



MONASH
University



Experiences as a user and as staff in a synchrotron

Dr. Diana E. Bedolla

Elettra Sincrotrone Trieste/Area Science Park

ICGEB/Monash University



The joint virtual event of the
African Light Source AfLS-2023 (6th)
and the
African Physical Society AfPS2023



Something about me...



- Bachelor in Physics @Universidad Autonoma del Estado de Morelos
 - Summer Internship @ Fermi National Laboratory
- Master's in Modelling and Simulation of Complex Realities @ ICTP
- TRIL Programme with SISSA and Elettra Sincrotrone Trieste
- PhD in Neuroscience @SISSA
- Postdoc SISSI-Bio beamline @Elettra
- Postdoc TWINMIC beamline @Elettra
- Postdoc @Monash University in Australia
- Postdoc SISSI-Bio @Elettra
- Next: Marie Curie Fellowship



Synchrotrons I have been

- Elettra
- CLS (Canadian Light Source): Mid-IR
- ESRF (European Synchrotron Radiation Facility): ID-21 with Hiram Castillo
- Diamond Light Source: Scanning X-ray Microscopy Beamline I08 – SXM with Burkhard Kaulich.
- ANSTO (Australian Nuclear Science and Technology): Infrared microspectroscopy with Mark Tobin and Pimm Vongsvivut



ICTP Diploma Programme



Fields of research








 High Energy, Cosmology and Astroparticle Physics 

 Condensed Matter Physics 

 Mathematics 

 Earth System Physics 

 Quantitative Life Sciences 

	Diploma Programme
	BSc (but a MSc is preferred) in physics or mathematics under the age of 28, from UN member country
	for Developing countries
	Trieste
	1 year, from 1 September to 31 August
	Call To be announced
	ICTP

ICTP Master's Programme



Master Degree
International Master, Physics of Complex Systems
Students with a bachelor's degree in physics, mathematics and information engineering
for Developing countries
Trieste, Torino, Paris
2 years
Call To be announced
ICTP Politecnico di Torino University International School for Advanced Studies (SISSA) Sorbonne Université Université Paris Cité Université Paris-Saclay

Master Degree
Master in High Performance Computing
An academic degree is required, although equivalent work experience may also be considered
for Developing countries
Trieste
18 months
Call To be announced
ICTP International School for Advanced Studies (SISSA)

Master Degree
Master of Advanced Studies in Medical Physics
The Programme is open to young qualified graduates (generally below 30 years of age) from countries that are members of the United Nations, UNESCO or IAEA
for Developing countries
Trieste (first year), medical physics department of a hospital in the programme's training network (second year)
2 years
Call To be announced
ICTP University of Trieste

Dr. Diana Bedolla, November 14th, 2023.

For students: ICTP PhD Fellowships in Trieste

- Physics, including astrophysics, condensed matter physics, theoretical physics, medical physics, and biophysics (scholarship code D/11)
- Earth science, fluid dynamics and mathematics. Interactions and methods (scholarship code D/1)
- Industrial and information engineering (scholarship codes D/2 and MD/4)









TRIL (Training and Researche in Italian Laboratories) Programme



The TRIL Programme offers scientists from developing countries the opportunity to undertake training and research in an Italian laboratory in different branches of the physical sciences.

The aim of the programme is to promote, through direct contacts and side-by-side high-level research, collaborations between the Italian scientific community and individuals, groups and institutions in developing countries. This programme thus addresses an important aspect of the mission of ICTP, namely to help form and strengthen a permanent scientific expertise in developing countries, cognisant of local needs and resources and of the frontiers of science and technology, and to provide support towards a sustainable capacity in basic and applied research that can help their nations' progress.

	Laboratory Opportunity
	Scientists from developing countries
	for Developing countries
	Italy
	Up to 1 year
	Call To be announced

For students: Hercules School

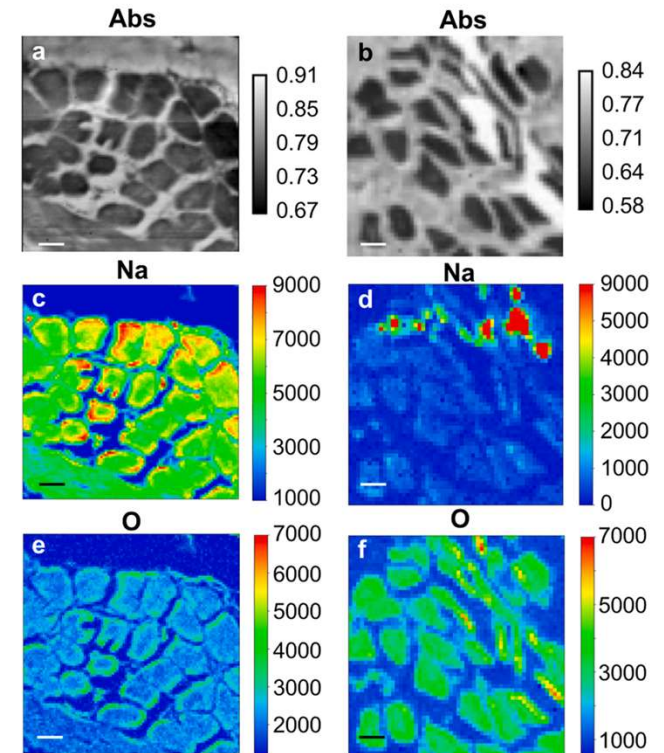
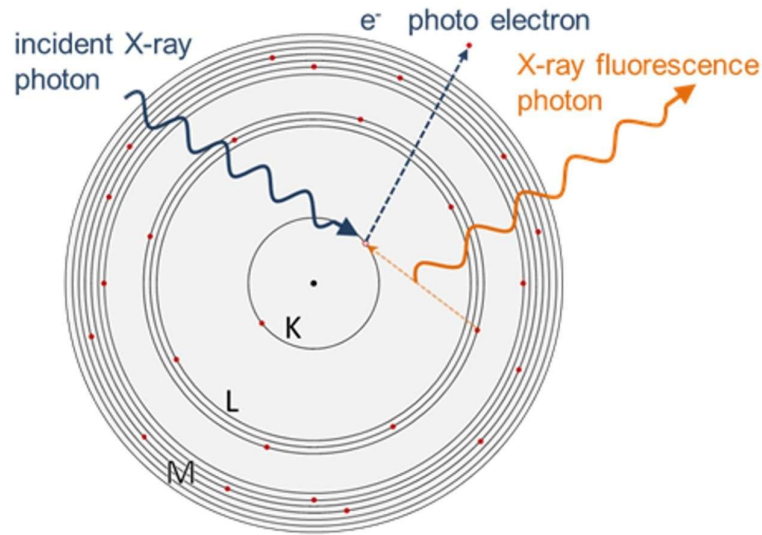
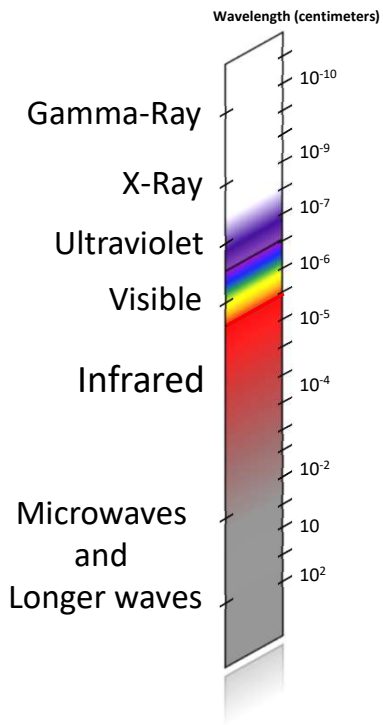
HERCULES
European School

