

Interreg

Italia-Österreich

European Regional Development Fund



InCI Ma

Project Overview

Dr. Lisa Vaccari
Elettra Sincrotrone Trieste

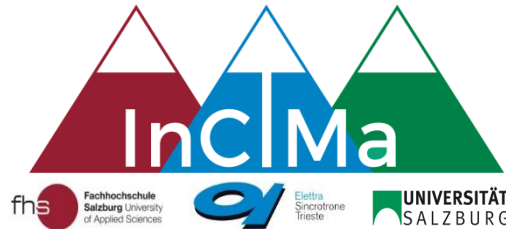
InCI Ma Kickoff meeting, 16th-17th March 2017, Trieste, Italy

InCI Ma is a project funded by the European Regional Development Fund and Interreg V-A Italy-Austria 2014-2020.

www.interreg.net

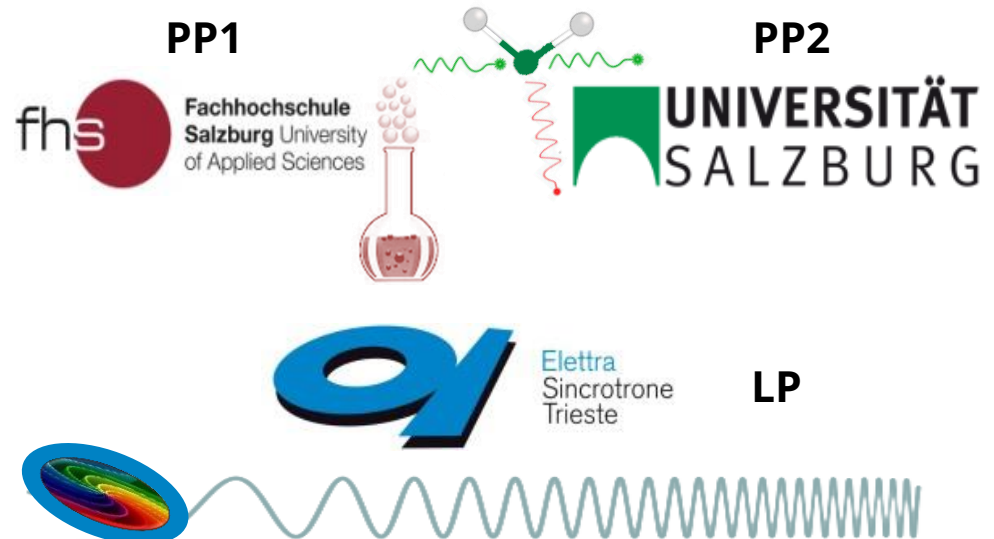
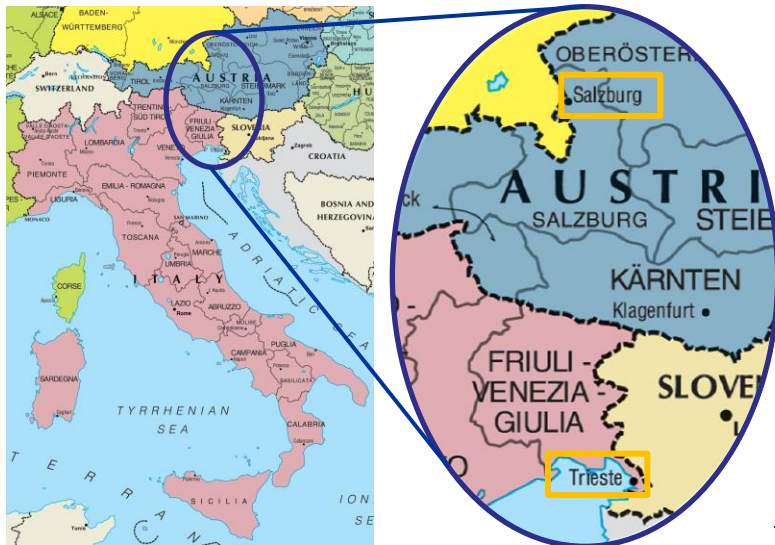


**Intelligente Caratterizzazione
di Materiali Intelligenti**



**Intelligente Charakterisierung
von Intelligenten Materialien**

The main goal of the ITAT1023 InCI MA project is the establishment of a **delocalized cross-border platform** for the **synthesis** and **characterization** of **functional smart materials** at nano, micro and macro scale, through the exploitation of state-of-the-art spectroscopic techniques of imaging and mapping, which use a wide radiation range, from far infrared to hard X-rays, encompassing both conventional and Synchrotron Radiation sources.



InCI Ma: Elettra, LP

Elettra is the largest materials research center in Italy, specialized in generation Synchrotron (SR) and free-electron laser (FEL) light for Material and Life Sciences research

