H2020-MSCA ITN
Grant n. 956099

ISTITUTO ITALIANO
DI TECNOLOGIA

The NanED project

Mauro Gemmi- Istituto Italiano di Tecnologia

Welcome

Welcome

NanED

NanED aims to train **a new generation of young electron crystallographers** that will transform 3D ED to a **stable, standardized, widely recognized and widely applied** method that can be easily implemented and used in any crystallography lab.

A total of **15 PhD** students

Day1 – Getting Together

09:15–10:15 Mauro Gemmi (IIT): **Project overview**

10:15–10:30 Giulia Zunino (IIT): **Administrative cookbook**

11:00 – 11:30 Philippe Boullay (CNRS): **Training and secondment**.

11:30 – 12:30 **ESR presentation**

12 :30–13 :00 Hongyi Xu (SU) : **Communication and dissemination strategy**

14 :30 – 15 :30 **Partner Presentation**

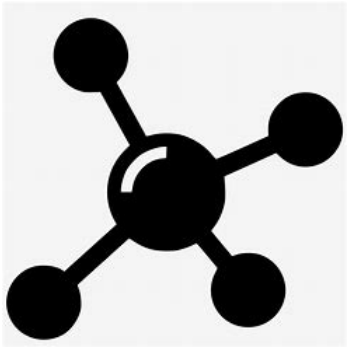
15 :30 – 16 :30

ESR meeting

Consortium meeting

16 :30-17 :00 Summary of Day1 ; Q&A time…..

Day2 – Scientific Overview



09:00–9:45 Mauro Gemmi (IIT): **WP1 – 3D ED techniques**

9:45–10:30 Xiaodong Zou (SU): **Serial 3D ED**

10:45–11:30 Lukas Palatinus (FZU): **WP3 – Precise electron crystallography**

11:30-12:15 Joke Hadermann (UA): **In-situ 3D ED**

12:15-13:00 Ute Kolb (JGU): **3D ED on defective materials**

14:00 – 14:45 Jan Pieter Abrahams (UBA): **WP2 – 3D ED on macromolecules**

14:45 – 15:30 Hongyi Xu (SU): **Structure-based drug discovery by 3D ED**

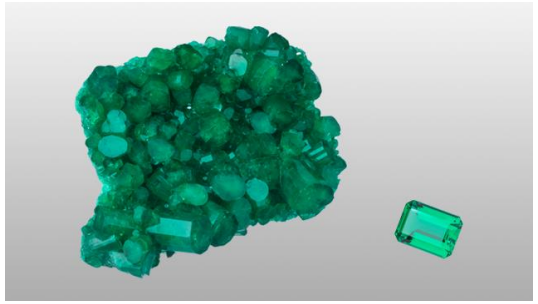
15:30 – 16:15 Ute Kaiser (UULM): **WP4 – Electron crystallography of 2D materials**

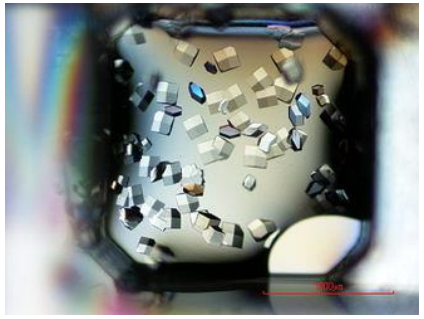
16:45 – 17:30 Philippe Boullay (CNRS): **3D ED on nanomaterials**

17:30 - 18:15 Cheuk-Wai Tai (SU): **Electron PDF studies**

What is all about?

Natural or synthetic unknown crystal

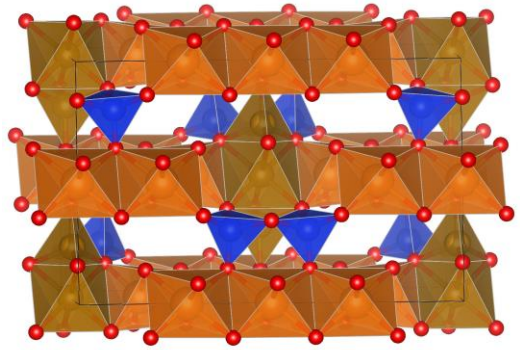


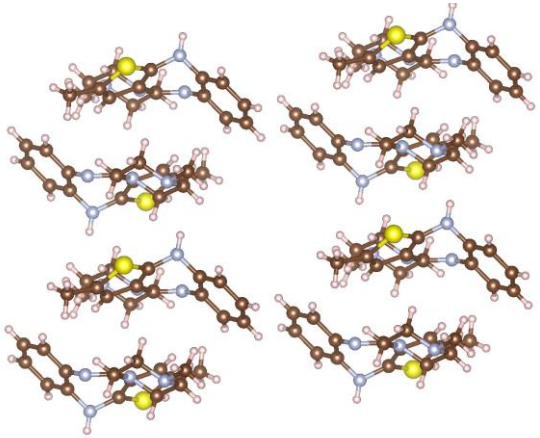


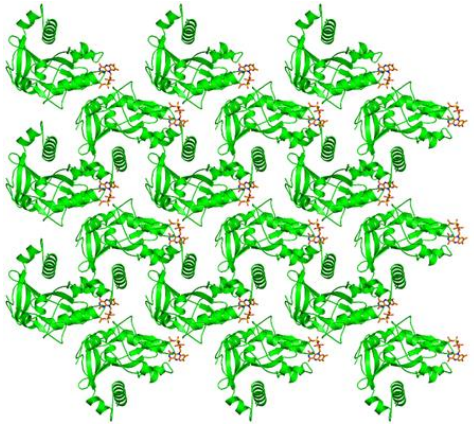
The crystallographic problem

Having a minimal knowledge:
Tentative chemical composition
Maybe we have the molecule…..

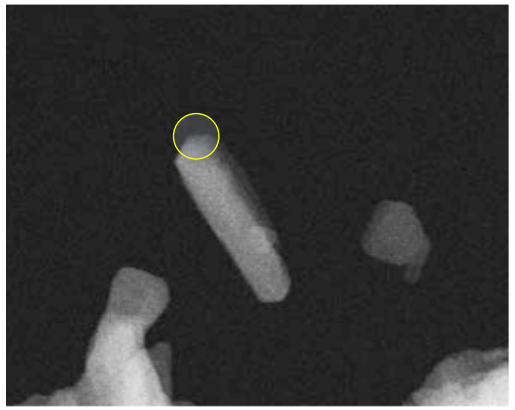
When the crystals get nano!!!!!

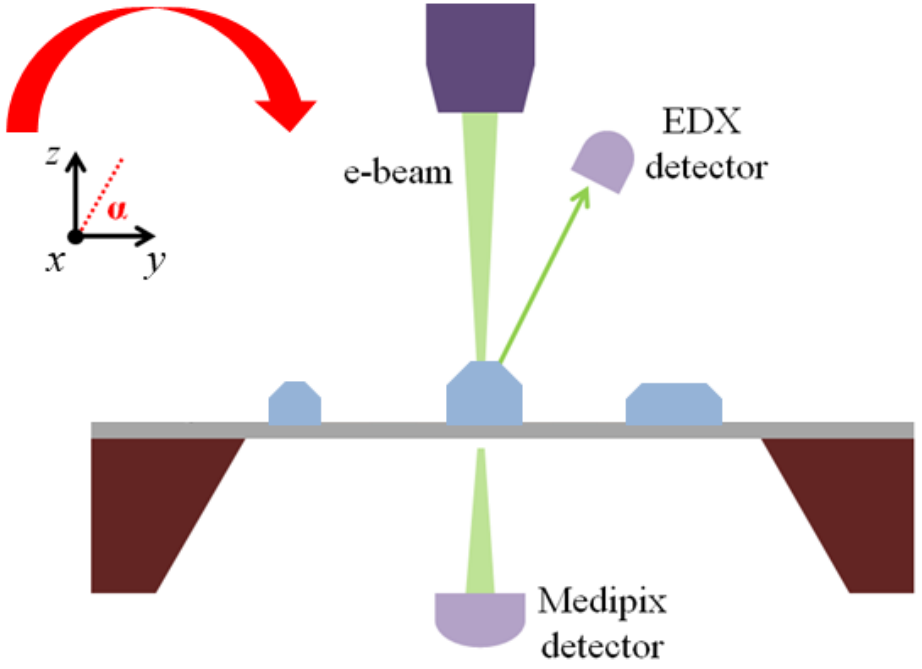


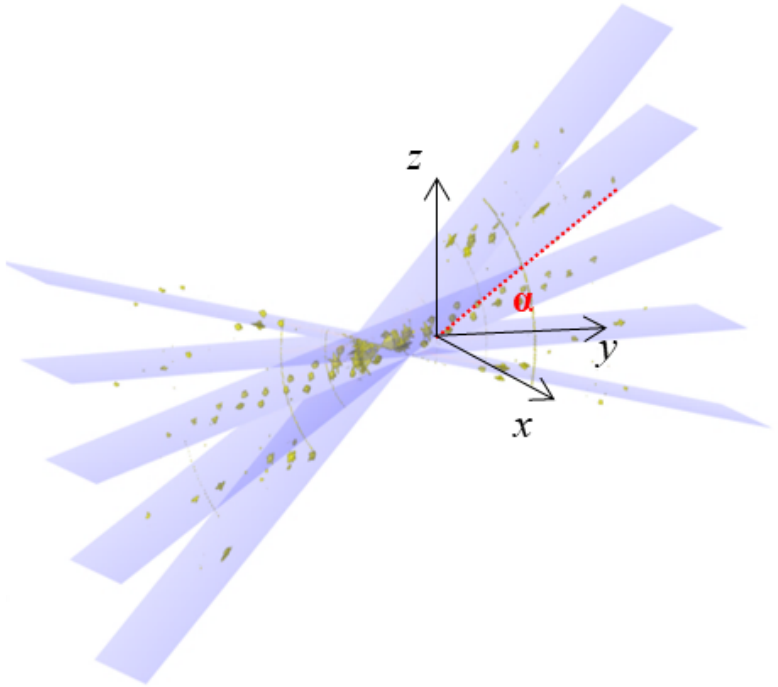




3D ED

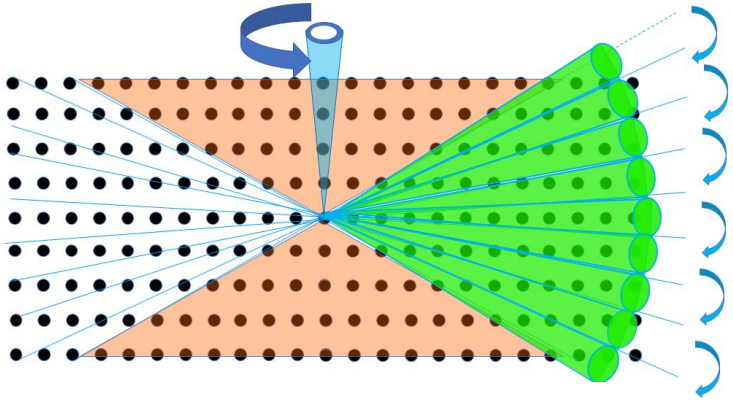






Scientific Objectives

Establish optimised and portable sample preparation, data collection and data reduction strategies for 3D ED experiments

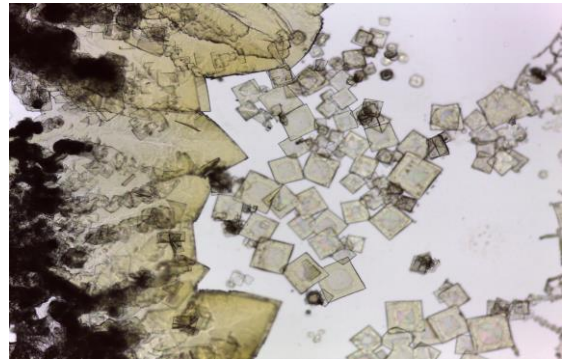


The technique

Enhanced refinement procedures for nanostructures.

