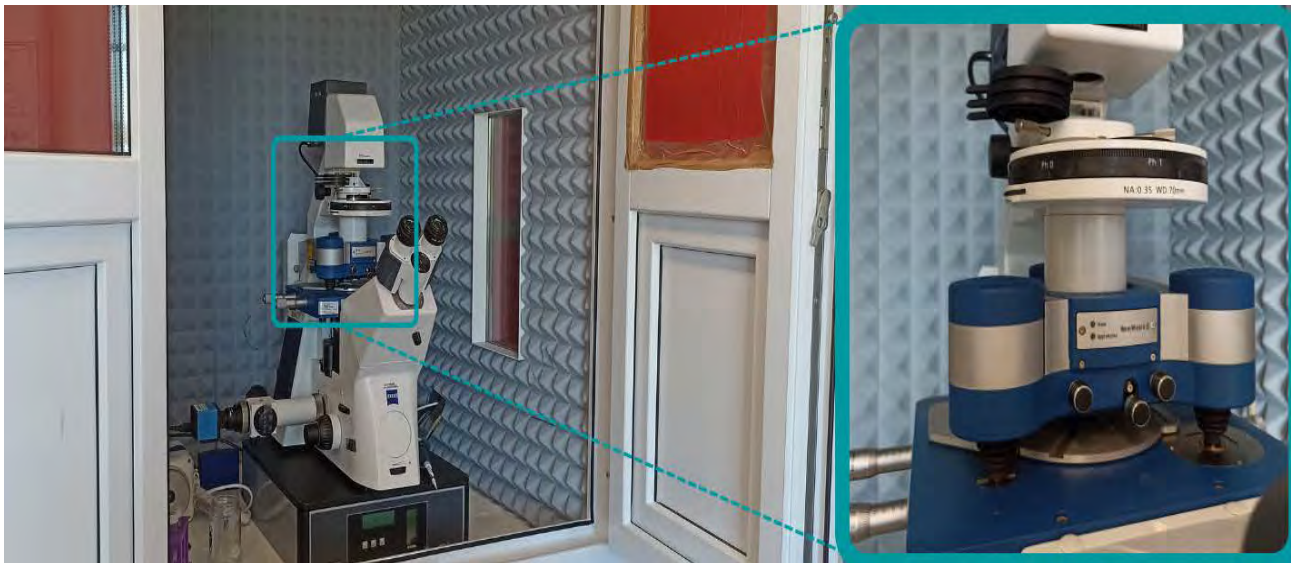
AFM	The Nanowizard II – JPK-Bruker
AFM Raman	Raman Spectrometer XploRA Plus
Confocal Microscope 1	Laser Scanning Confocal Microscope Leica TCS SP2
Confocal Microscope 2	Laser Scanning Confocal Microscope Leica TCS SP8
Confocal Microscope 3	Laser lines at 454, 488, 514, 635 nm
Cryogenic Electron Microscopy	CEM in Transmission, model Thermo Scientific™ Glacios™
Dynamic Mechanical Analyzer	DMA Star Systems – Mettler Toledo
FIB-SEM GAIA 3	FIB-SEM with simultaneous milling and EBSD
FT-IR Nexus	Nicolet Nexus 870
FT-IR Nicolet	Endowed with LightDrive Optical Engine components
Fluorescence Microscopy	BX51 microscope
Mass Spectrometer 1	Rapiflex™ MALDI Tissuetyper™
Mass Spectrometer 2	Orbitrap Fusion Tribrid mass spectrometer
NMR 600 MHz	Bruker Avance III 600 MHz NMR
Raman Confocal Microscope	Microscope inViaTM QontorTM model
SAXS GISAXS	Xenocs XEUSS 3.0
SAXS WAXD	Saxspace Anton-Paar
SEM FEI	SEM FEI QUANTA 200
SEM LEO SUPRA	SUPRA 35 Field Emission SEM
SEM ZEISS GEMINI	FEG-SEM with a nominal resolution of 1.2 nm
SEM ZEISS SIGMA	Scanning electron microscope with field-emission source
SEM with correlative AFM	SEM system with EDS-SPM
Spectrofluorimeter	Varian Eclipse Spectrofluorimeter
TEM FEI	LaB6 source (120 kV) and BF detector and FEI Eagle
TEM High Resolution	ThermoFisher Talos F200X
TEM JEOL	JEOL JEM 2100 Plus with a LaB6 emitter
X-Ray diffractometer	Rigaku SmartLab SE
XRD TOMOGRAPHY	RIGAKU Nano3DX

Techniques



AFM

UNIT: University of Milano Bicocca
Category: Microscopy
Key instrumentation: AFM Nanowizard II - JPK-Bruker



General information

The Nanowizard II - JPK-Bruker is designed for biological samples. It is equipped with a Zeiss fluorescence microscope, and it is used for high resolution imaging and nanomechanical characterization.
The Nanowizard II – JPK-Bruker is designed for biological samples. It is equipped with a Zeiss fluorescence microscope and it is used for high resolution imaging and nanomechanical characterization.

Technical description

The AFM Nanowizard II - JPK-Bruker is optimal for soft material (live cells, cell membranes, biomaterials) investigations as well as force spectroscopy studies (ligand binding, protein unfolding and cell adhesion). It allows high-resolution images and force measurements both in air and fluid environment. The NanoWizard II is coupled with a Zeiss inverted microscope with Colibrì lamp source for wide spectral fluorescence excitation (365 nm, 470 nm, 590 nm). and it can allow for DirectOverlay™ of AFM and optics images. It has a large scan field (100x100 μm^2) and a 15 μm Z scan range with highest closed loop performance through capacitive sensors. It allows for Patented DirectOverlay™ software feature for combining AFM and optical images distortion free.

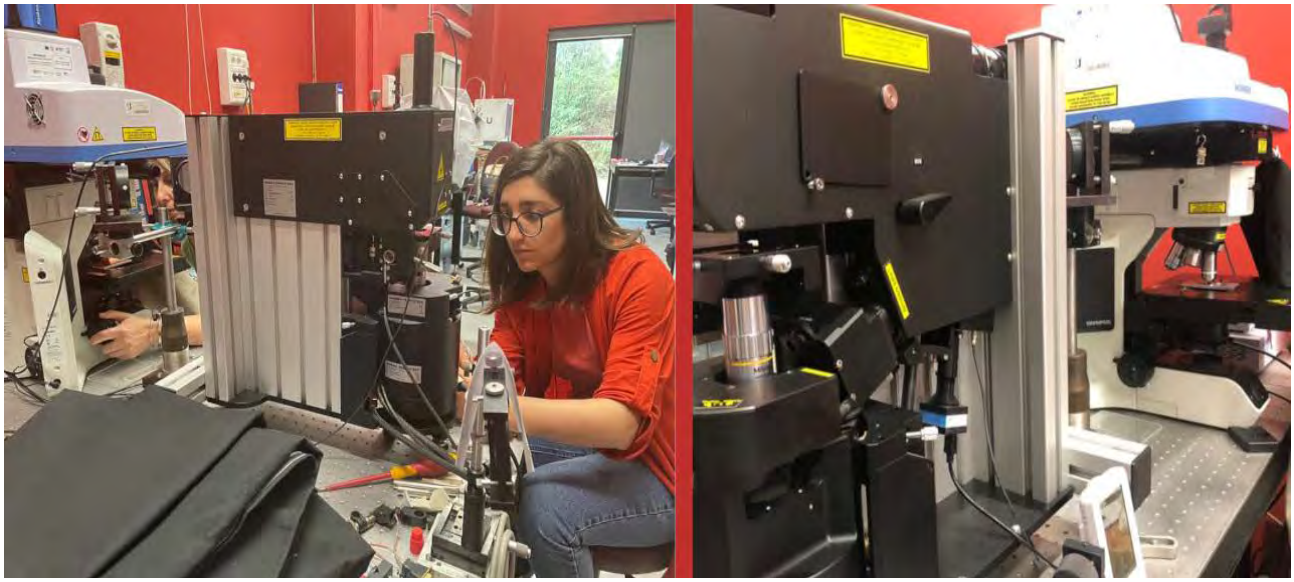
Research areas and applications

Characterization of morphology of single filament of DNA and single cells, nanomechanics of single cells and biological materials, single molecule protein unfolding.

AFM Raman

General information

UNIT: NAST Centre - University of Rome Tor Vergata
Category: Microscopy
Key instrumentation: Tip-Enhanced Raman& PL spectroscopy Horiba - TERS/TEPL



The Raman Spectrometer XploRA Plus is a compact and fully automated micro-spectrometer using the vibrational Raman spectroscopy and an AFM for combined Raman-AFM and TERS. The operation modes combine confocal Raman, fluorescence and photoluminescesce imaging and spectroscopy, through external manipulators and probes.
The Raman Spectrometer XploRA Plus is a compact and fully automated micro-spectrometer using the vibrational Raman spectroscopy and an AFM for combined Raman-AFM and TERS. The operation modes combine confocal Raman, fluorescence and photoluminescesce imaging and spectroscopy, through manipulators and probes.

Technical description

The RAMAN Microscope includes 3 internal lasers (532, 638 and 785 nm) combined with 12 density filters levels and 4 gratings (600, 1200, 1800 and 2400 g/mm) to cover all the UV-Vis range with maximum resolution. The wavelength range covers from 75 up to 4000 cm-1.

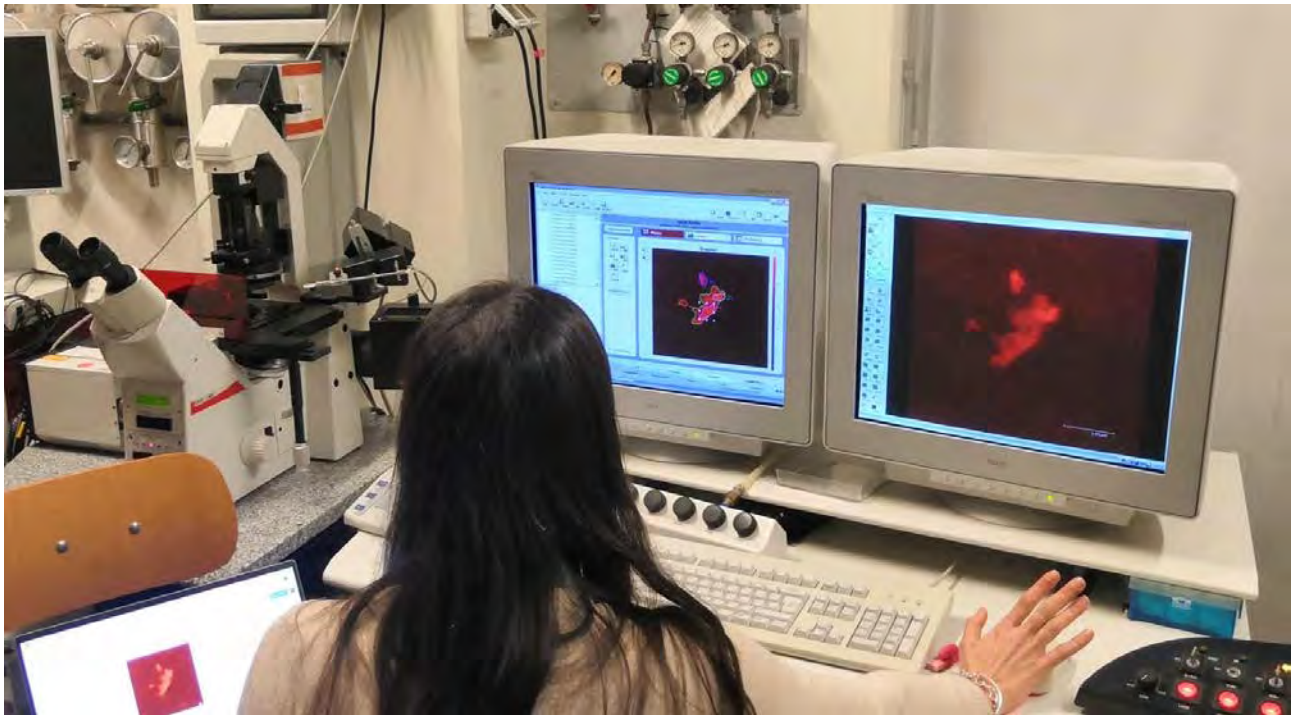
Research areas and applications

Nanostructured materials characterization; spatial characterizations; 3D Raman imaging; polymers; pharmaceuticals; gem investigation and mineral phases.

Confocal Microscope 1

General information

UNIT: CSGI - University of Florence
Category: Microscopy I Spectroscopy
Key instrumentation: Laser Scanning Confocal Microscope



Laser Scanning Confocal Microscope Leica TCS SP2 equipped with 3 fluorescence PMT detectors.

Technical description

The instrument allows users to perform 3D imaging, spatially-resolved emission, spatially resolved FRET and FRAP, and a transmission PMT. The lasers available allow 8 excitation lines, and the microscope table allows motorized motion in 3D for imaging of larger samples. Compared to the Leica TCS SP8 microscope, this instrument represent a “entry level” version.

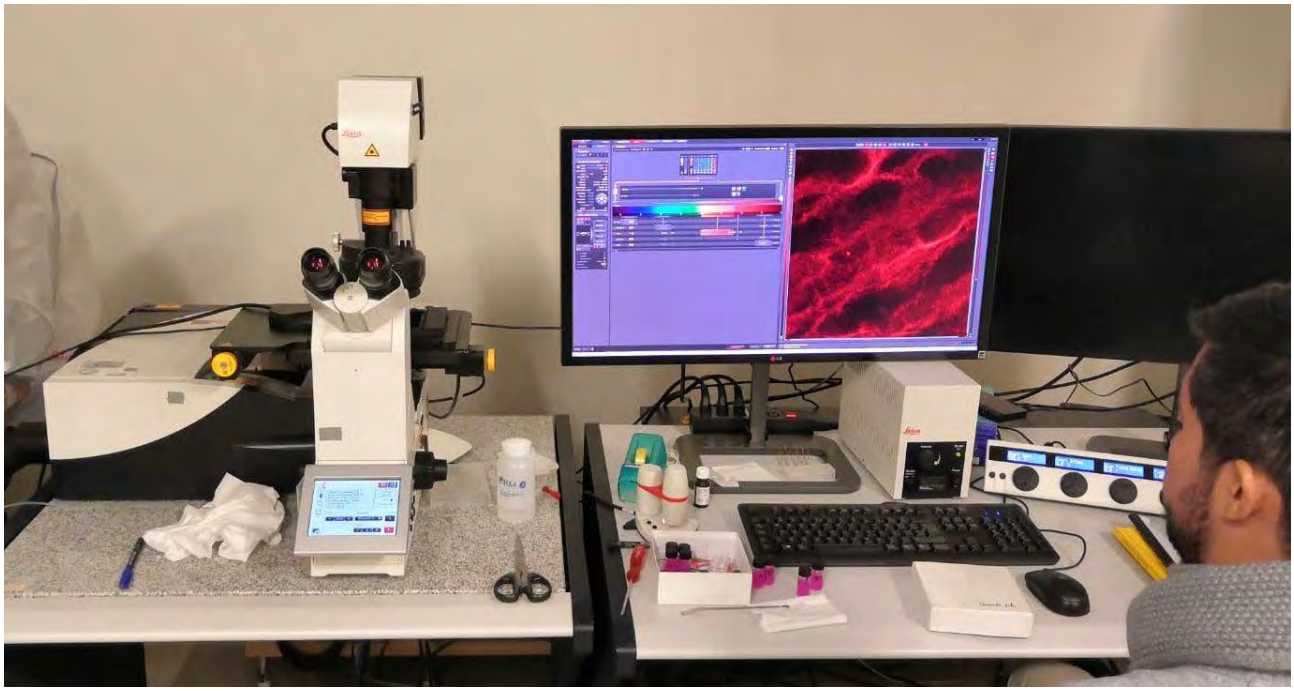
Research areas and applications

The instrument allows 3D chemical mapping of complex systems and interfaces; Electronics & Semiconductor, Automotive & Transportation; Metals & Machine Engineering; Medical Device QA/QC; Technical Cleanliness, Metallography, Material Analysis, Sample Preparation for Materials Science; live Cell Imaging, 3D Cell Culture.

Confocal Microscope 2

General information

UNIT: CSGI - University of Florence
Category: Microscopy I Spectroscopy
Key instrumentation: Laser Scanning Confocal Microscope



Laser Scanning Confocal Microscope Leica TCS SP8 equipped with DMI8 microscope, FCS Picoquant module and with PMT detector for transmission imaging and 5 internal detectors.

Technical description

The Laser Scanning Confocal Microscope is a Leica TCS SP8, equipped with DMI8 microscope, FCS Picoquant module and with PMT detector for transmission imaging and 5 internal detectors. The latter are two PMT, one hybrid detector and two cooled hybrid detectors, suitable for Single Molecule Detection, 3D imaging, spatially resolved imaging, and spatially resolved FRET, FRAP, FCS and FCCS. The lasers available allow 8 excitation lines, and the microscope table allows motorized motion in 3D for imaging of larger samples. Compared to the Leica TCS SP2, this instrument is recommended when FCS and FCCS analysis are required.

Research areas and applications

The instrument allows users to perform 3D chemical mapping of complex systems and interfaces; Electronics & Semiconductor, Automotive & Transportation; Metals & Machine Engineering; Medical Device QA/QC; Technical Cleanliness, Metallography, Material Analysis, Sample Preparation for Materials Science; live Cell Imaging, 3D Cell Culture. In particular, the FCS and FCCS options are relevant samples of biological interest, where dynamics and diffusion processes are investigated.

CONFOCAL MICROSCOPE 3

General information

UNIT: University of Milano Bicocca
Category: Microscopy
Key instrumentation: Leica TCS SP5 II Fluorescence

This is a state of the arte confocal microscope with excitation given by laser lines at 454, 488, 514, 635 nm and equipped wit Hybrid PMT detectors. The system has spectral resolution on the images. In addition the microscope is equipped with a STED superresolution module.

TECHNICAL DESCRIPTION

This is a state of the arte confocal microscope with excitation given by laser lines at 454, 488, 514, 635 nm and equipped wit Hybrid PMT detectors. The system has spectral resolution on the images. In addition the microscope is equipped with a STED superresolution module.

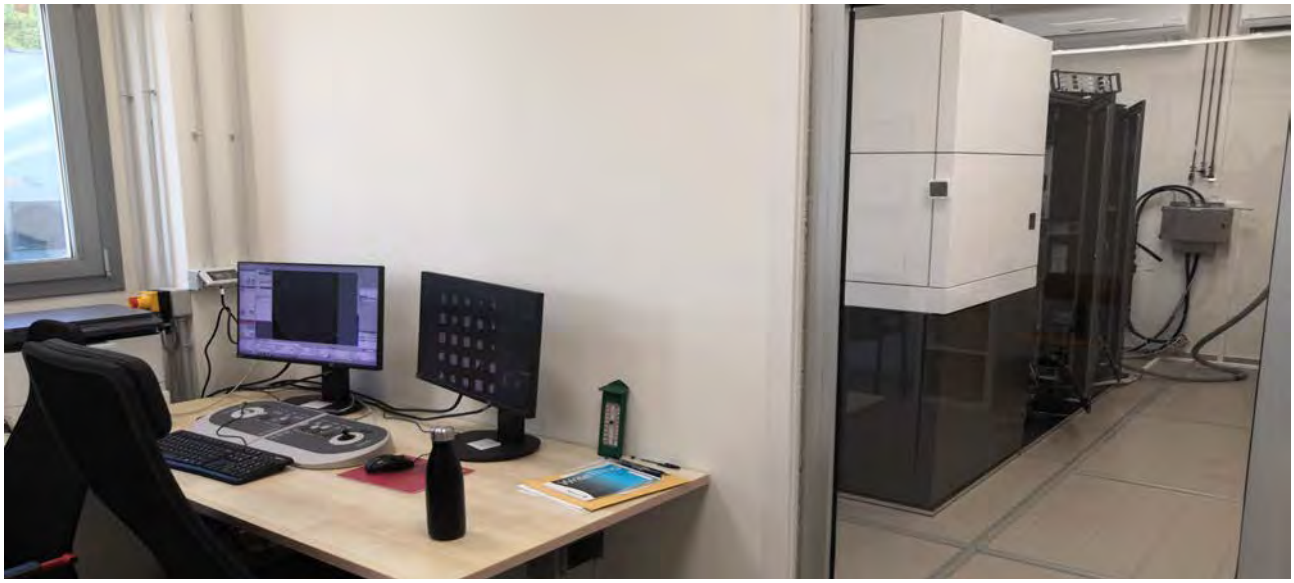
RESEARCH AREAS AND APPLICATIONS

Biomedical and cellular biology research.

Cryogenic Electron Microscopy

General information

UNIT: CSGI - University of Florence
Category: Microscopy
Key instrumentation: Cryogenic Transmission Electron Microscopy



Cryogenic Electron Microscopy in Transmission, model Thermo Scientific™ Glacios™. The instrument is equipped with XFEG optics at 200 keV, cryogenic system of the sample preparation and handling, and software and support tools for the analysis of collected images. The Cryo-TEM is equipped with XFEG optics at 200 keV.

TECHNICAL DESCRIPTION

The instrument is equipped with XFEG optics at 200 keV, cryogenic system of the sample preparation and handling, and software and support tools for the analysis of collected images.

RESEARCH AREAS AND APPLICATIONS

Biomacromolecules and polymers solution structure at medium/high resolution; weakly bonded and reactive materials, interfaces and phases; 3D chemical mapping of complex systems and interfaces; nanostructure and chemistry of solid-electrolyte interphases, cathode-electrolyte interphase, and electrode materials in batteries; hybrid perovskite solar cells, and metal–organic-frameworks

DYNAMIC MECHANICAL ANALYZER

General information

UNIT: NAST Centre - University of Rome Tor Vergata
Category: Bio&Chem&Mag Characterization
Key instrumentation: Bio-Chemical-Magnetic Characterization


DMA 1 Star Systems – Mettler Toledo – allows Dynamic mechanical analysis to measure the mechanical and viscoelastic properties of materials as a function of temperature, time and frequency. Measurements can be carried out in all standard deformation modes, even in liquids or at defined relative humidity levels. It is coupled to a liquid nitrogen generator for a free-standing production of liquid nitrogen and low-temperature operations. DMA Star Systems – Mettler Toledo – allows Dynamic mechanical analysis to measure the mechanical and viscoelastic properties of materials as a function of temperature, time and frequency.

Technical description

Features and benefits of the METTLER TOLEDO DMA 1 include: Flexible positioning of the Measuring Head – measurements in all deformation modes, even in liquids or at different relative humidity levels; Easy operation – allowing fast change of deformation modes; TMA measurements – for measuring expansion coefficients, effects due to creep, and relaxation times; Humidity option – for sorption and desorption measurements; Ergonomic design with large touchscreen – for convenient sample loading and monitoring of the measurement process; Wide temperature range – from –190 to 600 °C; Extremely efficient and economical cooling – saves valuable measurement time and reduces liquid nitrogen consumption. A unique aspect of the DMA 1 is its rotatable Measuring Head. Measurements can be carried out in all standard deformation modes, even in liquids or at defined relative humidity levels.

Research areas and applications

Thermoplastics, Thermosets, Elastomers, Ceramics, Thermal Energy Storage materials.

FIB-SEM GAIA 3

General information

UNIT: CNR ICCOM
Category: Fabrications I Microscopy
Key instrumentation: Electron Microscope / Scanning Probe Microscope

FIB-SEM with simultaneous milling and EBSD. The intrument allows preparation of high-quality ultra-thin TEM lamellae, delayering processes in technology nodes, precise nanopatterning and high-resolution 3D reconstructions. It has a unique 3-lens electron optical design capable of dedicated modes for extreme high-resolution imaging, enhanced depth of focus, undistorted ultra-low magnification imaging, and live 3D stereo imaging.
FIB-SEM with simultaneous milling and EBSD. The intrument allows preparation of high-quality ultra-thin TEM lamellae, delayering processes in technology nodes, precise nanopatterning and high-resolution 3D reconstructions.

TECHNICAL DESCRIPTION

It allows preparation of high-quality ultra-thin TEM lamellae, delayering processes in technology nodes, precise nanopatterning and high-resolution 3D reconstructions. It has a unique 3-lens electron optical design capable of dedicated modes for extreme high-resolution imaging, enhanced depth of focus, undistorted ultra-low magnification imaging, and live 3D stereo imaging. The smart chamber design of the instrument allows for the simultaneous milling and collection of EBSD patterns without the need to move the sample. This flexibility is unique to TESCAN and will provide best-in-class accuracy and throughput for EBSD and 3D-EDS.

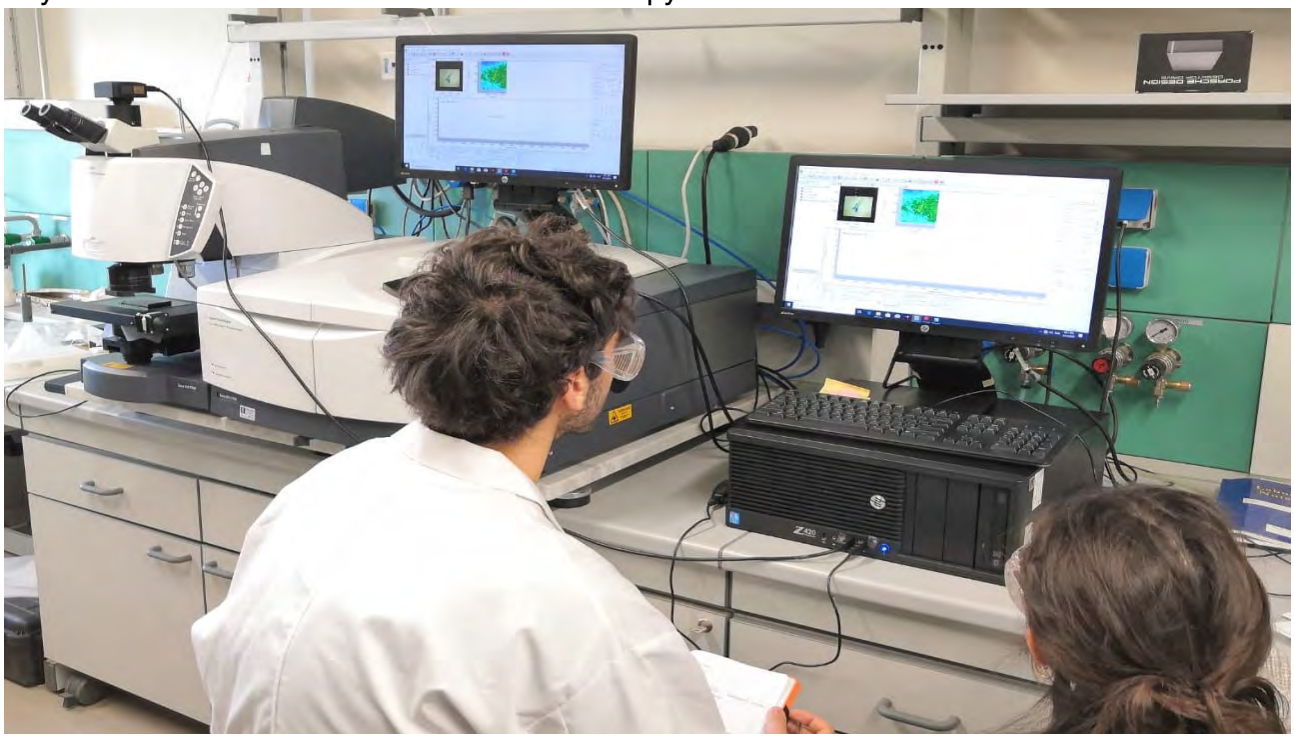
RESEARCH AREAS AND APPLICATIONS

material science, structural analysis

FT-IR Nexus

General information

UNIT:CSGI - University of Florence
Category: Microscopy I Spectroscopy
Key instrumentation: FT-IR and FT-IR Microscopy



Nicolet Nexus 870. Instrument for FT-IR spectroscopy and microscopy, model Nicolet Nexus 870, equipped with external optical table, two external detectors (MCT e TRS), GeATR, one Hind photoelastic modulator, and one IR Continuμm microscope.

Technical description

Nicolet Nexus 870. Instrument for FT-IR spectroscopy and microscopy, model Nicolet Nexus 870, equipped with external optical table, two external detectors (MCT e TRS), GeATR, one Hind photoelastic modulator, and one IR Continuum microscope. The instrument allows for the contemporaneous imaging and FT-IR analysis of micrometric particles/domains, allowing for the chemical mapping of flat samples as well as powders.

Research areas and applications

FTIR (Fourier transform infrared spectroscopy) is a fast, easy and reliable technique for material identification and quantification of constituents in a sample. The combination with optical microscopy allows for the chemical mapping of complex systems and interfaces, such as mixtures, surface coatings, films, pharmaceuticals, etc.