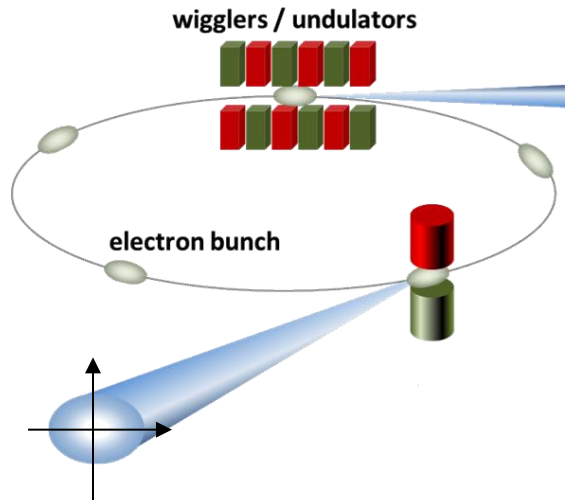
Elettra Synchrotron Radiation Facility



FERMI seeded Free Electron Laser Facility

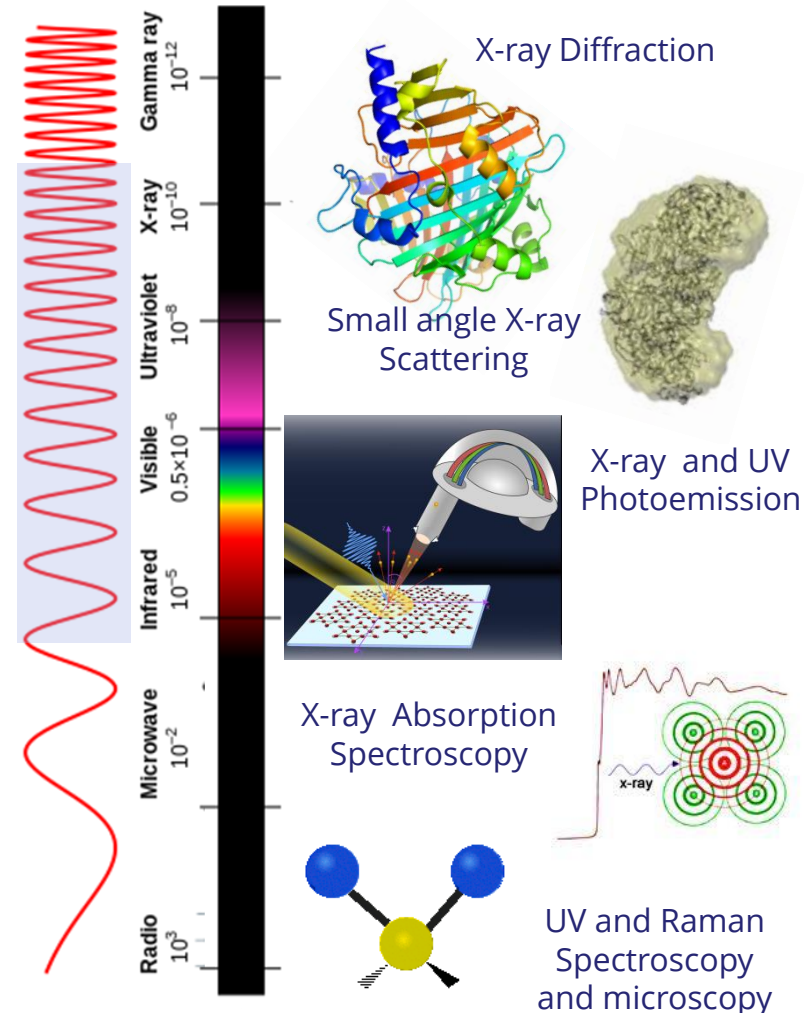
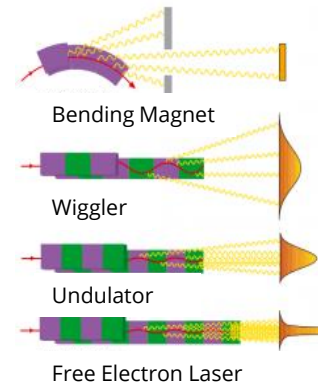
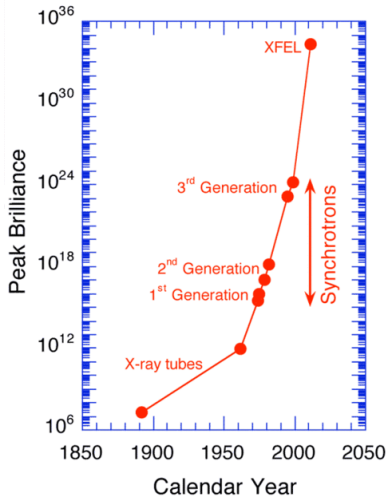
InCIMA: Elettra, LP

What's SR ?



SR Properties

- **10^{10} brighter than the most powerful (compact) laboratory sources**
- **SR is a light source that irradiates all "colors"**