NanoED

Ab-initio methods for structure solution of macromolecules.

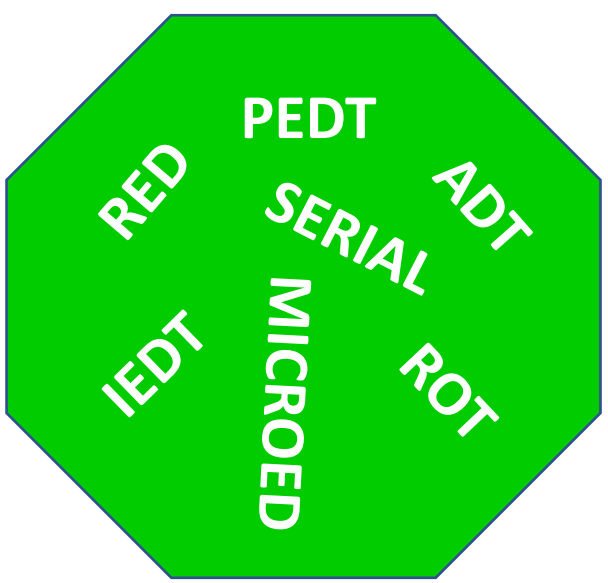


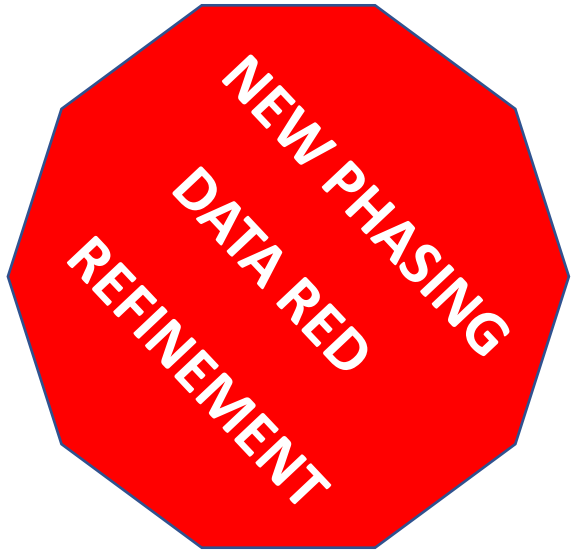
The materials

Road map to nano.

The technique

The proper recipe for any sample



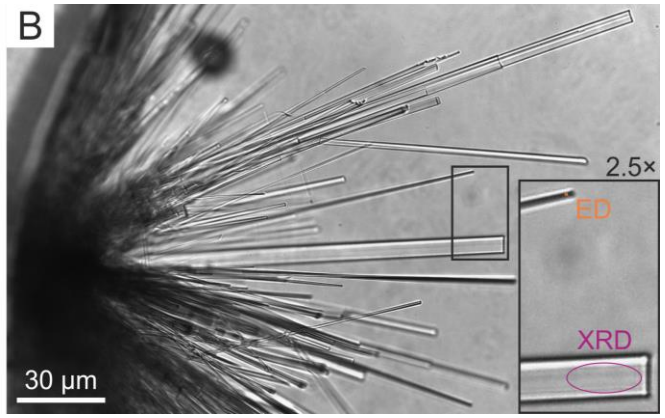


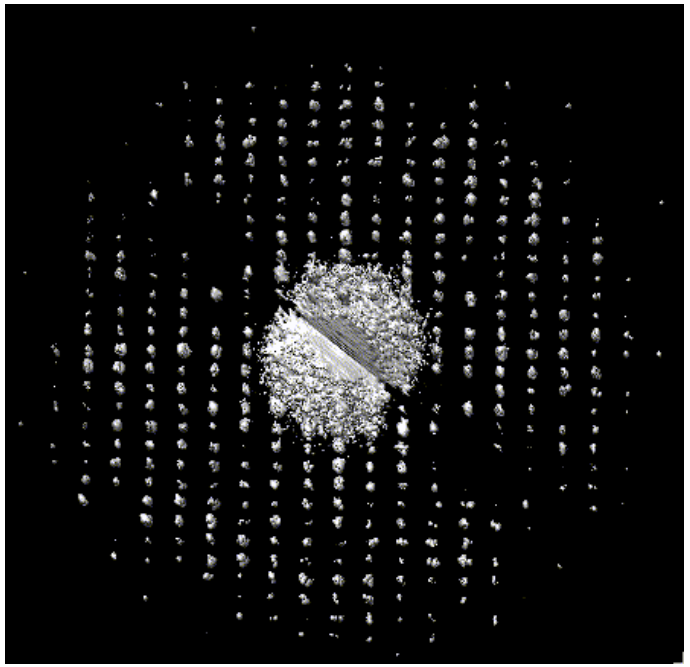
SELECT **TEST** **ANALYZE**

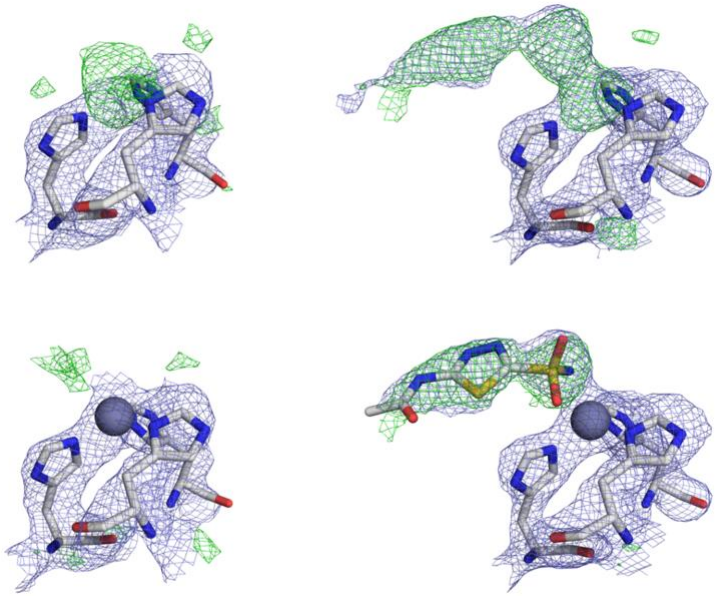
This is what will give expertises to our student to spend

The materials

Ab-initio methods for structure solution of macromolecules.







VERY VERY CHALLENGING !

Can we phase ab-initio 3D ED on proteins?

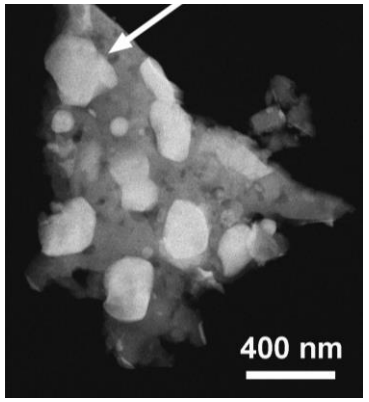
Can we use peculiarity of 3D ED to detect charge states?

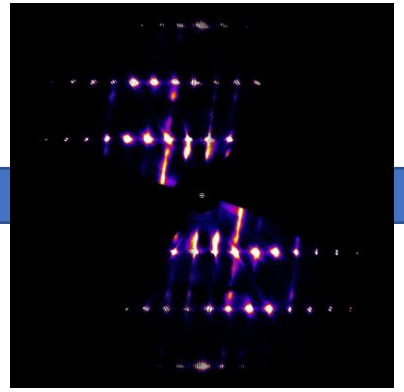
Can we use imaging for phasing?