- <https://hercules-school.eu/>
- Applications open September 4th.
- Some grants can be requested for emerging countries.
- 5 weeks course.
- It includes lectures, practicals, tutorials, and visits of Large Facilities: ALBA in Barcelona, KIT in Karlsruhe, DESY and European XFEL in Hamburg, Elettra and FERMI in Trieste, ESRF and ILL in Grenoble, SOLEIL in Paris-Saclay, and PSI in Villigen.



X-ray Fluorescence

Electromagnetic Spectrum



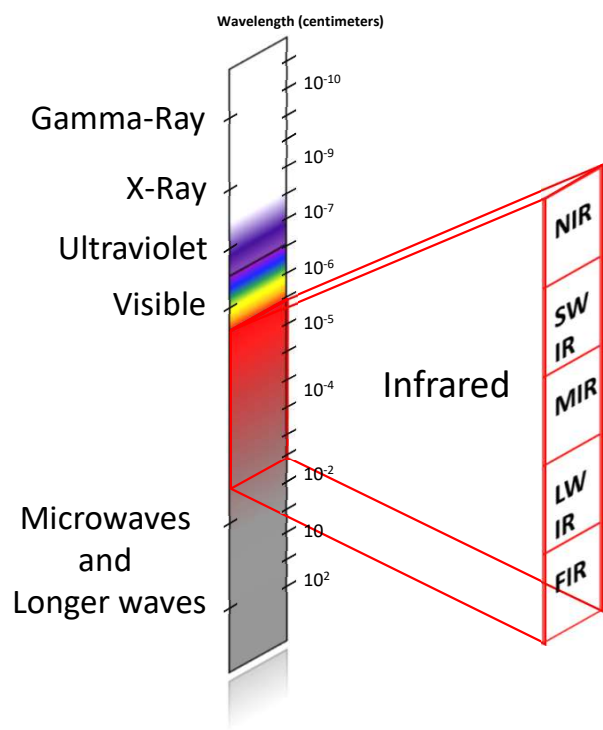
Evaluation of the effects of Azadirachtin on internal structures of *Rhodnius prolixus* head using low-energy X-ray microfluorescence

Gabriela Sena^{a,b,*}, Regina C. Barroso^a, Delson Braz^b, Liebert P. Nogueira^c, Marcos V. Colaço^a, George Kourousias^d, Matteo Altissimo^d, Diana E. Bedolla^d, Giuliana Tromba^d, Patricia Azambuja^{e,f}, Marcelo S. Gonzalez^{e,f}, Arissa Pickler^g, Gabriel Fidalgo^h, Jairo J. S. Enríquezⁱ, Simone F. Silva^g, Gabriela B.N. Leitão^g, Carolina N. Spiegel^e, K. Paiva^a, Renan Barcellos^a, Carla Calligaro^h, Alessandra Gianoncelli^d

Dr. Diana Bedolla, November 14th, 2023.

What's Infrared?