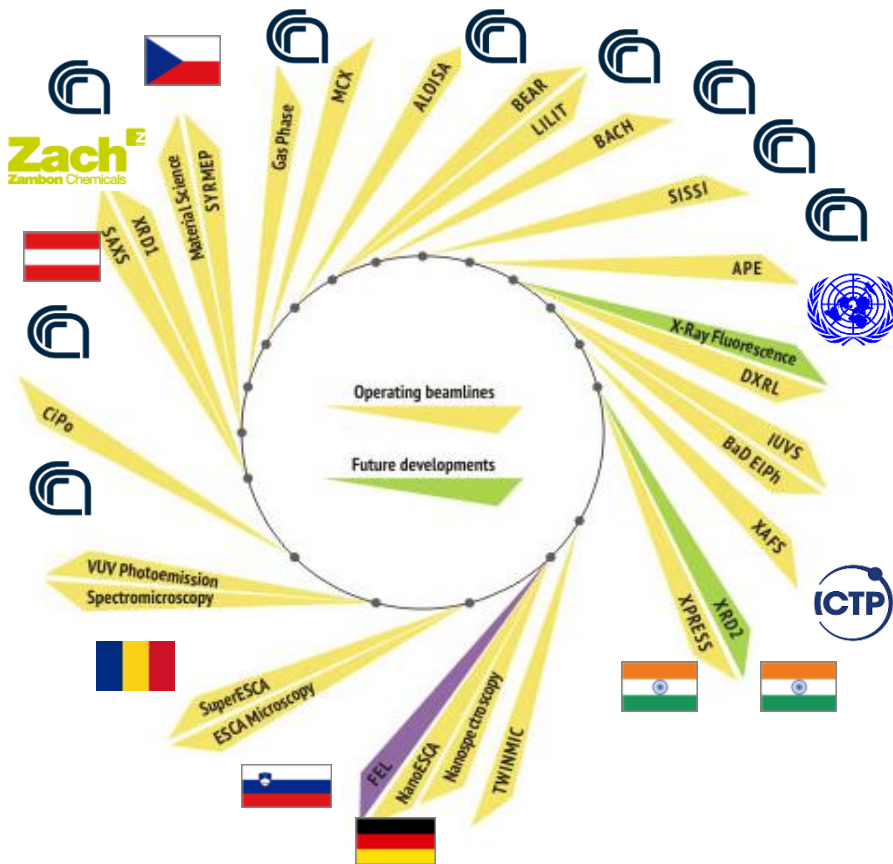


InCIMA: Elettra, LP

Elettra is a facility open to users

The access of scientists to the beamlines is free of charge and granted through proposal merit.

Twice per year, worldwide researchers submit proposal for experiments, that are evaluated by international Peer-Review-Committees (accordingly to the research area)



In 2016

934 Proposals received

from > 50 countries

Italy 41%: truly international center

438 ISI publications

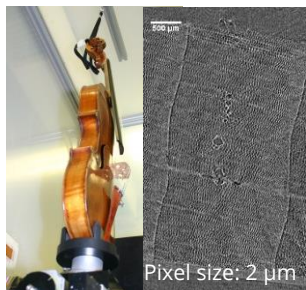
28 beamlines in operation

SYRMEP

The X-ray Imaging and Tomography beamline

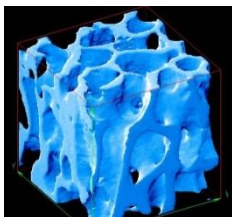
Cultural Heritage

Guadagnini violin (1753)



Pixel size: 2 μm

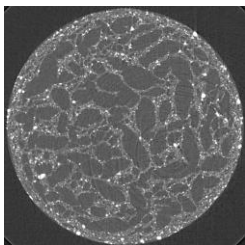
Biomedicine Biology



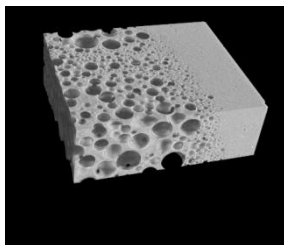
Bone trabecular structure

Materials science (Porous materials)

Alginate/Hydroxyapatite scaffolds

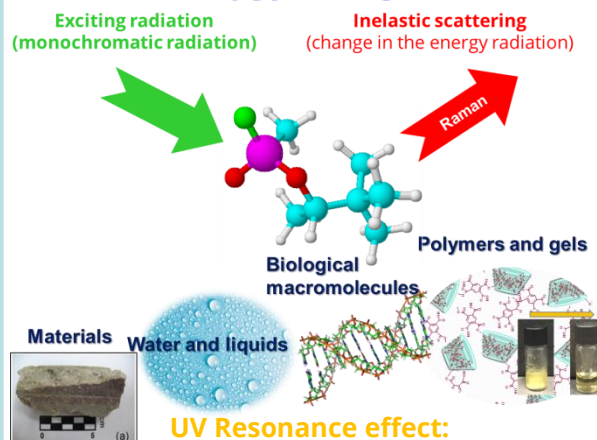


Aerated cioccolato



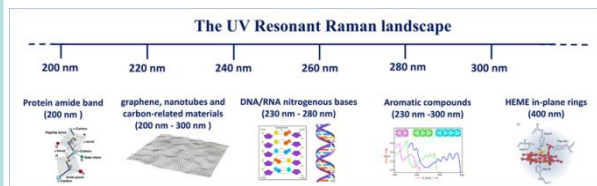
IUVS

The UV inelastic scattering beamline



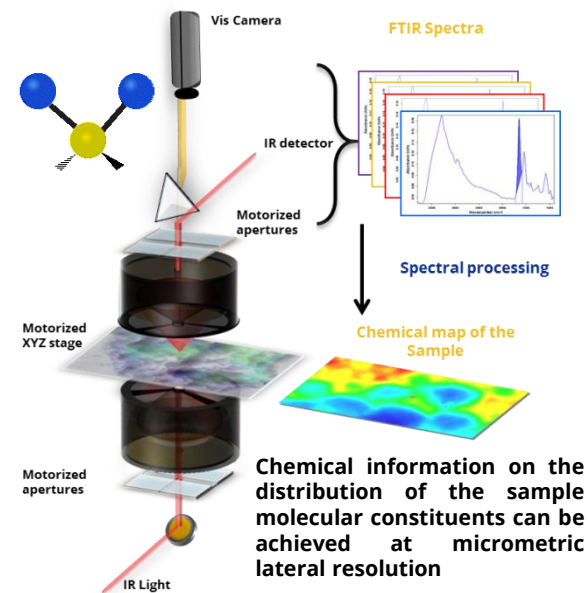
Increase sensitivity (lower concentrations)

Increased selectivity (the Raman modes associated to specific parts of the molecule are selectively enhanced in the spectra)



SISSI

Synchrotron Infrared Source for Spectroscopy and Imaging



Applications

Wide application range, from materials to Life Sciences

Toxicology, Cancer Research, Neurodegenerative disorders, ...