The materials

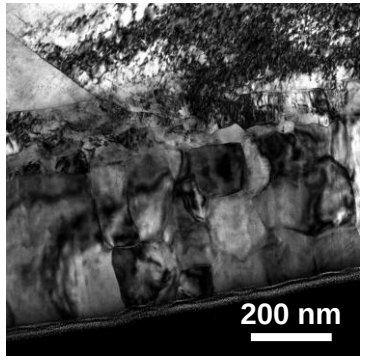
Road map to nano

Embedded

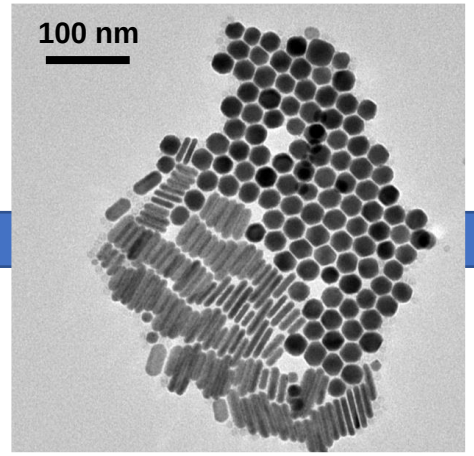




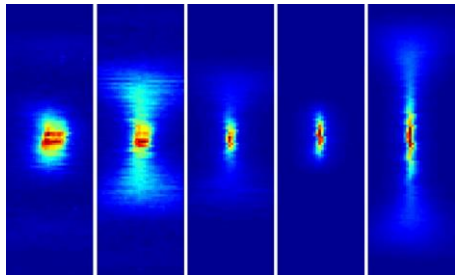
Disordered

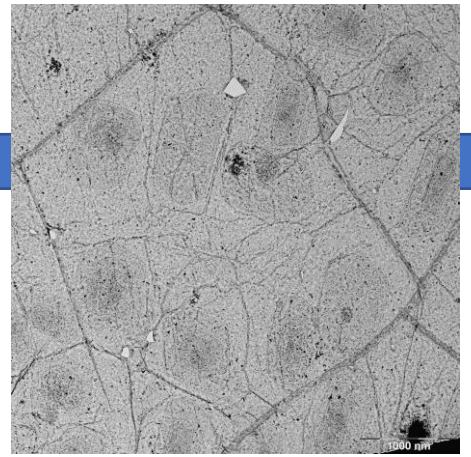


Thin films

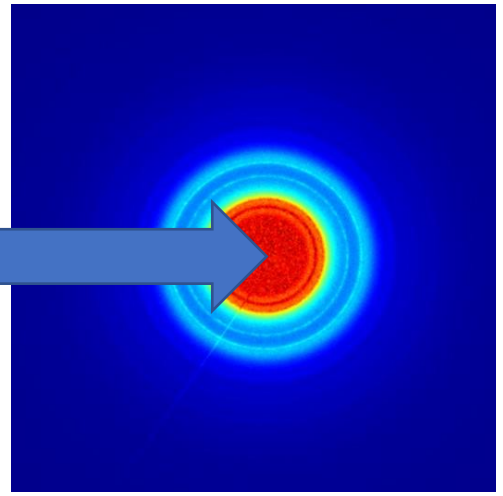


Nanoparticles





2D Materials



Amorphous

E-PDF

Minimum crystal size ?
Diffraction with nanobeams

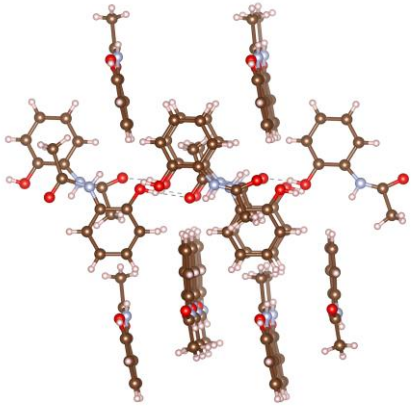
Are small crystals the same as bulk?

Unconventional samples

Project scientific implementation

Workpackages

WP1 Beam and vacuum sensitive materials

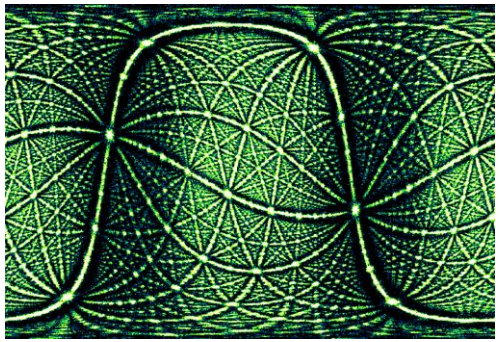


IIT

WP2 Electron crystallography for life science

UBA

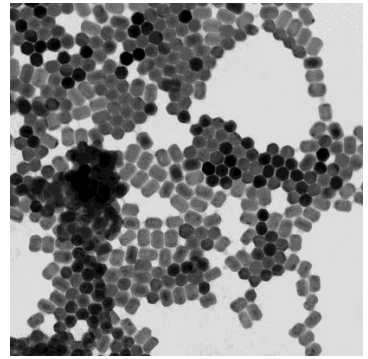
WP3 Accurate crystallography of complex nanomaterials

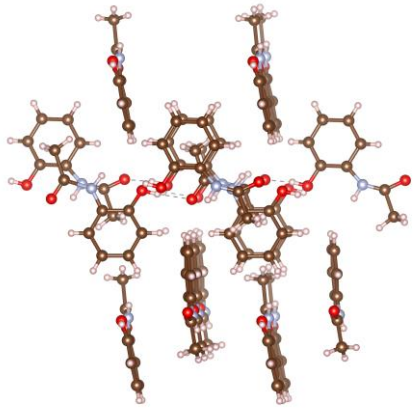


FZU

WP4 Crystallography beyond nanocrystals

UULM

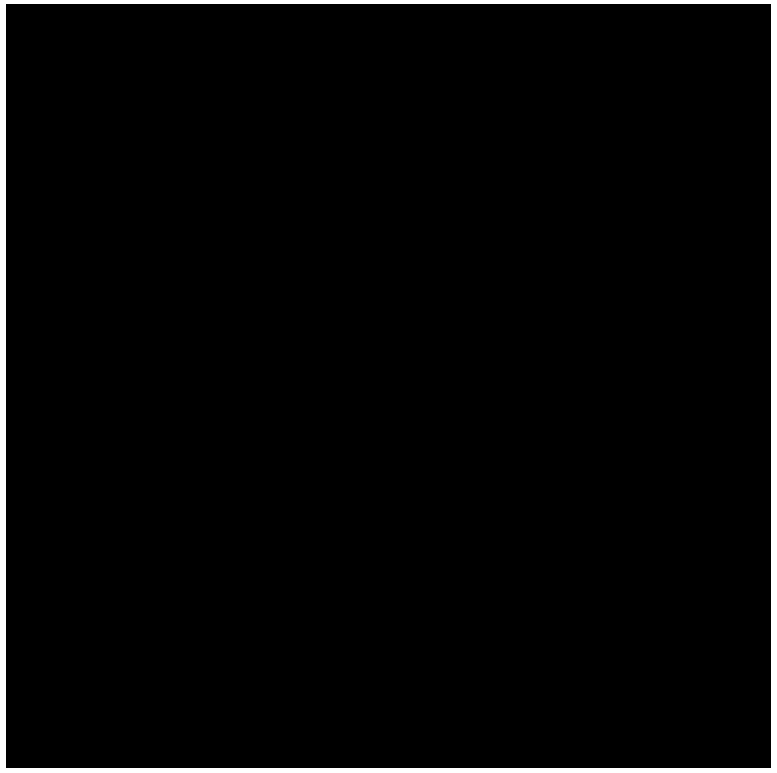




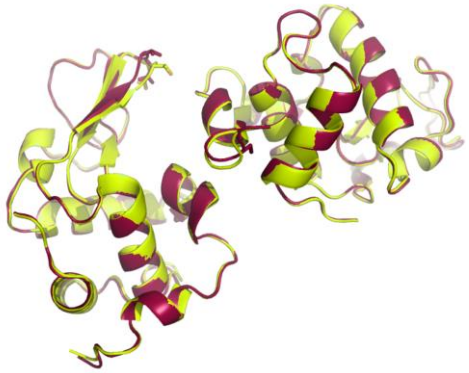
WP1 Beam and vacuum sensitive materials

IIT

WP1 aims at the seting-up of sample preparation, data acquisition and data reduction strategies for an efficient structure characterisation of beam and vacuum sensitive materials.



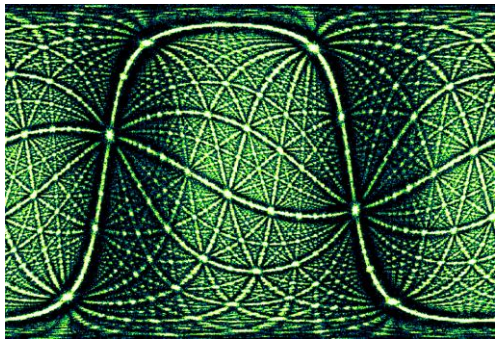
- Fast and low dose data collection
- Fast crystal search strategies
- Special strategies of sample preparation to protect beam and vacuum sensitive samples



WP2 Electron crystallography for life science

UBA

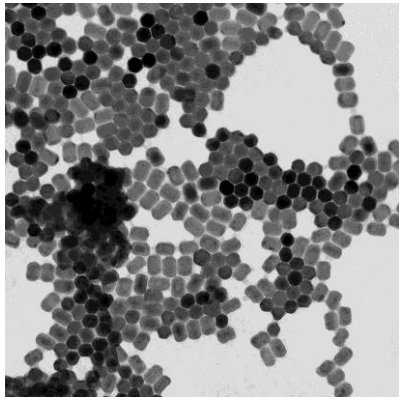
WP2 is devoted to the development of both the experimental procedures and ab-initio structure solution methods for the investigation of macromolecular nanocrystals.



WP3 Accurate crystallography of complex nanomaterials

FZU

In WP3 accuracy and precision of structure refinement will be pushed in order to be fully comparable with x-ray diffraction methods.



WP4 Crystallography beyond nanocrystals

UULM

WP4 aims to expand the applicability of 3D ED to complex nanomaterials that cannot be considered properly crystalline.

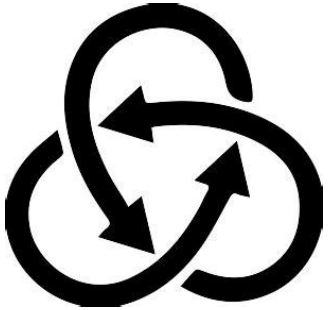
Management Workpackages

WP5 ESR networking and training activity — CNRS

WP5 is devoted to organize, coordinate, control and supervise the network training activities.

WP6 Dissemination, communication and exploitation — SU

WP6 aims to ensure the proper communication and dissemination of project outcomes to different target audiences and to guarantee appropriate protection measures to ensure exploitation



WP7 Project management — IIT

WP7 aims to ensure an efficient project execution leading to the achievement of NanED's objectives