FT-IR NICOLET

General information

UNIT: NAST Centre - University of Rome Tor Vergata
Category: Spectroscopy
Key instrumentation: Nicolet iS20 Attenuated Total Reflection Infra Red

The Thermo Scientific™ Nicolet™ iS10 is a FTIR (Fourier-transform infrared spectroscopy) Spectrometer that allows the determination of unidentified contaminants, conduct failure analysis, allowing precisely analyze mixtures, thanks to the spectral power of the Thermo Scientific™ LightDrive™ Optical Engine integrated. The FTIR is able to discern multi-component samples: the advanced LightDrive optical engine technology delivers higher spectral resolution (better than 0.25 cm-1) and single-to-noise ratios (50 000:1) to help identify possible contaminants or characterize defects present in small quantities. Its performance can be validated through an integrated validation wheel with Shott NG-11 glass and NIST traceable, serialized polystyrene film.

TECHNICAL DESCRIPTION

The FTIR (dimensions 570 x 550 x 250 mm) is endowed with LightDrive Optical Engine components (source, laser, interferometer and detector) and a solid-state, temperature-controlled diode laser that with its enhanced long-lifetime and temperature-stabilized design guarantees accurate and precise data acquisitions.

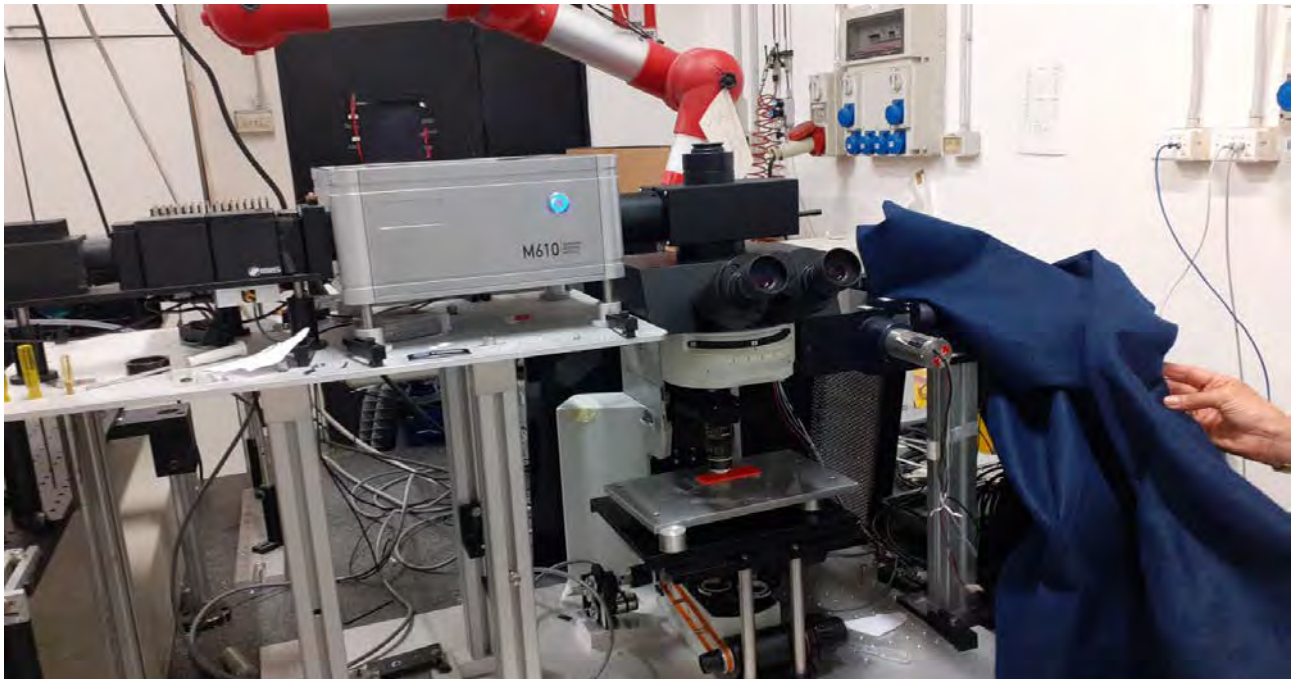
RESEARCH AREAS AND APPLICATIONS

Polymers and Plastics; Analytical Services; Quality Control QA/QC; Pharmaceuticals; Education; Forensics; Gemstone Analysis.

FLUORESCENCE MICROSCOPY

General information

UNIT: University of Milano Bicocca
Category: Microscopy
Key instrumentation: Nonlinear excitation fluorescence microscope based on pulsed infrared laser MaiTai and Olympus Bx51 scanning microscope



Development of new methods for optical non-linear microscopy to be applied to biophysics and medical physics in-vivo. In this field the Biophotonics group is developing two-photon excitation fluorescence imaging microscopy and second harmonic generation microscopy. One of the main application aims to the study of the motion of lymphocytes in lymph nodes in order to model the immune response of mice. This work is being carried out in collaboration with the Biotechnology group of our University.

TECHNICAL DESCRIPTION

The instrumentation is based on a BX51 microscope coupled to a scanning head for raster scanning biological samples. The excitation is given by a femtosecond laser tunable in the range 680 nm - 1040 nm with peak power of 3.5 W, 80MHz of repetition rate. The laser source allows to induce non-linear absorption in biological samples and recover images in fluorescence (two-photon excitation) or second harmonic generation signals.

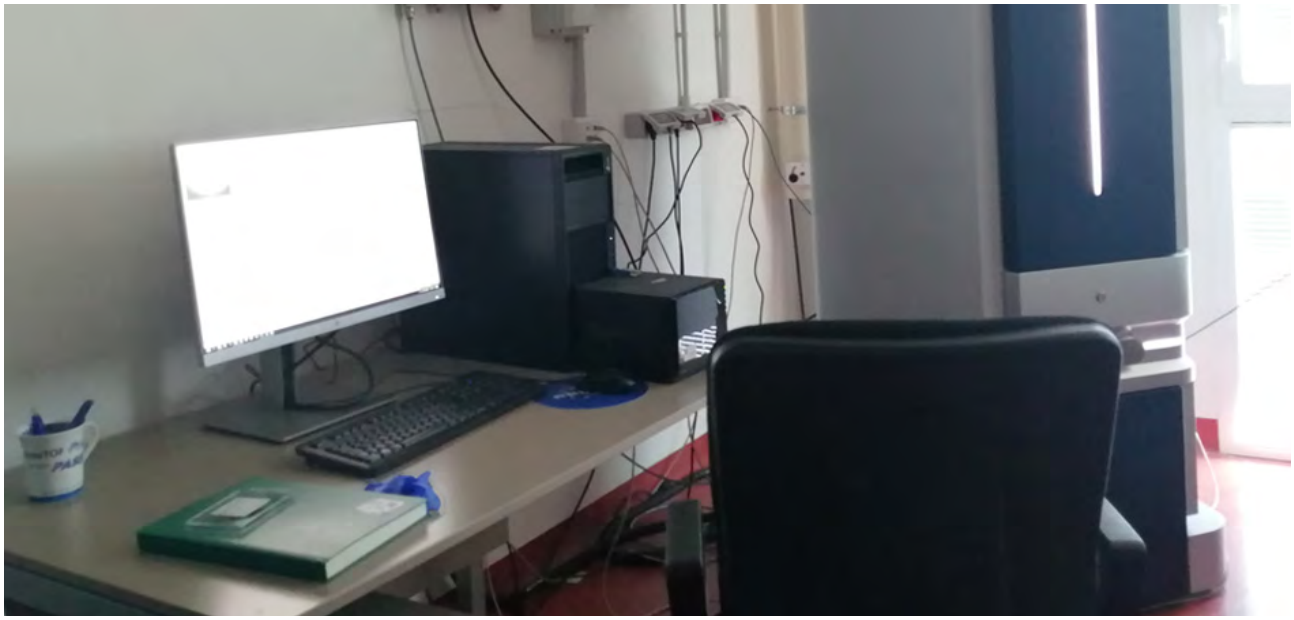
RESEARCH AREAS AND APPLICATIONS

Biomedical Research, Imaging of tissue and cells, Nanoscopy for biotechnology and Medicine (Collini, Chirico), Stochastic Simulations for Biophysics (Chirico), GFP mutants for biotechnology (Collini), Nanoparticles for Biomedical Applications (Chirico, D'Alfonso), In-vivo non-linear microscopy for biotechnology and Medicine (Sironi)

MASS SPECTROMETER 1

General information

UNIT: University of Milano Bicocca
Category: Mass Spectrometry
Key instrumentation: Rapiflex TissueTyper MALDI-TOF/TOF MS System



Rapiflex TissueTyper MALDI-TOF/TOF MS System mass spectrometers are of high accuracy and sensitivity. They have a resolution of over 40,000 RP and a mass accuracy of better than 2-5ppm. The rapiflex™ MALDI Tissuetyper™ is specifically designed for MS imaging with a spatial resolution of 10-20 μm, so as to obtain information at the single cell level, and with a speed 10 times better than other commercial MS-Imaging tools.

TECHNICAL DESCRIPTION

The rapiflex™ MALDI Tissuetyper™ is specifically designed for MS imaging with a spatial resolution of 10-20 μm, so as to obtain information at the single cell level, and with a speed 10 times better than other commercial MS-Imaging tools.

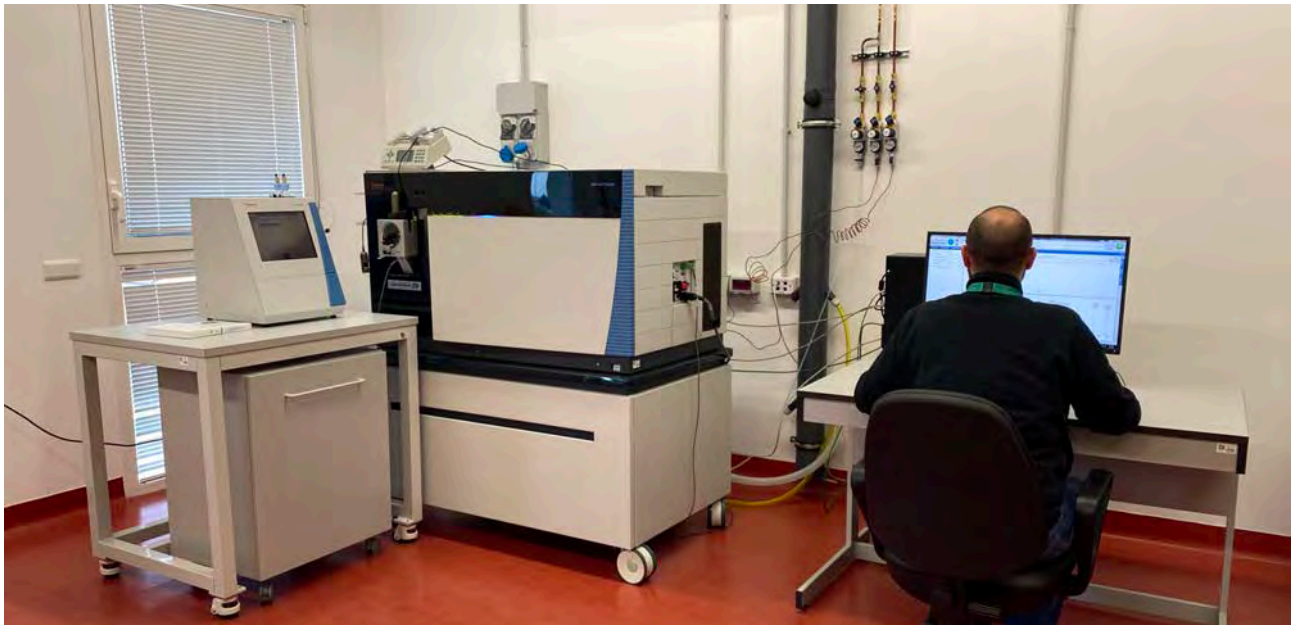
RESEARCH AREAS AND APPLICATIONS

Clinical research.

MASS SPECTROMETER 2

General information

UNIT: University of Milano Bicocca
Category: Mass Spectrometry
Key instrumentation: Orbitrap Fusion Tribrid mass spectrometer



Orbitrap Fusion Tribrid mass spectrometer for the analysis of molecules and supramolecular complexes with ultra-high resolution for proteomics, structural proteomics and other omics sciences. The instrument supports multiple fragmentation modes (CID, HCD, ETD) and their combinations and is coupled with a nano-flow UHPLC EASY-nLC 1000, enabling automated, high-performance LC/MS for the analysis of complex biological matrices.

TECHNICAL DESCRIPTION

The Orbitrap Fusion mass spectrometer enables the analysis of molecules and supramolecular complexes in the 50-6,000 m/z range, with high resolution (up to R=450,000), scan rate (MSn up to 20 Hz), mass accuracy (5,000) and sensitivity (100 fg total amount of the reserpine standard). The instrument is characterized by a great flexibility of scan protocols based on multiple fragmentation modes, i.e. collision-induced dissociation (CID), higher-energy collisional dissociation (HCD), electron-transfer dissociation (ETD) and their combinations, that can be performed in two different collision cells (quadrupole or linear ion trap) and analyzed by two different analyzers (linear ion trap or Orbitrap). These features support bottom-up, top-down and middle-down proteomics studies and enable high-throughput and high-depth analysis of small molecules, peptides, proteins, post-translational modifications, protein-ligand interactions, and other polymers. Quantitative shotgun proteomics can be implemented by either stable-isotope or label-free approaches. The instrument is equipped with a regular and a nano electrospray ionization (ESI) sample source and can be coupled to a nano-flow UHPLC EASY-nLC 1000, enabling automated, high-performance LC/MS analyses of complex biological matrices. Proteomics data analysis is performed by the software Proteome Discoverer 2.2.

RESEARCH AREAS AND APPLICATIONS

Clinics, Integrated Biology

NMR 600 MHz

General information

UNIT: University of Milano Bicocca
Category: Spectroscopy
Key instrumentation: Bruker Avance III 600 MHz NMR spectrometer

The NMR spectrometer is Bruker Avance III 600 MHz NMR, equipped with three probes suitable for the analysis of liquid, solid and heterogeneous samples.

TECHNICAL DESCRIPTION

The probe for liquid samples is a QCI (1H, 13C, 15N, 31P) cryo-probe, suitable for the analysis of low-concentration samples, for structural studies on biological macromolecules, rapid analysis of unstable samples (i.e. unstable proteins or prone to change their folding or aggregation state over time).

RESEARCH AREAS AND APPLICATIONS

Chemical areas, pharma areas (including nutraceuticals and cosmetics) – materials area (including crystalline materials and polymers)

RAMAN CONFOCAL MICROSCOPE

General information

UNIT: CSGI - University of Florence
Category: Microscopy I Spectroscopy
Key instrumentation: Raman Confocal Microscope

Microscope inViaTM QontorTM model, with excitations at 532 and 785 nm, with motorized XYZ stage, flexible arm and Raman imaging techniques

TECHNICAL DESCRIPTION

inViaTM QontorTM. Raman Confocal Microscopy, inViaTM QontorTM model, with excitations at 532 and 785 nm, with motorized XYZ stage, flexible arm and Raman imaging techniques. The microscope is equipped with the LiveTrackTM technology allowing the real-time sample focusing during the measurement and the Raman map acquisition. This allows the study of samples with coarse or uneven surfaces.

RESEARCH AREAS AND APPLICATIONS

3D chemical mapping of complex systems and interfaces

SAXS GISAXS

General information

UNIT: CSGI - University of Florence
Category: Photons
Key instrumentation: SAXS, USAXS and GISAXS

Xenocs XEUSS 3.0 system operates in SAXS (Small Angle X-ray Scattering), USAXS (Ultra SAXS) and GISAXS (Grazing Incidence SAXS) modes. It is equipped with sample holders for measurements on powders, pastes, gels, liquids and films, temperature control and robot for automation of sample preparation.

TECHNICAL DESCRIPTION

Xenocs XEUSS 3.0 system operating in SAXS (Small Angle X-ray Scattering), USAXS (Ultra SAXS) and GISAXS (Grazing Incidence SAXS) modes, equipped with sample containers for powders pastes, gel, liquids and thin films, temperature control and automated sample preparation for liquid sample via a Universal Robot. The scattering wavevector range for U/S/WAXS is between 0.0002 and 3.1 Å-1.

RESEARCH AREAS AND APPLICATIONS

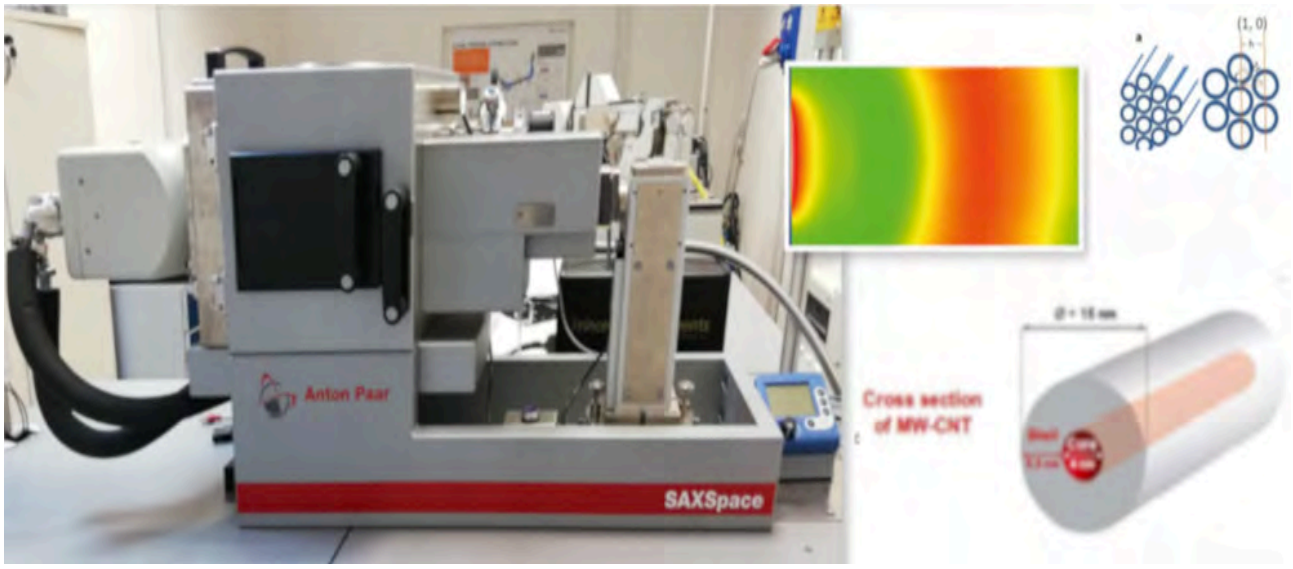
The system allows for studying (fr instance):

- Particle size distribution ranging from few nanometers to more than 350 nm in diameter
- Crystallization rates and lamellar structure of semicrystalline polymers
- Size and shape analysis of surfactants or proteins in solutions
- Organization and orientation of nanomaterials at atomic or nanoscale, in bulk phases or at surfaces
- Phase segregation studies of alloys
- *In situ* studies of nanostructure transitions

SAXS WAXD

General information

UNIT: CNR-IPCB
Category: Photons
Key instrumentation: Electron Microscope / Scanning Probe Microscope / X-Ray microanalysis



Saxspace Anton-Paar. Small and Wide Angle X-ray Diffractometer. X-ray scattering in the angular range of 0 – 10° detected by CCD or imaging plate, and up to 60° detected by using an imaging plate for the systems coupling SAXS and Wide Angle X-Ray Scattering, WAXS. Small and Wide Angle X-ray Diffractometer. Samples can be measured at different temperature, humidity, high pressure and under mechanical stress/strain conditions. Special features: – TrueFocus: self-alignment with X-ray beam; – TrueSWAXS: simultaneous SWAXS studies up to 60° 2Θ.

TECHNICAL DESCRIPTION

The investigated sample is irradiated with a monochromatic radiation, and scattered X-rays are typically collected in an angular range of 0 – 10° by a suitables (ie. CCD or imaging plate) and up to 60° (by using an imaging plate for the systems coupling SAXS and Wide Angle X-Ray Scattering, WAXS). Samples can be measured under various conditions, like at different temperature, humidity, high pressure and under mechanical stress/strain conditions. Special features: - TrueFocus: self-alignment with X-ray beam; - TrueSWAXS: simultaneous SWAXS studies up to 60° 2Θ; - StageMaster: YZ stage with auto-recognition of sample stages. Accessible q range 0.03 nm-1 to 40.7 nm-1, 200 nm > d > 0.15 nm. System resolution qmin: 0.03 nm-1.

RESEARCH AREAS AND APPLICATIONS

material science, structural analysis

SEM FEI

General information

UNIT: CNR IPCB
Category: Microscopy
Key instrumentation: Scanning Probe Microscopes

Field Emission Scanning electron microscopy QUANTA 200 with Energy Dispersive X-ray analysis. Scanning Electron Microscope with field emission source, equipped with SE, BSE and Environmental (GSED) detectors, EDS system (Oxford Inca Energy System 250), heating stage (FEI) and tensile/compression test module (Gatan MST200).

TECHNICAL DESCRIPTION

Scanning Electron Microscope FEI QUANTA 200 with field emission source, equipped with SE, BSE and Environmental (GSED) detectors, EDS system (Oxford Inca Energy System 250), heating stage (FEI) and tensile/compression test module (Gatan MST200).

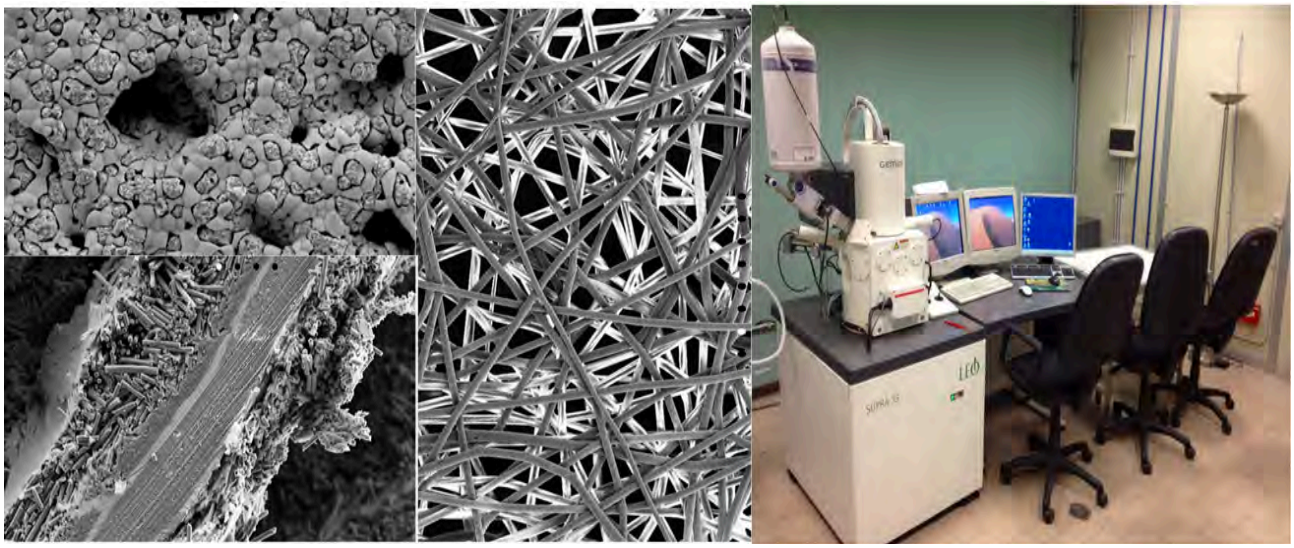
RESEARCH AREAS AND APPLICATIONS

material science, composites, nanocomposites, biomaterials, morphological analysis, elemental analysis, element mapping

SEM LEO SUPRA

General information

UNIT: NAST Centre - University of Rome Tor Vergata
Category: Microscopy
Key instrumentation: SUPRA 35, Field Emission Scanning Electron Microscope- ZEISS



The SUPRA 35 Field Emission SEM provides improved image resolution and a high productivity and versatility. The SUPRA 35 Field Emission SEM provides improved image resolution and a high productivity and versatility.

TECHNICAL DESCRIPTION

The FE-SEM electron gun is a Schottky Field Emission Gun and it is endowed with several detectors: Back Scattering Detector, Everhart Thornley and In-lens Secondary Electron Detector and an Energy Dispersive Spectrometer (EDS) from Oxford Instruments INCA 200. The ability to detect BSE leads to the obtaining of sub-surface information and nano-scale composition.

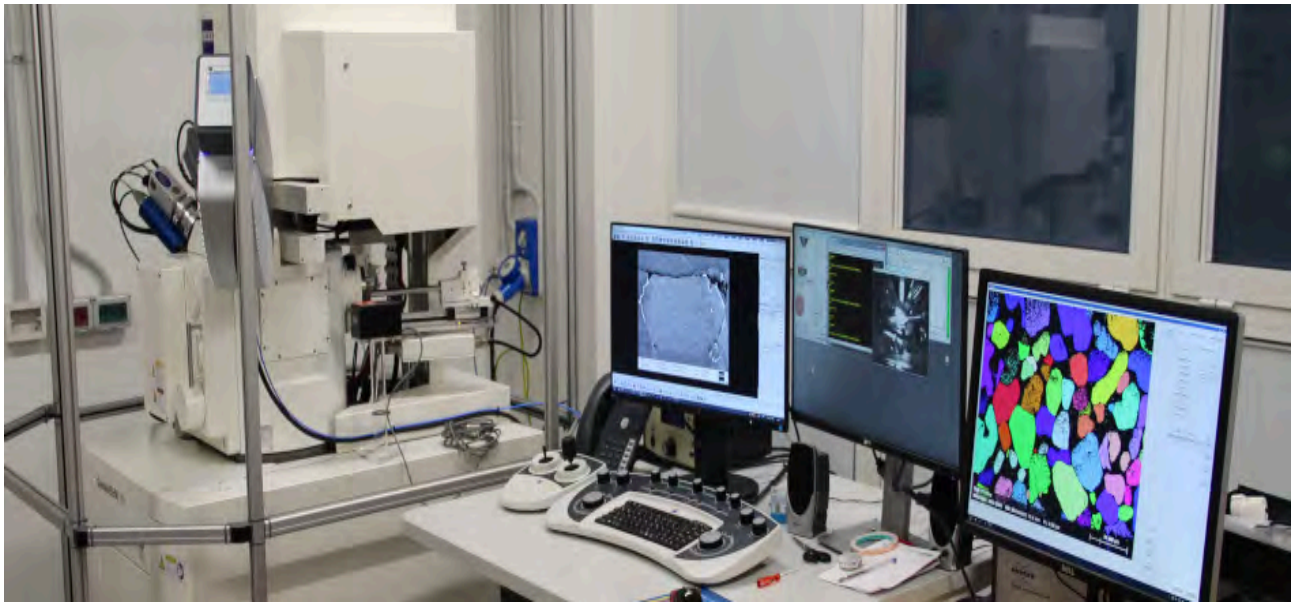
RESEARCH AREAS AND APPLICATIONS

Materials characterization: solid-state or biological specimens, conductive and non-conductive.

SEM ZEISS GEMINI

General information

UNIT: University of Milano Bicocca
Category: Microscopy
Key instrumentation: Field Emission Scanning Electron Microscope, Zeiss Gemini 500



FEG-SEM with a nominal resolution of 1.2 nm, equipped with an integrated EDS/WDS micro-analytical system and with an EBSD detector for the crystallographic analysis of the sample surface.

TECHNICAL DESCRIPTION

Scanning Electron Microscope (SEM) Zeiss Gemini 500 with a Field Emission Gun (FEG). The microscope can operate with an accelerating voltage between 1 kV to 30 kV and has a nominal resolution of 1.2 nm. In addition to the common “in-camera” BSE (Backscattered) and SE (Secondary Electron) detectors, the instrument is equipped with “in-lens” detectors (BSE/SE) for high-resolution imaging and with a STEM detector for the observation of thin specimens or biological samples in transmission mode. The FEG-SEM is also equipped with a Bruker integrated EDS/WDS (Energy Dispersive/Wave Dispersive) micro-analytical system, specially designed for light elements. Finally, the FEG-SEM is equipped with an EBSD (Electron Backscattered Diffraction) detector (Bruker) for the crystallographic analysis of the sample surface. The EBSD comes with the Argus FSE (Forward Scattered Electrons) and BSE detector for the acquisition of orientational contrast images. The wide gamma of detectors makes this instrument a very powerful characterization tool for the investigation at a sub-micrometre scale of solid samples and biological tissues.

RESEARCH AREAS AND APPLICATIONS

General mineralogy, advanced organic-inorganic hybrid functional nanomaterials, mineral forms for nuclear waste, dangerous airborne mineral dusts and fibers, REE and critical metals

SEM ZEISS SIGMA

General information

UNIT: CSGI - University of Florence
Category: Microscopy I Spectroscopy
Key instrumentation: Scanning electron microscope with field-emission source

Scanning electron microscope with field-emission source, equipped with detectoirs for EDS, backscattered and secondary electrons.