Fachhochschule Salzburg - Salzburg University of Applied Science



The Salzburg University of Applied Sciences (FHS) is the University for Technology, Health and Media

~2700 Students (18 Bachelor Programs, 10 Master Programs, 3 postgraduate Programs)

- **Engineering**
- **Business and Social Sciences**
- **Design**
- **Media and Arts**
- **Health Studies**

FHS is focused in solving applied questions with innovation purposes

The University is a pioneer of future-oriented degree programmes and practice-oriented solutions for business and society

Intimate connection with the Salzburg land production base

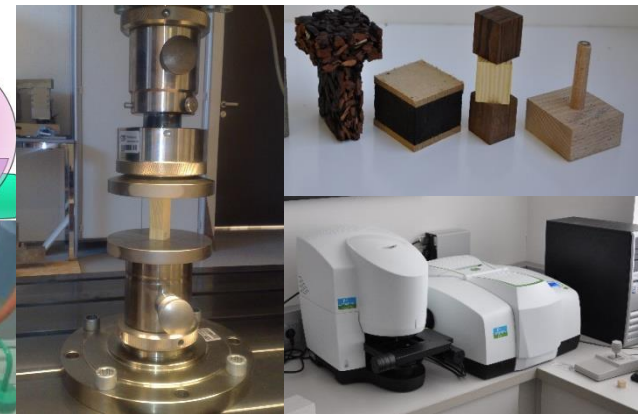
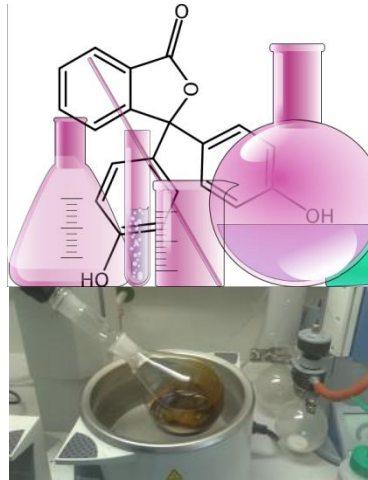


Forest product technology & Timber construction The Wood technology department - Kuchl

- Around 500 students (3 Bachelor and 3 Master Programs)
- Applicative research - support for the companies
 - The students are dealing with projects (company or industry driven) from the 1st to last year of the study degree

Laboratory Equipments

- Hydraulic press
- Mechanical testing device
- FT-MIR and NIR
- HPLC with DAD and RI detector
- Conductimeter (lambda-meter)
- Digital microscopes
- Portable colorimeter



FH-Prof. Dr. Gianluca Tondi

InCIMA: PLUS, PP2

PARIS LODRON UNIVERSITY OF SALZBURG



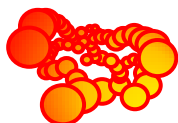
- The Paris Lodron University of Salzburg (PLUS), with over 18000 students and 2800 employees in research, teaching and administration, is the largest educational institution in both the city and province of Salzburg.
- The name of the university reflects its founding by Prince Archbishop Paris Lodron in 1622. Since the re-establishment of the University of Salzburg in 1962, it has developed into a modern and lively University that meets the highest requirements with its four faculties – Cultural and Social Sciences, Catholic Theology, Law, Natural Sciences - in teaching and research.
- Currently, more than 30 fields of study and 80 Diploma, Bachelor, Master or Doctoral degree programs are offered. Lifelong Learning is also encouraged in the form of numerous university courses and the special educational opportunities offered through "University 55+".

Department of Chemistry and Physics of Materials Professorships

InCIMA: PLUS, PP2



Prof. Dr. Nicola Hüsing
Sol-Gel Processes, Highly
Porous Materials / Materials
with High Specific Surfaces



Prof. Dr. Maurizio Musso
Raman spectroscopy



Prof. Dr. Michel Bockstedte
Theoretical Solid State Physics

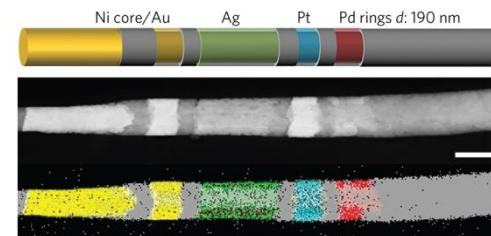
2017: In total about 30 university employees and 30 research funded employees.

University courses: Joint-Degree Bachelor of Engineering PLUS-TUM, Master Chemistry and Physics of Materials