The team

IIT
Istituto Italiano di Tecnologia

CNRS
Centre National de la Recherche Scientifique

FZU
Fyzikální ústav AVČR

JG|U
Johannes Gutenberg Universität Mainz

SU
Stockholms Universitet

UA
Universiteit Antwerpen

UB
Universität Basel

ULM
Universität Ulm

The team

Mauro Gemmi

Project Coordinator and WP1/7 leader

Jan Pieter Abrahams

WP2 leader

Philippe Boullay

WP5 leader

Xiaodong Zou

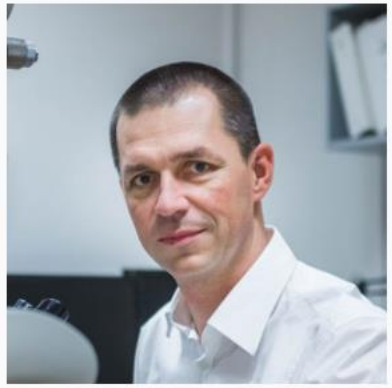
WP6 leader

Joke Hadermann

Ute Kaiser

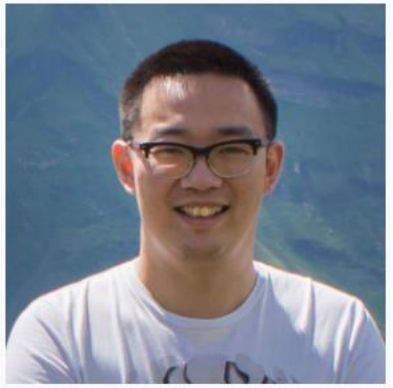
WP4 Leader

Ute Kolb



Lukas Palatinus

Cheuk-Wai Tai



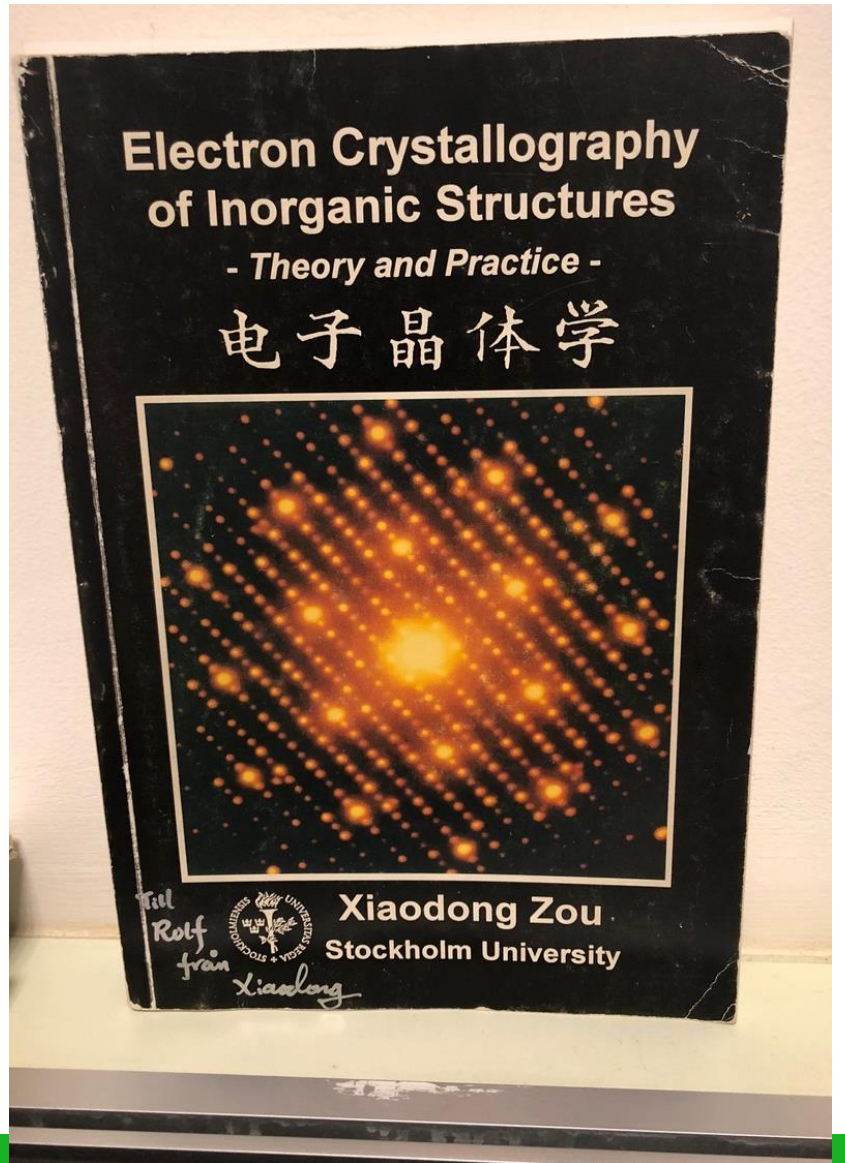
Hongyi Xu

Xiaodong Zou
WP6 leader

Xiaodong Zou

She is a pioneer of the structure solution using electron data

Arrheniuslaboratoriet



Hongyi Xu

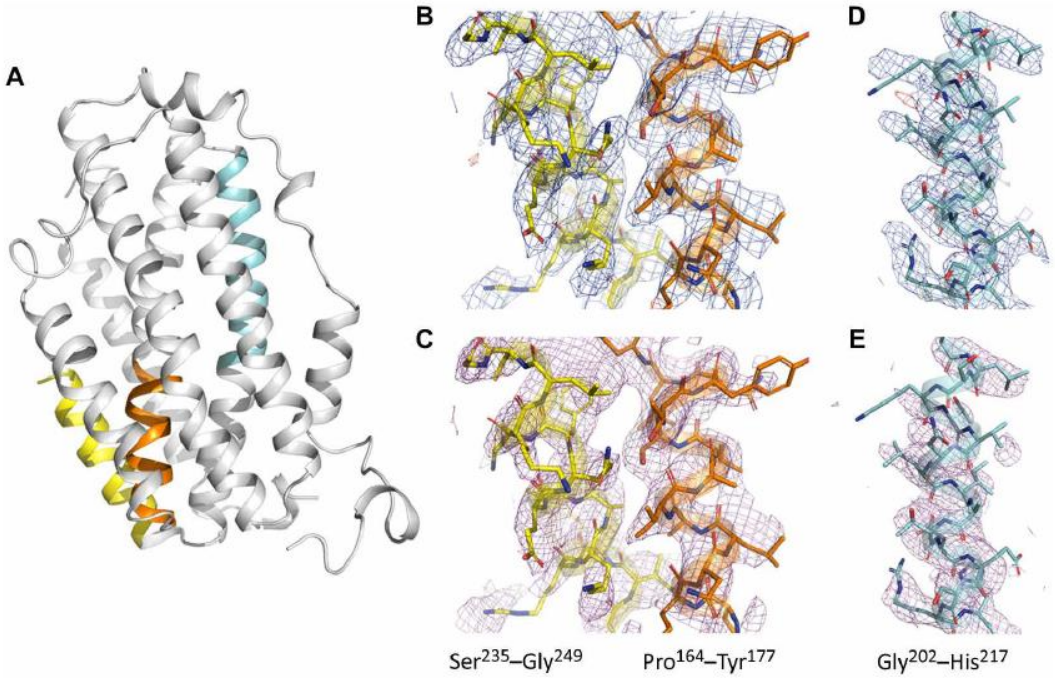
SCIENCE ADVANCES | RESEARCH ARTICLE

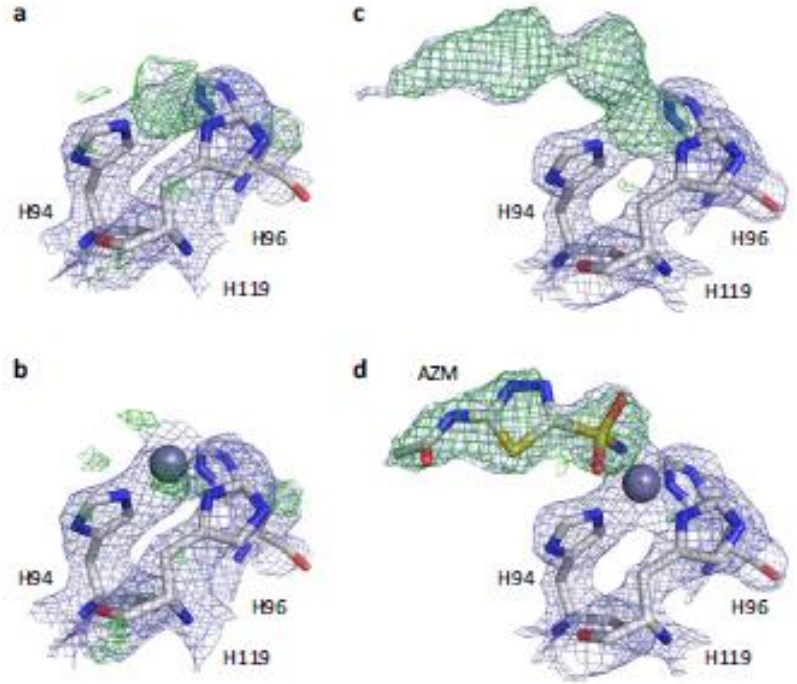
Stockholm University

STRUCTURAL BIOLOGY

Solving a new R2lox protein structure by microcrystal electron diffraction

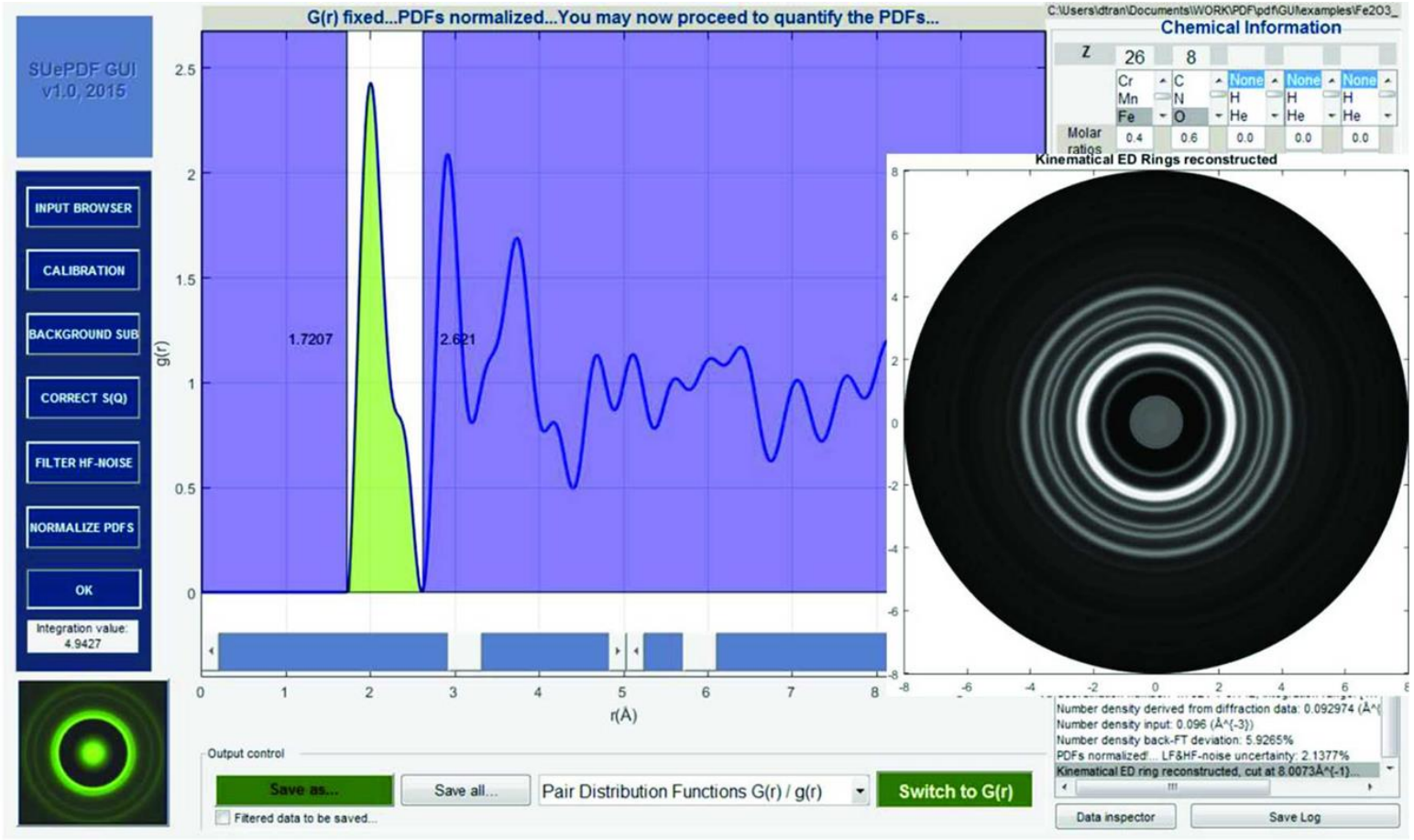
Hongyi Xu[1*†], Hugo Lebrette[2†], Max T. B. Clabbers[1†], Jingjing Zhao[1], Julia J. Griese[2,3], Xiaodong Zou[1*], Martin Högbom[2*]