TECHNICAL DESCRIPTION

Zeiss Sigma scanning electron microscope with field-emission source, equipped with a GEMINI column and In-Lens detector, allowing the aquisition of high-resolution images on both conducting and non-conducting samples. The microscope is equipped with X-ray detectors (EDS), backscattering (BSE) and secondary electrons (SE). The X-ray detection system is from Oxford Instruments and, in addition to conventional X-ray analysis capabilities, produces high-resolution maps of the electron emission. This instrument is especially well-suited for samples with poor electronic contrast and that cannot be chemically modified or coated, as it allows the the use of very low accelerating voltages (as low as 100 V).

RESEARCH AREAS AND APPLICATIONS

Thanks to its flexibility, the Zeiss Sigma microscope finds many applications in the investigation of morphology and chemical composition of solids, also without metal coatings or chemical treatments. Materials Science (polymers, fibers, semiconductors, metals, alloys,…), life sciences (micro- and nanostructure of microrganisms, bones, prosthesis,…), geosciences and natural resources (rocks, minerals,…) and, more generally, industrial applications (such as in the case of powders) are some examples.

SEM WITH CORRELATIVE AFM

General information

UNIT: NAST Centre - University of Rome Tor Vergata
Category: Microscopy I Spectroscopy
Key instrumentation: Electron & Scanning Probe Microscopes, AFM & X-Ray microanalysis

TECHNICAL DESCRIPTION

The TESCAN VEGA SEM is equipped with various types of detectors: X-ray for EDS microanalysis (Oxford Instruments INCA 200), back-scattering (BSE), Everhart-Thornley and In-lens Secondary Electron (SE) detectors, plus a water vapour detector for low vacuum. EDS microanalysis allow identification of elemental distribution of sub-micrometre areas of the specimens. The large vacuum vessel (340 x 315 x 320 mm3) allows the insertion of large samples. The electron gun consists of a Schottky Field Emission Gun. SEM parameters: a high tension range from 3 keV to 30 keV, a beam current from 10 pA to 100 nA and a wide magnification range going from 500X to 10 000X. The focussing of lens allows high-resolution images on conducting samples; for non-conducting samples the microscope operation is available either in high or low vacuum (with a partial pressure from 7 up to 500 Pa in nitrogen and water vapour. There is also the possibility to perform sputter coating with gold using the Quorum sputter coater, in order to avoid loading of non-conducting samples. Unique feature of this instrument is the presence of a SPM, particularly an AFM Microscope, useful for colocalized scanning-electron and nano-probe microscopy characterization. The AFSEM system enables to combine the possibilities of a Scanning Electron Microscope (SEM) with the capabilities of an atomic force microscopy (AFM). The AFM system can be inserted inside the SEM chamber for AFM surface measurements during SEM operation.

RESEARCH AREAS AND APPLICATIONS

Fundamental Materials Research, Quality control and failure analysis, Technical Cleanliness, Forensics, Catalysis Research, Materials Testing (energy storage, automotive, etc). Characterization of composite materials and interfaces in medicine, cultural heritage, prosthetics, robotics and microelectronics. Topography and spectroscopic characterization of surfaces and interfaces of polymers, semiconductors, composite materials, with application also in cultural heritage.

SPECTROFLUORIMETER

General information

UNIT: University of Milano Bicocca
Category: Spectroscopy
Key instrumentation: Varian Cary Eclipse spectrofluorimeter

The spectrometer Eclipse, Varian, is a fluorimeter for the measurement of excitation and emission spectra of fluorophores in solutions.

TECHNICAL DESCRIPTION

The excitaiton lamp is a Xenon flash lamp (80 Hz) with excitation and emission range = 200-900 nm. The system is equipped with a temperature control that allows to perform programmable temperature ramps. Phosphorescence times can also be measured.

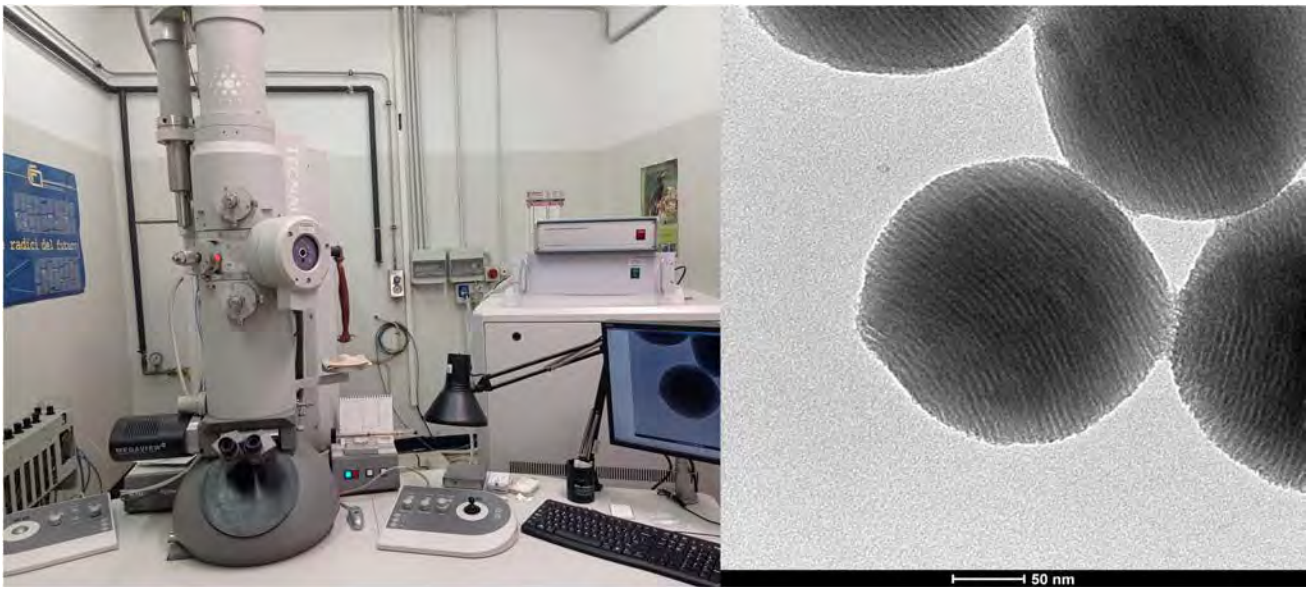
RESEARCH AREAS AND APPLICATIONS

Fluorescence spectrum measurements of organic molecules and biomolecules

TEM FEI

General information

UNIT: CNR IPCB
Category: Microscopy
Key instrumentation: Transmission Electron Microscope



Transmission Electron Microscope with LaB6 source (120 kV) and BF detector and FEI Eagle 4k CCD camera (bottom mounted).

TECHNICAL DESCRIPTION

Transmission Electron Microscope with LaB6 source (120 kV) and BF detector and FEI Eagle 4k CCD camera (bottom mounted). Operating modes: Bright field imaging; Electron Diffraction.

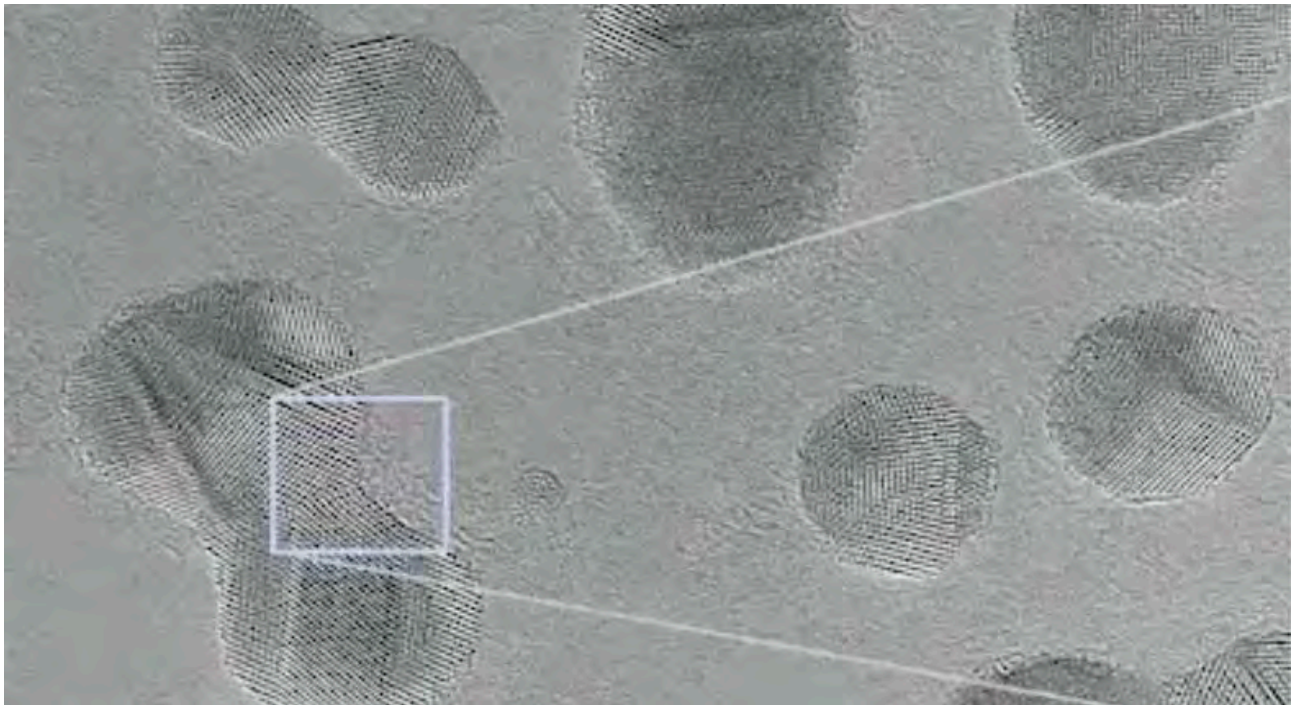
RESEARCH AREAS AND APPLICATIONS

material science, biomaterials, morphologycal/structural analysis

TEM HIGH RESOLUTION

General information

UNIT: CNR ICCOM
Category: Microscopy
Key instrumentation: High-resolution TEM



The TEM instrument – ThermoFisher Talos F200X – combines outstanding high-resolution S/TEM and TEM imaging with high performance energy dispersive x-ray spectroscopy (EDS) signal detection and 3D chemical characterization with compositional mapping.

TECHNICAL DESCRIPTION

The instrument allows for one of the best HRTEM imaging, and one of the fastest and most precise EDS analysis in all dimensions (1D-4D) at the state of the art. The applications are wide from energy materials, process control, and material science. A ULTRAMICROTOME RMC PowerTome PC with CR-X Cryosectioning system for the preparation of ultra thin sections for electron microscopy. The study of biologic samples, polymer, rubber or metals is also available

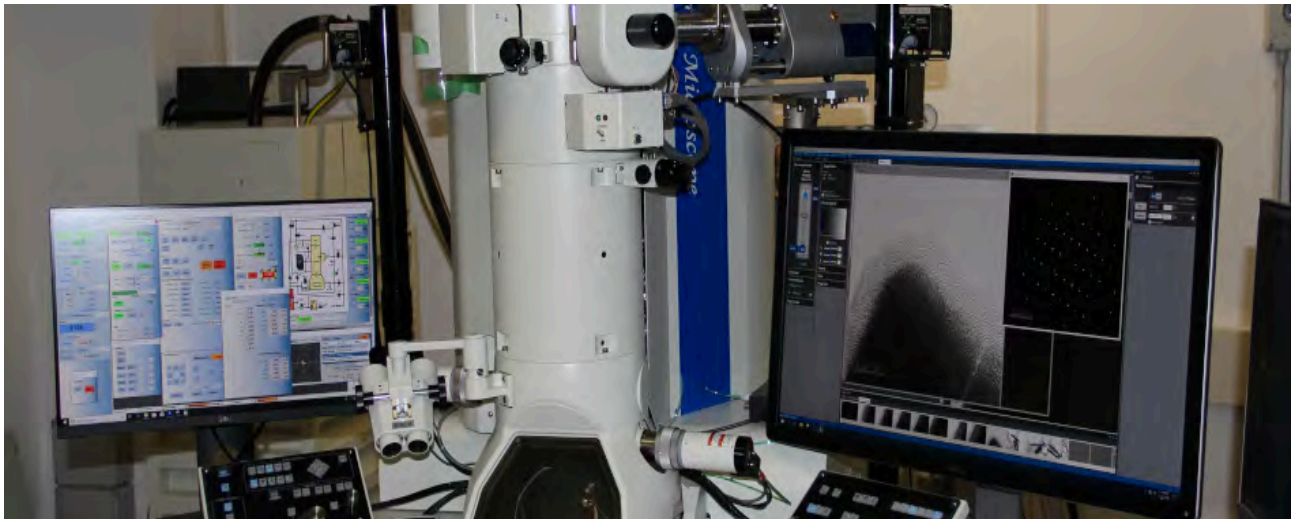
RESEARCH AREAS AND APPLICATIONS

3D chemical mapping of complex systems and interfaces; material science; microscopy; morphology; elemental analysis; nanostructure

TEM JEOL

General information

UNIT: University of Milano Bicocca
Category: Microscopy
Key instrumentation: Transmission Electron Microscope - JEM 2100Plus with EDS



Transmission Electron Microscope (TEM) with LaB6 emitter, 80-200 kV accelerating voltage, point-to-point resolution of 0.24 nm, EDS micro-analysis, 9 Mpx CMOS camera.

TECHNICAL DESCRIPTION

Transmission Electron Microscope (TEM) JEOL JEM 2100 Plus with a LaB6 emitter. The accelerating voltage can be set between 80 and 200 kV. The high-resolution objective pole piece allows a point-to-point resolution of 0.24 nm in TEM mode. The instrument can operate in STEM (scanning) mode and can acquire BF (Bright Field) and HAADF (High Angle Annular Dark Field) images with a nominal 1 nm resolution. The microscope is equipped with and 80 mm2 Oxford Energy Dispersive System (EDS) for spot analysis and chemical mapping and with a 9 Mpixel Gatan CMOS camera for image acquisition. A special in-gap aperture allows to reduce the damage on beam sensitive materials, as biological samples. The wide tilt range (+/- 45° with a standard double-tilt holder) along with the wide range of detectors and the high-resolution capability, makes this instrument a very versatile one.

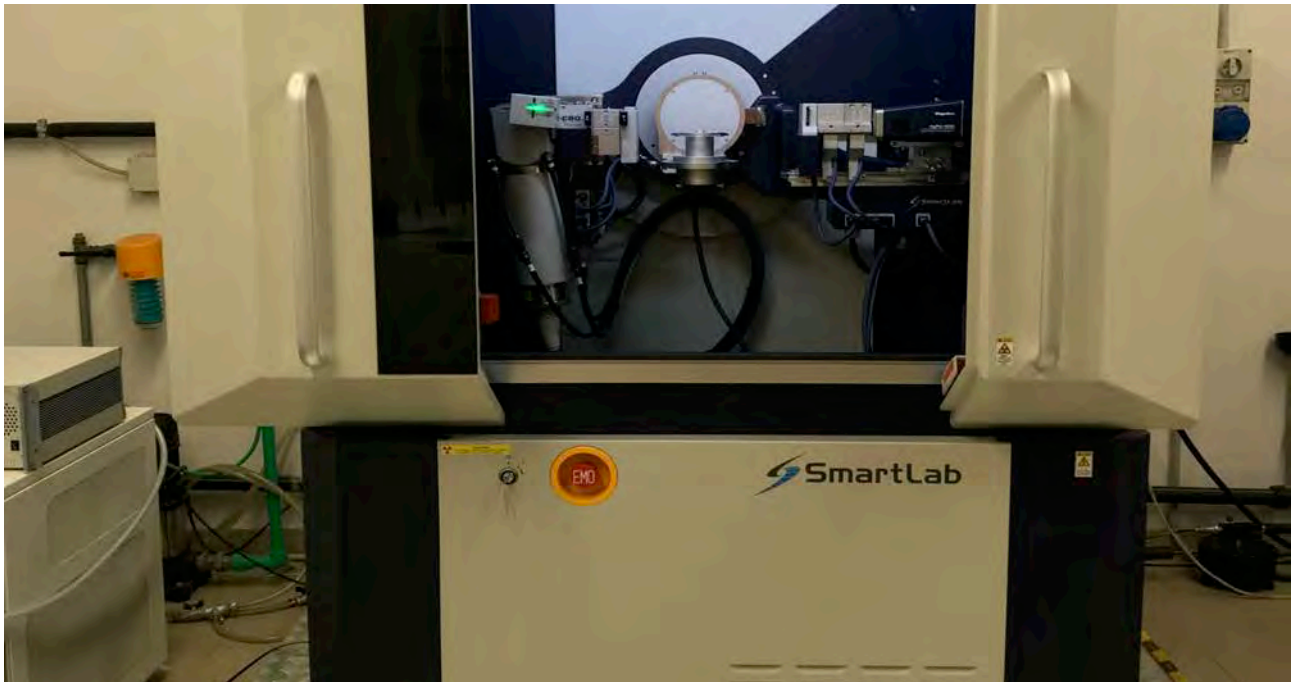
RESEARCH AREAS AND APPLICATIONS

nanoparticles, semiconductors, hazardous mineral particles and fibres, proteins, citotoxicity studies, cell ultrastructure, nanoplastics

X-RAY DIFFRACTOMETER

General information

UNIT: University of Milano Bicocca
Category: Photons
Key instrumentation: Rigaku SmartLab SE



Rigaku SmartLab SE is an X-ray powder diffractometer for thin film diffraction, SAXS, pole figure, residual stress and non-ambient experiments, and with automatic alignment.

TECHNICAL DESCRIPTION

Rigaku SmartLab SE features SmartLab Studio II software based on a new architecturally integrated modular platform; Cross-beam optics module switches between Bragg-Brentano and parallel beam without the need to change optics; HyPix-400 2D detector enabling seamless switch between 0D, 1D and 2D detection mode depending on application type; D/teX Ultra 250 1D detector accelerates powder diffraction by a factor of 250 in speed and provides adjustable energy resolution of approximately 20% or 4% depending on sample type; Integrated intelligent Guidance software enables fully automated measurement including optics and sample alignment; and Self-aligned optics maximize instrument uptime and minimize cost of ownership.

RESEARCH AREAS AND APPLICATIONS

Thin Films, Materials Science, Engineering

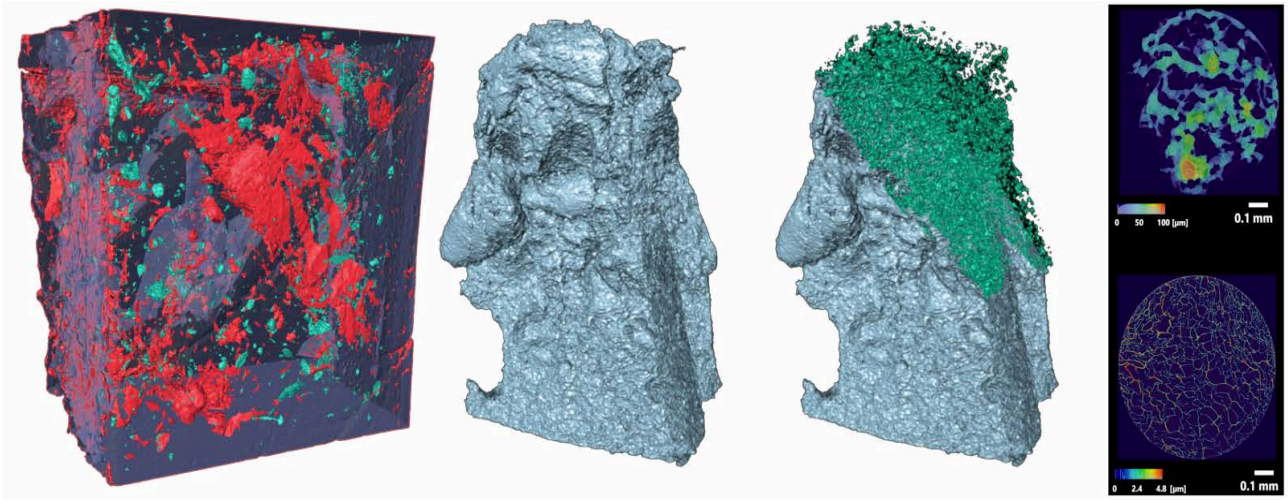
XRD TOMOGRAPHY

General information

UNIT: CNR-IPCB

Category: Microscopy

Key instrumentation: The RIGAKU Nano3DX is a X-ray microscope to measure large samples at high resolution.



The RIGAKU Nano3DX is a X-ray microscope to measure large samples at high resolution. This is achieved with a high-power rotating anode X-ray source and a high-resolution cMOS-type detector. The instrument allopws CT reconstruction, image processing, 3D visualization and segmentation, quantitative analysis.

TECHNICAL DESCRIPTION

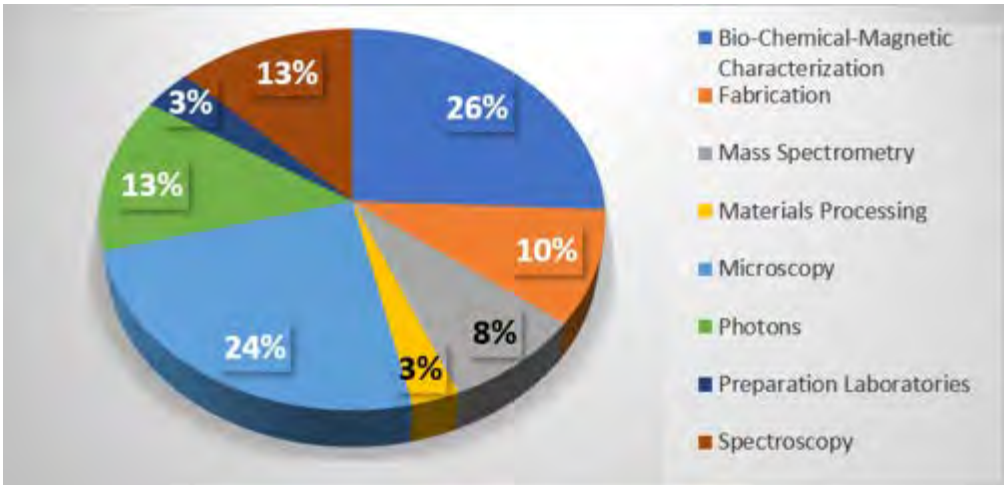
"Specifications: - 1 kW continuous rotating anode X-ray generator, complete with integral X-ray protection hood, with: - Dual anode: Cr/Mo or any other combination that provides high versatility of analysis - Max. source spot diameter 80 microns to minimize source drift - Detector type: high resolution sCMOS (0.325 to 7micron/pixel resolution), with 2048x2048 pixels, pixel size 6.5x6.5 microns, 16-bit A/D converter and standard 0.325 to 2.6 µm lens, 0.66 mm × 0.66 mm FOV - Changing pixel size from 325nm to 5200nm by replacing the lens - Two interchangeable lenses: 1. Max. FOV 10.64 mm × 10.64 mm - Minimum pixel size 5200nm 2. Max. FOV 2.66 mm × 2.66 mm - Minimum pixel size 1300 nm - Maximum spatial resolution achievable on a 2D graph below 500 nm - Near-parallel beam geometry instead of conical beam geometry enlargement for projection reduction - Maximum sample size: 20mm diameter x 40mm height - Automatic sample holder (Automatic sample holder) - Temperature control system and mechanical compression of sample during acquisition (temperature range RT-200°C, pressure range 1-200N maximum sample size Ø 10mm x 2mm"

RESEARCH AREAS AND APPLICATIONS

Advanced materials, Nanotechnologies, characterization of porous materials, evaluation of micrometric filler distribution in composites, hierarchical structure of materials

Annex – SRFs

The list of SRFs open for user service



Unit	Acronym	Model and brief description	Technique
UniMilano Bicocca	AFM_1	**AFM SOLVER P47 – NT**. The AFM Solver P47 – NT offers both qualitative and quantitative information on many physical properties including size, morphology, surface texture and roughness. Statistical information, including size, surface area and volume distributions, can be determined as well. The AFM instrument has a vertical resolution of 1 nm and X-Y resolutions of around 10 nm. It scans areas up to 30x30 square micron and is employed for the characterization of polymeric materials in ambient air.	Microscopy
UniRoma Tor Vergata	AFM_FLEX	**Quantum Design FlexAFM by Nanosurf**. Compact Atomic Force Microscope. Allows quick morphological analysis of any surface on which it can stand. Endowed with all main scanning force operational modes. It also locates quickly the area of interest at the micrometer scale, so that the probe scan speed can be reduced	Microscopy
CNR-DSCTM	AFM_ICLDS	**Local Dielectric Spectrometer** based on a Veeco Multimode AFM with Nanoscope IIIa controller, modified by external electronic instrumentation, both commercial and home-made, designed to perform local dielectric spectroscopy in intermittent-contact mode, with spatial resolution on dielectric properties as high as 3nm. The setup includes temperature and gaseous environment control. Typical application is to polymer glass formers ultrathin films, phase-separated blends, self-assembled nanostructures, hybrid nanocomposites.	Microscopy

CNR-DSCTM	AFM_RAMAN/TERS	**XploRa Nano – Horiba**. Micro-Raman spectrometer coupled with AFM/STM/Shear-Force Microscopes for colocalized μRaman/μPL - AFM, Tip-Enhanced Raman-(TERS) and Tip-Enhanced Photoluminescence (TEPL) Microscopy with excitation at 638 nm and 785 nm. The system is provided with a station for the fabrication of electrochemically etched TERS tips, providing enhancement factors of 104-105 and spatial resolution down to 10 nm. Excitation at 60 degrees insures applicability on both transparent and opaque samples. Spectral resolution down to 0.9 cm-1 (Diffraction gratings 600, 1200 and 1800, 2400 grooves/mm) CCD light detector Peltier Cooled at -60 °C (spectral range 400 – 1100 nm). The AFM/STM/Shear-Force system is a SmartSPM-1000, working in different configurations, including Kelvin Probe Force Microscopy (KPFM). The MicroRaman spectrometer is also coupled with a Olympus BX41 microscope (objectives: 5X, 10X, 50X, 50X LWD and 100X) for confocal μRaman/ μPL analysis with diffraction limited spatial resolution.	Microscopy
UniRoma Tor Vergata	AFM_SEM	**Quantum Design AFSEM**. Atomic Force Microscope for Correlative AFM during SEM measurement able to work both in the SEM chamber and outside the SEM. It also locates quickly the area of interest at the micrometer scale, so that the probe scan speed can be reduced	Microscopy
CNR IBFM	BIOCHEM_AN_1	**YSI 2950 biochemistry analyser**. An easier way to investigate the major biochemical species: YSI 2950 biochemistry analyzer, the Gold Standard in bio-analytical instruments with highly accurate sensors and rapid results. YSI 2950 is the easiest to use and most cost effective way to measure the following chemistries in a wide range of matrices: Glucose, Lactate, Glutamine, Glutamate, Ammonium, Potassium, Ethanol, Methanol, Sucrose, Galactose, Lactose, Choline, Glycerol, Hydrogen peroxide.	Bio-Chemical-Magnetic Characterization
CNR IBFM	BIOCHEM_AN_2	**Seahorse XF24**. An easier way to investigate the major biochemical species: Seahorse XF24, that uses label-free technology to detect discrete changes in cell bioenergetics in real- time, providing a window into the critical functions driving cell signaling, proliferation, activation, toxicity and biosynthesis.	Bio-Chemical-Magnetic Characterization
UniRoma Tor Vergata	BONDER	**West Bond 4KE with microscope**. Automatic Wire Bonder. Allows wire bonding on micrometer structured electronic circuits under microscope observation. The wire bonds are performed using ultrasonic transducers that convert a high frequency electronic signal to mechanical energy in the ultrasonic range (63kHz).	Materials Processing
CSGI-UniFirenze	CA_1	Contact Angle model 300 Ramèr-Hart (USA) equipped with an automatic programmable dispenser for static drop or advancing / receding drop measurements. The instrument allows the measurement of the contact angle at the solid / liquid interphase both in equilibrium conditions and as a function of time.	Photons
CNR-DSCTM	CA_2	**DSA 30S Krüss Optical system.** Such system allows to characterize properties like: Contact angle of sessile drops on a surface, both static and dynamic; surface tension of liquids, calculated with the pendant drop method; surface energy of solids. Camera with acquisition speed up to 2000 fps. Accuracy of 0.3° for contact angle measurements, 0.3 mN/m for surface tension measurements. Maximum sample size 320 mm × ∞ × 275 mm (width x depth x height) (132 mm × 132 mm × 27 mm for measurements in the TC40 chamber). Two PT100 probes to monitor the temperature on the surface and in the syringe. Possibility to establish automated measurement and dispensing routines. Equipped with a tilting table for sliding angle measurements. Equipped with a TC40 chamber with a Peltier cell for measurements at temperatures ranging from -25 to 150°C.	Photons