Prof. Dr. Oliver Diwald

Assoc. Prof. Gilles Bourret

Particles / Interfaces and Nanostructures

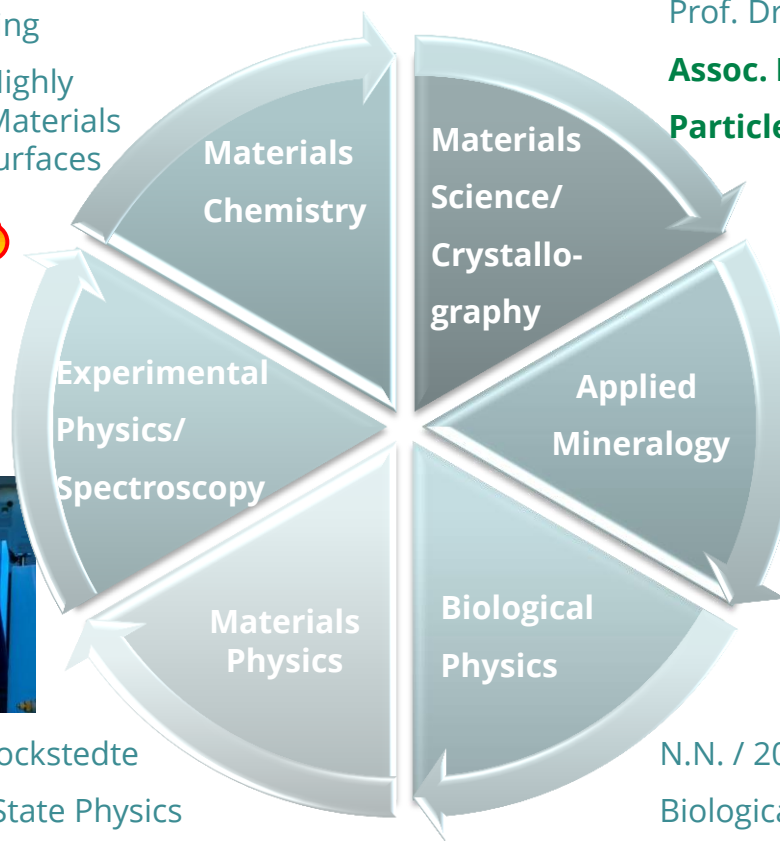


N.N. / 2018

Functional Materials

N.N. / 2017

Biological Physics



InCI Ma: Why together?

Today

The Italy-Austria cross-border situation is characterized by several, and often small, research and educational centers, that very rarely established long-term collaborations.

In 2010-2015, only 133 proposals over 2842 were submitted to Elettra by Austrian users, and just 1 from Salzburg

Splitting technological and human resources strongly diminishes the quality of the research and the possibility to efficiently impact on the economical and social life of the territory





InCI Ma: Why together?

Tomorrow

A delocalized cross-border platform
for the synthesis and
characterization of functional smart
materials





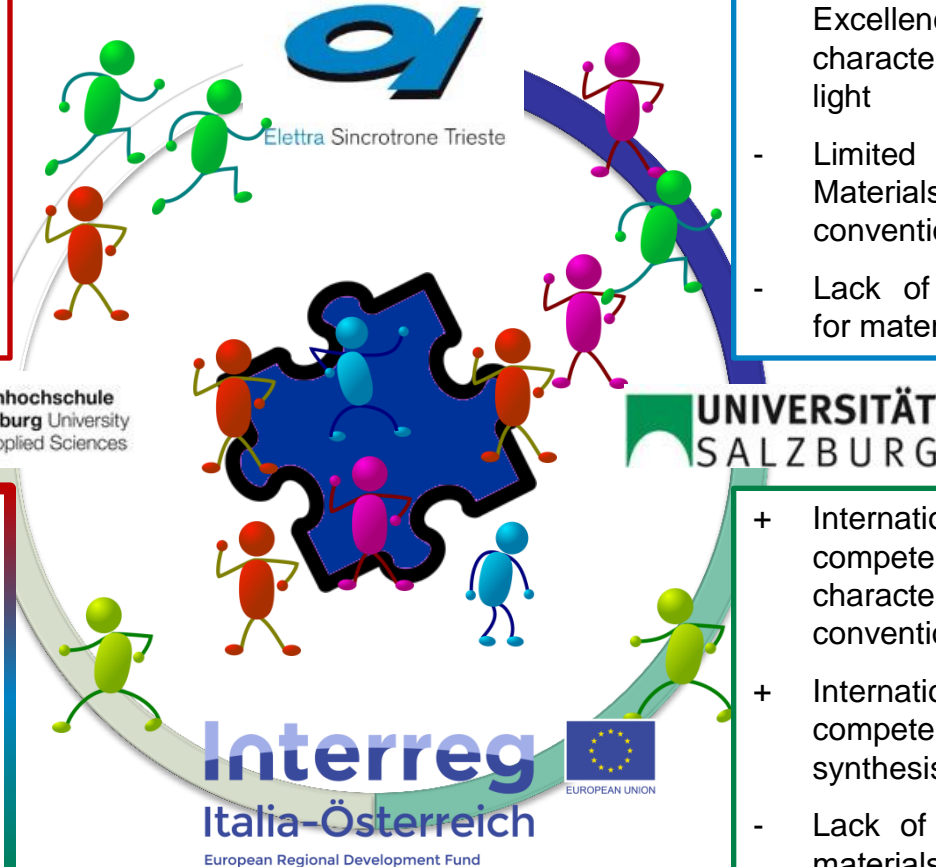
InCIMA: Why together?

- + Internationally recognized competences in materials' synthesis and macro-analysis
- Limited in-house resources for materials' characterization with conventional light sources
- Lack of in-house resources for materials' characterization with SR

- + International Centre of Excellence for materials' characterization with SR and FEL light
- Limited in-house resources for Materials' characterization with conventional light sources
- Lack of in-house competences for materials' synthesis



The partnership of InCIMA is established on the complementary of competences and expertise, in order to promote a novel dynamic research and educational reality that will allow to the partners to improve their international recognition and impact of the social and economic life of the Regions.



- + Internationally recognized competences in materials characterization with conventional light sources
- + Internationally-recognized competences in metamaterials synthesis and characterization
- Lack of in-house resources for materials' characterization with SR





InCIMA: How together?

To reach the “mountaintop” (the “CIMA”)

Sharing of competences and expertise



Technological improvements



Exchange of personnel

Students' Exchange programs



New people on board!