Electromagnetic Spectrum

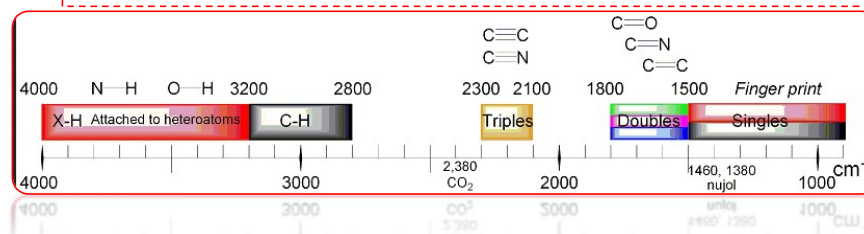


Vibrational Modes



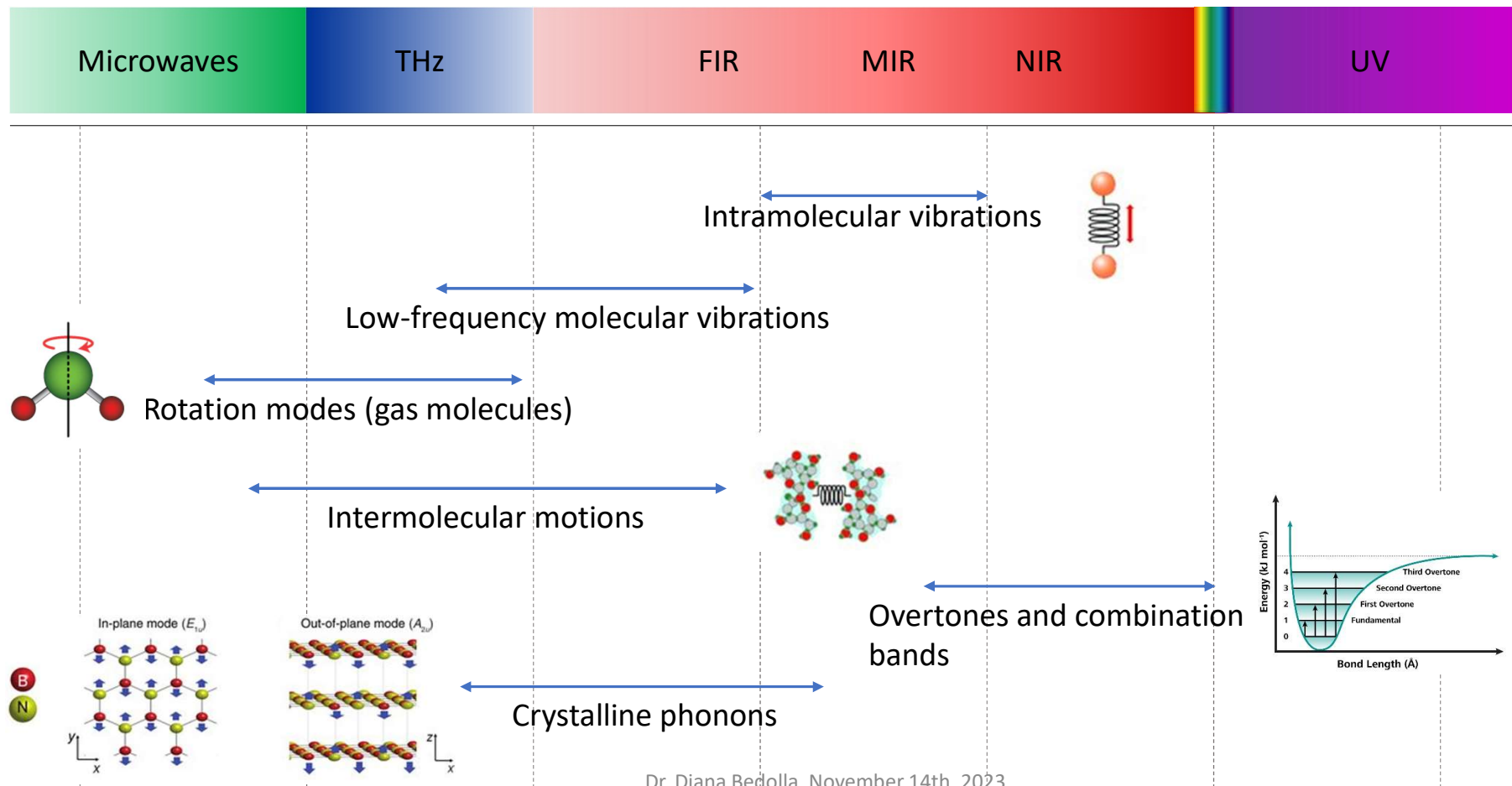
IR active are only the vibrational modes that produce a net change of dipole moment of the molecule

Vibrational Energy of organic molecules



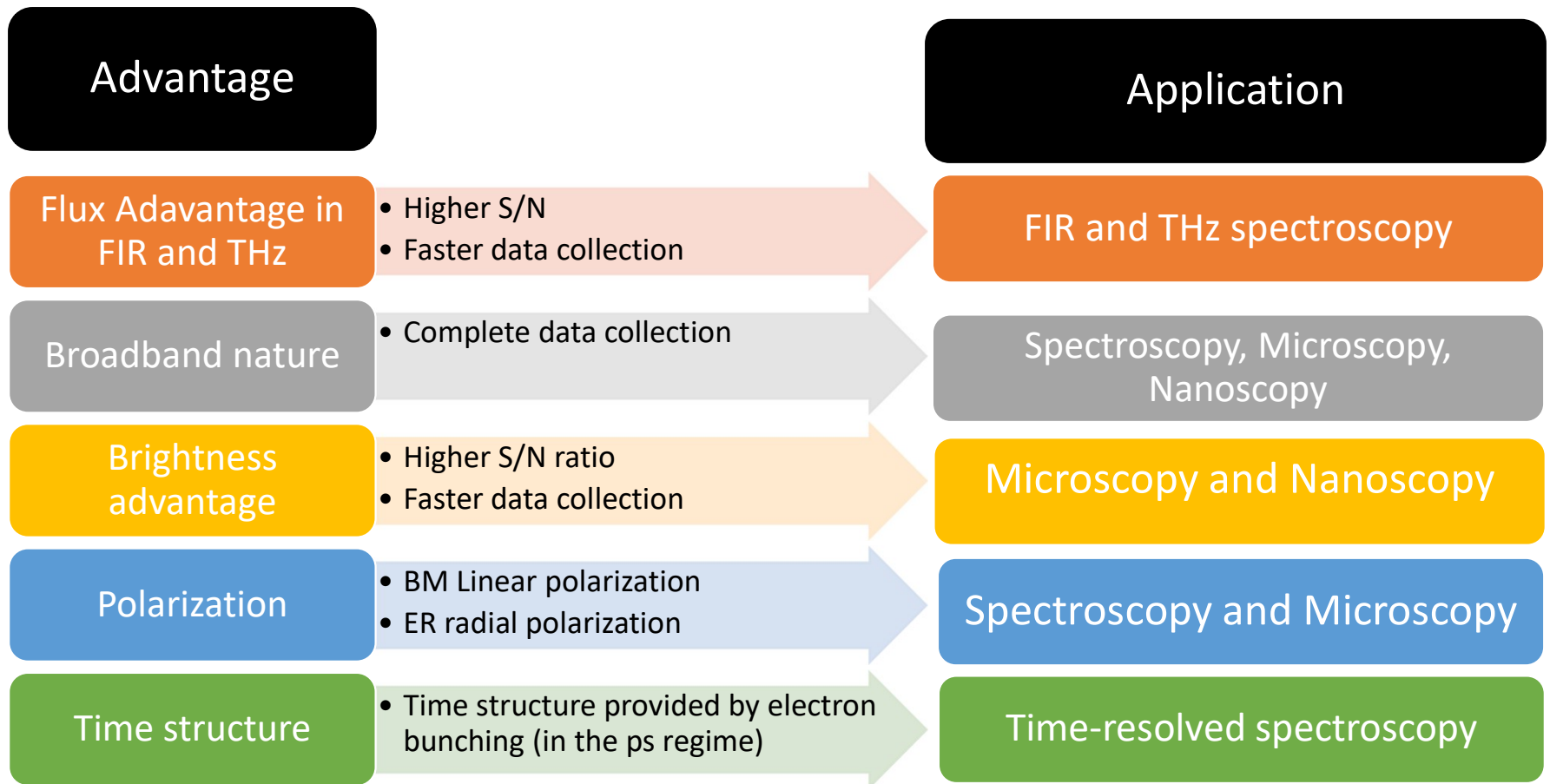
	NIR	MIR	FIR	THz
λ (μm)	0.74	3 30	300	3000
ν (THz)	400	100 10	1	0.1
ν (cm^{-1})	~13000	~3333 ~333	~33	~0.33
E (eV)	1.65	0.413 0.041	0.004	0.0004
E (Kcal/mol)	37	10 1	0.1	0.01