CSGI-UniFirenze	CD	Circular dichroism. The Jasco J-715 circular dichroism measures the difference in the absorption coefficient of active samples against circularly polarized light in both directions. It is the ideal method for the study of conformational differences, such as the secondary and tertiary structure of proteins, in the study of folding and unfolding mechanisms, or in the study of the purity of optically active molecules.	Spectroscopy
UniMilano Bicocca	CISP	**HYPERSPEC VNIR**. This system is a hyperspectral imaging system useful for spectroscopy analysis of different surfaces. The camera is a Headwall Nano-Hyperspec system, operating in the 400-1000nm spectral range, with 270 spectral bands, and a spectral resolution of 6nm. Typical applications are for airborne and ground remote sensing. An hypercube of reflectance is generated from a dedicated processing chain and used for precise mapping of forest, agricultural, water and snow parameters.	Bio-Chemical-Magnetic Characterization
UNIMILANO BICOCCA Milan	COLD_LAB	**Eurocold Lab**. EUROCOLD lab - integrated laboratory with controlled atmosphere for simulate the mean antarctic environmental conditions. Cold rooms till -50°C at very clean environmental conditions are available.	Preparation Laboratories
UniRoma Tor Vergata	CONF_AFM_RAMAN	**Horiba Xplora Nano**. Atomic Force Microscope with integrated Raman spectroscopy and confocal microscopy for microRaman applications and allowing Tip-Enhanced Raman Spectroscopy (TERS): Atomic Force Microscope with integrated Raman spectroscopy and confocal microscopy for microRaman applications and allowing Tip-Enhanced Raman Spectroscopy (TERS):a) microRaman, b) microluminescence; c)confocal microscopy; c) tip enhanced Raman spectroscopy; d) Tip enhanced fotoluminence; e) AFM; f) STM	Microscopy
UniMilano Bicocca	CONF_FLUO	**Leica TCS SP5 II**. Allows to increase radial resolution down to 60 nm exploiting the excited state depletion operated by a doughnut shaped beam at 592 nm. Equipped with AOBS and AOTF devices, coupled 454, 476, 488, 514, 562, 633 nm laser lines; it has a resonant scanning head operating at 8 KHz of line scanning frequency therefore allowing to perform fluxes measurements up to several mm/s. Other optical instrumentation available: UV-Vis-NIR spectrophotometer Jasco V570; UV-Vis fluorimeter Varian, with temperature control; FTIR spectropolarimeter Jasco; dynamic light scattering (homemade set-up); frequency domain fluorimeter K2 (ISS) for lifetime measurements that can be coupled to an Argon ion laser (2025 Spectra Physics) or to modulated diodes (378 nm, 430 nm, 633 nm).	Microscopy
UniRoma Tor Vergata	CONF_MIC_1	**Leica Microsystems Stellaris**. Confocal Microscope. Detects optical signals from micrometric section of the sample under observation. Scanning the focus position along the z axis allows 3D reconstruction of the sample, typically living cells	Microscopy
UniMilano Bicocca	CONF_MIC_2	**Nikon A1R**. The Nikon A1R confocal optical microscope is equipped with a hybrid scanner with the possibility of classical (galvanometric) and Resonant scanning to perform ultrahigh temporal resolution acquisitions ranging from 20 to 420 fps. The instrument is equipped with a 32-channels spectral detector (400- 750 nm) for accurate spectral separation of overlapping fluorescence. A digital camera (Andor Zyla) and a micro incubator (Okolab) allow measurements in epifluorescence and controlling temperature and CO2 respectively.	Microscopy
UniMilano Bicocca	CONF_MIC_3	**Operetta CLS High-Content Analysis System – PerkinElmer**. The Operetta High Content analysis system is a highly automated, high resolution confocal microscope suited to analysis of many samples in microplates. It allows quantitative image analysis of both fixed and live cells and the study of complex cell systems (e.g., spheroids, organdies). Its hardware/software integration allows advanced assays such as FRET to investigate conformational changes and protein-protein interactions, radiometric imaging and robust phenotypic fingerprinting.	Microscopy

UniMilano Bicocca	CONF_RAMAN_2	**Renishaw InVia Qontor**. Class 1 Qontor confocal Raman microscope, equipped with 532 and 660 nm laser sources, with autofocus and motorized stage allowing micrometric resolution. It can be used for 2D and 3D characterization of natural and synthetic materials.	Microscopy
UniMilano Bicocca	CYFM_1	**CytoFLEX S B2-R3-VO-Y4**. Benchtop flow cytometer, equipped with three lasers and nine fluorescent channels. Cytexpert software is very user friendly, and 561 nm laser enables optimal detection of fluorescent reporter proteins. In details: 488nm blue laser, 525/40 - 690/50 BP filters; 561nm yellow-green laser, 585/42 -610/20 – 690/50 – 780/60 BP filters; 638 nm red laser, 660/20 – 712/25 – 780/60 BP filters	Photons
UniMilano Bicocca	CYFM_2	**BD FACSMelody™ Cell Sorter**. Cell sorter of the latest generation with fixed alignment and "cuvette based". BD FACSMelody is able to detect up to 11 parameters simultaneously: 9 fluorescences and 2 physical parameters. It has 3 spatially separate lasers; Blue 488 nm (20mW), Red 640 nm (40mW), Violet 405 nm (40mW). The Counting chamber is a gel-coupled quartz, to minimize background noise and to ensure maximal sensitivity. It can acquire up to 40,000 events / second on eleven parameters. It is equipped with a BD FACSMelody Reflection optical system and full digital electronics for signal processing and data acquisition.	Photons
CSGI-UniFirenze	DLS_1	**Brookhaven BI900AT**. Multi-angle Brookhaven system based on light scattering for the study of colloids using quasi-elastic dynamic light diffusion and static light diffusion. The instrument allows the study of the dimensions, the shape and scattering properties of objects dispersed in colloidal systems.	Photons
CSGI-UniFirenze	DLS_2	**Brookhaven BI-90**. Instrument for the determination of article sizes and Zeta (electrokinetic) potential based on light scattering, model Brookhaven BI-90, for the study of dispersed systems, both for the determination of the dimensions of the objects responsible for the scattering of light and for their surface charge.	Photons
CSGI-UniFirenze	DLS_3	**Mastersizer 3000**. Instrument for the granulometry measurement based on light diffraction, model Laser Mastersizer 3000, with additional accessories for the study of solid powders in dispersion samples and emulsions, with dimensions between 50 nm and few millimetres.	Photons
CNR-IPCB	DLS_4	Malvern Zetasizer. Instrument for the determination of average particle size, particle size distribution and zeta (electrokinetic) potential of dispersed systems based on dynamic light scattering (DLS), model Zetasizer Nano ZS (Malvern Instruments),	Photons
UniRoma Tor Vergata	DNA_SEQ	**Illumina NextSeq 550**. Automatic DNA sequencer for genomic sequence determination. Its fast DNA-to-results workflow enables rapid sequencing of exomes, targeted panels, and transcriptomes in a single run, with the flexibility to switch to low- or high-throughput sequencing as needed.	Bio-Chemical-Magnetic Characterization
UniMilano Bicocca	ELLI	**Woollam Inc. Corp. VASE**. The VASE UV-Vis-NIR ellipsometer is an accurate and versatile ellipsometer for research on all types of materials: semiconductors, dielectrics, polymers, metals, multi- layers, and more. It combines high accuracy and precision with a wide spectral range.	Spectroscopy
UniMilano Bicocca	ESMF	**R2Sonic 2022**. The R2Sonic 2022 is a wideband high resolution shallow water multibeam echosounder (i.e.: an offshore surveying tool able to map a swath of the seabed), that can operate at multiple frequencies (from 170 to 450 kHz) providing variable swath coverage selections from 10° to 160° to generate reliable and remarkably clean bathymetric measurements through all range settings to roughly 400m. TruePix™ Backscatter at multiple frequencies and Raw Water Column data can also be collected. The 60 kHz signal bandwidth collects up to 1024 soundings per ping at a maximum speed of 11.1 knots for full coverage. The system is integrated with an Inertial Navigation System (I2NS™) and a sound velocity sensor.	Bio-Chemical-Magnetic Characterization

CNR-IPCB	FDM_1	**Flashforge Creator Pro**. Fused deposition modelling (FDM) 3D printer equipped with a versatile dual extruder that allow printing a wide range of materials, including ABS, PLA, HIPS, Flex, T-glass, and composites. The main features of the machine are: build volume of 227×148×150 mm, max. extruder temperature: 260°C, Max. heated bed temperature: 120°C,	Fabrication
CNR-IPCB	FDM_2	**CreatorBot F430**. High temperature FDM 3D printer for processing high performance materials as PEEK and PEI. F430 equipped with dual extruders, The left 260°C hotend is able to print with PLA, ABS, PC, Nylon, Carbon fiber, Flexible, etc. The right 420°C hotend is able to print High performance material like PEEK, ULTEM. The main features of the machine are: build volume of 400×300×300 mm, max. extruder temperature: 260-420°C, Max. heated bed temperature: 140°C, max chamber temperature: 70°C.	Fabrication
CNR-IPCB	FDM_3	**I3D PivotMaker FULL**. This FDM 3D printer allows realizing large objects and prototypes in a single print. The main features of the machine are: very large build volume (850x850x850 mm), resolution layer Z axis: 100 – 500 µm.	Fabrication
CNR-IPCB	FDM_CFC	**Anisoprint Composer A3**. It is a continuous fiber 3D printer. The Composer works both with the patented CFC technology (Composite Fiber Coextrusion) and with standard FFF 3D printing technology. Composer A3 offers a build volume of 420 x 297 x 210 mm.	Fabrication
CNR-IPCB	FDM_CFR	**Markforged Mark Two**. FDM 3Dprinter able to print polymer object with continuous fibres reinforcement. The main features of the machine are: build dimension 320x132x154 mm, Z-axis max resolution 100 µm.	Fabrication
UniRoma Tor Vergata	FEMTO-LASER	**Onefive Origami 10 XP - APE pulseCheck SM 2000**. Femtosecond Laser and High-resolution and high-sampling rate autocorrelator. High average and peak power and repetition rate up to 1 MHz at 1030 nm allow fast micromachining of hard materials as well as efficient vaporization of solids for pulsed laser ablation and deposition.	Fabrication
CNR-IPCB	FTIR_1	FTIR spectrometer (Spectrum One Perkin Elmer) equipped with Universal ATR accessory, for chemical analysis of organic and inorganic materials. Wavelength range 7,800 – 350 cm-1. Resolution 0.5 cm-1 to 64 cm-1	Spectroscopy
UniRoma Tor Vergata	FTIR_2	**Thermo Fisher Scientific**. A portable Fourier transform infrared (FT-IR) spectrometer to carry out chemical analysis of materials by collecting data in the mid-IR spectral range using a variety of accessories including attenuated total reflection (ATR), and reflectance mode.	Spectroscopy
UniMilano Bicocca	FTIR_3	**Jasco mod.6200FV**. Fourier transform infrared spectrophotometer. The FT/IR-6200 is an Infrared spectrometer operating from 50 to 4000 cm-1 in transmission and reflection mode. It has a sample compartment operating in full or partial vacuum or in nitrogen or argon atmosphere, with separate control of the interferometer and optical pathways. It has been equipped with a continuous closed cycle refrigerator cryostat in order to collected spectra from 10 K to 450 K	Spectroscopy
UniRoma Tor Vergata	FTIR_4	**Thermo Fisher Scientific Nicolet iS20**. Attenuated Total Reflectance–Fourier Transform Infrared. Spectral Resolution Better than 0.25 cm-1. Applications Polymers and Plastics; Analytical Services; Quality Control QA/QC; Pharmaceuticals; Education; Forensics; Gemstone Analysis.	Spectroscopy
CSGI-UniFirenze	GAS_ADS_1	**3Flex Micromeritics**. The system is a physical adsorption analyser for gas porosimetry at high pressures, (adsorption gas: N2, with the possibility to use other gases). It allows the determination of the specific surface area, starting from 0.01 square meter per gram, and of the distribution of dimensions of pores between 3.5 and 5000 Angstrom.	Bio-Chemical-Magnetic Characterization

CNR-IPCB	GAS_ADS_2	**Micromeritics 3FLEX**. High-performance gas adsorption analyzer for measuring surface area, pore size, and pore volume of powders and particulate materials, microporous and mesoporous materials. Main specifications: 3 analysis ports with pressure transducer of 1000 mmHg, 10 mmHg and 0.1 mmHg; P0 port with dedicated pressure transducer for continuous monitoring of saturation pressure; Isotherm data collection begins in the 10-6 torr range; ECR (Enhanced Chemical Resistance) treatment of the surfaces; Compatible for analysis with N2, O2, Ar, CO2, CO, H2, butane and with corrosive gases.	Bio-Chemical-Magnetic Characterization
CNR-DSCTM	GAS_ADS_3	**ASAP 2020 K C MP**, (Micromeritics) Apparatus for Phisy-Chemisorption (N2, Kr, CO2, H2, O2, CO) equipped with vapours (H2O, organics) adsorption module. Suitable for characterization of textural properties (micro- meso-porosity, surface area) of materials (organic, inorganic, composites, bulk, nano, films), determination of active surface of nanomaterials; adsorption properties of small molecules vapours (H2O, solvents, organics)	Bio-Chemical-Magnetic Characterization
UniRoma Tor Vergata	GC_AUTO	**HTA HT2850T**. Gas-Chromatography Autosampler. The HT280T is an all-in-one autosampler that combines in a single unit a traditional liquid sample injection, a headspace and a SPME (Solid Phase micro-extraction) autosampler.	Bio-Chemical-Magnetic Characterization
UniRoma Tor Vergata	GC_IMS	**GAS FlavourSpec**. Gas Chromatograph with Ion Mobility Spectrometer. FlavourSpec: Sensitive Analyser for Food, Flavour and Beverage testing. The FlavourSpecE comprises advantages of a Gas Chromatograph (GC) with regard to selectivity and outstanding sensitivity of an Ion Mobility Spectrometer (IMS) enabling the analysis of volatiles in the headspace of liquids and solid samples without any sample pre-treatment.	Mass Spectrometry
UniRoma Tor Vergata	GC_MS	**Shimadzu GCMS-QP2020**. Gas Chromatography - Mass Spectrometry FOR Testing/inspection of food, pharmaceutical, chemical and environmental applications. With excellent performance and smart operability, the instrument satisfies a wide range of needs for single quadrupole GC-MS systems, e.g. testing/inspection of food, pharmaceutical, chemical and environmental applications.	Mass Spectrometry
UniMilano Bicocca	GC_TQ_AS	**GC CP 3800 e triplo quadrupolo 320-M**. Gas Chromatograph with triple quadrupole and autosampler for the analysis of organochlorine micropollutants.	Bio-Chemical-Magnetic Characterization
UniMilano Bicocca	GEN_AN	**3100-Avant Applied Biosystems**. The 3100 Genetic Analyzer is a multi-color fluorescence-based DNA analysis system with 16 capillaries operating in parallel, which offers high-quality data and efficient sample processing.	Bio-Chemical-Magnetic Characterization
UniRoma Tor Vergata	GP_RAD	**Ekko 100 A**. Ground Penetrating Radar Pulse Ekko 100 A with three different types of antennas (50 Mhz, 100 MHz e 200 MHz) characterized by a low system noise which easily allow high resolution investigations for subsurface stratigraphy in geological, geotechnical, glaciological and archaeological problems. A borehole antenna is also available for downhole surveys. Presently a new GPR COBRA CBD wireless georadar system has been acquired with a CBD antenna capable to transmit three frequencies 70/200/400/800 MHz antennas that can replace multiple antennas which can be used both on-board of a DIJ M600 UAV or on the ground by a smart cart. This allows for rapid investigations over large areas.	Bio-Chemical-Magnetic Characterization
CNR-DSCTM	HI_FI	**Hi-FIF.** The facility covers the entire value chain from the fabrication to the photophysical and electrophysiological characterization of complex bio-nanostructured interfaces and systems. The facility enables (i) the realization of organic, inorganic and bio-hybrid interfaces and systems with no-conventional deposition techniques,(ii) the definition and investigation of new paradigms for stimulating, revealing, and modulating biological events at the interface with functional materials and devices and (iii) the implementation of innovative tools for biomedical research, biodiagnostics, and neuro- regenerative medicine.	Fabrication

CNR-DSCTM	HYP	In-house built **Magnetic Heating Equipment** equipped with a CELES MP6 generator, operating in the 50-450 kHz frequency range with magnetic fields up to 19 kA/m for magneto-thermal measurements	Bio-Chemical-Magnetic Characterization
UniMilano Bicocca	ICP_OES	**ICP OES OPTIMA 7000 DV**. The ICP OES OPTIMA 7000 DV isused for the identification and determination of most of the periodic table elements, particularly alkaline earth metals and transition metals, for which sensitivity is optimal. The limits of detection vary from a few ug/L to mg/L. It has high robustness and a high linearity dynamic range, which allows the simultaneous determination of many elements in the same sample, even if they are present at very different concentrations. Applications concern the determination of metals after acid digestion of samples, including drinking water, soils, sediments, plant extracts, foods and biological fluids.	Spectroscopy
UniRoma Tor Vergata	IMP	**Cicci Research Srl**. Time Resolved Photo Luminescence (TRPL) upgrade Sistema CHARON -Archeo + n. 1 multichannel system for the characterization of electronic devices in terms of cyclovoltammetry, chronopotentiometry and independence spectroscopy in controlled temperature,	Bio-Chemical-Magnetic Characterization
CNR-DSCTM	LIBS	**LIBS**. The Laser-Induced Breakdown Spectroscopy (LIBS) is a type of atomic emission spectroscopy which uses a highly energetic laser pulse as the excitation source that lets the in-situ elemental analysis (from % to ppm scale) on most types of substance (solids, liquids, gases, conductive materials, etc) without sample preparation. A number of applications of the LIBS technique have been proposed in the fields of materials science, industrial process control, environmental protection and cultural heritage conservation and study. ICCOM has one conventional and one mobile instrument.	Spectroscopy
UniRoma Tor Vergata	MACHINE_SHOP	Machine Shop including milling and turning tool, cutting machine, small drill press, grinder, micro lathe, and a numerically controlled milling machine.	Materials Processing
CNR-IPCB	MECH	**LITeM**. The device is used for the measurements of mechanical properties of polymer composite specimens, coupling static and dynamic measurements (including fatigue characterization). The maximum force is 7kN.	Bio-Chemical-Magnetic Characterization
CNR-IPCB	MELTMIX	Melt mixer Brabender Plastograph EC Plus, for the mixing of thermoplastic polymers, with speed and temperature setting and torque measurement system, suitable for material development, optimization of the production process and lab-scale production of polymer blends and composites	Materials Processing
CNR IBFM	METABOLOMICS	**Agilent Technologies 7200 GC-QTOF & Agilent Technologies 6550 Ion-Funnel LC-QTOF**. A metabolomics facility with complex mass spectrometers, and complementary instruments: Mass spectrometers, coupled with gas or liquid chromatography: Agilent Technologies 7200 GC-QTOF, with an associated automatic samples preparation instrument (Agilent Sample Prep Workbench), that provides consistent precision and eliminates errors associated with mundane sample preparation procedures, such as dilutions, internal standard additions, and derivatization; Agilent Technologies 6550 Ion-Funnel LC-QTOF, coupled with the UHPLC 1290	Mass Spectrometry
CNR-DSCTM	MICRO_DIG	**HIROX RH-2000.** Last generation digital microscope equipped with two statives: one for contact analysis with magnification from 6 to 160x, and one with 3 objectives with magnification in the 35-5000x range. The column statives have Z axis motorized and reclinable up to 90° in both right and left directions. Motorized sample holder table that allows programming the XY movement with micrometric precision (0.04 micron) for a 40×40 displacement and automatic surface topographic 3D reconstruction. Possibility to carry out 2D and 3D measures. The microscope is provided with a motorized optical head able to rotate 360° on the optical axis enabling the observation of specimens from all directions without need to move the sample. This instrument is particularly suited for failure analysis, but also to analyze highly porous components.	Microscopy

UniMilano Bicocca	MICRO_FLUO_1	**Olympus Bx51**. System for in vivo imaging in controlled atmosphere composed by an upright microscope (BX51, Olympus, Japan) operating with a high working distance objective (N.A. = 0.95,wd=2 mm, 20X, water immersion, XLUMPlan FI, Olympus, Japan) equipped with a confocal scanning head (FV- 300, Olympus, Japan) operating in a home-made three-channels non-descanned mode. The laser source is a mode-locked Ti:sapphire laser (Mai Tai HP, Spectra Physics, CA), 80 MHz pulse repetition frequency (FWHM is estimated to be 220-240 fs on the sample plane and it is controlled by a DeepSee unit (Spectra Physics, CA) which optimizes the pulse width at the selected wavelength in order to maintain an efficiency of penetration depth. The microscope is updated to perform Fluorescence Lifetime Imaging (FLIM).	Microscopy
CNR-DSCTM	MICRO_FLUO_2	**Advanced inverted microscope ECLIPSE Ti-E – NIKON.** The Ti- E is equipped with a unique Perfect Focus System (PFS) that automatically corrects focus drift in real time during a prolonged period of time-lapse imaging. The Ti-E utilizes Nikon's NIS- Elements software allowing operations from advanced image acquisition to analysis and measurement by integrating control of microscope, camera and peripherals. Ti-E also enables exceptionally well-integrated and fast acquisition of multipoint, multi-colour time-lapse imaging and Z-axis data capture. Objectives: Plan Fluor 10x, Plan apo 20x, Super Plan Fluor 40x, Plan apo oil 63x. Fiters: DAPI, FITC, TRITC. Camera: High resolution DC-QiMc	Microscopy
CSGI-UniFirenze	MICRO_FLUO_PT	Particle Tracking. Fluorescence microscope Nikon Ti2-S, equipped with a 4 wavelength LED illuminator (CoolLED PE300-Ultra) and a high-speed/large CMOS camera (Hamamatsu Orca Flash v4). It allows the high-rate acquisition of time-series of images of fluorescently labeled objects (particles, cells, bacteria, ...), that can be analyzed by particle tracking for investigating passive and active transport phenomena, such ad diffusion in complex environments or flow in microfluidic channels.	Microscopy
CSGI-UniFirenze	MICRO_FTIR	Nicolet Nexus 870. Instrument for FT-IR spectroscopy and microscopy, model Nicolet Nexus 870, equipped with external optical table, two external detectors (MCT e TRS), GeATR, one Hind photoelastic modulator, and one IR Continuμm microscope.	Microscopy
UniMilano Bicocca	MICRO_RAM_1	**HR Evolution – Horiba**. The spectrometer has a focal length of 800 mm, two grids (1800 and 600 grooves / μm), and a CCD detector (1024x256 px, -60 °C). There is also a 9-position filter system (from 100 to 0.01%) for EDGE and ULF (Ultra Low Frequency). The green Nd laser source (532 nm) has a power of 300 mW. High visualisation is by an Olympus BXFM petrographic microscope for transmitted and reflected light, connected with a 5Mpx camera (objectives: 5X, 10X, LWD 50X, and 100X). The presence of a motorised sample holder stage and the confocal system enables the acquisition of two- and three-dimensional profiles and maps in 2D and 3D at the (sub)μm scale. The system is compatible with a LINKAM THMS600 heating/freezing stage for analysis in the temperature range from 300 to -180°C.	Microscopy
UniMilano Bicocca	MICRO_RAM_2	**Dilor-Jobin-Yvon, Labram**. Micro-spectrophotometer LabRAM HR (Horiba - Jobin Yvon) in backscattering configuration for micro- Raman and micro-photoluminescence analysis and mapping, with Ar laser at 488 nm and HeNe laser at 633 nm as light sources, light signal collection by a polychromator and a charge-coupled-device with a final resolution of about 1 cm-1, with sample temperature control in the range 77-350 K by means of a cryostat working with liquid nitrogen flux and programmable heater with a final stabilization within ±2 K	Microscopy

UniMilano Bicocca	MICRO_RAM_3	**Jobin Yvon T64000**. The Jobin-Yvon T64000 Raman spectrometer is a 640 mm focal length triple stage spectrometer that can be used in triple subtractive and single spectrometer configuration. The triple spectrometer configuration allows measuring spectra down to 5 1/cm with any excitation laser, also with deep-UV excitation. The setup is connected to a microscope for sub-wavelength spatial resolution. A thermal stage can be connected in order to change the temperature of the samples.	Microscopy
CNR-DSCTM	MICRO_RAM_4	**HR800 – Horiba -** Micro-Raman spectrometer coupled with an Olympus BX41 microscope (objectives: 5X, 10X, 50X, 50X LWD and 100X) for confocal μRaman/ μPL analysis with diffraction limited spatial resolution. The system is coupled with different lasers for multiwavelength excitation at 454, 476, 488, 515, 561, 633, 785nm. Spectral resolution down to 0.4 cm-1 (Diffraction gratings 600, 1200 and 1800) CCD light detector Peltier Cooled at -60 °C (spectral range 400 – 1100 nm). InGaAs array detector LN cooled (900 – 1600 nm). The system can perform mapping using both a motorized (Merzhauser) and a high precision piezoelectric (PI 200x200 μm) stage. The system is coupled with a Linkam heating/cooling stage for variable temperature measures.	Microscopy
CNR-DSCTM	MICRO_RAM_FT	**RamanScope III – Bruker. Raman spectrometer** with NIR (1064nm) excitation and Fourier Transform spectrometer (VERTEX70) for measurements of solid and liquid samples. The system is coupled to an optical microscope that allows for the acquisition of Raman spectra and maps with micrometric spatial resolution (~ 10 micron). Spectral range: 20 cm-1 and 15000 cm-1. Spectral resolution better than or equal to 0.4 cm-1. Minimum measurable stoke shift of 50 cm-1. Light source: 1064nm Nd: YAG laser, 1 W power, Automatic power variation system, automated control linear polarization, TEM00 emission mode, line width <0.5 cm-1. Liquid nitrogen cooled germanium detector for Raman spectroscopy in the near infrared (NIR). Possibility of Macro measurements with backscattering and 90 ° collection. The microscope is equipped with 2 objectives, (10X, 40X magnification) optimized for NIR focusing and collecting light.	Microscopy
CNR-DSCTM	MICRO_RAM_TW	**Optical Tweezers setup** coupled with a Raman spectrometer (Horiba Triax). The system exploits a single laser beam, tightly focused, to optically trap individual micro and nanoparticles in liquid environment and perform their spectroscopic (Raman/PL) analysis. Individual nanoplastics (300nm), nanotubes and graphene flakes can be investigated. Lasers at 515, 633, 785nm are used for trapping and excitation. Microscope objectives: 100X, oil and water immersion (NA 1.3). The spectrometer is equipped with a 1200 lines/mm grating giving a spectral resolution of 8 cm-1, and coupled to a silicon Peltier-cooled CCD camera (spectral range 400 – 1100nm). A CMOS camera is used for particle visualization and size determination (down to the diffraction limit). The sample cell can be translated with a piezoelectric stage (PI, 200 x 200 μm) with nanometric precision.	Microscopy
CNR-DSCTM	MICRO_RAMAN_IR	**IR and Raman vibrational spectroscopy facility.** Confocal micro- Raman spectrometer equipped with cw laser sources (632, 514 and 488 nm) with 1 micron lateral resolution. FT-Raman spectrometer with 1064 nm excitation laser source. FT-IR spectrometer equipped with microscope with 25 microns lateral resolution and capable to perform time resolved measurements.	Microscopy
UniMilano Bicocca	MICRO_TOMO_1	**CT/DR BIR ACTIS 130/150**. X-ray computerised microtomography (microCT). The industrial micro CT system available atUniMilano Bicocca is a BIR Actis 130/150, upgraded in 2017. Resolution of the images depends on the position of the specimen with respect to the X-rays source (maximum theoretical resolution 7 microns).	Photons