Cheuk-Wai Tai

Stockholm University



JOURNAL OF APPLIED CRYSTALLOGRAPHY
ISSN 1600-5767

SUePDF: a program to obtain quantitative pair distribution functions from electron diffraction data

Dung Trung Tran,*‡ Gunnar Svensson and Cheuk-Wai Tai*

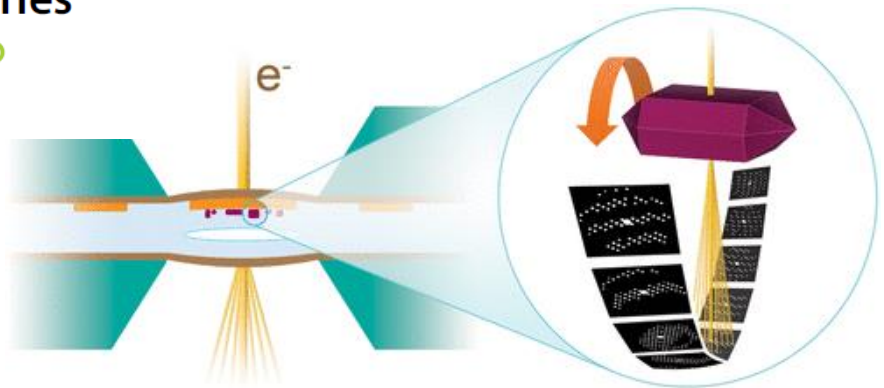
Joke Hadermann

University of Antwerp

NANO LETTERS
Letter
Cite This: *Nano Lett.* 2018, 18, 6286–6291
pubs.acs.org/NanoLett

In Situ Electron Diffraction Tomography Using a Liquid-Electrochemical Transmission Electron Microscopy Cell for Crystal Structure Determination of Cathode Materials for Li-Ion batteries

Olesia M. Karakulina,[†] Arnaud Demortière,[*,‡,§] Walid Dachraoui,[§] Artem M. Abakumov,[∥] and Joke Hadermann[*,†]



Philippe Boullay

Inorganic Chemistry

Article

pubs.acs.org/IC

Precession Electron Diffraction Tomography for Solving Complex Modulated Structures: the Case of $Bi_5Nb_3O_{15}$

Philippe Boullay,*[,†] Lukas Palatinus,[‡] and Nicolas Barrier[†]

Appl Cryst JAC JOURNAL OF APPLIED CRYSTALLOGRAPHY

ISSN 1600-5767

Precession electron diffraction tomography on twinned crystals: application to $CaTiO_3$ thin films

Gwladys Steciuk,[a,b] Adrian David,[a] Václav Petříček,[b] Lukáš Palatinus,[b] Bernard Mercey,[a] Wilfrid Prellier,[a] Alain Pautrat[a] and Philippe Boullay[a]*

NANO LETTERS

Letter

Cite This: *Nano Lett.* 2017, 17, 6575-6582

pubs.acs.org/NanoLett

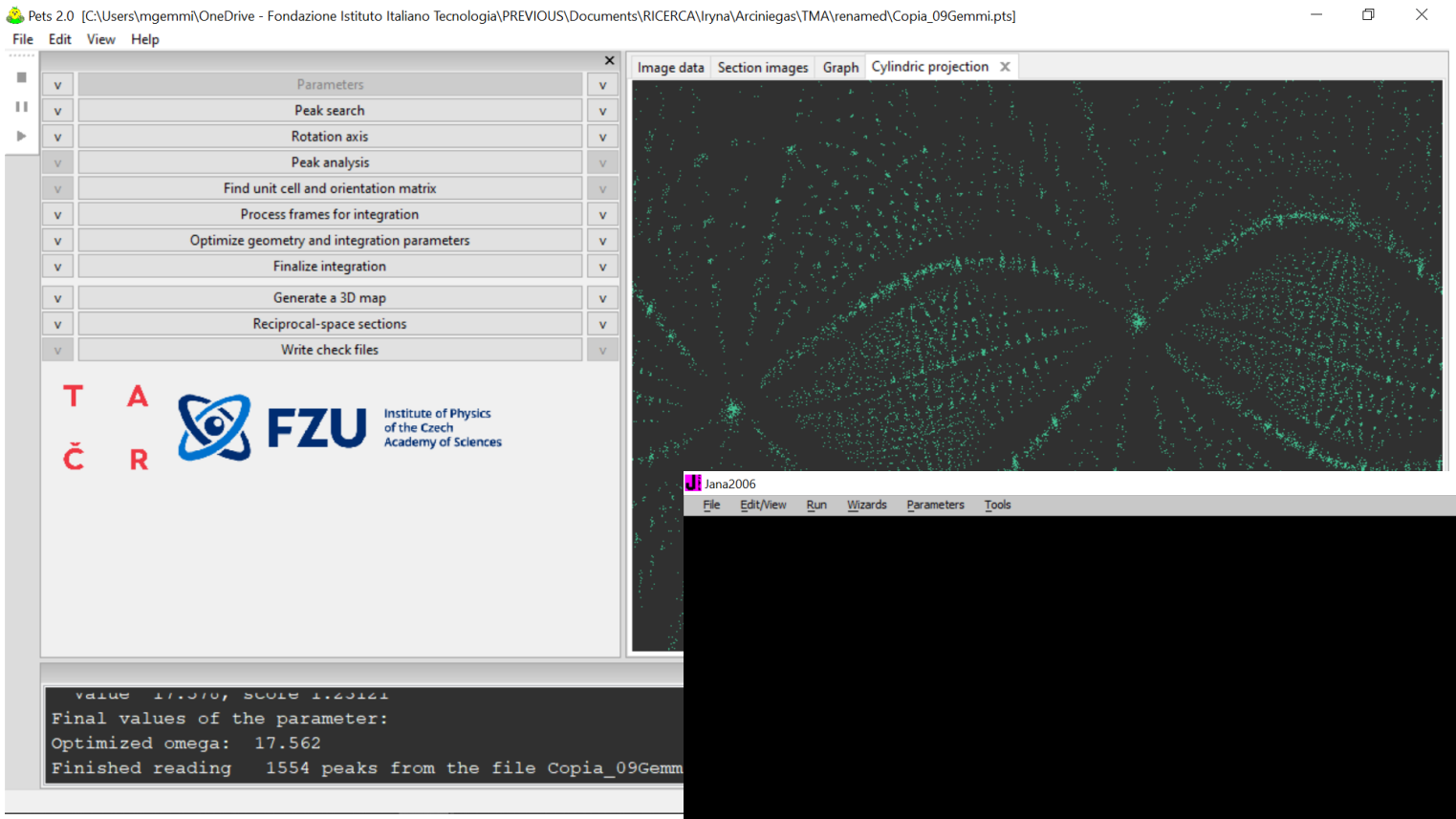
Novel Layered Supercell Structure from Bi_2AlMnO_6 for Multifunctionalities

Leigang Li,[†,‡] Philippe Boullay,[§,▽] Ping Lu,[∥] Xuejing Wang,[†] Jie Jian,[†] Jijie Huang,[†] Xingyao Gao,[†] Shikhar Misra,[†] Wenrui Zhang,[‡] Olivier Perez,[§] Gwladys Steciuk,[§] Aiping Chen,[⊥] Xinghang Zhang,[†] and Haiyan Wang*[,†,‡,#]