What is IR spectroscopy used for?

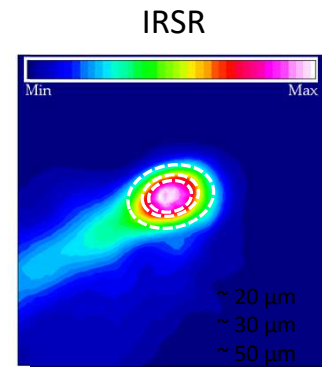
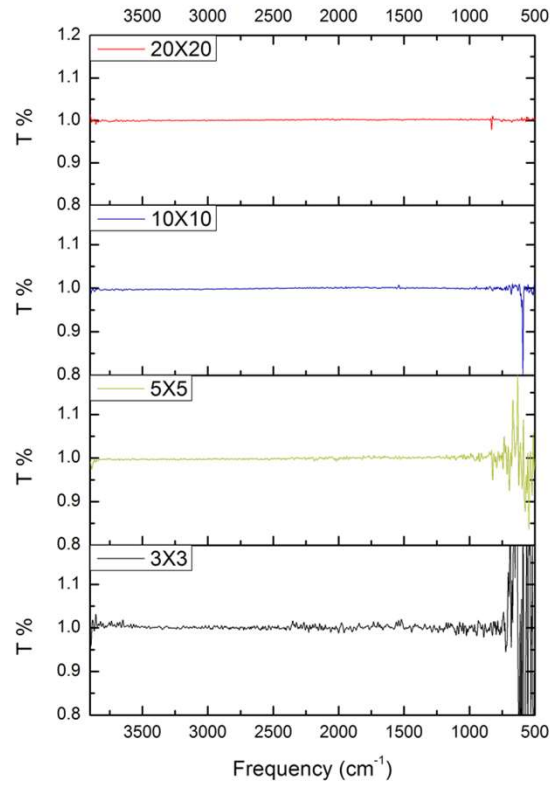
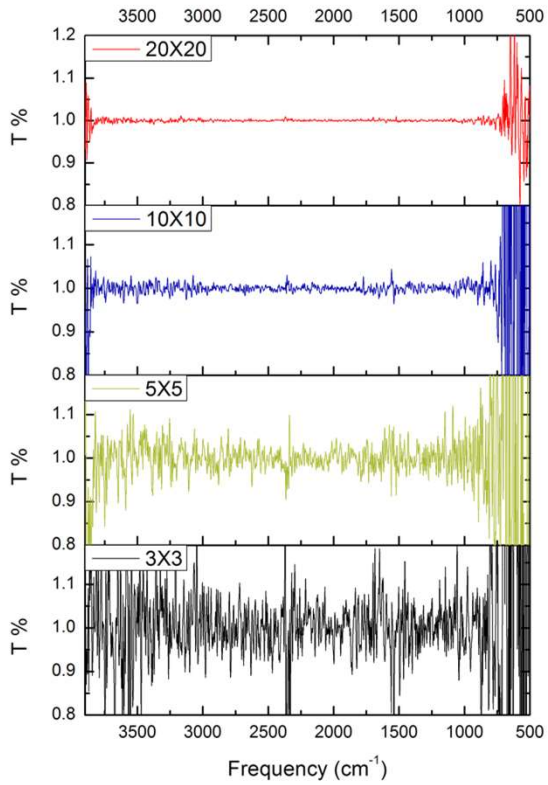
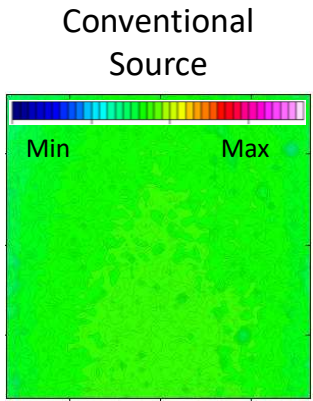


Dr. Diana Bedolla, November 14th, 2023.