UniMilano Bicocca	MICRO_TOMO_2	**Skyscan 1176**. High performance in vivo and ex vivo micro-CT scanner for the investigation of the morphology of the samples in a non-destructive manner in preclinical research. The image field of view is 68 mm allowing full body mouse and rat scanning or distal limb in larger animals, such as rabbits, at resolution of 9, 18 and 35µm. Allows imaging in diverse research applications: from lungs to abdominal organs (with contrast agents) up to teeth or bones.	Photons
CNR-IPCB	MICRO_TOMO_3	**High resolution computed tomography (CT) X-ray nano-microscope**, which can be used to visualize the internal three- dimensional structure of small objects with a resolution of several hundred nanometers (at least 400nm for small samples, 7-800nm for samples in the range of a few mm and a few microns for samples of at least 2cm3), usable for the characterization of samples of traditional and innovative composite materials with nano and microparticles, biological samples and biomaterials, gels and scaffolds, films, fibers, coating and foams. The contrast level allows the identification of carbonaceous materials in a polymer matrix.	Photons
CNR-DSCTM	MOKE	**MOKE** Longitudinal Magneto Optical Kerr effect magnetometer equipped with He-Ne laser and electromagnet (Hmax=0.3T).	Bio-Chemical-Magnetic Characterization
UniMilano Bicocca	MSPEC_1	**Nu Instruments Noblesse**. Multicollector mass spectrometer equipped with a Nier source and three collectors: one Faraday collector and two ion counters. It is designed to measure the isotopic compositions of He, Ne, Ar, Kr and Xe. The applications include 30Ar-40Ar dating of minerals; the noble gas diffusivities of apatite and feldspar, and to study the noble gas and halogen geochemistry of mantle rocks.	Mass Spectrometry
UniMilano Bicocca	MSPEC_2	**TSQ Quantum Access Max**. Triple quadrupole mass spectrometer, an LC-MS/MS instrument with high sensitivity, specificity, and flexibility. The detection mass range is up to m/z 3000 to support a wide range of applications. This mass spectrometer can meet the quantitative and qualitative needs of a wide range of applications	Mass Spectrometry
UniMilano Bicocca	MSPEC_3	**RAPIFLEX**. This MALDI-TOF / TOF mass spectrometer is of high accuracy and sensitivity. It has a resolution of over 40,000 RP and a mass accuracy of better than 2-5ppm. The sensitivity is in the order of a few femtomoles. It is specifically designed for MS imaging with a spatial resolution of 10-20 µm. It allows "Imaging" by mass spectrometry (MSI) to obtain the spatial distribution and relative intensity of the molecules of interest directly in tissues and cells.	Mass Spectrometry
UniMilano Bicocca	MSPEC_4	**Bruker Daltonics**. This MALDI-TOF / TOF mass spectrometer is of high accuracy and sensitivity. It has a resolution of over 40,000 RP and a mass accuracy of better than 2-5ppm. The sensitivity is in the order of a few femtomoles. In particular, this instrument allows "Imaging" by mass spectrometry (MSI) to obtain the spatial distribution and relative intensity of the molecules of interest directly in tissues and cells.	Mass Spectrometry
CNR-DSCTM	MSPEC_5	**High Resolution ESI-Mass Spectrometer, Q-Exactive Orbitrap Thermo.** The Thermo Fischer Q-Exactive Hybrid Quadrupole- Orbitrap Mass Spectrometer is a mass spectrometer system combining quadrupole precursor ion selection with high-resolution, accurate-mass Orbitrap detection, with electrospray ion source (ESI). The system can be coupled with UHPLC UltiMate 3000 Dionex equipped with an autosampler that allow to analyze a big number of samples in a short time. Capillary and nano columns can be used to small analyte concentration. The flexible capabilities of the Q Exactive instrument allow the identification and characterization of wide spectrum of compounds, ranging from small molecules to large polymers and reaching accuracy (nanomolar), sensitivity and resolution suitable for many applications	Mass Spectrometry

CNR-DSCTM	MSPEC_6	**MALDI TOF/TOF Mass Spectrometer 5800 AB SCIEX.** The AB SCIEX 5800 MALDI is a mass spectrometer with TOF/Reflectron analyzer. It provides improved protein identification results for single spot analysis. The MALDI source enables deeper analysis into each sample, even if mixed with salts, and much faster acquisition. A variable rate 1000Hz laser increases the speed of each acquisition by collecting more spots per unit time. The instrument is equipped with a TOF/reflectron mass analyzer. The Time Of Flight (TOF) analyzer enables an ultra-sensitive analysis. The Reflectron mode improve the high resolution analysis. The extended mass range linear detector provides enhanced sensitivity up to m/z of 300,000. These acquisition features provide high quality MS/MS data with minimized sample consumption (ng).	Mass Spectrometry
UniMilano Bicocca	MSPEC_ICP	**Element XR Thermo-Fisher**. ICPMS Thermo Fisher Element XR Thermo-Fisher: high resolution magnetic ICPMS for ultra-trace element analysis	Mass Spectrometry
UniMilano Bicocca	MSPEC_TIMS	**timsTOF flex**. SpatialOMx platform, timsTOF fleX, that offers dual capability for MALDIimaging and Omics in a single high- performance MS platform equipped with the novel Trapped Ion Mobility Spectrometry (TIMS) for unparalleled mobility resolution and reproducibility. SpatialOMx is the integration of MALDI imaging with LC-MS/MS.	Mass Spectrometry
UniRoma Tor Vergata	Nd_YAG	**JK LASERS**. Nd YAG nanosecond Pulsed Lasers with second, third and fourth harmonic	Spectroscopy
UniMilano Bicocca	NGS	**Ion GeneStudio S5 Prime System**. The Ion GeneStudio S5 Prime System is a semiconductor-based next-generation sequencing (NGS) system that enables simple targeted sequencing workflows. It works with a rapid turnaround time from a benchtop NGS system enabling breadth and depth, from large panels or exomes to clinical oncology research. The system is simple to use and offers scalability and flexibility. It supports a broad range of high- throughput sequencing for clinical research and research applications from microbial genomes and gene panels to exomes and transcriptomes (from 3M to 130 M reads).	Bio-Chemical-Magnetic Characterization
UniMilano Bicocca	NMR_1	**Bruker Advance III 600 MHz**. Equipped with probes suitable for the analysis of liquid (cryo, 1H, 13C, 15N, 31P), solid (MAS, 1H, 13C, 15N) and heterogeneous (HR-MAS, 1H, 13C, 15N) samples. The cryo-probe shows a sensitivity about 40 times higher than a conventional probe. The HR-MAS probe allows the analysis of the molecular composition of cells and tissue fragments from biopsies (e.g., concentration and relative abundance of specific metabolites, biological membrane compositions).	Bio-Chemical-Magnetic Characterization
CNR-DSCTM	NMR_2	**Bruker Avance NEO 500 MHz NMR**. It allows the characterization of the most relevant structural and dynamic properties, on wide spatial (0.1-100 nm) and time (10-12 -1 s) scales and as a function of temperature, both in solids and in liquids. Thanks to the multinuclear methods, important information on the synthesis, structure, and activity relations could be obtained.	Bio-Chemical-Magnetic Characterization
CNR-DSCTM	NMR_3	**600 MHz Bruker DRX (14.1T)**, 1H/BB BBI 5mm Z axis gradient probe (50 gauss/cm); TXI 5mm triple resonance probe, 1H (direct detection), 13C and 15N (inverse detection), Z axis gradient unit (50 gauss/cm). Working temperature range: T = -20°C +60°C. Material research, Life Science, Food, OMICS. 600 MHz Bruker Avance Neo (14.1 T), high sensibility probe, liquid nitrogen cooled (Prodigy, triple resonance) with 5 and 3mm shaped inserts, multi receiver acquisition system, with 4 channel simultaneous acquisition, automatic matching and tuning, Z axis gradient unit (60 gauss/cm). Working temperature range: T = -20°C +60°C. Thermostatic autosampler (24 slots), specific integrated software for: a) metabolomics, b) automatic resonance assignment of small molecules, c) relaxation data analysis, d) protein dynamic center, e) statistical data analysis. Material research, Life Science, Food, OMICS	Bio-Chemical-Magnetic Characterization

CNR-DSCTM	NMR_4	Bruker Avance III 300 MHz with gradient field spectroscopy Features: Two probes for high-resolution analysis of liquids: BBI (1H-13C-15N-31P) and BBFO (1H-13C-15N -31P). Other accessible nuclei: 11B, 19Ag, 23Na, 29Si, 27Al, etc. Probe for solid-state: CP-MAS multinuclear 1H/31P-15N. Expertize with 13C, 29Si, 31P, 27Al. T range: -200 - +400°C	Bio-Chemical-Magnetic Characterization
UniMilano Bicocca	ONAB	**CGH-Agilent**. The platform enables to quickly and reliably identify aneuploidies, microdeletions, microduplications, as well as other types of chromosomal aberrations across the genome, starting from any type of sample (blood, cells, fresh frozen tissues and FFPEs). Agilent's CGH platform offers real comparative genomic data thanks to the 2-color approach, and unlimited flexibility in terms of format and content.	Bio-Chemical-Magnetic Characterization
UniRoma Tor Vergata	PARR	As the only electrochemical workstation available with the ability to provide you with a 4 A maximum current range, 40 pA minimum current range, 48 V of compliance voltage and frequency bandwidth up to 10 MHz, all standard, the PARSTAT 4000A provides today's researchers with the most functionality for your investment. Ideal for Energy Storage, Physical Electrochemistry, Nanotechnology Research and Corrosion Studies tof the analyzed battery	Bio-Chemical-Magnetic Characterization
UniRoma Tor Vergata	PLA_PLD	**ND:YAG Quantel Brilliant B, 0,9W average power**. Pulsed Laser ablation (PLA) AND Pulsed Laser Deposition (PLD) system. Allows microstructuring of surfaces including drilling and realization of highly controlled thin films in small areas. Can be interfaced also to the Origami femtosecond laser	Fabrication
CNR-DSCTM	PPMS	**Quantum Design - Physical Property Measurement System – PPMS** Equipped with: Vibrating Sample Mode and AC susceptometer (10-10000 Hz) for static and dynamic magnetic properties measurements; Experimental setup for electrical and magnetic transport measurements. The instrument operates in the 0-9 T magnetic field range and in the 2-400 K temperature range.	Bio-Chemical-Magnetic Characterization
UniRoma Tor Vergata	PRINT_3D_1	**Ultimaker S5 Pro Bundle**. 3D Print for polymer and composite materials, allowing multi-material printing. Unlock easy, always-on 3D printing with automatic material handling, efficient air filtering, and filament humidity control.	Fabrication
UniRoma Tor Vergata	PRINT_3D_2	**Ultimaker S5**. 3D Print for polymer and composite materials, allowing multi-material printing. Allows quick and cheap prototyping of experimental parts as well as preparation of sub-millimeter patterned specimens	Fabrication
CNR-IPCB	PRINT_BIO_1	**Rokit Dr. INVIVO 4D2**. Clean-chamber 3D bioprinter (HEPA filter, UV lamps for disinfection) capable of printing freeform cell suspensions, hydrogels, thermoplastic filaments, pastes, and other composite materials, enabling both hard and soft tissue engineering.	Fabrication
CNR-DSCTM	PRINT_BIO_2	**CELLINK BIO X 3D Printer.** 3D bioprinter allows for printing and combining biomaterials, in order to fabricate structures that maximally imitate natural tissue characteristics. A complete standalone system, providing flexibility with exchangeable printheads and features (Heated printheads. Cooled printheads. Heated print bed. Cooled print bed. Clean Chamber Technology. Piston-driven syringe head. Pneumatic printheads. Multi well-plate printing. Touchscreen control.)	Fabrication
UniRoma Tor Vergata	PRINT_MAT	**Fujifilm Dimatix DMP-2850**. The Dimatix Materials Printer (DMP) is a cost-effective, easy-to-use precision materials deposition system. It has leveraged its piezoelectric inkjet technology and MEMS fabrication processes with its extensive inkjet product and system knowledge to produce a materials printer specifically designed for R&D and feasibility testing.	Fabrication
UniRoma Tor Vergata	PWVA	**ALAM MEDICAL Complior Analyse**. With Complior Analyse, it is possible to assess arterial stiffness and central pressure in a single acquisition Complior Analyse uses non-invasive pressure sensors to simultaneously record pulse wave velocity and central pressure.	Bio-Chemical-Magnetic Characterization

UniMilano Bicocca	RAMAN	**Spettroscopio Raman, Renishaw – InVia Laser: 532 nm, 785 nm**. Class 1 inVia™ confocal Raman microscope, equipped with 532 and 785 nm laser sources, with 3 axes motorized stage and micrometric resolution. It can be used for the characterization of natural and synthetic materials applied to Chemical, Environmental and Earth Sciences and to non-destructive analyses in Archaeology and Cultural Heritage.	Spectroscopy
UniMilano Bicocca	RAMAN_XRF_1	**BWTech iRaman/Madatech**. The Bruker Artax 200 portable XRF spectrometer is equipped with a Mo anode X-ray tube performing a beam collimated at 0.65 mm diameter (sample excited area 0.33 mm2) and a SSD detector. The system presents an exchangeable filter slide with three positions and its sensitivity ranges from 2 to 40 keV. The compact portable Raman spectrometer I-Raman Plus BW Tec works with fibre optic configuration. The probe has a flexible fibre coupling encased in a protective jacketing material that performs Rayleigh scatter rejection as high as 10 photons per billion. It could be fixed to a xyz stage for micrometric positioning and the latter placed on a tripod. It is equipped with a diode laser emitting at 785 nm (max power at the sample 60 mW), a TE Cooled Linear Array detector (2048 pixel; pixel size 14μmx200μm). The spectral range is 200-3000 cm-1, while the spectra resolution is about 3–5 cm-1.	Spectroscopy
UniRoma Tor Vergata	RAMAN_XRF_2	**Bruker**. A portable spectrometer designed to carry out in situ, fast and non-destructive combined elemental and molecular analyses, by means of the complementary ED-XRF and Raman techniques. The device works in a complete contactless mode with an optimal focus distance of about 1 cm from the sample.	Spectroscopy
UniMilano Bicocca	ROV_THERM	**DJI Matrice 210 RTK**. Drone equipped with a multi-sensor system in a compact payload for collecting spectral reflectance and surface temperature data useful for different environmental applications. The onboard sensors are represented by a VNIR multispectral camera 9 bands (MAIA S2) a radiometric thermal camera (DJI Zenmuse XT2) integrated with an RGB camera. This system allows to estimate net radiation, apparent thermal inertia of materials, physical parameters of snow, bio-optical water quality parameters, biophysical and structural vegetation parameters and some characteristics of rocks and soils.	Preparation Laboratories
UniMilano Bicocca	ROV_UW	**Remotely Operated Vehicle Under Water**. The Steelhead inspection-class ROV (Remotely Operated Vehicle) is a portable, lightweight and stable underwater robotic system equipped with a standard definition NTSC/PAL zoom camera, optimized for lowlight conditions, and 4 powerful thrusters that allow variable speed & directional ROV control. The system has a depth rating of 300m and can be remotely operated using standard umbilical lengths of 165m. It includes an integrated controller and LCD monitor module with auto depth, auto heading, and a digital video recorder. USBL (Ultra Short BaseLine) positioning is available when operated from a boat/vessel.	Preparation Laboratories
CSGI-UniFirenze	SAXS	**S3 Micro Hecus**. SAXS S3 Micro Hecus with point-like collimation and Kratky camera, equipped with two 1D Position-Sensitive Detectors (Methane/Ar) and Genix generator. The scattering wavevector range is for SAXS between 0.008 and 0.6 Å-1, for WAXS (concurrently available) between 18 and 26 degrees (Bragg's spacings between 0.34 and 0.49 nm).	Photons
CNR-IPCB	SAXS_WAXD	**Saxspace Anton-Paar**. X-ray scattered in the angular range of 0 – 10° detected by CCD or imaging plate, and up to 60° detected by using an imaging plate for the systems coupling SAXS and Wide Angle X-Ray Scattering, WAXS. Samples can be measured at different temperature, humidity, high pressure and under mechanical stress/strain conditions. Special features: - TrueFocus: self-alignment with X-ray beam; - TrueSWAXS: simultaneous SWAXS studies up to 60° 2Θ; - StageMaster: YZ stage with auto-recognition of sample stages. Accessible q range 0.03 nm-1 to 40.7 nm-1, 200 nm > d > 0.15 nm. System resolution qmin: 0.03 nm-1.	Photons

UniMilano Bicocca	SEM	**Zeiss Gemini 500**. Accelerating voltage between 1 kV to 30 kV, nominal resolution of 1.2 nm. In addition to the common "in-camera" BSE and SE detectors, the instrument is equipped with "in-lens" detectors (BSE/SE) for high-resolution imaging and with a STEM detector. The FEG-SEM is also equipped with a Bruker integrated EDS/WDS micro-analytical system, specially designed for light elements. Finally, the FEG-SEM is equipped with an EBSD detector (Bruker) for the crystallographic analysis of the sample surface. The EBSD comes with the Argus FSE and BSE detector for the acquisition of orientational contrast images.	Microscopy
UniRoma Tor Vergata	SEM_EDS_SPM	**Tescan Vega (4th Series)**. This Scanning Electron Microscope (SEM) is equipped with X-Ray microanalysis (EDS) and Scanning Probe Microscopy (SPM). It is also equipped with BSE, low vacuum, water vapour detectors and co-localized SPM analysis	Microscopy
UniRoma Tor Vergata	SEM_FE_1	**Thermo Fisher Scientific Phenom Pharos**. Field Emission Scanning Electron Microscope offers a resolution of 2.0 nm at 20 kV. Such performance shows the shape of nanoparticles, imperfections in coatings, or other features that would be missed by tungsten SEMs or other tabletop SEMs.	Microscopy
CNR-IPCB	SEM_FE_3	**FEI Quanta 200 FEG**. Scanning Electron Microscope with field emission source, equipped with SE, BSE and Environmental (GSED) detectors, EDS system (Oxford Inca Energy System 250), heating stage (FEI) and tensile/compression test module (Gatan MST200).	Microscopy
CNR-DSCTM	SEM_FE_4	**Sigma Zeiss SEM-.FEG:** high-resolution scanning electron microscope with field emission gun and accelerating voltage from0.02 to 30kV.The Gemini in-lens detection c ensures efficient signal detection by detecting secondary (SE) and/or backscattered (BSE) electrons minimizing time-to-image. The maximum resolution can reach ~1nm. The SEM is equipped with energy-dispersive X-ray spectroscopy (EDS) system that enables sample element analysis and a sputter coater for the preparation and coating of non- conductive samples with this layers of Au or Cr.	Microscopy
UniRoma Tor Vergata	SIG_AN	**Keysight Technologies N9000B**. Signal Analyzer with a wide frequency range of 9 kHz to 26.5 GHz with up to 25 MHz analysis bandwidth, Performs	Bio-Chemical-Magnetic Characterization
UniMilano Bicocca	SIVA	**FMT1500 Perkin Elmer**. The FMT imaging system is the leading platform for tomographically quantitating a broad range of in vivo imaging biomarkers, disease pathways and therapeutic response levels in vivo. The PerkinElmer FMT system available at theUniMilano Bicocca U8 animal facility preserves a linear relationship between activity in vivo and detector signal when imaging deep (non-surface) targets and biologies by reconstructing threedimensional (3D) maps of fluorophores inside living animals.	Photons
CNR-IPCB	SLS	**Sharebot Snowhite**. Selective laser sintering 3D printer capable of process a wide range of materials including thermoplastic polymer and composites. The main features of the machine are: CO2 Laser Power 14W, laser spot dimension 0,3 mm, temperature range up to 190 C° degrees, laser speed range up 3.500 mm sec, tank powder from 200 gr to 1,5 Kg.	Fabrication
UniRoma Tor Vergata	SOLAR_SIM	**GreatCell Energy Hyperion III**. LED Solar Simulator, compact design, emission band 360 nm -1100 nm;22 cm X 22 cm illumination area; user friendly driving software interface, top quality LEDs, spectrum customizable by user portable	Preparation Laboratories
CSGI-UniFirenze	SPM	**Park-Systems XE-7.** Scanning Probe Microscope, using atomic force microscopy Park Systems (https://www.parksystems.com) model XE-7, operating in contact mode, True Non-Contact® and tapping, equipped with temperature control and liquid sample container.	Microscopy

UniRoma Tor Vergata	SPM_CRYO	**Low-Temperature Scanning Probe Microscope**. The system comprises a loadlock chamber for sample introduction, a preparation chamber and an analysis chamber. All the chambers are under ultra-high vacuum (base pressure better than 2x10-10 mbar). The preparation chamber is used to clean and prepare samples in a clean and controlled environment thanks to the presence of a heating stage (both radiative and resistive heating methods), a sputter gun, a molecular evaporator and an e-beam evaporator. A quartz microbalance can be used to calibrate fluxes during deposition. A low-energy electron diffraction/Auger electron spectroscopy (LEED/AES) system is also present for surface characterization. Several leak valves for gas insertion are available. The analysis chamber features a scanning probe microscope working at a base temperature of 10 K able to perform both scanning tunneling microscopy and non-contact atomic force microscopy (qPlus sensor) measurements. Omicron-style sample holders are used in LT-SPM.	Microscopy
CNR-DSCTM	SPM_HV	**HV-SPM** The Scanning Probe Microscope (HV Smena Stand alone, NT MDT) operating in HV (10-6 mbar) with specification to perform bimodal imaging thanks to Forcetool bi-modal control unit, producing two different vibrations simultaneously. Additional two high vacuum chambers have been home built for in situ electrical measurements of OFET after thin film deposition and for electrical measurement of OFET performed in closed gas atmosphere.	Microscopy
CNR-DSCTM	SPRITZ	**SPRITZ.** State-of-the-art infrastructure for digital technologies targeted to materials and applications focused on data-driven technologies (artificial intelligence and big-data), virtualization, simulation and multi-scale modelling. Computing and data processing facility constituted by a locally-managed HPC cluster with high-performance CPUs (Intel Xeon and AMD Epyc) and Nvidia GPUs, including nodes with interconnected A40 GPUs (slots with 384 TB of connected GPU RAM for ML/DL applications), high performance network (100Gbps InfiniBand), high-performance and scalable (>100TB) storage. The infrastructure includes a cloud- based scalable and data sharing facility with multiple 10Gbps external links, enabled by the CNR/GARR network and connected to the European GEANT network (up to 100Gbps).	Bio-Chemical-Magnetic Characterization
CNR-IPCB	SPUT_COAT	**Emitech K575**. Sputter coater for coating of non-conductive samples. The system employs a magnetron target assembly, which enhances the efficiency of the process using low voltages and giving a fine-grain, cool sputtering. Main specifications: Target: 54mm diameter x 0.2mm thick; specimen Stage 60mm diameter, rotating stage with tilt facility; vacuum gauge range 1x10-3 - 1x10-4 mbar; deposition current 0-150mA; deposition rate 0-20nm/Minute; sputter timer 0-4 minutes; turbomolecular pump 60 litres/second (ultimate vacuum 1x10-8 mbar). Au/Pd target installed. Further targets can be mounted on request.	Materials Processing
CNR-DSCTM	SQUID_1	**Quantum Design - Magnetic Property Measurement System - MPMS**: SQUID magnetometer operating in the 1.8-400 K temperature range, with AC susceptibility option (0,1 – 1000 Hz), static magnetic field up to 5 T, single crystal rotator and set-up for photomagnetic measurements.	Bio-Chemical-Magnetic Characterization
CNR-DSCTM	SQUID_2	**Quantum Design MPMS XL-5 SQUID magnetometer** ($\mu_0 H$max = 5 T, T = 2.5 - 400 K) equipped with DC and RSO transport, AC susceptometer, and ultra-low-field measurement facility. Measurement of sample magnetization as a function of temperature (2.5-400 K) and applied field (± 5 T). Sample can be solid or liquid, mass in the mg to µg range. Sensitivity: 10-6 emu. Typical experiments: ZFC and FC magnetization, IRM and TRM, hysteresis loops, DCD, magnetic memory and viscosity, AC magnetization.	Bio-Chemical-Magnetic Characterization

UniRoma Tor Vergata	STM_UHV	Ultra-High Vacuum Vessel with Scanning Tunnelling Microscope and Access to Laser Beams and microscopy light collection with spectroscopic analysis	Microscopy
UniRoma Tor Vergata	TA_DMA_1	**METTLER TOLEDO DMA 1**. The sample is subjected to a periodic stress in one of several different modes of deformation to measure the mechanical and viscoelastic properties of materials such as thermoplastics, thermosets, elastomers, ceramics and metals.	Bio-Chemical-Magnetic Characterization
CNR-DSCTM	TA_DMA_2	**Dynamic Mechanical Analyzer, DMA Q800, TA Instrument.** Dynamic Mechanical Analysis measures the viscoelastic properties of materials as a function of time, temperature, and frequency. These analyses allow the determination of: mechanical properties, such as moduli, strength, strain at break, damping; glass transition temperature, degree of crystallinity, additives/fillers effect, etc.. Output values: Complex Modulus, Storage Modulus, Loss Modulus, Complex/Dynamic Viscosity, Time, Creep Compliance, Stress/Strain, Frequency, Tan Delta (δ), Static/Dynamic Force, Sample Stiffness, Temperature, Displacement. Modes of Operation: • Multi strain or multi stress, Multi Frequency/Strain or multi frequency/stress, Creep, Stress relaxation, Controlled force, Iso-strain, Strain rate.	Bio-Chemical-Magnetic Characterization
CSGI-UniFirenze	TA_DSC	**DSC TA Instruments 2500 Discovery**. Last-generation calorimeter with advanced Tzero® technology for the optimization of the measured baseline. The instrument is equipped with an automated sample changer with 54 positions, ideal for the study of different thermal events including heat transfer or variations in the thermal capacity (phase transitions, chemical reactions, structural variations, etc..) allowing the determination of enthalpies and kinetic properties of processes (velocity constants, activation energies, kinetic laws, etc.). The temperature range available is between -90°C and 725 °C.	Bio-Chemical-Magnetic Characterization
CSGI-UniFirenze	TA_DTA	**TA Instruments SDT650 Discovery**. Differential Thermal and Termogravimetric Analysis. Horizontal dual-beam design for superior heat flow and weight measurements. The instrument allows the concurrent determination of heat flux and gravimetric variations in the temperature range between room temperature and 1500 °C.	Bio-Chemical-Magnetic Characterization
CSGI-UniFirenze	TA_RHEO	**TA Instruments Discovery Hybrid HR3**. The Rheometer operates in controlled conditions of shear stress in the torque range between0.5 nN.m and 200 nN.m. The instrument allows all standard rheological tests for the mechanical characterization of complex fluids, including the dynamic viscosity, the viscoelasticity (components G' and G'' of complex viscosity), and creep and yield stress tests. The system is equipped with a Peltier plate allowing temperature control in the range between -40 °C and 200 °C. Available geometries include smooth plate, and coarse plate, both with 40mm diameter. The system is also equipped with DMA operating in tension mode, allowing the direct measurement of the Young modulus in the temperature range between -160°C and 600°C.	Bio-Chemical-Magnetic Characterization
CSGI-UniFirenze	TDI_1	**Kruss Force Tensiometer**. The instrument measures the interphase tension through the method of the Du Nouvy ring, of the Wilhelmy plate, or directly using solid surfaces. The instrument is equipped with two automated dispensers for the study of the critical micellar concentrations.	Bio-Chemical-Magnetic Characterization
CSGI-UniFirenze	TDI_2	**IT Concepts "The Tracker"**. The Tracker is an instrument for dynamic interphase tensiometry. The instrument measures the interphase tension using the method of the pendant drop over temporal scales from 500 ms to hours. The instrument can measure both the static tension at equilibrium and the dynamic through the deformation of the drop and the controlled variation of the surface of the drop, so as to determine the viscous-elastic properties of the interphase.	Bio-Chemical-Magnetic Characterization

UniMilano Bicocca	TEM_1	**JEOL JEM 2100 Plus**. Equipped with a LaB6 emitter. The accelerating voltage can be set between 80 and 200 kV. The high- resolution objective pole piece allows a point-to-point resolution of0.24 nm in TEM mode. The instrument can operate in STEM (scanning) mode and can acquire BF (Bright Field) and HAADF (High Angle Annular Dark Field) images. The microscope is equipped with and 80 mm2 Oxford EDS for spot analysis and chemical mapping and with a 9 Mpixel Gatan CMOS camera for image acquisition. A special in-gap aperture allows to reduce the damage on beam sensitive materials, as biological samples. The wide tilt range along with the wide range of detectors and the high- resolution capability, makes this instrument a very versatile one.	Microscopy
CNR-IPCB	TEM_2	**FEI Tecnai G12**. Transmission Electron Microscope with LaB6 source (120 kV) and BF detector and FEI Eagle 4k CCD camera (bottom mounted). It is foreseen that in 2024 it will be replaced by a new Cryo-TEM (cost about Eur 1.000.000).	Microscopy
CNR-DSCTM	TEM_HR_SCITEC	**200kV ZEISS LIBRA200FE** is a High-Resolution Transmission Electron Microscope (HR-TEM) that combines the second- generation OMEGA filter in column with a high efficiency Field Emission gun as electron source. It operates in standard mode (TEM/HR-TEM), as well as in energy filtered mode (EFTEM), and in scanning (STEM) mode. Its configuration allows for quantitative chemical analysis by EELS (low-Z elements) and EDS/EDX (high- Z elements), and spatially resolved chemical analysis (elemental maps) with nanometer resolution by EFTEM and EDS/EDX. The Cryo-holder for soft materials is also available. Tomographic reconstruction of the 3D shape of the specimen is also possible in TEM and STEM mode. Ultra-cryo-microtome Leica EM FCS, equipped with specific diamond blades, allows to obtain thin (tens of microns) and ultra-thin (50 nm) sections of massive samples. The sectioning can be carried from room temperature down to about - 140 ° C. It allows for the preparation of samples for TEM, SEM, AFM, and OM.	Microscopy
CNR-IPCB	TGA_FTIR	Evolved gas analysis system based on thermogravimetric analysis combined with FTIR: TGA Perkin Elmer Pyris 1 coupled to a Perkin Elmer Spectrum™ Frontier FTIR spectrometer by a TL 8000 transfer line with a 10 cm gas cell. The transfer line and gas cell can be heated to 300 °C to avoid condensation of organic compounds.	Spectroscopy
CNR-IPCB	ULTRA_MICROT	**Leica EM UC6/FC6**. Cryo-ultramicrotome for sectioning of TEM samples, that allows for the preparation of semi- and ultra-thin sections, as well as perfectly smooth surfaces required for different microscopy analysis. It is equipped with a touchscreen control. Using the FC7 cryochamber, ultrathin cryo-sections at temperatures between -15°C and -185°C can be realized, allowing for the TEM analysis of a variety of samples ranging from frozen biological material to polymers and rubbers.	Preparation Laboratories
CNR-DSCTM	UPLC	**Waters ACQUITY UPLC H-Class PLUS – XEVO TQS Micro** The Waters Xevo TQS allows separation of complex mixtures of organic contaminants (pesticides, pharmaceuticals, ..) in water and quantification with detection limits low to ppt level. In particular, it is optimized for PFAS analysis at trace level in water.	Mass Spectrometry
CSGI-UniFirenze	UV_VIS_NIR	UV-Vis-NIR spectrophotometry. Perkin Elmer Lambda 900 spectrophotometer with accessories for polarization / depolarization and acquisition of absorption spectra, kinetic measurements and linear dichroism. The instrument is equipped with a temperature probe and optical fibers for experiments on unconventional samples (air-water interphase, thin films, ...)	Spectroscopy
UniRoma Tor Vergata	VASC_AN	**DMT Pressure Myograph System 114P**. The device is used to measure small arteries, veins, and other vessels physiological function and properties. It allows studying pharmacological effects of drugs and other vasoactive compounds on small, isolated vessels under near-physiological conditions.	Bio-Chemical-Magnetic Characterization