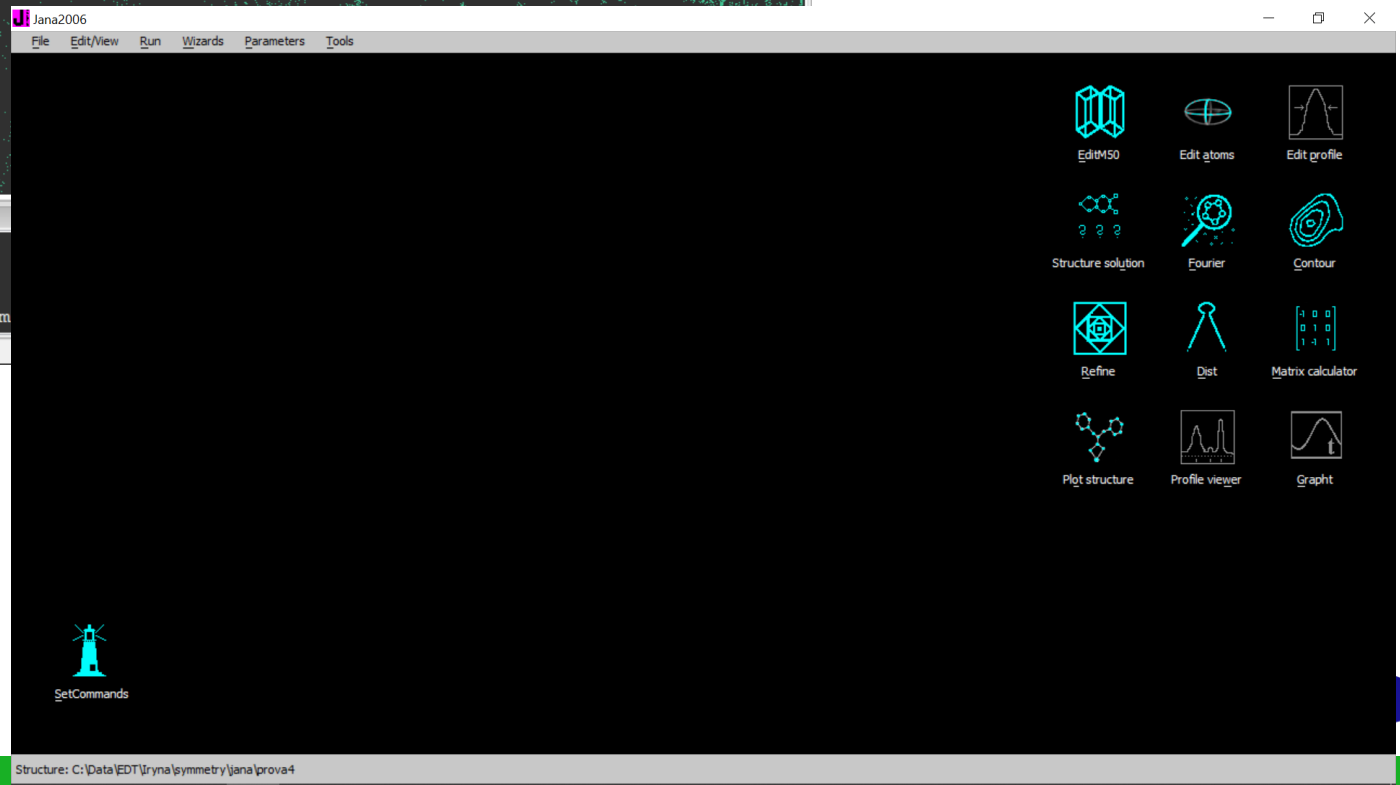
Lukas Palatinus

Fyzikální ústav Akademie věd České republiky

PETS



Jana

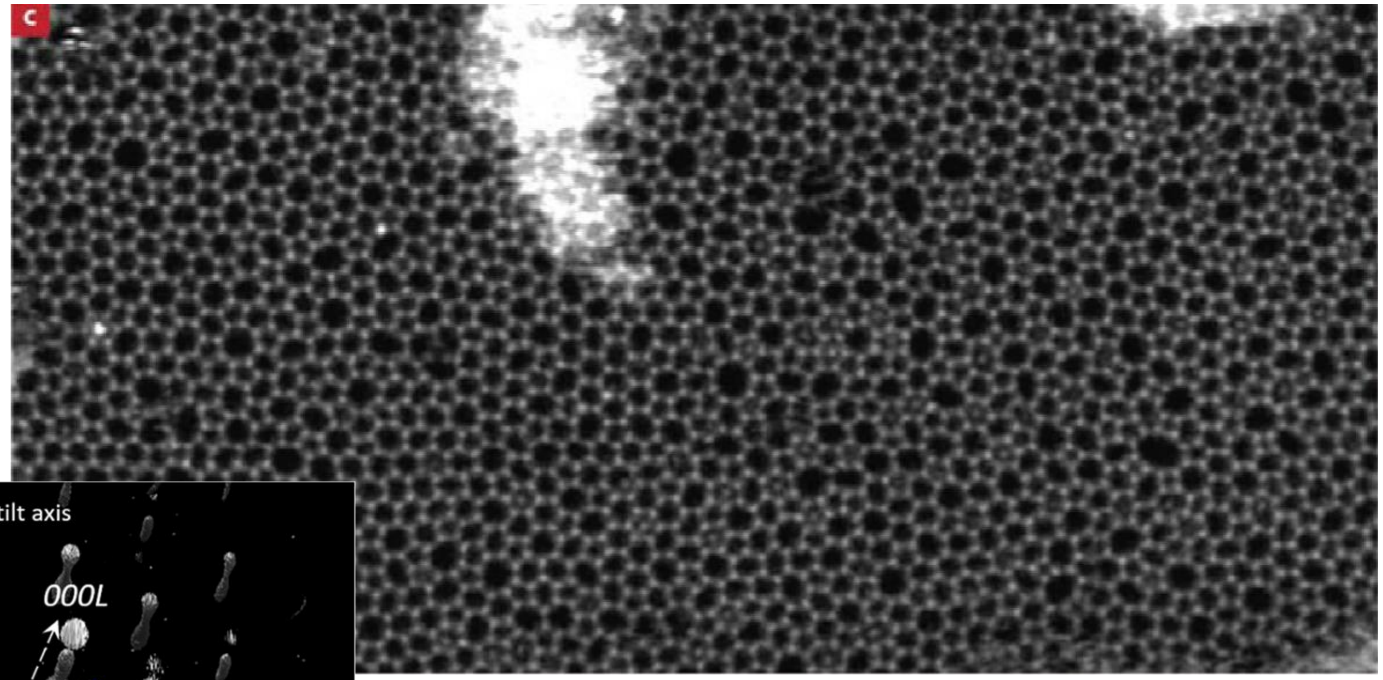


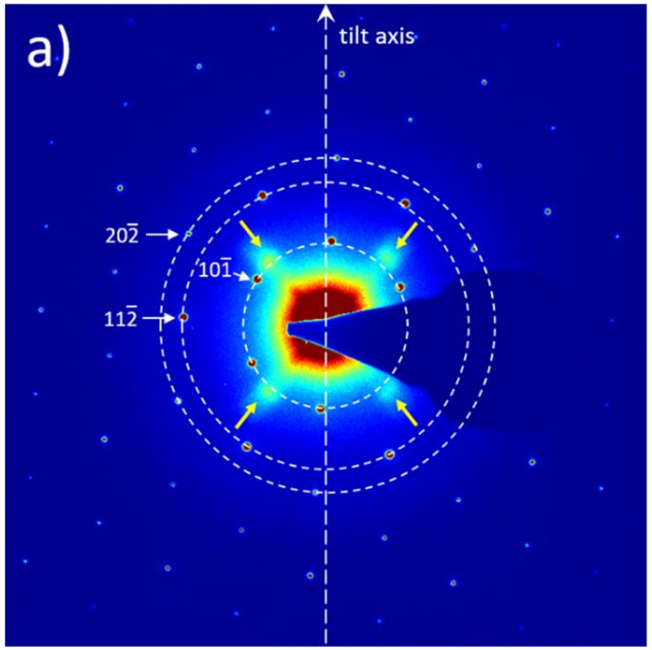
Ute Kaiser

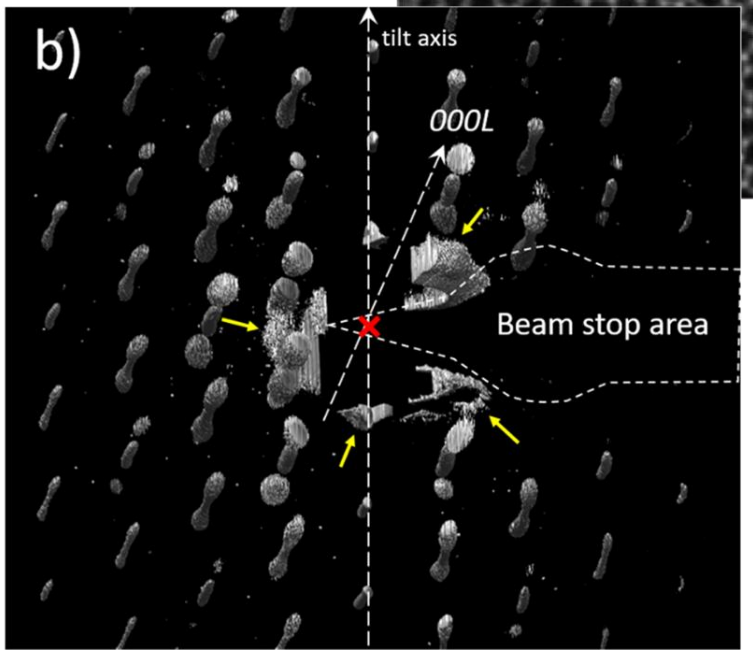
Tatiana Gorelik

ulm university universität ulm

She is directing the SALVE project for low-voltage aberration-corrected electron microscope enabling sub-Angstrom resolution







Jan Pieter Abrahams

Universität Basel

Acta Crystallographica Section D
Biological Crystallography
ISSN 0907-4449

A Medipix quantum area detector allows rotation electron diffraction data collection from submicrometre three-dimensional protein crystals

Igor Nederlof, Eric van Genderen, Yao-Wang Li and Jan Pieter Abrahams*

When protein crystals are submicrometre-sized, X-ray radiation damage precludes conventional diffraction data collection. For crystals that are of the order of 100 nm in size, at best only single-shot diffraction patterns can be collected

Received 18 April 2012
Accepted 9 April 2013

Ute Kolb

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JG|U

Towards automated diffraction tomography: Part I—Data acquisition

U. Kolb[a,*], T. Gorelik[a], C. Kübel[b], M.T. Otten[c], D. Hubert[c]

Ultramicroscopy 109 (2009) 758–765

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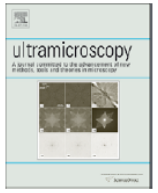
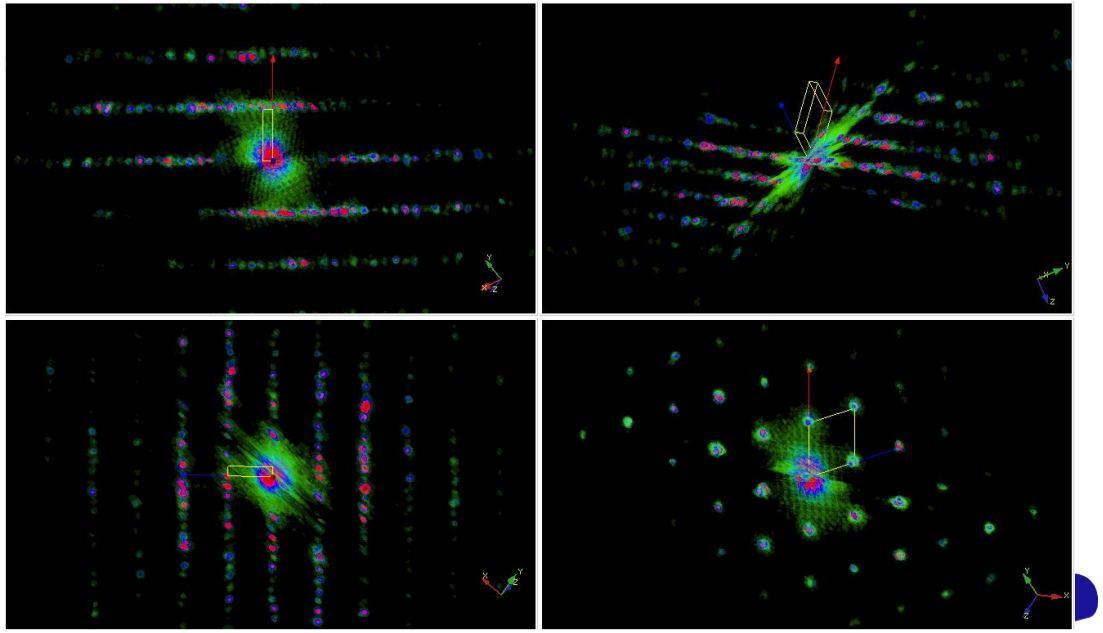