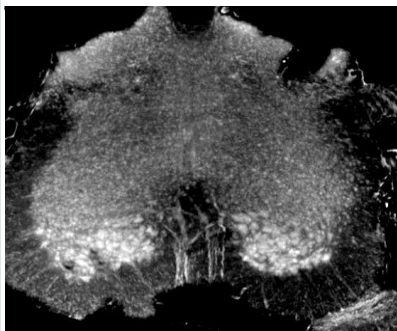


InCI Ma: Elettra Improvements (WP3)

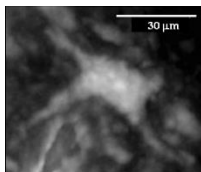
SYRMEP

Multiscale X-ray Tomography

- It consists in multiple microCT scans at different resolution scales performed on the same sample
- Now it requires a time consuming and not efficient procedure
- The availability of new optics will allow for a procedure optimization



Reconstructed slice of a mouse spinal cord (hor. size: 1.2 mm)



IUVS

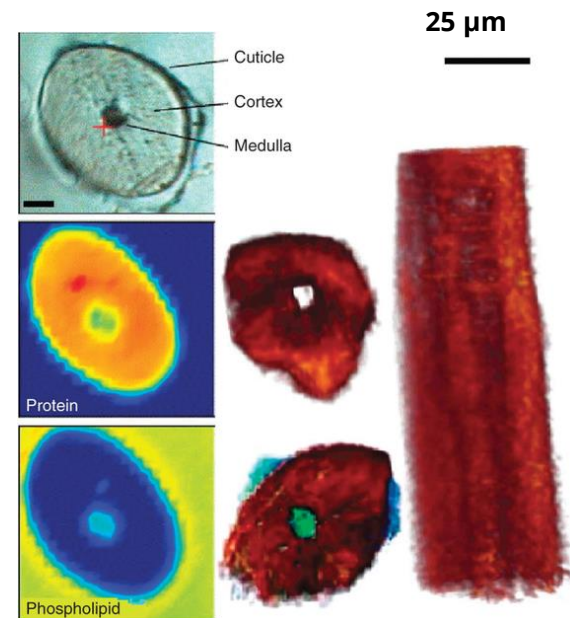
From macro to micro capabilities

UV-optimized Microscope with motorized X-Y stage



SISSI

From 2D to 3D chemical imaging



Miller, L.M. & Dumas, P. Biomembranes (2006)

Martin M. Et al., Nature Methods (2013)

InCI Ma: PLUS Improvements (WP3)