CNR-DSCTM	XMI_LAB	**X-ray MicroImaging Lab.** Imaging X-ray diffraction facility for molecular and atomic scale analysis of fabrics, natural or engineered biotissues, thin films, nanocomposites, nanostructured surfaces, nanocrystal assemblies, polymers. Rotating anode Fr-E+ superbright microsource (CuKa) coupled to a SMAX3000 camera (Rigaku). Beam spot of 70 to 100 microns diameter. Detectors: multiwire Triton, up to 2 m sample-to-detector distance (SDD); Image Plate (IP) with RAXIA scanner, for a 3 cm up to a 20 cm SDD. Kapton windows can be inserted to keep the sample at atmospheric pressure (flight tube at about 10-1 mbar). Data collection: small and wide-angle scattering data in transmission (SAXS / WAXS) or reflection mode (GISAXS / GIWAXS), absorption; scanning SAXS and simultaneous average WAXS; simultaneous SAXS and WAXS. Microscopies processed by the in-house developed software (SUNBIM).	Photons
CNR-DSCTM	XPS	Thermo Scientific™ ESCALAB™ Xi+. XPS Microprobe. XPS with parallel imaging and high-resolution mapping; UPS, ISS and REELS; Al and Ag monochromatic sources; Al and Mg non-monochromatic sources; cluster ion gun "MAGCIS"	Spectroscopy
UniRoma Tor Vergata	XRD_1	**Rigaku SmartLab SE**. X-ray Diffractometer Powder diffraction, thin film diffraction, SAXS, pole figure, residual stress and non-ambient experiments. Highly versatile multipurpose X-ray diffractometer with built-in intelligent guidance: automatic alignment	Photons
UniMilano Bicocca	XRD_2	**Rigaku SmartLab SE 2D**. The powder X-ray diffractometer is dedicated to the study of organic, inorganic and hybrid crystalline materials and thin films and is equipped with an apparatus for collecting variable temperature powder patterns from 200 K to 750K. Crystal structure determination by Rietveld refinement and phase transition are routinely carried out. In situ experiments under controlled atmosphere such as nitrogen and carbon dioxide can be performed. It is endowed with a high flux energy source and a high- energy-resolution 2D multidimensional detector which allows to obtain accurate diffraction patterns.	Photons
CNR-DSCTM	XRD_3	**Crystallography Lab. Suite of X-ray diffractometers** for qualitative and quantitative crystallographic analysis of powders, thin films, single crystals. Powders: Rigaku 18kW rotating anode, copper target, asymmetric Johansson Ge(111 monochromator, NaI scintillator counter and Silicon strip D/teX Ultra detector. Thin films: Bruker D8 3.3KW tube, Goebel Mirror, NaI(Tl) scintillator and Eurelian Cradle; Single Crystals: 3kW KappaCCD Bruker-Nonius, graphite monochromator, CCD detector; nitrogen cryostat (80-400 K). Data analysis performed with in-house developed software (EXPO, SIR, QUALX, OCHEMDB).	Photons
CNR-DSCTM	XRD_4	**XRD1 beamline** is a multipurpose X-ray diffraction beamline. The beamline source is a multipole wiggler producing an intense beam in the 4-21 keV energy range where a tuneable double crystal monochromator allows for a rapid selection and optimization of the anomalous scattering condition. XRD1 allows for macromolecular and small-molecules single-crystal crystal X ray diffraction crystallography, powder diffraction, also at variable temperature, and grazing-incidence diffraction measurement. A laser-based sample alignment facility together with a helium-path for low energies measurements are available for grazing-incidence condition.	Photons
UniMilano Bicocca	XRF	**Varian Cary Eclipse**.It a fluorometer for fluorescence, phosphorescence, chemiluminescence, and bioluminescence measurements from polymeric solutions. It is equipped with programmable temperature control that allows to perform thermodynamic studies. It hosts up to 6 samples. Fast data collection enables kinetics measurements with millisecond resolution.	Spectroscopy

UniMilano Bicocca	XRF_ED	**EDXRF Malvern Panalytical Epsilon 3 XL**. Benchtop energy dispersive x-ray fluorescence (EDXRF) spectrometer. It can handle solids, pressed and loose powders, liquids and filters, weighing from a few grams to larger bulk samples. It allows for data treatment through advanced spectrum processing and correction quantification algorithms. It is enhanced by standardless, fingerprinting and regulatory compliance modules. The Epsilon 3 XL conforms to the requirements of relevant international standards such as ASTM, ISO and DIN.	Spectroscopy
CNR-DSCTM	XRF_NANP	**Nanoparticle Tracking Analysis System (NTA) Nanosight NS300** equipped with Green Laser module. provides an easy-to- use, reproducible platform for nanoparticle characterization and specifically rapid analysis of the size distribution and concentration of all types of nanoparticles from0.01 - 1 μm* in diameter. Equipped with interchangeable laser modules and motorized filter wheel to analyse different fluorescent labels. can be analysed. Sample temperature is fully programmable through the Nanoparticle Tracking Analysis (NTA) software. This instrument is able to count and size synthetic nanoparticles as well as liposomes and biological nanoparticles such as extracellular vesicles.	Spectroscopy

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Annex - MRFs Proposals - Direct Access Rounds I and II 2023

Medium Range Facilities	
AFM	The Nanowizard II – JPK-Bruker
AFM Raman	Raman Spectrometer XploRA Plus
Confocal Microscope 1	Laser Scanning Confocal Microscope Leica TCS SP2
Confocal Microscope 2	Laser Scanning Confocal Microscope Leica TCS SP8
Confocal Microscope 3	Laser lines at 454, 488, 514, 635 nm
Cryogenic Electron Microscopy	CEM in Transmission, model Thermo Scientific™ Glacios™
Dynamic Mechanical Analyzer	DMA Star Systems – Mettler Toledo
FIB-SEM GAIA 3	FIB-SEM with simultaneous milling and EBSD
FT-IR Nexus	Nicolet Nexus 870
FT-IR Nicolet	Endowed with LightDrive Optical Engine components
Fluorescence Microscopy	BX51 microscope
Mass Spectrometer 1	Rapiflex™ MALDI Tissuetyper™
Mass Spectrometer 2	Orbitrap Fusion Tribrid mass spectrometer
NMR 600 MHz	Bruker Avance III 600 MHz NMR
Raman Confocal Microscope	Microscope inViaTM QontorTM model
SAXS GISAXS	Xenocs XEUSS 3.0

SAXS WAXD	Saxspace Anton-Paar
SEM FEI	SEM FEI QUANTA 200
SEM LEO SUPRA	SUPRA 35 Field Emission SEM
SEM ZEISS GEMINI	FEG-SEM with a nominal resolution of 1.2 nm
SEM ZEISS SIGMA	Scanning electron microscope with field-emission source
SEM with correlative AFM	SEM system with EDS-SPM
Spectrofluorimeter	Varian Eclipse Spectrofluorimeter
TEM FEI	LaB6 source (120 kV) and BF detector and FEI Eagle
TEM High Resolution	ThermoFisher Talos F200X
TEM JEOL	JEOL JEM 2100 Plus with a LaB6 emitter
X-Ray diffractometer	Rigaku SmartLab SE
XRD TOMOGRAPHY	RIGAKU Nano3DX

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IM@IT Calls Direct Access Rounds I and II 2023

GP Number	Instr Requested	Days req	Title	Institution	State
2022009	SAXS Xenocs Xeuss	3	SAXS characterisation of artificial skin samples for application in skincare products	Arterra Bioscience SpA	ITALY
2023001	Raman Confocal Microscope	1	Raman Confocal Microscope investigation of artefacts for training students on the characterisation of structural and spectroscopic properties	Institute National de la Recherche Scientifique	CANADA
2023002	SAXS Xenocs Xeuss	2	SAXS characterization of leather artefacts from Museo Egizio	Museo Egizio	ITALY
2023003	SAXS Xenocs Xeuss	2	GISAXS characterization of cathodes for photoinjectors	University of Rome Tor Vergata	ITALY
2023004	FIB-SEM GAIA 3	2	FIB-SEM characterization of CNT-based surface composites for sensors applications	University Roma TRE	ITALY
2023005	High Resolution TEM	2	Electron Microscopy For discriminating Healthy from Cervix Cancer Human tissues	University of Coimbra	PORTUGAL

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2023006	Raman Confocal Microscope	4	Chemical characterization of Hydrogen Permeation Barrier coatings.	CNR	ITALY
2023007	SEM ZEISS SIGMA	4	Measurement of B4C thickness of converting layers of a new Multi-layer Boron-coated GEM detector to be used at the ISIS-VESUVIO beam-line	University of Milano-Bicocca	ITALY
2023008	High Resolution TEM	2	TEM characterization of CNT-based surface composites for sensors applications	University Roma TRE	ITALY
2023009	SAXS Xenocs Xeuss	3	SAXS characterisation of artificial skin samples for application in skincare products	Slovack Academy of Sciences	SLOVAKIA
2023010	Cryogenic Electron Microscopy	1	Phase Change Material Emulsions	CNR	ITALY
2023011	SAXS Xenocs Xeuss	2	WAXS/SAXS characterisation of ancient Egyptian linen textiles from Museo Egizio	Fondazione Museo Antichità Egizie	ITALY
2023012	Raman Confocal Microscope	2	Raman characterisation of ancient Egyptian linen textiles from Museo Egizio	Fondazione Museo Antichità Egizie	ITALY
2023013	FT-IR Nexus	2	FT-IR characterisation of ancient Egyptian linen textiles from Museo Egizio	Fondazione Museo Antichità Egizie	ITALY

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2023014	FIB-SEM GAIA 3	3	Preparation of TEM lamellae of CaREE-flourcarbonates with the FIB lift-out technique	University of Milano-Bicocca	ITALY
2023015	High Resolution TEM	2	Structural characterization of protein fibrils and microcrystals	INFN	ITALY
2023016	SAXS Xenocs Xeuss	2	Structural characterization of protein fibrils and microcrystals	INFN	ITALY
2023017	High Resolution TEM	5	TEM investigation of NiMn-based alloys for elastocaloric and magnetocaloric properties	CNR	ITALY
2023018	High Resolution TEM	5	INSIGHT	ENEA	ITALY
2023019	Cryogenic Electron Microscopy	3	Ion Transport Through Lipid Membranes and the Effect of Antimicrobial Peptides	University Oslo	NORWAY
2023020	High Resolution TEM	3	Iron Based Coated Conductors (ICON)	ENEA	ITALY
2023021	SEM ZEISS SIGMA	4	SEM-based investigations of powdered-formulated ingredients for functional make-up	Arterra Bioscience SpA	ITALY
2023022	FIB-SEM GAIA 3	1	Studies on the inner structure of biocomposite alginate/HNTs fibres	University Florence	ITALY

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2023023	FIB-SEM GAIA 3	1	Investigation on the inner structure of porous and filled gelatin microparticles	University Florence	ITALY
2023024	High Resolution TEM	3	Disclose Exsolved double perovskite SFMN nanostructure	CNR	ITALY
2023025	SAXS Xenocs Xeuss	2	PVA-based Twin-Chain Networks with tuned porosity: structural features and pores investigation	University of Florence&CSGI	ITALY
2023026	FIB-SEM GAIA 3	3	Copy of: PVA-based Twin-Chain Networks with tuned porosity: structural features and pores investigation	University of Florence&CSGI	ITALY
2023027	SEM ZEISS SIGMA	2	Modulation of the filtering capacity of an electrospun polymeric membrane	CNR	ITALY
2023028	SAXS Xenocs Xeuss	1	Study of the nanoscale structure of alginate fibers crosslinked with different cations by means of small angle X-Ray scattering	University of Florence&CSGI	ITALY
2023029	FIB-SEM GAIA 3	1	Study of the internal structure of alginate fibers crosslinked with different cations by means of FIB-SEM	University of Florence&CSGI	ITALY
2023030	Confocal Microscope 2	4	Confocal based analysis of mechanosensation in an ex vivo model of re- innervated human skin.	Arterra Bioscience SpA	ITALY

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2023031	Raman Confocal Microscope	1	Confocal Raman Microscopy on Membrane-electrode assembly components	Enapter SRL	ITALY
2023032	FIB-SEM GAIA 3	2	PVP/CNTs Nanofiber composite: uncovering the inner architecture	CNR	ITALY
2023033	SAXS Xenocs Xeuss	2	SAXS on Membrane-electrode assembly components	Enapter SRL	ITALY
2023034	SEM ZEISS SIGMA	1	FE-SEM on Membrane-electrode assembly components	Enapter SRL	ITALY
2023035	Cryogenic Electron Microscopy	5	Study by Cryo-TEM imaging of the structure of the nanoparticle-surfactant layers stabilizing o/w emulsions	CNR	ITALY
2023036	Raman Confocal Microscope	4	Understanding the chemical composition of chemically functionalized cellulose nanofibers onto titanium dioxide substrates	CNR	ITALY
2023037	Confocal Microscope 1	2	Semi-interpenetrated PEG-based hydrogels as transparent network with pH-responsive porosity for diffusivity studies: structural and morphological investigation.	University Florence	ITALY
2023038	FIB-SEM GAIA 3	3	Semi-interpenetrated PEG-based hydrogels as transparent network with pH-responsive porosity for diffusivity studies: structural and morphological investigation	University Florence	ITALY

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2023039	SAXS Xenocs Xeuss	3	Semi-interpenetrated PEG-based hydrogels as transparent network with pH-responsive porosity for diffusivity studies: structural and morphological investigation	University Florence	ITALY
2023040	SAXS Xenocs Xeuss	3	Polymer-coated silica capsules with enhanced retention properties: structural and stability investigation	University Florence	ITALY
2023041	Confocal Microscope 1	3	Polymer-coated silica capsules with enhanced retention properties: structural and stability investigation.	University Florence	ITALY

MRFs and International Proposal Direct Access II Round 2023

2023044	XRD TOMOGRAPHY	4	Characterisation of the degree of damage by neutron induced single-event burnout failure in SiC MOSFET by means of X-Ray tomography	STMicrocelectronics	ITALY
2023045	SEM with correlative AFM	2	Characterisation of the degree of damage by neutron induced single-event burnout failure in SiC MOSFET by SEM measurements	STMicrocelectronics	ITALY
2023046	X-Ray diffractometer	4	Characterisation of the stress field in SiC MOSFET by means of X-Ray diffraction	STMicrocelectronics	ITALY

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2023047	AFM Raman	3	Characterisation of the stress field in SiC MOSFET by means of Raman spectroscopy	STMicrocelectronics	ITALY
2023048	SEM with correlative AFM	2	Characterisation of surgically removed vitreous humor samples by SEM measurements	IRCCS Fondazione G.B. Bietti	ITALY
2023049	TEM FEI	2	Characterisation of surgically removed human vitreous samples by TEM measurements	IRCCS Fondazione G.B. Bietti	ITALY
2023050	XRD TOMOGRAPHY	3	Characterisation of surgically removed human vitreous samples by X-Ray tomography	IRCCS Fondazione G.B. Bietti	ITALY
2023051	SAXS GISAXS	2	GISAXS characterization of cathodes for photoinjectors	University of Rome Tor Vergata	ITALY
2023052	SAXS GISAXS	2	Characterization of collagen and both tanning and colouring materials on leather artefacts from Museo Egizio by WAXS/SAXS/USAXS measurements	Fondazione Museo Antichità Egizie	ITALY
2023053	FT-IR Nexus	1	Characterization of collagen and both tanning and colouring materials on leather artefacts from Museo Egizio by FT-IR measurements	Fondazione Museo Antichità Egizie	ITALY

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2023054	AFM Raman	1	Characterization of collagen and both tanning and colouring materials on leather artefacts from Museo Egizio by AFM-Raman measurements	Fondazione Museo Antichità Egizie	ITALY
2023055	TEM FEI	1	Innovative sustainable inks for wearable sensors: analysis of fillers morphology by TEM FEI	Tomas Bata University in Zlin	CZECH REPUBLIC
2023056	TEM FEI	2	Analysis of filler spatial distribution by TEM FEI in polyninylalcohol/polyacrylic acid/MXenes nanocomposites	Skopje University	MACEDONIA
2023057	SEM FEI	2	SEM FEI morphological analysis of polyninylalcohol/polyacrylic acid/MXenes nanocomposites	Skopje University	MACEDONIA
2023058	SAXS WAXD	3	SAXS WAXD structural analysis of polyninylalcohol/polyacrylic acid/MXenes nanocomposites	Skopje University	MACEDONIA
2023059	SEM FEI	2	Innovative sustainable inks for wearable sensors: morphological characterization by SEM FEI	Tomas Bata University in Zlin	CZECH REPUBLIC
2023060	SAXS WAXD	3	Innovative sustainable inks for wearable sensors: structural characterization by SAXS/WAXD	Tomas Bata University in Zlin	CZECH REPUBLIC

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2023061	AFM Raman	4	Graphene-based thermoplastic composites: AFM Raman characterization	GrapheneUP SE	CZECH REPUBLIC
2023062	SAXS WAXD	3	Graphene-based thermoplastic composites: structural analysis by SAXS/WAXD	GrapheneUP SE	CZECH REPUBLIC
2023063	SEM FEI	2	Graphene-based thermoplastic composites: morphological characterization by SEM FEI	GrapheneUP SE	CZECH REPUBLIC
2023064	Dynamic Mechanical Analyzer	4	Characterization of recycled perfluorosulfonic acid membrane for a circular hydrogen economy	University College London	UNITED KINGDOM
2023065	AFM Raman	2	Understanding ritual practices in Neolithic Saudi Arabia using Raman spectroscopy on horn sheaths from Mustatils	Institut Català de Arqueologia Clàssica	SPAIN
2023066	SAXS GISAXS	2	Understanding ritual practices in Neolithic Saudi Arabia using SAXS on horn sheaths from Mustatils	Institut Català de Arqueologia Clàssica	SPAIN
2023067	SEM ZEISS SIGMA	1	Measurements of nanofibers distribution in IFOx sensor oxygen sensing element using SEM techniques	CNR - ISTP	ITALY

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2023068	Confocal Microscope 3	1	Measurements of dye uniformity in IFOx sensor oxygen sensing element using Confocal microscope	CNR - ISTP	ITALY
2023069	NMR 600 MHz	2	Training on the use of NMR spectroscopy to characterize phantom materials for neutron therapy	University of Rome Tor Vergata	ITALY
2023070	SEM with correlative AFM	3	Analysis of nails provided by different antique shipwrecks in the Mediterranean using SEM-EDS	Université de Genève	SWITZERLAND
2023071	SAXS GISAXS	2	Analysis of nails provided by different antique shipwrecks in the Mediterranean using SAXS	Université de Genève	SWITZERLAND
2023072	SAXS GISAXS	2	Cerium oxide nanoparticles: SAXS analyses for surface properties engineering	Italian Institute of Technology	ITALY
2023073	Mass Spectrometer 1	2	Fluorescence microscopy training for MSci students in Physics	University of Rome Tor Vergata	ITALY
2023074	AFM Raman	2	Nanofibers from textiles: determining photo-degradation induced physicochemical modification of natural and synthetic fibers surface by AFM-RAMAN	University of Milano-Bicocca	ITALY

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2023075	Confocal Microscope 3	2	Confocal microscopy training for MSci students in Physics	University of Rome Tor Vergata	ITALY
2023076	SAXS GISAXS	2	Cerium oxide nanoparticle's growth process: SAXS measurements during synthesis	Italian Institute of Technology	ITALY
2023077	SEM FEI	2	Morphological characterization of sustainable by design water and oil repellent biobased textile coatings	Next Technology Tecnotessile	ITALY
2023078	SAXS GISAXS	2	Soap formulations: investigation of the relationship between structural properties and their stability and performance	Ludovico Martelli S.p.A.	ITALY
2023079	Fluorescence Microscopy	3	Fluorescence microscopy characterization of MULtimodal Anticancer Nanohybrids (MULAN)	Università degli Studi di Milano	ITALY
2023080	XRD TOMOGRAPHY	4	X-ray diffraction tomography to study the effect of the application of phosphate-based coatings on the emission of ionizing radiations of lithotypes used as building materials	University of Catania	ITALY
2023081	FIB-SEM GAIA 3	3	Preparation and Study of TEM lamellae of CaREE-flourcarbonates	University of Milano-Bicocca	ITALY

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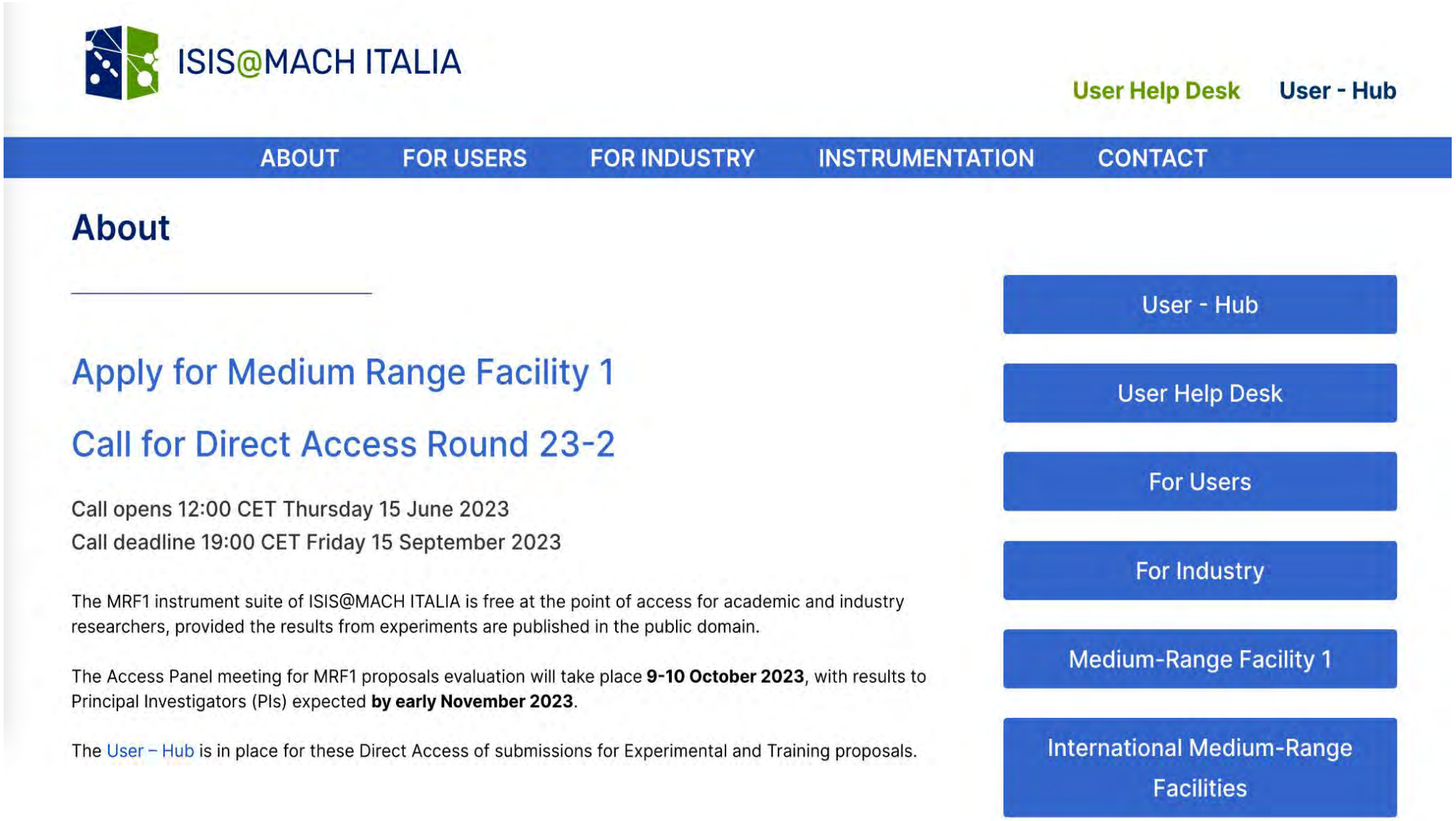
2023082	Confocal Microscope 3	1	Confocal Microscopy on meteorite samples, within a multimodal study	Università di Pavia	ITALY
2023083	SAXS GISAXS	2	Investigation of the architecture of agarose-based hydrogels prepared by controlled rate of cooling - AGAROCOOL	Università degli Studi di Trieste	ITALY
2023084	SAXS GISAXS	2	Training for SAXS on Membrane-Electrode assembly components	Enapter SRL	ITALY
2023085	Raman Confocal Microscope	2	Training for Confocal Raman Microscopy on Membrane-electrode assembly components	Enapter SRL	ITALY
2023086	Dynamic Mechanical Analyzer	4	Characterization of recycled perfluorosulfonic acid membrane for a circular hydrogen economy	University College London	UNITED KINGDOM
2023087	SAXS GISAXS	3	Effective interactions and phase behavior of PNIPAM-PNIPMAM copolymer microgels	CNR	ITALY
2023088	Confocal Microscope 3	2	Study of the internal structure of alginate fibers crosslinked with different cations by confocal laser microscopy	University of Florence & CSGI	ITALY

2023089	Fluorescence Microscopy	2	Characterization of Nitrogen-Vacancy Centers for Improved Quantum Sensing	Adamas Nanotechnolgoies, Inc.	UNITED STATES
2023090	XRD TOMOGRAPHY	1	Unlocking the structure and composition of a historical silver coin using XRD Tomography in combination with Muon and Neutron Techniques	ISIS Neutron and Muon Source	UNITED KINGDOM
2023091	SAXS WAXD	1	Unlocking the structure and composition of a historical silver coin using Wide Angle X-ray Diffraction in combination with Muon and Neutron Techniques	ISIS Neutron and Muon Source	UNITED KINGDOM
2023092	SEM with correlative AFM	2	Electrostrictive properties of Alginate-based composites including reduced graphene oxide and metal-based nanostructures	University of Florence & CSGI	ITALY

Annex – User-Hub



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Password

Sign In

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Update: Adding users to a visit/proposal

Users can now only be added by others to a visit/proposal once their account has been activated. In order for you to be able to add someone to a visit/proposal, they must have:

- Created an account
- Ticked the box to allow others to add them to Proposals and Visits
- Activated their account

If you are unable to add someone to a visit or a proposal, please check in the first instance that they have completed these steps.

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UKRI Science and Technology Facilities Council
ISIS Neutron and Muon Source

Direct access

Medium-Range Facilities (MRFs)

Training

Direct access

ISIS Neutron and Muon Source

List of MRFs for Direct Access at this LINK

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User Help Desk User - Hub

ABOUT FOR USERS FOR INDUSTRY INSTRUMENTATION CONTACT

Medium Range Facility 1

All Intrument types

All Units

Medium Range Facility 1

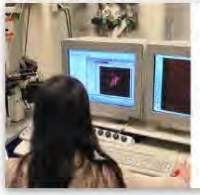
Found 28 Results

AFM

The Nanowizard II – JPK-Bruker is designed for biological samples. It is equipped with a Zeiss fluorescence microscope and it is used for high resolution imaging and nanomechanical characterization.

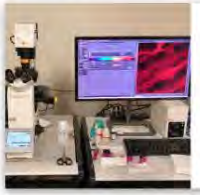
AFM Raman

The Raman Spectrometer XploRA Plus is a compact and fully automated micro-spectrometer using the vibrational Raman spectroscopy and an AFM for combined Raman-AFM and TERS. The operation modes combine confocal Raman, fluorescence and photoluminescesce imaging and spectroscopy, through manipulators and probes.