"Ab initio" structure solution from electron diffraction data obtained by a combination of automated diffraction tomography and precession technique

E. Mugnaioli, T. Gorelik, U. Kolb *

ADT3D



Mauro Gemmi

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Ultramicroscopy 84 (2000) 133–142

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ISTITUTO ITALIANO
DI TECNOLOGIA

Structure determination of ϕ-$Bi_8Pb_5O_{17}$ by electron and powder X-ray diffraction

M. Gemmi[a,b], L. Righi[c], G. Calestani[c], A. Migliori[a,*], A. Speghini[d], M. Santarosa[d], M. Bettinelli[d]

Acta Crystallographica Section A
Foundations of Crystallography
ISSN 0108-7673

Received 19 July 2002
Accepted 6 December 2002

Structure of Ti_2P solved by three-dimensional electron diffraction data collected with the precession technique and high-resolution electron microscopy

Mauro Gemmi,[a]*† Xiaodong Zou,[a] Sven Hovmöller,[a] Andrea Migliori,[b] Marie Vennström[c] and Yvonne Andersson[c]

Appl Cryst JAC JOURNAL OF APPLIED CRYSTALLOGRAPHY
ISSN 1600-5767

Fast electron diffraction tomography

Mauro Gemmi,[a]* Maria G. I. La Placa,[a] Athanassios S. Galanis,[b] Edgar F. Rauch[c] and Stavros Nicolopoulos[b]

Training

Local

Local training program
at the hosting institutions enrollment in a PhD program, direct research in the labs, local courses at the universities

Network

Network training program
through the participation to workshop events organized by NanED where experts both internal and external to the network will provide seminars and lectures on both technical and transferrable skills

Move

Secondment training program:
where the ERS will spend time:
i) in other beneficiaries of the network
ii) in partner organizations

Our partners

Amsterdam Scientific Instruments

AstraZeneca

BASF SE

CODEX International

DENSsolutions

Diamond Light source

ELDICO Scientific

Elettra – Sincrotrone Trieste

International Union of Crystallography

Univerzita Karlova

NanoMEGAS

Roche

TESCAN ORSAY HOLDING

Thermo Fisher Scientific

United Kingdom Research and Innovation

Università di Parma

Companies

Synthesis

AstraZeneca

BASF SE

CODEX International

Roche

Instruments

Amsterdam Scientific Instruments

DENSsolutions

ELDICO Scientific

Rigaku

NanoMEGAS

TESCAN ORSAY HOLDING

Thermo Fisher Scientific

United Kingdom Research and Innovation

Elettra – Sincrotrone Trieste

Diamond Light source

Large scale facilities

Università di Parma

Univerzita Karlova

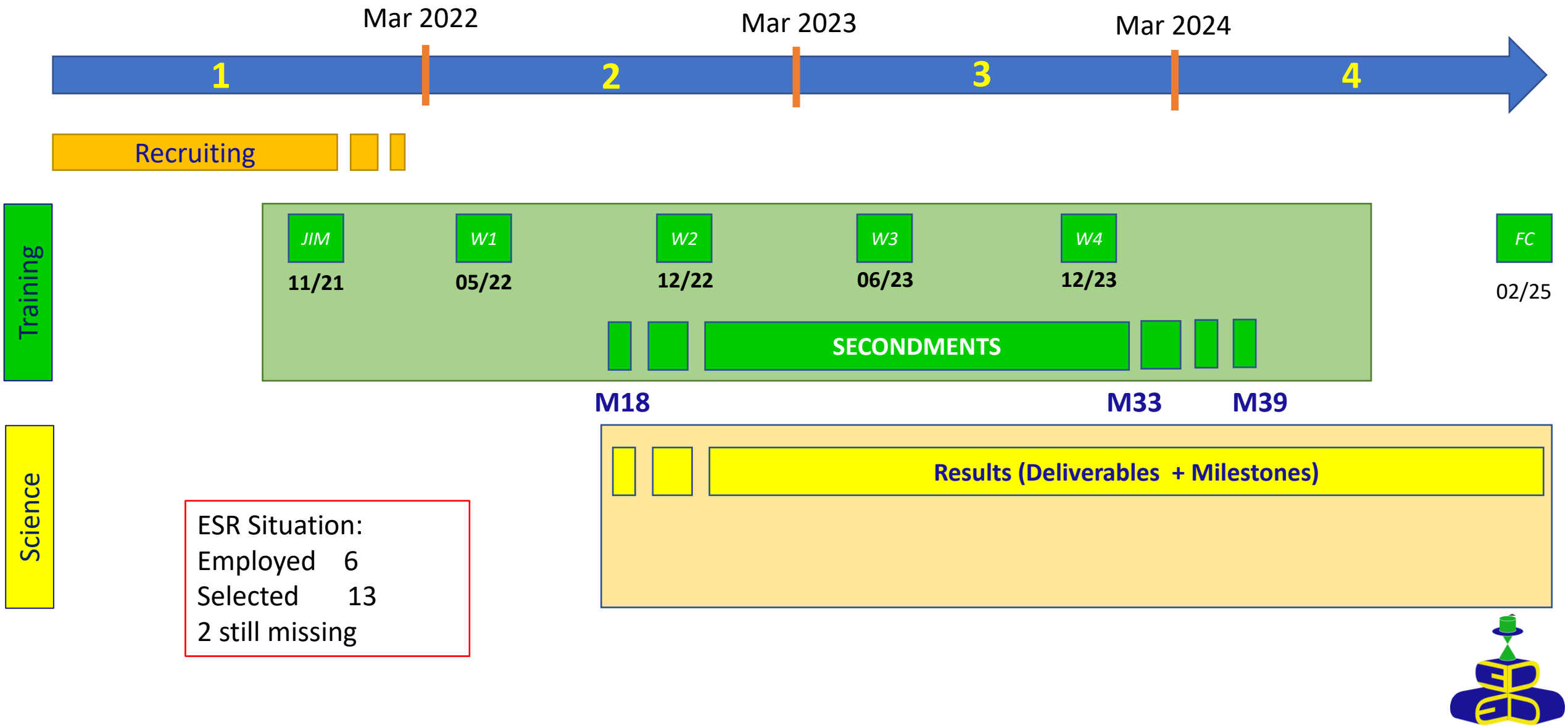
Universities

International Union of Crystallography

IUCr
a ruler in crystallography

ESR	Supervisory Team	
	Main Supervisor	Co-supervisors
ESR1	Gemmi (IIT)	Dalcanale(UNIPR), Nicolopoulos(NMG), Brázda (FZU), Batuk (UA), Yu(THF)
ESR2	Gemmi (IIT)	Dalcanale(UNIPR), Xu (SU), Van Genderen (UBA), Stowasser (RCH), McMahon (IUCr)
ESR3	Hadermann (UA)	Kolb (JGU), Perez (DENS), David (NU)
ESR4	Palatinus (FZU)	Boullay(CNRS), Plaisier (EST), Müller (BASF), Hadermann (UA)
ESR5	Palatinus (FZU)	Gemmi (IIT), van der Wal (TSC), Gorelik (ULM), McMahon (IUCr)
ESR6	Kaiser(ULM)	Boullay(CNRS), Abrahams (UBA), Prangsma (ASI)
ESR7	Gorelik(ULM)	Mugnaioli (IIT), Steinfeld (ELD), Zou (SU)
ESR8	Kolb (JGU)	Van Genderen (UBA), Müller (BASF), Hadermann (UA)
ESR9	Kolb (JGU)	Palatinus (FZU), Steinfeld (ELD), Boullay (CNRS), McMahon(IUCr)
ESR10	Xu(SU)	Käck (AZ), Brázda (FZU), Zhang (eBIC), Abrahams (UBA), Yu(THF)
ESR11	Zou(SU)	Waterman(STFC), Mugnaioli (IIT), Norberg (AZ), Kolb (JGU)
ESR12	Boullay (CNRS)	David (NU), Guilmeau (CNRS), Palatinus (FZU), Kolb (JGU), van der Wal (TSC)
ESR13	Boullay (CNRS)	Hadermann(UA), Kaiser(ULM), Plaisier (EST), Séguier (CDX)
ESR14	Abrahams (UBA)	Xu (SU), Prangsma (ASI), Kaiser (ULM), Zhang (eBIC)
ESR15	Abrahams (UBA)	Gemmi (IIT), Zou (SU), Waterman (STFC), Stowasser (RCH)