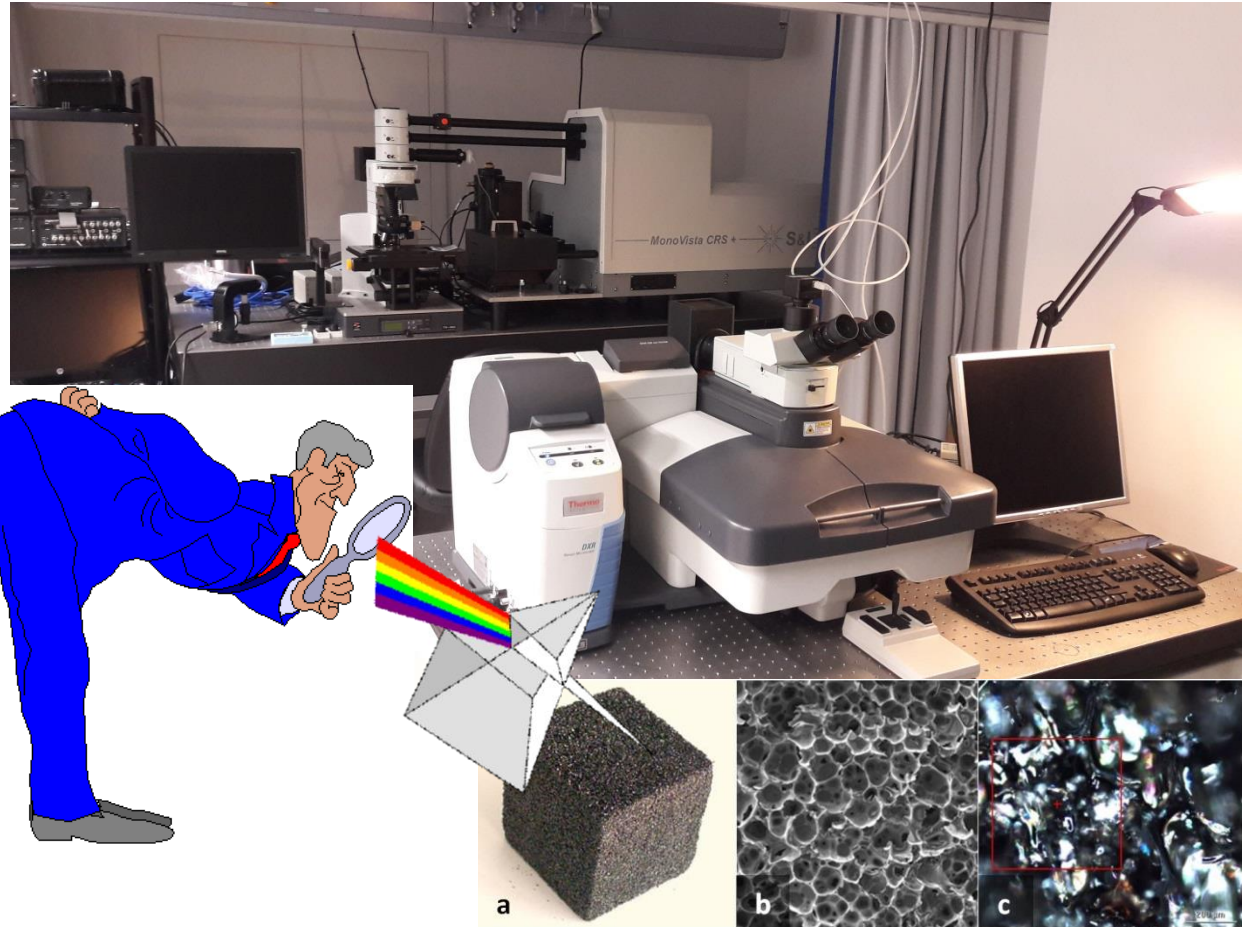
Core Facility Spectroscopy at PLUS

At present

- Multiwavelength (355 nm, 532 nm, 785 nm) Raman spectroscopic characterization of fluid and solid sample systems
- Raman spectroscopic measurements on microscopic and macroscopic samples with two independent instruments

Improvements

- Hardware and software modernization of the Raman microscope Thermo DXR (upgrade of the older instrument)
- New opportunity of polarization dependent measurements
- Instrument dedicated to the goals of the InCI Ma project for the duration of it

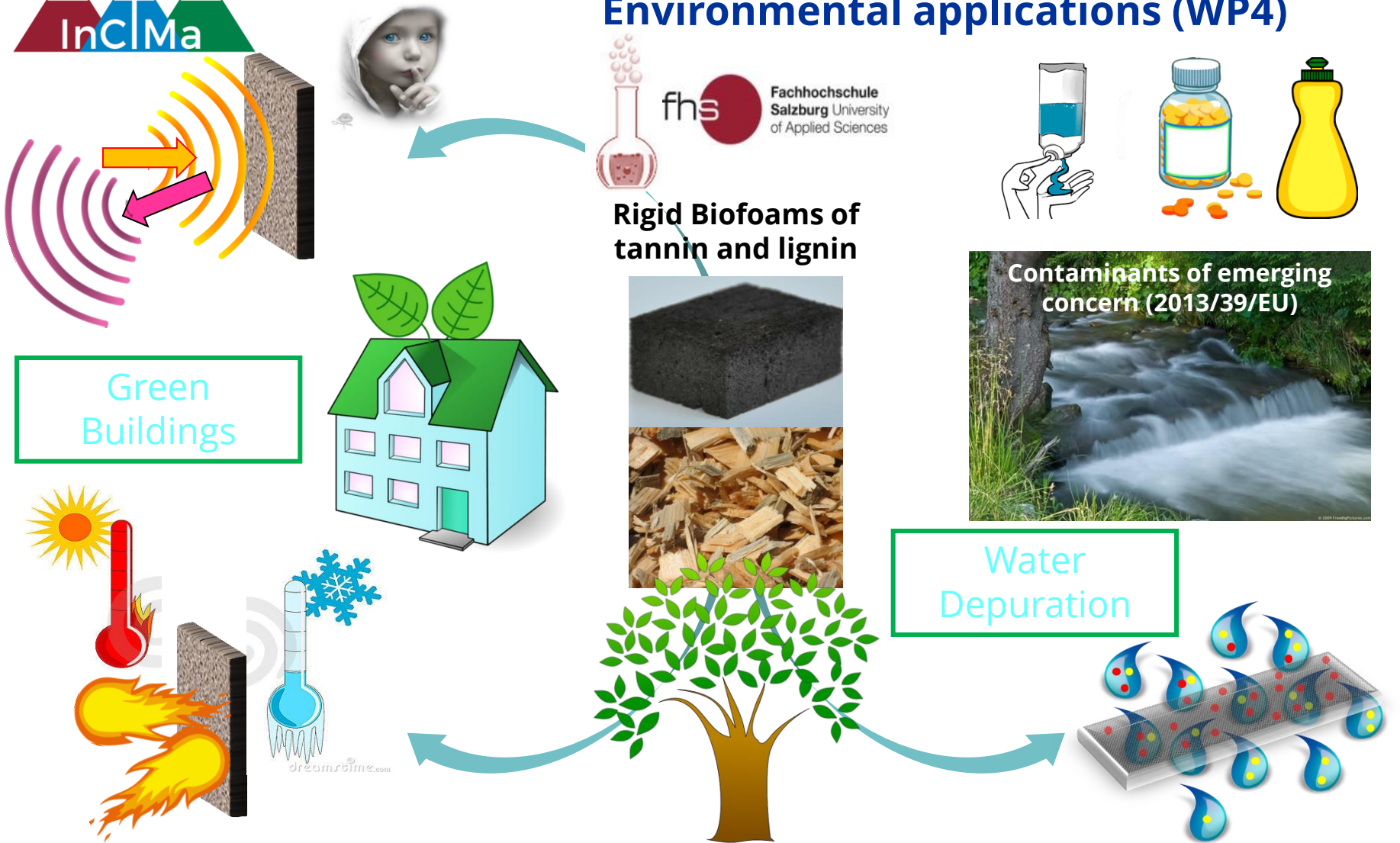


Raman spectroscopic investigation of tannin-furanic rigid foams

A. Reyer, G. Tondi, R.J.F. Berger, A. Petutschnigg, M. Musso, Vibrational Spectroscopy 84 (2016) 58-66



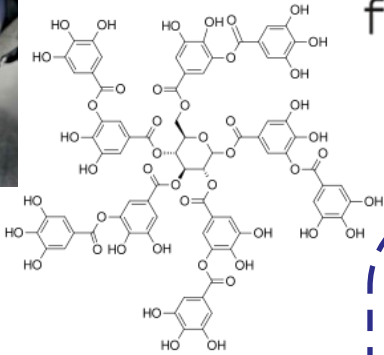
Specific Goal 1_ Characterization and optimization of smart materials for advanced Environmental applications (WP4)