Confocal Microscope 1

Laser Scanning Confocal Microscope Leica TCS SP2 equipped with 3 fluorescence PMT detectors



Confocal Microscope 2

Laser Scanning Confocal Microscope Leica TCS SP8 equipped with DMI8 microscope, FCS Picoquant module and with PMT detector for transmission imaging and 5 internal detectors.

Confocal Microscope 3

This is a state of the arte confocal microscope with excitation given by laser lines at 454, 488, 514, 635 nm and equipped wit Hybrid PMT detectors. The system has spectral resolution on the

List of International MRFs for Direct Access at this [LINK]

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ABOUT FOR USERS FOR INDUSTRY INSTRUMENTATION CONTACT

International Medium Range Facilities

All Intrument types

All Units

International Medium Range Facili

Found 4 Results

Bruker Invenio-R

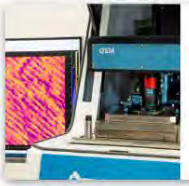
Laser Scanning Confocal Microscope Leica TCS SP8 with DMI8 microscope and FCS Picoquant module and with PMT detector for transmission imaging

Particle Size Analyser

The Mastersizer 3000 is used by many companies and research institutes across a wide range of applications. The access particle size range is 10 nm to 3.5 mm.

Perkin Elmer DSC 8000

Advanced double-furnace calorimeter with power compensation.



QSM – Quantum Scanning Microscope

The QSM is a next-generation scanning probe magnetometer based on diamond technology. The diamond probes employ a single magnetic impurity in the carbon lattice (Nitrogen-vacancy center) as an atomic-size magnetic quantum sensor.

Page 1 of 1

Annex - Case Studies

Jointly with its stakeholders (public & industrials user) IM@IT has developed several Case Studies in specific areas of societal challenges, within the national's science priorities, in specific areas of societal challenges which address national's science priorities in relevant thematic areas. Most of the time these Cases Studies envisaged for its stakeholders a 'TA generic' to SRFs (service), to MRFs (peer reviewed) and to LSFs (peer reviewed) through a single point of access (User@Hub). The 'TA generic' approach goes hand in hand with new typologies of access to LSFs developed by IM@IT which envisage the deployment of specific fundings for targeted Case Studies (see document Annex – TA for target-specific Case Studies).

Case Study 1

"Single particle structure and dYnamics of Macromolecules, BIOcomplexes and aggregaTEs" (SYMBIOTE)

Thematic Area 1 - Health, Agriculture, Biomaterials (HAB)

- **improving and protecting health and well-being**
- **developing health technologies and tools**
- **technologies and digital solutions for health and care**

Nanomedicine, personalised therapeutic treatments, and advanced diagnostic are already playing and are likely to have a central role in the coming years. New advancements in these fields strictly depend on the detailed knowledge of the structure and dynamics of the "active" molecules or macromolecular complexes of interest. As an example, G protein-coupled receptors (GPCRs) are one of the most important classes of proteins. SYMBIOTE proposes to study the structure/dynamics/function relationship in macromolecules/complexes connected to molecular signalling and recognition/aggregation mediated diseases, with an extensive use of neutrons, X-rays, and electrons sources. In this case some of GPCRs QTY variants are already available in a denatured "stable" state. Renaturation to the native state can be performed when needed with ancillary equipment and expertise already present in the IM@IT RI.

IM@IT Units: CSGI-UniFirenze (Coordinator), CNR-IPCB, UniMilano Bicocca, UniRoma Tor Vergata

Stakeholders: MediaLab MIT (US) BioMerieux, CONFAPI, AmypoPharma

Case Study 2

"NEw MAterials and meThODology for rEstoration of art" (NEMATODE)

Thematic Area 2 - Culture and Education (CE)

- **safeguarding cultural heritage**
- **promoting training and higher education**
- **improving and protecting health and well-being**

NEMATODE proposes a holistic approach (investigation and remedial conservation of CH) on several representative types of artefacts, using advanced materials and methodologies. The main approach is to develop innovative multifunctional and sustainable materials, by exploiting the concept of nanostructure both as fillers or water/solvent droplets dispersed in a polymeric matrix, enhancing the conservator capabilities in the cleaning, consolidation and protection of artworks. The cooperation with renowned museums and conservation centres to restore iconic historical and artistic items grants high visibility to the RI.

IM@IT Units: CSGI-UniFirenze (Coordinator), CNR-IPCB, UniMilano Bicocca, UniRoma Tor Vergata
Stakeholders: Peggy Guggenheim Collection (Venice), Museo Egizio (Turin), Fundation Venaria (Turin), Museo Archeologico di Reggio Calabria (MArRC), Chiesa di Sant'Adamo (Cantalupo, Rieti), Contamination hub, Zetema s.r.l., NIKKO Chemical (Tokyo), NOURYON (Sweden)

Case Study 3

"Development of new Integrated particle-, and neutron probes for healthy ageing, cardiovascular disease, obesity and metabolic syndromes, neurodegeneration, materials, coatings, and electronic components qualification" (DICEQ)

Thematic Area 1 - Health, Agriculture, Biomaterials (HAB)

- **improving and protecting health and well-being**
- **developing health technologies and tools**
- **technologies and digital solutions for health and care**

Thematic Area 3 - Digital, Industry, Space, Security (DISS)

- **Health Space, materials, coatings and electronic components qualification**
- **Development and verification of a new class of neutron detectors**

DICEQ will study the extreme space weather and its impact on the human aging, biological systems, and terrestrial electronic systems, innovative materials, coatings, and electronic components qualification for applications in new satellites, with a focus on i. Neutron Monitors, ii. on Mechanical Robustness, iii. Electronic Reliability, iv. Development and Verification of a New Class of Neutron Detectors will be developed.

i. Effects of natural ionizing radiation on the aging of the human body and their changes depending on the type and the intensity of environmental neutron radiation. On the Earth's surface, for example, the dose induced by neutron radiation, both primary and secondary, can change depending on the latitude and altitude, as well as on the materials present in the immediate vicinity (rivers, lakes, snow, mountains) and becomes increasingly important at transatlantic flight altitude, in low Earth orbit (LEO) and in space. DICEC aims to study the physical aging of the human body and other biological systems, depending on the type and intensity of environmental neutron radiation. The combination of a better understanding of both the cause (through monitoring of terrestrial-atmospheric-space neutron radiation) and the effect (through characterization and irradiation tests with analytical facilities) of extreme space weather conditions on the aging of the body human, biological systems, and terrestrial electronic systems will enable our society to be more resilient to the potential large-scale disruption of such space weather events– what is certain is that such extreme space weather events will occur ; what is uncertain is when and how large the extreme weather event will be. To monitor neutron doses in such terrestrial, atmospheric and space environments the use of a new Neutron Prototype Compact Monitor (nPCM) is being designed, beyond the state of the art of existing standards, equipped with standardized and compact IGY and NM64 detectors, much easier to transport, more efficient and with spectroscopic capabilities extended.
ii. Accelerated testing of the single-event-effect (SEE) occurrence in modern Si/GaAs/GaN based devices to evaluate their robustness for deployment in micro and n13ano satellites will be conducted. The objective is to select and test candidate COTS components, determine the reliability issues arising from radiation SEE effects and ensure their robustness. Another goal is to understand the impact of Additive manufacturing which is an example of a disruptive technology that is at the leading edge of space manufacturing allowing rapid prototyping and production to meet the requirement for weight and budget of micro and mini satellites as well as of new coating, composites, and constituent materials.

Characterization tests on above materials and devices - e.g. Lab-On-Chip, Organ-On-Chip, mock up of human body, biomedical devices implanted in humans (e.g., artificial heart and pacemaker, defibrillators), Si/GaAs/GaN based devices etc. - will be carried out using the MRF1 suite and MRF2 of IM@IT and the beam lines of ISIS Facility for irradiation (also accelerated)

IM@IT Units: UniRoma Tor Vergata (Coordinator), UniMilano Bicocca, CNR-ICMATE, CNR-IPCB
Stakeholders: ISIS FAcility, Thales Alenia Space Italia, Politecnico di Milano, Ministero della Difesa, INFN - Roma TRE, University of Lancaster

Case Study 4

"Supercooled Water study using Atmospheric data and Neutron Spectroscopy" (SWANS)

Thematic Area - Bioeconomy, Environment and Climate (BEC):

- **environmental observation and studies**
- **atmospheric studies**

SWANS proposes to develop an integrated approach to study atmospheric supercooled liquid water using: i) laboratory experiments to investigate molecular processes underlying the properties and activation of supercooled droplets; ii) atmospheric ground-based remote sensing data from permanent networks and cloud-resolving numerical models output; and iii) data from a measurement campaign carried out in the Arctic and from two campaigns to be arranged in Apennine mountains to study supercooled water clouds outside the urban/rural boundary layer and in a high-mountain site. The goal is to select and/or improve the cloud-resolving models CRM microphysics parameterizations, which will show the most significant differences in vertical profiles of the hydrometeor concentrations and in cloud mass flux. Finally, dedicated measurement campaigns on the Apennine mountains will be carried out to enhance the measurement-modelling synergy. Collected data will be arranged to be publicly available in a public data bank, in compliance with the international standards for data and metadata (e.g. ISO, CF convention, INSPIRE).
Neutron science with aerosols: From fundamental water research to clouds and extra-terrestrial ice geysers

1. Background**.** Paracelsus considered water to be one of four elements and wrote that it is the matrix of the world and of all its creatures. Centuries later, it is clear that water is an

absolutely vital component for a wide range of processes in biology, chemistry, geology, materials science as well as atmospheric and space research. Yet, many of water's famous anomalies are still poorly understood.[1] Recent research suggests that the key to understanding liquid water may be hidden at low-temperatures in the deeply supercooled regime where a second critical point may exist.[2-5]

At temperatures below this critical point, low- and high-density liquids may form, yet this scenario has very recently been further complicated by our discovery of medium-density amorphous ice.[6]

Despite recent progress using mainly advanced X-ray techniques[3-5] there is still no complete understanding of supercooled water. Our own research suggests that the low-temperature glass transitions of the amorphous ices correspond to the unfreezing of reorientation dynamics and that the unfreezing of translational motion should take place at higher temperatures in deeply supercooled water corresponding to the famous fragile to strong transition.[7] Evidently, further studies of deeply supercooled water are urgently needed.

The freezing of supercooled water is also still poorly understood including the structure of ice immediately after crystallisation and secondary processes such as the ejection of supercooled liquid jets, cracking of frozen droplets and strain-effects in the resulting ice crystals.[8] In addition to substantial gaps in our knowledge of pure supercooled water, the situation becomes even more complex for real-world scenarios such as in clouds, where dust particles mix with supercooled water droplets, and extra-terrestrial ice geysers, such as on Enceladus, where complex salt mixtures are dissolved in the liquid ejecta.

Neutrons are in principle fantastic probes for studying supercooled water across wide ranges of length and energy scales. Yet, so far, there is a clear lack of neutron studies in this area which is mainly due to the experimental problems of preventing and controlling crystallisation during the typically quite long neutron measurements.

The aim of this PhD project is to build a new sample environment for creating deeply supercooled aerosols under dynamic flow conditions. This will enable characterising constantly replenishing supercooled water droplets with a wide range of neutron techniques including standard and small-angle diffraction as well as deep-inelastic, quasi-elastic and inelastic neutron scattering. Our new *CryoMist* setup will enable us to address several key questions with respect to fundamental water research including studying the dynamics in the supercooled regime and crystallisation phenomena. In collaboration with other ISIS

users, we will also explore research questions related to processes in clouds and extra-terrestrial ice geysers. In addition to pure water, the *CryoMist* will be able to accept aqueous salt solutions and dispersions of insoluble materials. Beyond our immediate collaborations, we will make the *CryoMist* available as a new sample environment for the benefit of the wider ISIS user community. A schematic of the *CryoMist* is shown in Figure 1. The central component is a long tube through which dry nitrogen gas travels under laminar flow conditions. The temperature of the gas will be kept constant within the -50°C to room temperature range and the flow conditions will be adjusted with a mass-flow controller.

Into the middle of the flow of cold gas, a stream of water droplets will be injected. The water droplets will be generated at room temperature with the help of ultrasonic nebulisers. As the water droplets travel within the cold stream of surrounding gas, thermal equilibration will take place supercooling the water droplets. Due to the dry conditions within the tube and the relatively short residence times of the droplets it will be possible to suppress crystallisation within the supercooled regime. Towards the end of the tube, the neutron beam from various instruments will hit the flow of supercooled water droplets allowing a variety of different neutron experiments to be conducted.

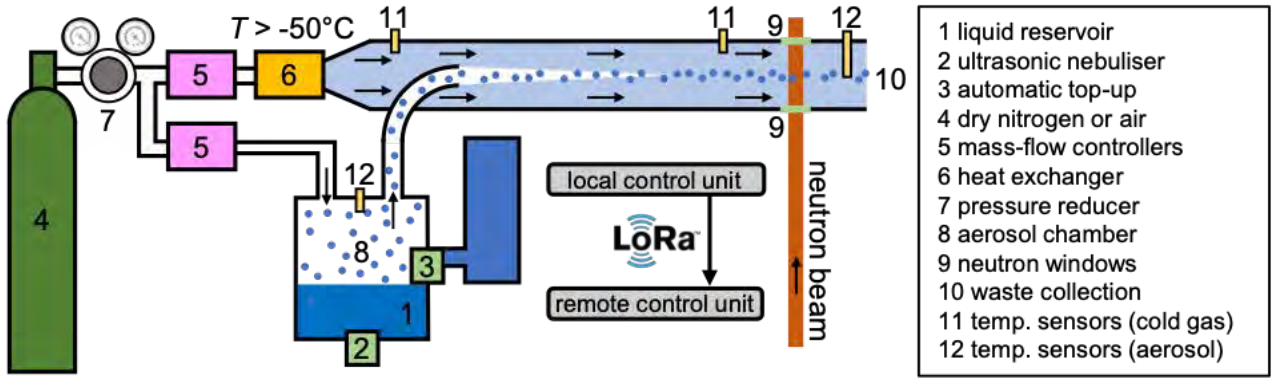


Figure 1. Schematic of the new CryoMist sample environment for measuring supercooled aerosols at various ISIS neutron beamlines. The various components are labelled as indicated in the legend on the right. The local control-unit communicates with a remote unit in either the instrument cabin or connected to the LabView interface of the DAQ computer through the LoRa radio-wave protocol.

The *CryoMist* will contain several Pt100 sensors to monitor and control the various temperatures, and will be connected via the Lora radio-wave protocol with a remote-control

unit which can be placed either in the instrument cabins or connected to the LabView interface of the DAQ computers.

The UCL group has extensive experience building and prototyping scientific instrumentation. The PI is highly experienced setting up microcontroller electronics as well as using 3D printing, CNC milling and laser cutting. We plan to use a TDK (NB-80E-01-H) nebuliser which produces

droplets in the 10 μm range.[9] However, commercial inhalers will allow producing larger droplets as well.

In year 1, the first prototype of the *CryoMist* will be built and tested at UCL using in-situ Raman spectroscopy which is highly diagnostic for differentiating liquid water and ice. The flow conditions and geometries will be optimised to achieve optimal and stable performances. The diameter of the supercooled droplet stream will be in the centimetre range to agree with the dimensions of the neutron beams. Target bulk densities of the supercooled aerosol stream will be up to 0.3 g cm^{-3} to ensure sufficient neutron signals. We will also aim to secure a place on the ISIS neutron training course for the student during year 1.

In year 2 *CryoMist* will be installed at ISIS on various beam lines. Much of this work can be done offline or during shutdowns. The first neutron experiment will be conducted on the NIMROD beamline to explore the low-temperature boundaries towards crystallisation of the droplets and the associated morphology changes upon crystallisation from the low-*Q* data. New insights into the dynamics of deeply supercooled water will be gained on the VESUVIO and IRIS/OSIRIS beamlines using deep inelastic (DINS) and quasi elastic neutron scattering (QENS), respectively. We clarified that QENS measurements of moving droplets are possible. Year 2 will also be an opportunity for the student to intensify their understanding of the various techniques and data analyses, and to connect the *CryoMist* to the sample environment softwares of the various instruments.

Year 3 the inelastic neutron spectroscopy measurements on MAPS will begin to follow the potential emergence of ice-like phonons in the deeply supercooled regime. Access to low Q is essential if you want to see the O-H stretch region. Low Q will also mitigate the effect of the relatively high temperature. Additionally, MAPS uses the standard 400 mm flange. The focus will then shift from fundamental to applied studies with collaborators regarding cloud science and extra-terrestrial ice geysers. Here, we will move away from

pure water to studying the effects of dispersed dust analogues and adding soluble salts to water using the previously accessed beamlines.

Year 4 is reserved for introducing the *CryoMist* to the wider user community.

Installing the *CryoMist* on the various beamlines may lead to instrument-specific complications. This will be mitigated, if needed, by switching beamlines, modifying the *CryoMist* or focussing the work on the beamlines where the *CryoMist* has been successfully installed. The many possible branches of the project at this stage will ensure the success of the overall project. The work with the collaborators once the *CryoMist* has been successfully installed is again deemed quite low risk and our collaborations are independent which minimises the risk for the success of the entire project.

3. Benefit to ISIS/Utilisation**.** This project will provide an entirely new sample environment to ISIS that will be made available and promoted to the wider user community. The *CryoMist* will bring aerosol science to ISIS with far-reaching scientific benefits. In addition to fundamental studies of water and the immediate collaborative work explored during this studentship, the *CryoMist* will enable a variety of additional research activities at ISIS including (1) in soft-matter research, (2) industrial aerosol feedstocks with non-aqueous solvents, (3) medical research regarding the interactions of viruses and asthma medication with aerosols, and (4) dispersions of nanomaterials.

5. References

[1] Gallo, P., et al., Chem. Rev., 2016 **116** 7463.

[2] Poole, P.H., et al., Nature, 1992 **360** 324.

[3] Sellberg, J.A., et al., Nature, 2014 **510** 381.

[4] Kim, K.H., et al., Science, 2020 **370** 978.

[5] Amann-Winkel, K., et al., Nat. Comm., 2023 **14** 442.

[6] Rosu-Finsen, A., et al., Science, 2023 **379** 474.

[7] Shephard, J.J., et al., J. Phys. Chem. Lett., 2016 **7** 2281.

[8] Kalita, A., et al., Nature, 2023 **620** 557.

[9] Kooij, S., et al., Sci. Rep., 2019 **9** 6128.

IM@IT Units: IMAA-CNR (Coordinator), UniRoma Tor Vergata, UniMilano BICOCCA, UNIFI

Stakeholders: ESA, ISIS Facility, Ministero della Difesa, University College London, University of Salerno,

Case Study 5

"Training and Outreach" (THROU)

Thematic Area - Training

- **transversal skills**
- **development of experimental proposals**
- **theoretical simulation tools and material modelling**
- **experimental lab techniques**

The main scope of the case study on Training and Outreach is to build capacities to combine training on the use of the IR with transversal skills that are fundamental in researchers' job and for their career.

Researchers are usually trained to carry out research in their own field, neglecting the so-called transversal skills, defined by UNESCO (2014[1]) as: "Skills that are typically considered as not specifically related to a particular job, task, academic discipline or area of knowledge and that can be used in a wide variety of situations and work settings."

These transversal skills can include Critical and innovative thinking, Science communication, Media and information literacy, Science diplomacy, Project development and fund raising, Management of Complex System, Institutional Strategy. Most of these skills are at the basis of RRI - Responsible Research and Innovation, the approach to research promoted by the European Union that takes into account effects and potential impacts on the environment and society. They are also linked to the third mission of research to address the growing societal and economic challenges through the transfer of knowledge and of technologies and innovations in the form of cooperation with public and private enterprises. In this case study, sessions on the above topics will be organised as stand-alone or integrated to technical training linked to other case studies and activities of the IR.

IM@IT Units: VIU (coordinator), AIRI, CNR-ICMATE, CNR-ICB, UniMilano Bicocca, UniRoma Tor Vergata

Stakeholders: Centro Alti Studi Difesa (CASD), SIF, University College London, University of Padua, QZABRE Zurich

[1] UNESCO Bangkok (2014). Education Policy Brief: Skills for holistic human development, Vol. 2, November 2014

Case Study 6

"Green Transitioning through Sustainable and Circular Chemistry" (GRETA)

Thematic Area – Green Chemistry and Sustainable Processes

- **Green Chemistry and Sustainable Processes**
- **Innovation in green and sustainable synthesis**
- **Functional and advanced catalysts**
- **Sustainable drug discovery**

The main scope of the case study on Circular Chemistry is to identify and optimize a portfolio of techniques, with low environmental impact, involving all the aspects of chemical transformations and synthesis including catalytic processes by homogeneous, heterogeneous and enzymatic catalysis, stereoselective reactions, sustainable solvents for reactions that require solvent and non-solvent processes, continuous flow and process intensification for improving atom economy as well as waste reduction and foster the development of the society in the direction of Circular Economy. In this case study it is proposed the development of novel sustainable synthetic methodologies and tools for bioactive molecules, organic intermediates, products and materials which meet the research needs of industries and fall within several strategic areas of the CNR

IM@IT Units: CNR-ICMATE (Coordinator), CNR-ICB, UniMilano Bicocca, UniRoma Tor Vergata

Stakeholders: University Camerino

Case Study 7

"Safeguarding water- Tracing novel entities by advanced analytical tools" (SINT)

Thematic Area - Bioeconomy, Environment and Climate (BEC):

- **environmental observation and studies**
- **atmospheric studies**

As stated in goal number 6 of the *Agenda 2030* of the United Nations, access to safe water is among the most basic human needs for health and well-being.

Surface water and groundwater are essential sources of drinking water for humans. Authorities must regulate and manage these resources to ensure safe consumption. The irrigation use of freshwater is the main driver of agricultural development and plays the most

important role in determining the world's food supply. Water bodies sustain a large biodiversity, and a part of this biodiversity is exploited by humans as a source of food and pharmaceutical compounds. Water is also used to produce energy and has allowed industrial development.

The recreational benefits of water are essential for human well-being, both mentally and physically. The presence of glaciers, rivers, lakes, and oceans with their beautiful and diverse natural surroundings are highly appealing to tourists and play a significant role in the economy.

At the current time demand for water is rising due to rapid population growth, urbanisation, and increasing water needs from the agriculture, industry, and energy sectors. An additional challenge is posed by climate change inducing water scarcity, the ecological crisis causing degradation of the water-related ecosystems.

In this context, the introduction of novel entities into the environment can lead to widespread contamination, posing an additional threat to water safety and limiting the amount of safe water available for humans. The qualitative and quantitative safeguarding of water resources is stated as a priority for the environmental policies in the EU. The EU directive 2000/60/EC (WFD: Water Framework Directive and its subsequent amendments), places particular emphasis on water quality control and on the monitoring of chemicals deriving from anthropic activities in the water supplies. To identify these chemicals and safeguard water it is fundamental to consider the interconnection between human activities and water in all its states and the complexity of the environment. This goal may be achieved only with a high integration of the most modern and technological facilities and expertise.

Starting from these statements, the proposed project aims at the development of new methods enabled by advanced analytical techniques that may help in the monitoring of the water cycle in all its complexity and highlight anthropic impacts. These methods will enable the collection of new data regarding the presence of novel entities in the water supply and will be a reference to advice for the new sustainable policy by prioritizations.

Among the novel entities thar require to be traced and can be the object of the development of new methods with the advanced analytical instrumentation available within the network we identified microplastics and nano plastics, plastic-associated contaminants, organic emerging contaminants, heavy metals, and radionuclides. Micro- and nano-plastics in the

aqueous environment represent still an open analytical challenge given the difficulty in sampling large volumes that allow the collection of the material, the possibility of distinguishing microplastics from sediments and the organic material present in the water, as well as from the fact that microplastics are often weathered, bio-contaminated and contain plastic ingredients that may prevent for their identification. Advanced spectroscopy techniques such as Raman spectroscopy and Fourier Transformed Infrared Spectroscopy are nowadays the golden standard for microplastic identification, while techniques based on mass spectrometry may help in the recognition of both the polymeric fraction and the plastic-associated contaminants and plastic accumulated pollutants such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), nonylphenols, and heavy metals, in particular Cd, Co, Cr, Hg, Pb and Zn. These pollutants can transfer from the plastic to organisms leaked in the environmental compartment or the gastrointestinal tract and potentially becoming irreversibly part of the trophic chain also reaching humans. Emerging contaminants are nowadays in the spotlight of analytical development, with nontarget analysis with high-resolution (HR) mass spectrometry (MS) as the hot trend in the development of workflows and more than 875 000 chemicals currently listed in the U.S. EPA's CompTox Chemicals Dashboard.

The actions of the project that will be carried out within the network will therefore concern the study and detection in different water bodies, snow, ice, and moisture/aerosol of micro and nano plastic, plastic-associated contaminants, emerging microorganic contaminants, and heavy metal. The instrumental facilities will be used both for advancing the development of the related analytical method and in the chemo-physical modelling. Both the interaction of the different emerging pollutants, and their environmental fate on the different water phases are poorly investigated topics in the current scientific literature. Specifically, ICPMS, Raman, and FTIR will be used to study the occurrence of micro, nano plastic, and plastic-associated contaminants in freshwater, seawater, ice, and aerosol. This advanced analytical tool will be used to advance in provenance capability, trace plastic sources, understand transport mechanism and discover chemo-physical interaction (i.e., repartition between microplastic and organic pollutants/heavy metals, the interaction between microplastic and ice nucleation, the effect of nano plastic onto aerosol light absorbance, water-induced photo-degradation of plastic material and plastic associated contaminants.
LC-MS and GC-MS will be used to discover and trace water emerging contaminants, understand their distribution in the plastisphere, and highlight possible impacts on aquatic

ecosystems and humans. ICPMS and PGNAA will be also used in the study and characterization of Alpine and Antarctic ice cores. Through the elemental analysis performed with high resolution ICPMS directly in water samples and the "delayed" neutron activation analysis (NAA) with fast neutrons associated with "Prompt Gamma" neutron activation (PGNAA) of the Neutron source present in the MRF2 *Sourire,* located in University Milano Bicocca IM@IT Unit, it will be possible to characterise all the elements present in the particulate matter.

IM@IT Unit: UniMilano Bicocca (Coordinator)

Annex - TA for target-specific Case Studies

Preamble

For many decades, all Large-Scale Facilities (LFS) in Europe have adopted similar approaches to granting access to academic and industrial researchers. In general, researchers with different national affiliations enjoyed different levels of non-proprietary (academic) access to a given facility, depending on the contribution of their 'home nation' to the budget of that facility. To be specific, a distinction was made between the following groups:

- Researchers affiliated with the facility's host country (for national facilities) or of associate/scientific member nations (for international facilities or national facilities with international agreements) could obtain beamtime up to a total that roughly correlated with the contribution of their 'home nation' to the facility.
- Researchers not so affiliated could access the facility only based on exceptionally strong scientific cases.

These principles were applied via a single proposal system: researchers of any national affiliation applied to the system in the same way, and proposals were evaluated and ranked by facility access panels (FAPs) purely based on their scientific merit. Subsequently, the facilities' directors 'normalised' the highest-ranked proposals so that they approximated the 'national quotas' and granted a small amount of 'discretionary beamtime' outside the quotas and to non-affiliated researchers. One specific feature of it is that the facilities acted as funding agents for accessing a very expensive commodity (their beamtime), privileging purely scientific considerations, and sidestepping central efforts to tension different research strands against each other based on national research and technology priorities.

A possible approach for small stakeholders

The strongest argument in favour of the system described above is that it ensures the best scientific return on investment for the large stakeholders (e.g. CNR in Italy). Conversely, the system appears rather inflexible for 'small' stakeholders, which may be more interested in accessing specific elements of the facility's portfolio for very specific non-proprietary purposes. Yet another case may be that of a country that sponsors a certain fraction of 'general TA' for its community but would like to provide additional access that is targeted to specific national research priorities. In Italy a case in point is related to the opportunities

provided by funding lines relating to specific research and development strands, i.e specific areas of societal challenges within the national's science priorities within thematic areas. A pertinent question for Italy and possibly other players is therefore: can the access mechanisms described in the preamble be minimally modified to account for these requirements? One obvious approach would be for proposals falling within these national priorities to be 'flagged', so that they can bypass national quotas, since they would attract additional funds for the facility, should beamtime be granted to them. Although details will need to be ironed out, allowing for this type of access does not appear to require major modifications, as outlined in the example here below.

- Flagged and unflagged proposals will be submitted in the same way; flags will not be known to the FAPs.
- Proposals to a given instrument will be considered in order or scientific merit, starting from the top proposals. 'Unflagged' proposals will be granted beamtime up to the national quota for general access (if any).
- 'Flagged' proposal lower down the list will be allocated beamtime if any is remaining on that instrument when their come up for consideration.
- The appropriate national authority will be billed for all 'flagged' proposal that received beamtime.