Exploitation of Infrared Synchrotron Radiation advantages



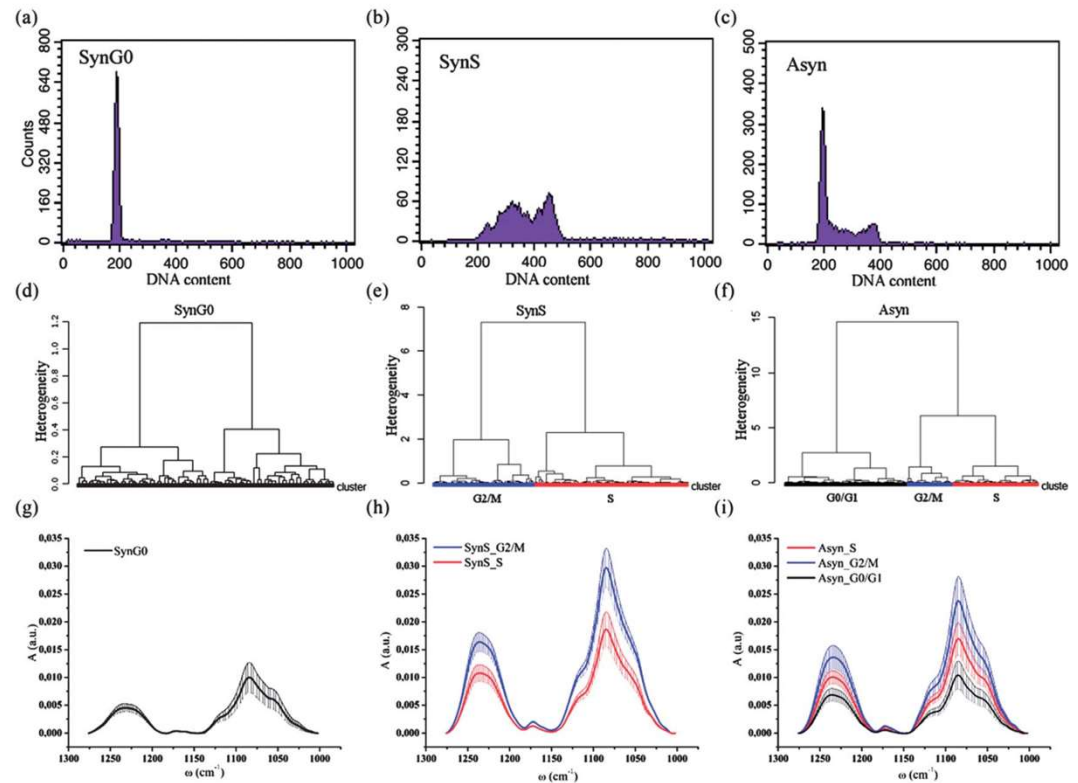
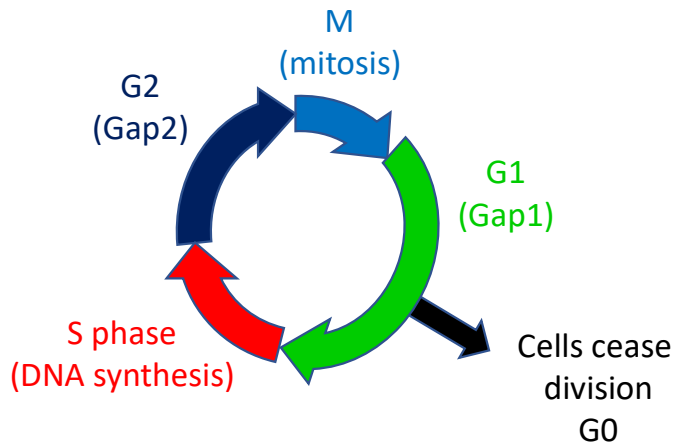
SISSI-Bio: far field spectromicroscopy



E=2.0 GeV
I=330 mA

Diffraction Limited FTIR Microscopy is practically achievable only with IRSR

Dr. Diana Bedolla, November 14th, 2023.



Determination of cell cycle phases in live B16 melanoma cells using IRMS

Diana E. Bedolla,^a Saša Kenig,^b Elisa Mitri,^c Paolo Ferraris,^a Alessandro Marcello,^d Gianluca Greci^e and Lisa Vaccari^{*a}

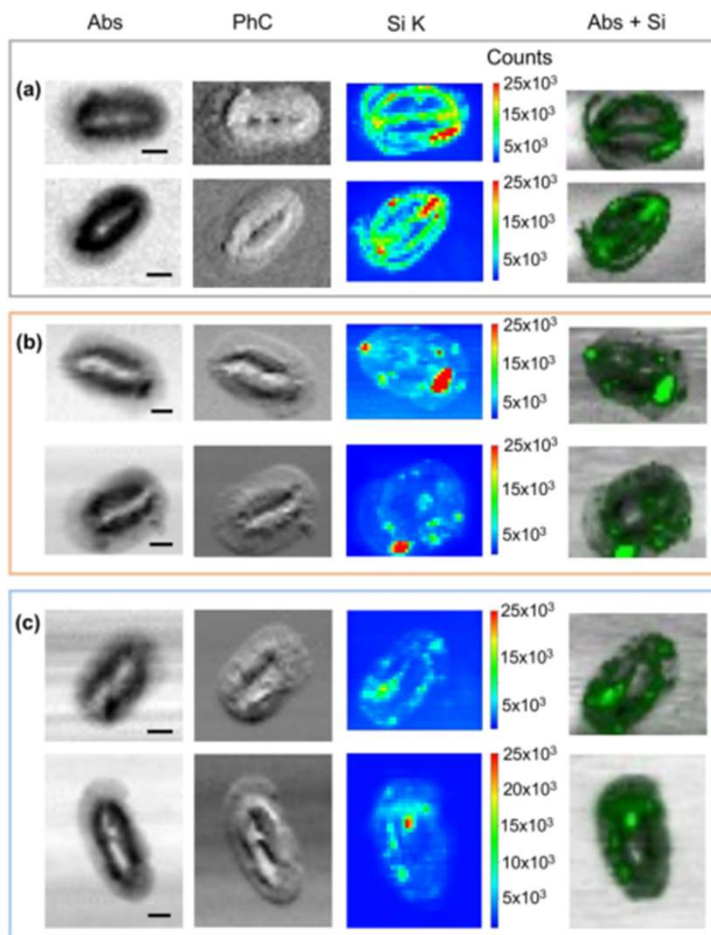


Figure 3. Examples of XRF maps collected at TwinMic on single coccoliths of *H. carteri* from monospecific culture sample C1 (a), and fossil samples F1 (b) and F2 (c). Absorption (Abs) and phase contrast (PhC) images of coccoliths are depicted together with the corresponding Si XRF map (Si_K) and the overlapping image of absorption and Si distribution (Abs + Si). All images were acquired at 1.92 keV with 300 nm step size and 60 ms acquisition time for Abs and PhC, while 15 s for XRF map. Scale bar is 2 μm . Color bars report the intensity counts. Maps were produced using PyMCA software package²⁶ (<https://pymca.sourceforge.net/>).