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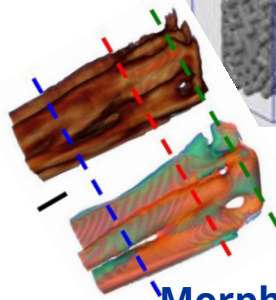
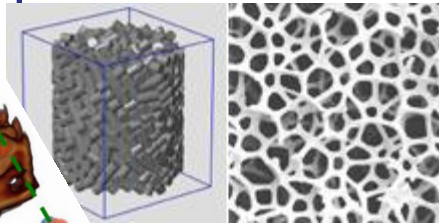
Black
Liquor



Molecular properties



**Micro-Nano
(Mesoscale)**



**Morpho-Chemical
Characterization**

The Mesoscale is the missed link between Molecular properties and Functional properties



Macro



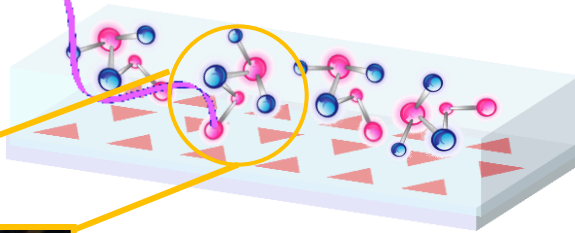
Functional properties

**Tune the synthesis parameters
for improving material
functionality via mesoscale
analysis**

Specific Goal 2_Characterization and optimization of smart materials for advanced Technological applications (WP5)

Plasmonic metamaterials for ultra-diluted analyte detection

Plasmonic sensors for Health and Environment



- Metallic Nanosheets
- Metallic Nanowires
- Metallurgical Processes

Production of nano- and micro-patterned plasmonic surfaces



Characterization of UV, Vis and IR plasmonic efficiencies



Integration of plasmonic nanostructure into bio-foams



InCI Ma: Regional, Cross-border and European Strategies



Smart Health

→ **Materiali Intelligenti**



Asse prioritario 1:

Potenziare l'infrastruttura per la ricerca e l'innovazione (R&I) e le capacità di sviluppare l'eccellenza nella R&I e promuovere centri di competenza, in particolare quelli d'interesse europeo

Prioritätsachse 1:

„Forschung und Innovation“ zur Stärkung grenzübergreifender Forschungs- und Innovationsprozesse zur Entwicklung von gemeinsamen Stärkefeldern“: umgesetzt im Rahmen des thematischen Ziels 1 „Verbreiterung und Verbesserung der grenzüberschreitenden F&I-Kapazitäten“



Action 1

To develop an effective research and innovation ecosystem

WISS 2025



Smart Materials



Societal Challenges



InCI Ma: Beyond the project End

Science Dissemination

Conferences

- Participation
- Organization

Publications

- Open access



Horizon 2020
European Union Funding
for Research & Innovation

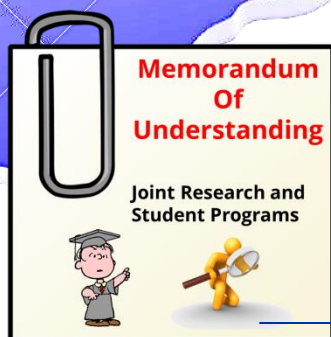
New Collaborations

Scientific Partners

- Improved Project capacities

Industrial partners

- Higher territorial Impact





InCI Ma: The territorial impact

The power of R&D



No in-house R&D



RESEARCH



Industrial Liaison Office



InCI Ma: Communication

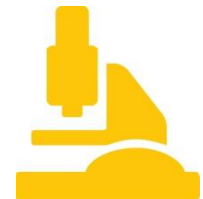
Science for All



Science Cafe



RESEARCH



<http://www.elettra.eu/Prj/InCIMA/>



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Smart Characterization of Smart Materials

InCIMA is a project funded by the European Regional Development Fund and Interreg V-A Italy-Austria 2014-2020.

The main goal of InCIMA project is the establishment of a delocalized cross-border platform for the synthesis and characterization of functional smart materials at nano, micro and macro level, through the exploitation of state-of-the-art spectroscopic techniques of imaging and mapping, which exploit a wide radiation range, from far infrared to hard X-rays. The cooperation will be realized by the synergic complementation and the improvement of several analytic techniques and synthetic approaches, nowadays employed by each partner individually, for the optimization of two material types:

1. Totally natural rigid foams derived from byproducts of wood industries, such as tannin and lignin, to be used as new materials for green-building (for thermic and acoustic isolation), as well as for water purification from contaminants of emerging concern (natural filtering systems).
2. Plasmonic metamaterials to be used in the infrared and ultraviolet spectral range, for application as sensor of diluted chemical analytes, for environmental and biomedical diagnosis. The ultimate vision of integration of contaminant absorption capacity and dilute analyte detection within a single material, such as the bio-foam, will be forecasted.



Elettra Sincrotrone Trieste



last update March 14, 2017, at 10:20 AM





Grazie!

Danke!