An innovative approach for TA to LSFs via IM@IT for target-specific Case Studies- the IM@IT role

Should this type of access be approved by a LSFs, the next question is how 'flags' would be granted at national level. It would clearly be in the interest of the funder that 'flagged' proposals are a) of outstanding scientific quality and b) aligned with the funder's priorities. This is where the IM@IT infrastructure plays a decisive role. For example, IM@IT:

- Facilitate the formation of Case Studies targeting specific problem of 'small' stakeholders of national relevance.
- Share expertise on best practice in proposals writing.
- Award flags on specific proposals based on a separate evaluation, which would be done by IM@IT-MAP, following best practices based those adopted by LSFs.

Most proposal applications for TA for target specific Case Studies shall be assessed scientifically and technically within the framework of the IM@IT MAP and ISIS FAPs on the same basis as all other applications. Priority will be given to proposals that have exploited

the suite of MRFs instrumentation available at IM@IT to fully prepare and support the need for ISIS beamtime and the implementation of ISIS. These proposals will prioritise the participation of pools of industry, including SMEs, and of new users.

Annex –'Daughter' Projects

Project **HARDEST- HANE HARDENING FOR SATELLITE SYSTEMS**

Proponents ISIS@MACH ITALIA jointly with Thales Alenia Space Italia (TASI) (TA for target-specific Case Study 3)

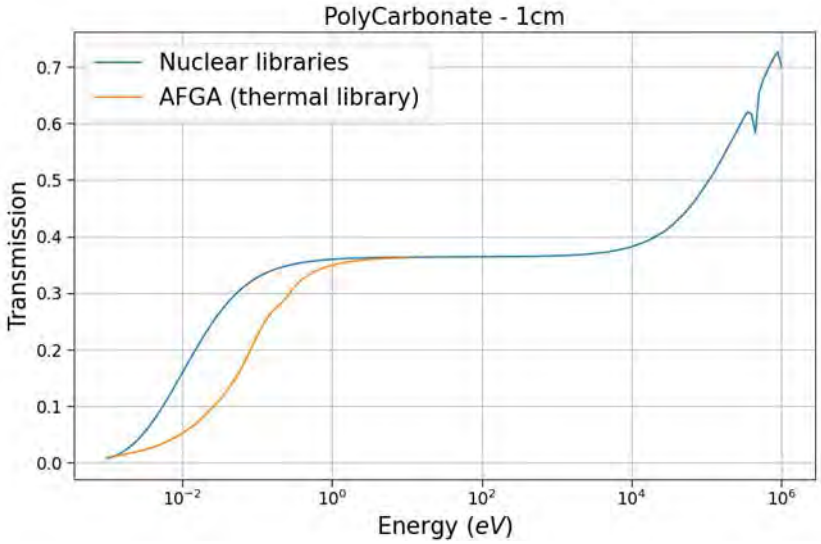
Abstract
Over the last years, major countries and alliances have started preparing for the defence of space. One of the most significant threats arises from nuclear detonation of nuclear bombs at high altitude (HANE). Among other factors, the war in Ukraine and the continued nuclear testing conducted by North Korea in the last years have made the risk of nuclear threat ever more concrete. The protection of military satellite systems (both on board and on the ground) becomes a necessity and a technological challenge of our days. The experiments conducted by the USA and the Soviet Union in the 1960s have demonstrated an important vulnerability of satellite systems not protected from this type of threat, and next-generation devices are required to satisfy the requirement of protection against such threats.
The aim of the HARDEST project is to define the requirements for protection of electronic devices used in space applications against HANE threats, studying and developing parametric models of physical phenomena and software tools predicting the effects of a high-altitude nuclear detonation. The results will support future activities in the design and validation of hardening and mitigation solutions to be adopted in this field.

Technical description
A main objective of the project is to identify novel composite materials to minimize the effects of a HANE threat on a satellite or electronic device. For such purpose, sample materials will be irradiated at research infrastructures exposing them to several sources of radiation, including electrons, gamma rays and neutrons. The models used will be tested with simulations and experiments and will allow to define a baseline for future tests. Therefore, we will first carry out a phase of testing materials already available and used in satellite missions and, subsequently, we will evaluate innovative materials that will allow to have a significant increase in terms of optimization of cost and weight compared to the materials currently used for shielding.

In particular, the IM@IT unit of the University of Roma Tor Vergata has a consolidated know-how in the modelling of attenuation and transport of neutron radiation in complex neutron and gamma radiation fields. Recent results include the measurements of the attenuation factor, over up-to seven decades of the incident neutron energy, of several complex shielding materials, such as baritic cement. The group has also developed a method for the modelling of the total neutron scattering cross section of polymer materials as a function of the molecular composition and chemical-physical characteristics (Average Functional Group Approximation-AFGA). The AFGA method, which was recentrly included into the GEANT4 Monte Carlo transport code, will be used for the prediction of the shielding properties of the materials to be designed and developed within HARDEST.

A use of this approach, exemplified in the following figure, allows to quantify the effect of the properties of the polymer properties of the material of interest with an accuracy superior to that achievable with the simulation code due to the use of the nuclear standard library, and finally to evaluate the effects of prompt and delayed neutrons after detonation. In the

energetic regions of slowing down of neutrons, the nuclear standard libraries overestimate the transmission of radiation, and consequently the thickness and mass of the material used for shielding or encapsulation.



Neutron transmission, as a function of the incident energy of the particle, through a shielding layer of polycarbonate, as estimated using AFGA and compared to the nuclear libraries available at present.

The inclusion of these effects has a practical impact on the evaluation of the thickness of homogeneous materials and composites used for nuclear hardening, including the time of neutron activation induced by the slowing of neutrons for the initial radiation effects and the residue after detonation.

Within the HARDEST project, the materials tested and the survey objects will include systems such as, for example, polyethylene (possibly borate), as the outer layer, to attenuate beta radiation (minimizing the bremsstrahlung component) and moderate neutrons; one intermediate layer of plastic coated with tungsten (up to 8 g/ml and 90% tungsten content) or similar material as further screening for beta and gamma radiation; An inner layer of mu-metal (iron-based) or similar material, which can be used as a shield for EM fields at high frequency (15-250 MHz) or as a shield for X rays from a second generation layer shielding the previous ones.

The materials to be studied will be obtained commercially or synthesized (e.g., with 3D printing) in such a way as to optimize the dimensions and weight of the screen. At a parity of shielding capacity, materials will be selected that allow minimizing the effects of neutronic activation, which could cause malfunctions of the electrical device even in the phase after the electromagnetic pulse. Once the optimal material is defined through Monte Carlo simulations of the transport of radiation in the material, the material will be irradiated to the research infrastructure, through a mode of access with confidential management of experimental data, with a source of electrons, gamma rays, and neutrons.

Project **HiCHIP: Radiation hardness tests of hard Si/SiC/GaAs/GaN based chips and chip components of pacing-based devices for biomedical applications.**

Proponents: ISIS@MACH ITALIA jointly with Thales Alenia Space Italia (TASI) (TA for target-specific Case Study 3)

Problem addressed

Who?	ISIS@MACH ITALIA
What?	Radiation hardness and characterisation of hard Si/SiC/GaAs/GaN based chips and chip components of pacing-based devices for biomedical applications. The proponents agreed on the involvement of TASI (and of the other companies mentioned) to use the devices and related hardware & software specifications necessary to prepare the devices for the experimental tests. Access to the testing infrastructures will be guaranteed by the IM@IT within the framework of the agreement with the UK testing facility.
When?	2023 - 2025
Where?	National IM@IT Units
Why?	To enhance chips' design tools, device reliability, susceptibility of SRAM bit cells designed to be immune to Single Event Upsets.

Abstract
The primary goal of the proposed study is to conduct accelerated neutron tests of the single-event-effect (SEE) occurrence in both modern hard Si/SiC/GaAs/GaN based chips devices and in chip components of pacing-based devices for biomedical applications – e.g. pacemakers and implantable cardioverter defibrillators (ICD)- to evaluate their robustness for deployment in ground level, avionic applications and micro-and nano satellites. The *pacing* systems market demands chips with high device reliability and longevity to avoid the patient discomfort and risk associated with device replacement or malfunction.
Additionally the materials composing the soft and hard devices will be characterised at ISIS (2D and 3D) by thermal neutron to measure the residual stress and defects at the interface of the chips. Materials-to-circuits characterisation will be performed using the instrument suite of IM@IT, each of which is individually optimised for the study of different types of matter.
This project will allow to acquire a deeper understanding of neutrons impact on the electronics behaviour in hard based devices as well as the first understanding of electronics behaviour in modern hard Si/SiC/GaAs/GaN based chips and chips in pacing devices for biomedical applications. This will make possible to characterize and deliver to chip manufactures the probability of occurrence of functional damages of neutron Single Event Effects (Soft Error) in the control electronics of the devices, in order they can create more reliable and radiation-resistant chips.

Work packages (WP)
WP 1 – Fast Neutrons radiation Hardening Tests of hard and soft [ISIS (Chipir and Nile beamlines)]. Objective of this WP is to provide both Trans-National and Virtual access to IM@IT and ISIS within the project which can offer instrumentation, tools, and know-how in the framework of radiation hardness tests using fast neutrons.
WP 2 –Thermal Neutrons semiconductor materials analysis (2D and 3D) using ENGIN-X, IMAT, VESUVIO neutron beamlines. Objective of this WP is to provide both Trans-National

and Virtual access to IM@IT and ISIS, which can offer instrumentation, tools, and know-how in the framework of semiconductor materials analysis using thermal neutrons.
WP 3 – Materials-to-circuits characterisation using the instrument suite of IM@IT [X-diffraction, reflectometry, SANS, USANS, Microscopy, SEM-EDS] and ISIS [prompt gamma activation analysis (PGAA), Objective of this WP is to provide both Trans-National and Virtual access to IM@IT and ISIS which can offer instrumentation, tools, and know-how in the framework of characterizations of semiconductor materials, especially at the atomic and nanometric scales.
WP 4 – Industrial Engagement and creation of a national business case for radiation hardness, by using consolidated methodologies and resources at major European infrastructures such as ESS, ILL and ESRF.

Deliverables (D)
D1 (month 14): Report on the experimental procedure of irradiation tests ISIS, data analysis and results on the fast neutron radiation hardening tests on hard Si/SiC/GaAs/GaN.
D2 (month 16) Report on the experimental procedure of irradiation tests ISIS, data analysis and results on the impact of neutron on the reliability of the chip of the pacing devices.
D3 (month 20) Report on the results of the 2D and 3D analysis at the atomic level of semiconductor materials, materials-to-circuits, of residual stress, and of defects at the interface of the hard devices with thermal neutrons.
D4 (month 24) Report on the results of Materials-to-circuits characterisation with thermal neutrons and optical characterizations at the atomic level of the pacemaker.

Aim of the research
Neutrons produced by cosmic ray interacting with atmospheric constituents, and with avionic and space components are present from ground level to aerospace and space altitudes. Therefore, electronic devices on aircrafts in atmosphere and in heavily shielded spacecrafts (*e.g.* the international space station) are subject to functional damages of neutron Single Event Effects.

Experimental Plan
We plan to conduct Accelerated Irradiation Neutron (AIN) tests of the single-event-effect (SEE) occurrence in modern Si/Sic/GaAs/GaN based devices and, for the first time, of the chip component of *pacing* systems (Pacemakers or defibrillator medical devices).

- **AIN tests of Si/Sic/GaAs/GaN**
  Wide-Bandgap materials such as silicon carbide (Sic) and gallium nitride (Gan) have gained popularity in recent years. These are mature technology and has become a viable alternative to silicon-based power devices and GaAs in high-efficiency and high-power density applications. The Si/Sic/GaAs/GaN based devices operating in various environments will be tested to measure their susceptibility to neutrons. We will also examine various error mitigation techniques as well as the susceptibility of SRAM bit cells designed to be immune to Single Event Upsets.
  Si/SiC/GaAs/GaN based devices available. The devices will be provided by Thales Alenia Space Italia (TASI) and ST Microelectronics or by other national manufacturers we are currently in contact with.
- **AIN tests of pacing systems – Pacemaker device**
  For the first time a chip component of a pacemaker will be irradiated under neutron beams to test the possible presence of SEE. We plan to record two distinct signals: a) the 'ouput-signal' registered by the pacemaker programmer once the devise is located at a terrestrial

environment; b) the 'ouput-signal' registered by the pacemaker programmer under irradiation tests at the Chipir or NILE.
Pacemaker Device available. The device will be provided by MEDICO srl Italia or by other national manufacturers we are currently in contact with. The manufacturers that currently produce pacemakers for the world market are Abbot, Biotronik, Boston Scientific, MEDICO, Medtronic and Microport. Each of these companies have adopted over time different strategies to increase the security and longevity of their devices, both as regards the type of materials used for batteries (for example Li/MnO2) or the type of algorithms for managing pacemaker functions. This has led in recent years to almost double the life of the devices and to significantly reduce the size, circumstance which makes these medical devices increasingly subject to functional damages of neutron Single Event Effects (Figure 1).

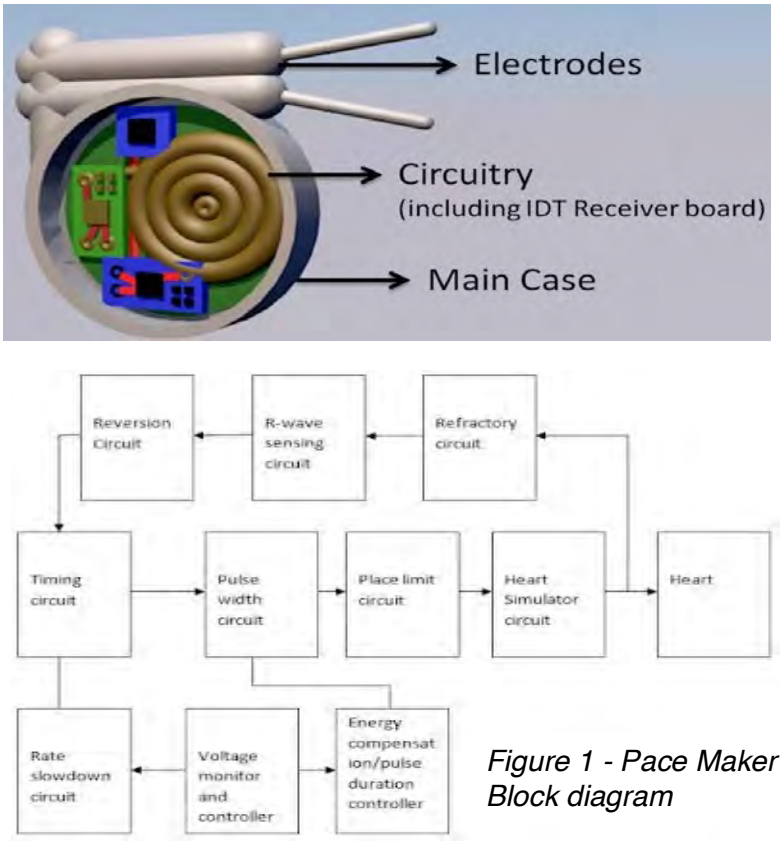


Figure 1 - Pace Maker Block diagram

Methodology

- **AIN of Si/SiC/GaAs/GaN and pacing systems**
  The irradiation tests of hard and soft based devices will be carried out at the Chipir and/or NILE neutron beamlines operating at ISIS pulsed neutron and muon source a world-leading centre for research located at the STFC Rutherford Appleton Laboratory in Oxfordshire, England. ChipIr (for Chip Irradiation) is the unique beamline dedicated to the irradiation of microelectronics and is specifically tailored to the study of Single-Event Effects (SEEs). Neutrons are naturally present in the earth's atmosphere, at sea level and even more abundant at aircrafts altitudes, in avionics and heavily shielded spacecrafts. They are generated by spallation reactions which occur when energetic protons (> 100 MeV) interact with atomic nuclei. This process takes place in the upper atmosphere, from the interaction of primary cosmic rays, but also in a spallation source like ISIS, where protons are accelerated up to 700 or 800 MeV and are collided against a tungsten target to produce neutrons. For this reason, a spallation source can be used to reproduce an atmospheric-like spectrum, with the resulting spectrum extending up to the energy of the accelerator. In the case of ChipIr, the design of the instrument is optimized to mimic the

terrestrial and atmospheric neutron spectrum, with a flux many orders of magnitude higher than the natural one to enable accelerated testing of electronic devices. Neutrons themselves do not deposit charge in the device, rather they transfer their energy via inelastic and elastic reactions with the substrate (silicon), and hence they produce secondary ions which deposit charge in the device' sensitive volume according to their respective LET. A scheme of the ChipIr Facility at ISIS is presented in Figure 2.
The hard and soft based devices will be placed in front of the neutron source. A green cross mark constructed of two laser pointing beams will be used for indicating the centre of the neutron beam to assist the positioning of the devices correctly in front of the beam. Due to the very long range of neutrons, there will be no need to decapsulate the devices under test. The experiment will be controlled from the screened room using a laptop computer. The boards need to be supplied with the appropriate voltages through the patch panels which connect the screened room and the irradiation room. The irradiations will be performed while a cadmium foil placed in front of the neutron beam, to reduce the number of thermal neutrons. A circular drum and a set of jaws, that can move independently, can define a beam from cm dimension (pencil) up to 0.4 m aperture (flood). The beam in the experiment can be collimated down to 70x70 mm. to avoid any influence on other electronic components. The measured flux of neutrons above 10 MeV is approximately 1.4×10^{10} n/cm^2. The source is considered as a point like source at 13.9 meters from sample position and the flux decreases with $1/r^2$.

- **Characterizations of hard and soft devices**
  The hard devices will be 2D and 3D characterised to measure the residual stress and defects at the interface of the chips:
  - using a suite of thermal neutron beamlines at ISIS Facilities, *i.e.* ENGIN-X, IMAT, VESUVIO, and the suite of equipment at the Medium Range Facilities
    The pacemaker device will be 2D and 3D characterised:
  - using a suite di optical and microscopes instrumentation at the Medium Range Facilities

Research Task.
Accelerated irradiation fast neutron tests will be performed at ISIS facility.
Characterization thermal neutron tests on chips will be performed at ISIS and IM@IT Facilities
Description:

a) IM@IT – ISIS Facility – TASI (or other providers) teams will carry out the identification of biomedical devices and components to be tested and provide the **AIN tests and Characterizations of all devices** plans during months 1-6 of the project at ISIS Facility;

b) IM@IT - TASI (or other providers) teams will carry out the experimental proposals preparation at IM@IT during months 7-10 of the project; c) IM@IT - ISIS Facility - TASI (or other providers) teams will carry out the neutron irradiation tests at ISIS (UK) during months 12-17 of the project; IM@IT - TASI (or other providers) teams will carry out data analysis and deliver final reports during months 18-24 of the project.

Military/Dual Valence
"Radiation hardness assurance" is increasingly needed in industry and in those small and medium-sized enterprises active in the aerospace and nuclear research sectors, with an increasing number of devices exposed to radiation of greater intensity and for longer time periods, and the consequent need for an appropriate assessment of the radiation resistance of the systems used. Results of this project will help to protect safety critical systems and national infrastructure against the effects of severe neutron space weather.

The tests and analysis methods (SEE and study of residual stress at the interface) proposed in this project will yield information that can mitigate risk by means appropriate for the military mission and the radiation threat. This may include cataloguing ways to minimize the rate or occurrence, minimize the effect, recover normal operations, or bound the probability of occurrence.
Radiation test and analysis approaches must control and minimize the predominant sources of uncertainty associated with each radiation threat.
A changing paradigm can be achieved by gaining a greater understanding of how the devices are affected by SEE for specific parts of the architecture and how it is possible to mitigate these as part of the design; for example, the determination of the minimum charge to upset an electronic component, makes it possible to redesign the component to limit charge build below the upset threshold.
This approach can foster finding the characteristics dominating error rates and developing mitigation as integral part of the design. This contrasts with a retrospective hardening approach which largely relies on general redundancy, performance reduction or expensive (and slow) hardening. Such an achievement would allow to revert the scenario for smarter routes towards SEE mitigation in complex devices, and at the same time provide essential knowledge for the development of European based technologies for components with increased reliability.

References

[1] Andreani, C., Senesi, R., Paccagnella, A., Bagatin, M., Gerardin, S., Cazzaniga & C., Sarno, M. (2018). Fast neutron irradiation tests of flash memories used in space environment at the ISIS spallation neutron source. AIP Advances, 8(2), 025013.
[2] Paz, O., Teodorovich, N., Kogan, Y., & Swissa, M. (2017). Transatlantic flight: Not only jet lag. Heart Rhythm, 14(7), 1099–1101. https://doi.org/10.1016/j.hrthm.2017.03.033
[3] Haran, A., Yitzhak, N. M., Mazal-Tov, E., Keren, E., David, D., Refaeli, N., ... &, Andreani, C. (2021). Ultralow power system-on-chip SRAM characterization by alpha and neutron irradiation. IEEE Transactions on Nuclear Science, 68(11), 2598-2608.

Project **EU-SEE Forum for intercultural exchange on Sustainable MAnagement of Cultural Heritage - SMACH Forum.** Central Europe Initiative Know-how Exchange Programme - CEI- KEP CALL

Proponents: ISIS@MACH ITALIA in partnership with City of Venice, Ss. Cyril and Methodius University, University of Belgrade, Sarajevo School of Science and Technology, University of Montenegro (TA for target-specific Case Study 2).

Problem addressed.

Who?	ISIS@MACH ITALIA
What?	promoting know-how exchange between the SEE Region on sustainable cultural heritage management in relation to climate change and other sustainability challenges
When?	2024 - 2026
Where?	National IM@IT Units
Why?	To contribute to support intercultural cooperation, sustainability of local cultural heritage and communities, and enhancement of climate resilience

Abstract

SMACH Forum will promote mutual exchange of systematic, interdisciplinary good practices along with research on cultural policies, heritage management and heritage science expertise among the different SEE heritage institutions, and also with the different existing European platforms such as E-RIHS, Joint Programming Initiative (JPI) and Cultural Heritage Research in Europe (ARCHE). It will eventually establish and launch an EU-SEE forum on sustainable cultural heritage management, shared heritage science research and policy, bringing together EU and SEE researchers, policy-makers and international platforms.

Work packages (WP)

WP 1 – Mapping of critical research, good practices and policy initiatives of sustainable cultural heritage management in Europe and SEE Region. The activity will be carried out through desk research, survey and interviews with key stakeholders at different levels. The results will be gathered in a report that will provide the state of the art on current existing research, initiatives, policies as well as of relevant management bodies in the Region. This report will be conceived as the second step of the SMACH report on the needs in the Region.

WP 2 – Developing a sustainable cultural heritage strategy tailored for SEE Region. This activity will be based on the organization of an International Colloquium on sustainable management of cultural heritage at one of the provider partner's facilities. The colloquium will aim at presenting and discussing the results of the mapping with key stakeholders from national and international authorities, including representatives of other SEE and EU organizations, international platforms such as JPI, ARCHE, E-RIHS, ECCO, ICCROM, and the project partners. etc. to develop a joint statement for feasible cost-effective sustainable cultural heritage management in the Region.

WP 3 – Know-how exchange program to foster awareness, **build capacities on sustainable cultural heritage management, and promote intercultural exchange among research and policy between EU and SEE Region**. This activity will include the organization of 1 national event at each of the beneficiary partners/target countries (around

12 participants each) to present the outputs of activities 1 and 2 to local key stakeholders; a series of online training session, also concerning the access to ISIS@MACH ITALIA, for all of the participants to the local events and beyond to favour the interregional networking, involving also the work with UNESCO Chair holders in the Region, giving special attention also to science diplomacy.

WP 4 – Establishment and Launch of the EU-SEE Forum on sustainable Cultural Heritage Management. It will be based on the organization of 1 top level meeting for policy makers at one of the provider partner's facilities, to establish a Forum bringing together EU and SEE researchers; 1 final workshop as dissemination event of the results of the project and promotion of the Forum, to be organised possibly in the Region, in collaboration with the Italian Embassies and/or within or back to back to existing events, e.g. the Conference of Ministers of Culture.

Deliverables (D)

D1 (month 8): 1 report mapping current research, initiatives, stakeholders, policy and decision-making bodies in the field of sustainable management of cultural heritage in the Region;

D2 (month 12): 1 shared strategy for future collaboration on sustainable cultural management, research and policy-making within the Region, with the EU and EU international platforms.

D3 (month 18): 1 joint statement for feasible cost-effective sustainable cultural heritage management tailored on the SEE Region.

D4 (month 16): know-how exchange program involving over 40 stakeholders and researchers from the Region, to support sustainable cultural heritage management, whether locally or globally.

D5 (month 18): a EU-SEE Forum bringing together researchers, policy-makers and EU platforms to promote intercultural exchange and collaboration on cultural heritage management in the Region.

Aim of the research

SMACH Forum aims at promoting know-how exchange between the SEE Region on sustainable cultural heritage management in relation to climate change and other sustainability challenges.

Experimental Plan

We plan to train the participants in the know-how exchange program to the use of the ISIS@MACH ITALIA tools to the Sustainable MAnagement of Cultural Heritage.

Project: **CHARMANT - Extreme space weather and its impact on the aging human body, biological systems, and terrestrial electronic systems**

Proponents: ISIS@MACH ITALIA (TA for target-specific Case Study 3)

Abstract
Study of the extreme space weather and its impact on the human aging, biological systems, and development of a new class of neutron detectors to measure neutron flux (and doses) in terrestrial, atmospheric and space environments.

Research Activity (2024-2025)
The project will investigate the effects of natural ionizing radiation on the aging of the human body and their changes depending on the type and the intensity of environmental neutron radiation. On the Earth's surface, for example, the dose induced by neutron radiation, both primary and secondary, can change depending on the latitude and altitude, as well as on the characteristics of the immediate vicinity (rivers, lakes, snow, mountains) and becomes increasingly important at transatlantic flight altitude, in low Earth orbit (LEO), and in space. The physical aging of the human body and other biological systems depends on the type and intensity of environmental neutron radiation. The combination of a better understanding of both the cause (through monitoring of terrestrial-atmospheric-space neutron radiation) and the effect (through characterization and irradiation tests with analytical facilities) of extreme space weather conditions on the aging of the human body, biological systems, and terrestrial electronic systems will enable our society to be more resilient to the potential large-scale disruption of such space weather events. While it is certain that such extreme space weather events will occur, it is uncertain is when and how large the extreme weather event will be. A new Neutron Prototype Compact Monitor (nPCM) is being designed to monitor neutron doses in terrestrial, atmospheric, and space environments. Such nPCM is beyond the state of the art of existing standards, equipped with standardized and compact IGY and NM64 detectors, much easier to transport, more efficient, and with extended spectroscopic capabilities.

Mid- and long-term technical and scientific objectives.
To create and operate one latest generation nPMC monitor is the key to study the nature and type of those extreme space weather events that have resulted and will continue to result in a strong increase in the flux of fast neutrons both on the ground and at atmospheric level and in aerospace. The neutron monitor at the MRF2 by IM@IT will be the first of the latest generation in Italy. The Italian nPMC monitor will operate to record neutrons at terrestrial level (intensity, frequency and energy spectrum of events called GLE - Ground Level Enhancement Events). The latter are a particular subset of solar particle events in which particles coming from the Sun have sufficient energy to generate effects that are measurable on the Earth's surface.
To perform characterization tests on above materials and devices - e.g. Lab-On-Chip, Organ-On-Chip, mock-up of human body, biomedical devices implanted in humans (e.g., artificial heart and pacemaker, defibrillators), Si/GaAs/GaN based devices etc. - will be carried out using the MRF1 suite and MRF2 of IM@IT and the beam lines of ISIS Facility for irradiation (also accelerated) such as ChiPIR, ENGIN-X, IMAT e Nile.
Based on accelerated tests, the simultaneous measurement of neutron flux and aging effects on human body/biological system mock-up will allow adapting these results to the final application, i.e. estimating the aging effects caused by neutrons at different altitudes and latitudes, and in space.

References

[1] Bibliografia su Lab-on-Chip and Organ on-Chip [D'Orazio et al., Scientific Reports, 2022]
[2] Extreme space weather: impacts on engineered systems and infrastructure, www.raeng.org.uk/spaceweather, 2013; Direttiva 2013/59/EURATOM, https://eur-lex.europa.eu/legal-content/IT/TXT/?uri=celex%3A32013L0059 ;
[3] Hapgood, M., Angling, M. J., Attrill, G., Bisi, M., Cannon, P. S., Dyer, C., et al. (2021) "Development of space weather reasonable worst-case scenarios for the UK National Risk Assessment. Space Weathe", 19, e2020SW002593, https://doi.org/10.1029/2020SW002593
[4] "Severe Space Weather—Social and Economic Impacts". NASA Science: Science News.
https://science.nasa.gov/science-news/science-at-nasa/2009/21jan_severespaceweather
[5] *C. Andreani, A. Pietropaolo, A. Salsano, G. Gorini, M. Tardocchi, A. Paccagnella, S. C. D. Frost, S. Ansell, S. P. Platt, Applied Physics Letters*, **92**, 114101 (2008)
[6] Carrington, R. C. Monthly Notices of the Royal Astronomical Society, 20, 13-15 (1859), DOI:10.1093/mnras/20.1.13