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Unexpected silicon localization in calcium carbonate exoskeleton of cultured and fossil coccolithophores

M. Bordiga, C. Lupi , G. Langer, A. Gianoncelli, G. Birarda, S. Pollastri, V. Bonanni, D. E. Bedolla, I. Vaccari, G. Gariani, F. Cerino, M. Cabrini, A. Beran, M. Zuccotti, G. Fiorentino, M. Zanoni, S. Garagna, M. Cobianchi & A. Di Giulio

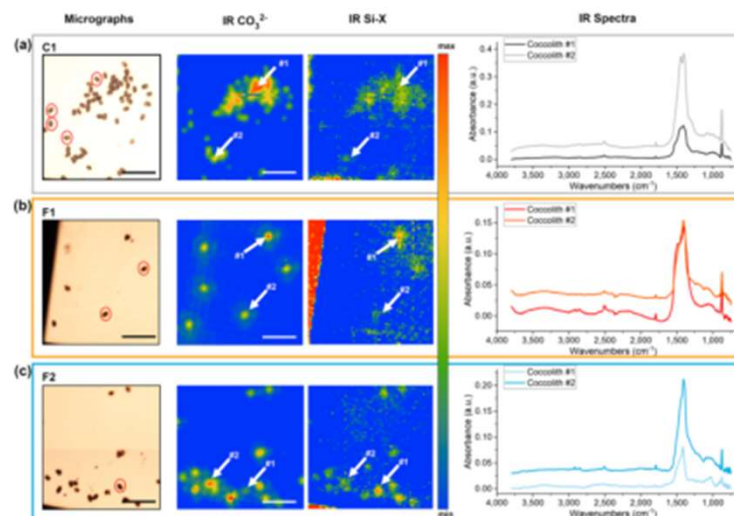
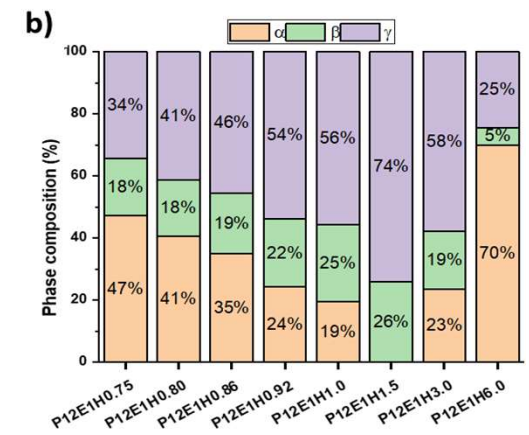
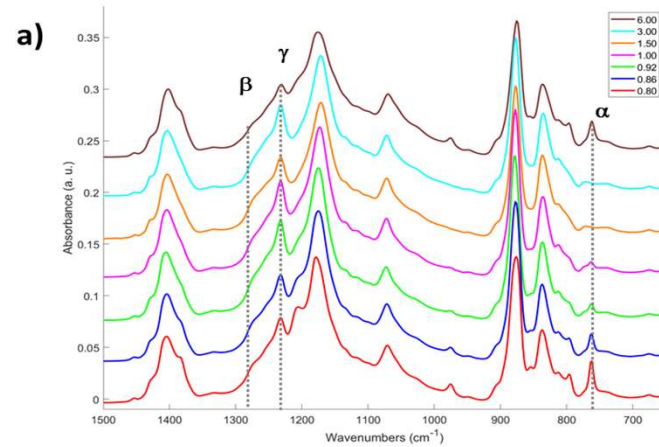
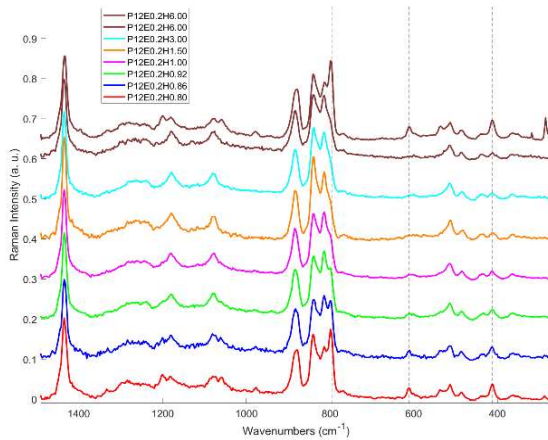
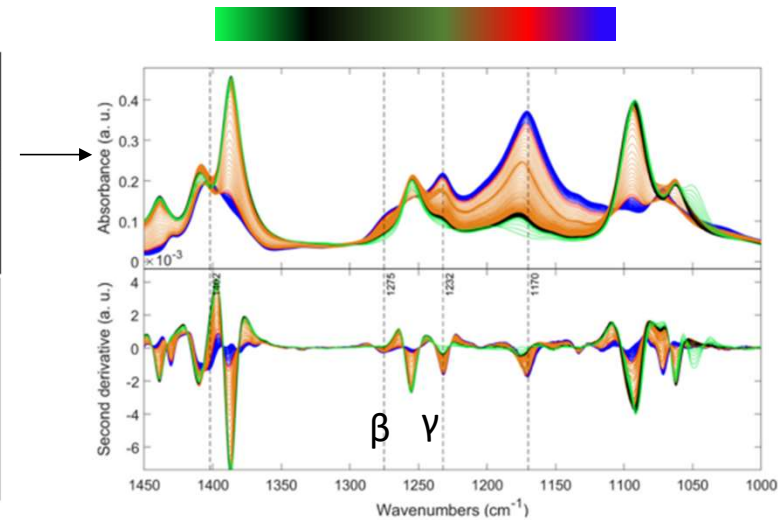
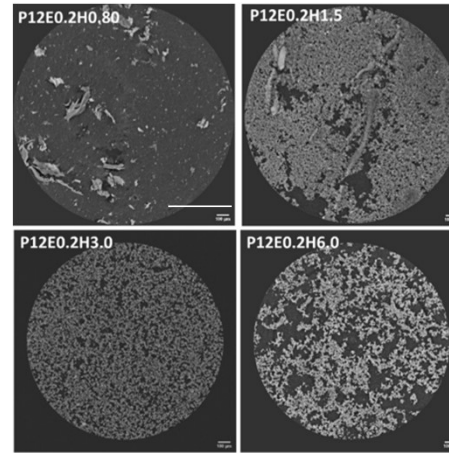
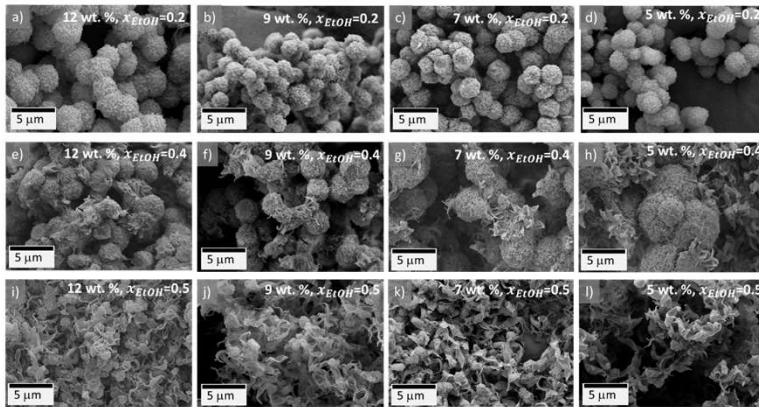


Figure 4. Examples of micrographs, CO_3^{2-} , and Si-X maps collected through SISSI-Bio beamline on single coccoliths of *H. carteri* isolated from monospecific culture sample C1 (a), and fossil samples F1 (b) and F2 (c). Some of the coccoliths analyzed at both SISSI-Bio and TwinMic beamlines are highlighted with red circles. Scale bar is 50 μm . Reported spectra are derived from the coccoliths named #1 and #2 and highlighted by the white arrows. In the spectra, the crystalline form of CaCO_3 , is ascribable to the 1600–1300 cm^{-1} broad band and the peak at 865 cm^{-1} ; whereas the Si chemical bonds with other elements are identifiable by the band from 1200 to 950 cm^{-1} with a peak at 1075 cm^{-1} . Maps and spectra were generated using Quasar software²⁷ (<https://quasar.codes/>).

Polyvinylfluoridene (PVDF) aerogels



Dr. Diana Bedolla, November 14th, 2023.

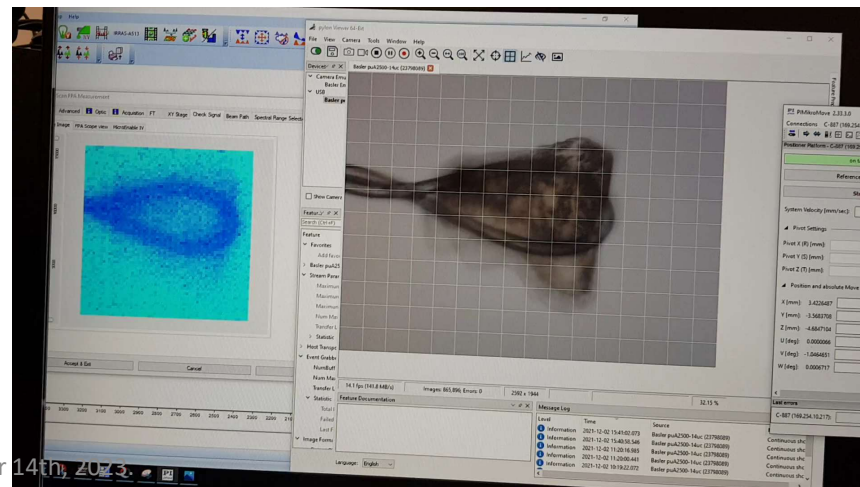
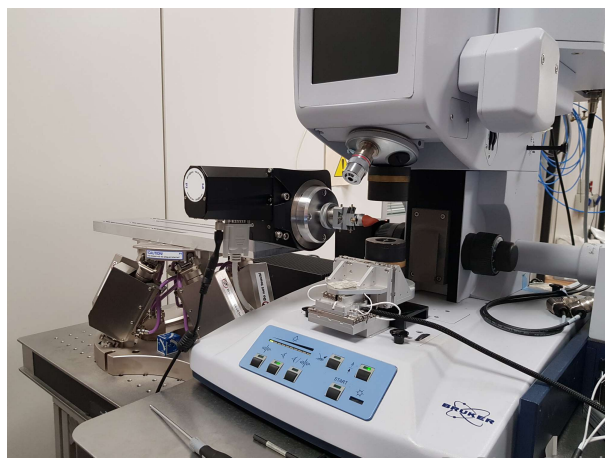
Torres-Rodriguez J, et.al Gels 2022, 8, 727

Development and improvement of new technologies

Open Access Article

Study of the Spatio-Chemical Heterogeneity of Tannin-Furanic Foams: From 1D FTIR Spectroscopy to 3D FTIR Micro-Computed Tomography

by  Nicola Cefarin ^{1,2,†}  Diana E. Bedolla ^{1,3,†}  Artur Surowka ^{1,4,†}  Sandro Donato ^{5,6,†}  Thomas Sepperer ^{7,8}  Gianluca Tondi ^{7,9}  Diego Drossi ¹  Nicola Sodini ¹  Giovanni Birarda ^{1,*} and  Lisa Vaccari ¹




Dr. Diana Bedolla, November 14th, 2021

Synergy with other techniques

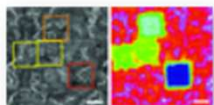
JSR RESEARCH PAPERS

J. Synchrotron Rad. (2018). **25**, 848-856
<https://doi.org/10.1107/S1600577518003235>




Cited by  8



ACCESS  



Effects of soft X-ray radiation damage on paraffin-embedded rat tissues supported on ultralene: a chemical perspective

D. E. Bedolla, A. Mantuano, A. Pickler, C. L. Mota, D. Braz, C. Salata, C. E. Almeida, G. Birarda , L. Vaccari , R. C. Barroso  and A. Gianoncelli 



- Using FTIR microspectroscopy as a probe to evaluate the X-ray radiation damage due to sampling using LEXRF.



Open Access Article

Polyvinylidene Fluoride Aerogels with Tailorable Crystalline Phase Composition

by  Jorge Torres-Rodriguez ^{1,2},  Diana E. Bedolla ^{3,4} ,  Francesco D'Amico ³ ,
 Ann-Kathrin Koopmann ^{1,2},  Lisa Vaccari ³ ,  Giulia Saccomano ^{3,5} ,  Richard Kohns ^{1,2}  and
 Nicola Huesing ^{1,2,*} 

Dr. Diana Bedolla, November 14th, 2023.

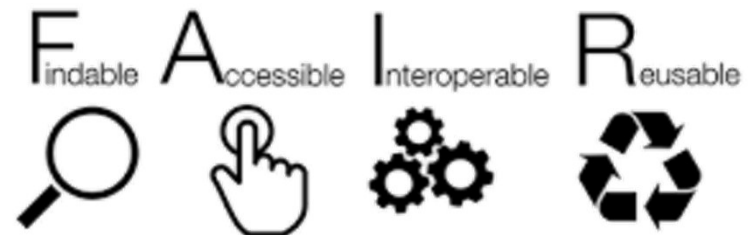
- ➔ Combining X-ray microtomography, Raman spectroscopy, and ATR-FTIR.

Suggestions for a successful beamtime

- Before the proposal:
 - Talk to the scientist of the beamline to know the potential of the technique for your purposes.
- For proposal:
 - Talk to the scientist of the beamline
 - Plan the experiment very carefully and in advance (Time is limited)
 - To have clear objectives
- For the experiment:
 - Be open to learning how to use the instruments
 - actively participating in the beamtime
- After the experiment:
 - Be proactive in the analysis, beamline staff has limited time.

New requirements for many projects: Open Science

- Open access articles
- FAIR (Findable Accessible Interoperable Reusable) Data



How to apply?



<https://www.elettra.eu/>

Deadlines twice per year
March and September



<https://www.ceric-eric.eu/>

Deadlines twice per year
April and October



<https://www.nffa.eu/>



<https://www.trieste.nffa.eu/>

SMART-X

Learn from
the best

MSCA-COFUND: **DESTINY**

- <https://www.destiny-phd.eu/>
- Linked to Batteries 2030+ Partnership
- 5 years, 50 PhDs
- Schools open to external students



HERCULES 2023 - Trieste

MSCA-ITN (former name for DN)

- <https://www.smartx-itn.eu/the-project/>
- Carrier transport in materials by time-resolved spectroscopy with ultrashort soft X-ray light
- Schools open to external students

20 universities + 12 Research centres, networks, large scale facilities & National Agencies + 8 companies							
UPIV Amiens	UoB Bath	UB Bordeaux	CU Cambridge	DTU Copenhagen			
TU Delft	CHALMERS Göteborg	TU Graz	FSU Jena	LU Lancaster			
UM Montpellier	UN Nantes	OXF Oxford	CDF Paris	UPPA Pau			
USTAN St Andrews	UPS Toulouse	UT Twente	UU Uppsala	WUT Warsaw			
ALISTORE	CEA Grenoble	CiCe Vitoria	CIDETEC San Sebastian	ELETTRA Trieste	ICMAB Barcelona		
IEK Jülich	ILL Grenoble	NIC Ljubljana	RSZE	SOLEIL Saint Aubin	Région Pays de la Loire		
JÜLICH	NEUTRONS FOR SOCIETY	NATIONAL INSTITUTE OF CHEMISTRY	RSIÉ	SOLEIL SYNCHROTRON	REGION PAYS DE LA LOIRE		
Région Nouvelle Aquitaine	BASF	PKN ORLEN	RENAULT	SAFT	SOLVAY	TIAMAT	UMICORE
Nouvelle-Aquitaine	BASF	ORLEN	RENAULT	SAFT	SOLVAY	TIAMAT	umicore

- **ReMade@ARI:**
Beamtime for experiments on **circular economy** topics
- Experts support



a hub for materials research



Laserlab-Europe V:


- Training schools and Mobility
- **Trans-national access programme**

NFFA Europe Pilot:

- Training schools
- **Trans-national access programme**




https://www.iaea.org/events/evt2205740




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Training Workshop on Synchrotron Technologies and Techniques and their Applications

23 – 27 Oct 2023

Trieste, Italy

Event code:
EVT2205740

To allow people with no or limited experience in synchrotron light experiments to participate in hands-on experiments and training at different beamlines, as well as to learn how to write successful proposal applications in order to be able to secure beamtime for themselves. The training will include experimental activities at the following beamlines operating at Elettra Sincrotrone Trieste:

- [XRF](#)
- [XAFS](#)
- [MCX](#)

Related resources

-  [Information Sheet](#)
-  [Participation Form \(Form A\)](#)
-  [Grant Application Form](#)

Target Audience

The audience will typically be younger scientists, preferably from developing countries or from areas with limited or no local access to synchrotrons. The participants should have a degree in natural sciences; e.g., physics, chemistry, biology, and related fields (BSc, MSc or PhD). The scientists are required to submit an abstract about their research interests and the possible experiments they would like to run in the future using the techniques that form part of this training (XRF, XAS, XRD and closely related techniques).

Thank you for your attention!



Dr. Diana Bedolla, November 14th, 2023.

Dr. Diana Bedolla, November 14th, 2023.