Project Timeline

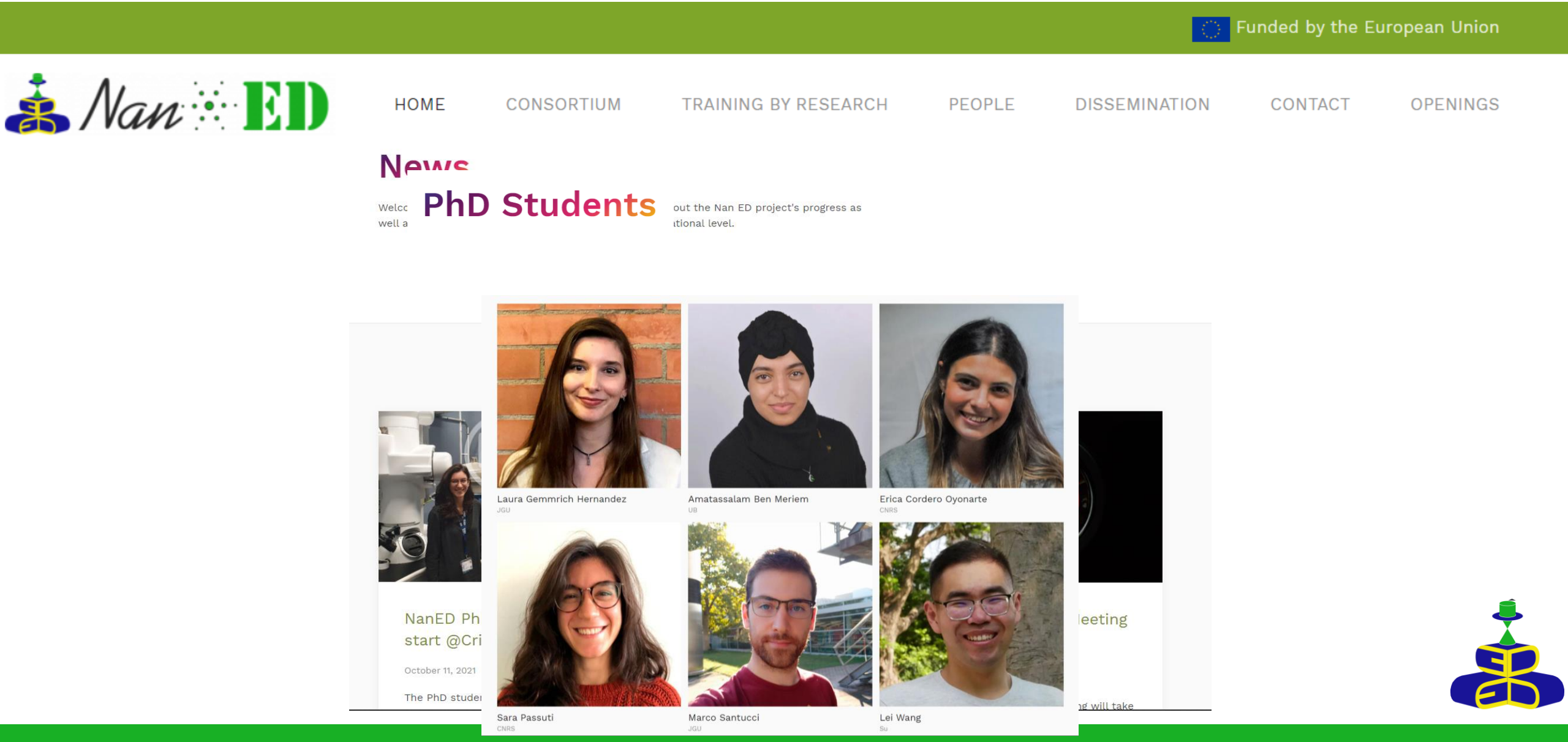


ESR Situation:
Employed 6
Selected 13
2 still missing

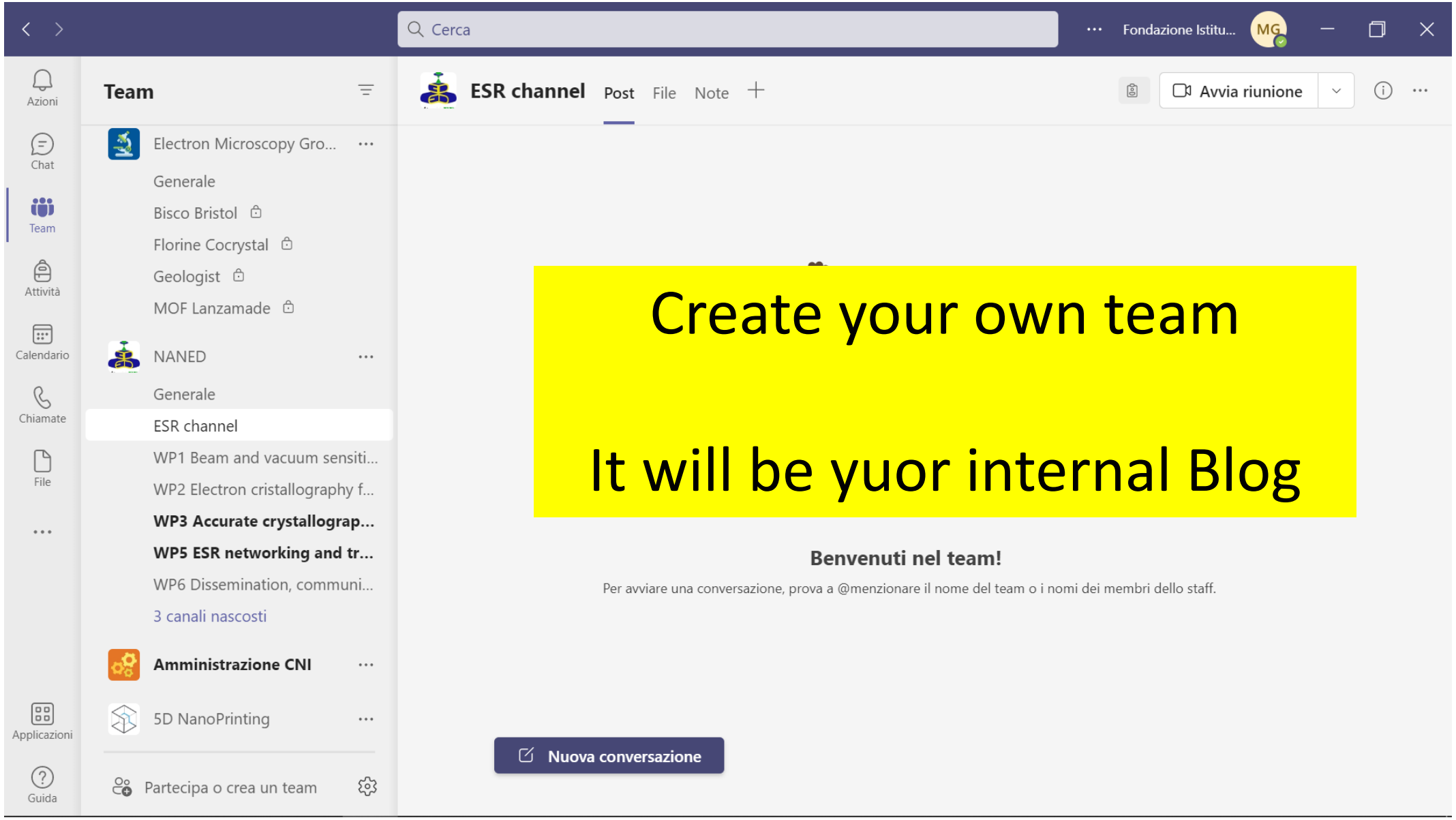
Website: naned.eu

Nicholas Dring
Head of Digital at the IIT

Website: naned.eu



NanED team on Teams



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scripts.iucr.org
Teaching space-group diagrams to chemistry stud...
`Symmetry and Space Group Tutorial' (by Jerry P. Jasinski and Bruce M. Foxman) provides chemistry

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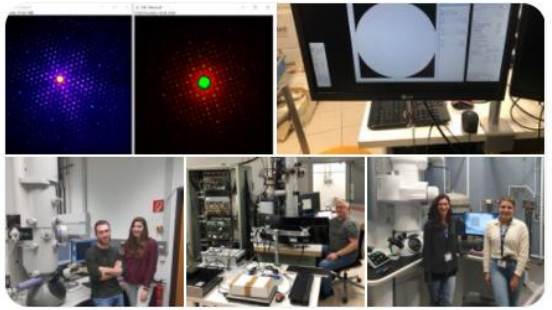

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Trends for you

Trending in Italy
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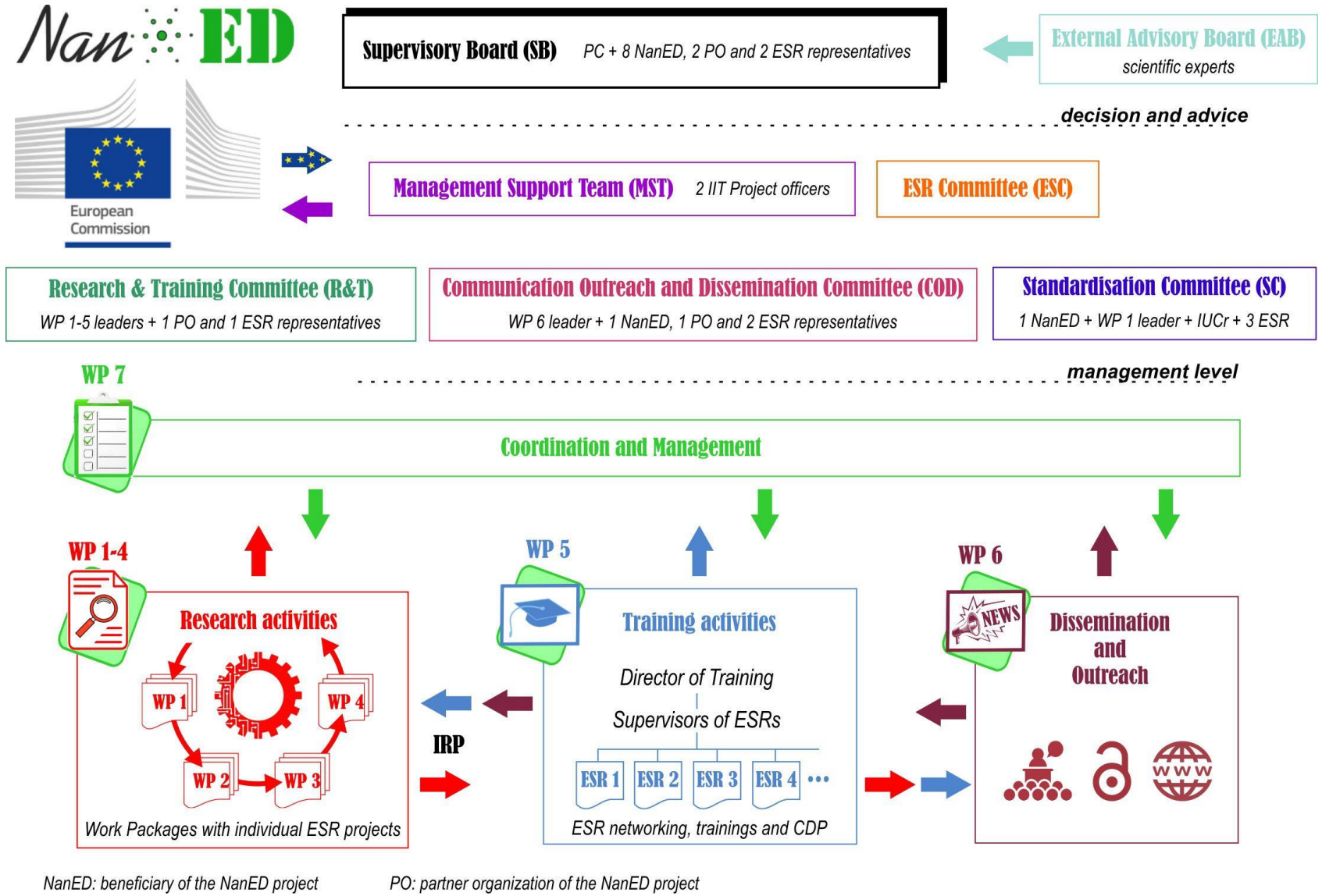
256K Tweets

NanED Governance

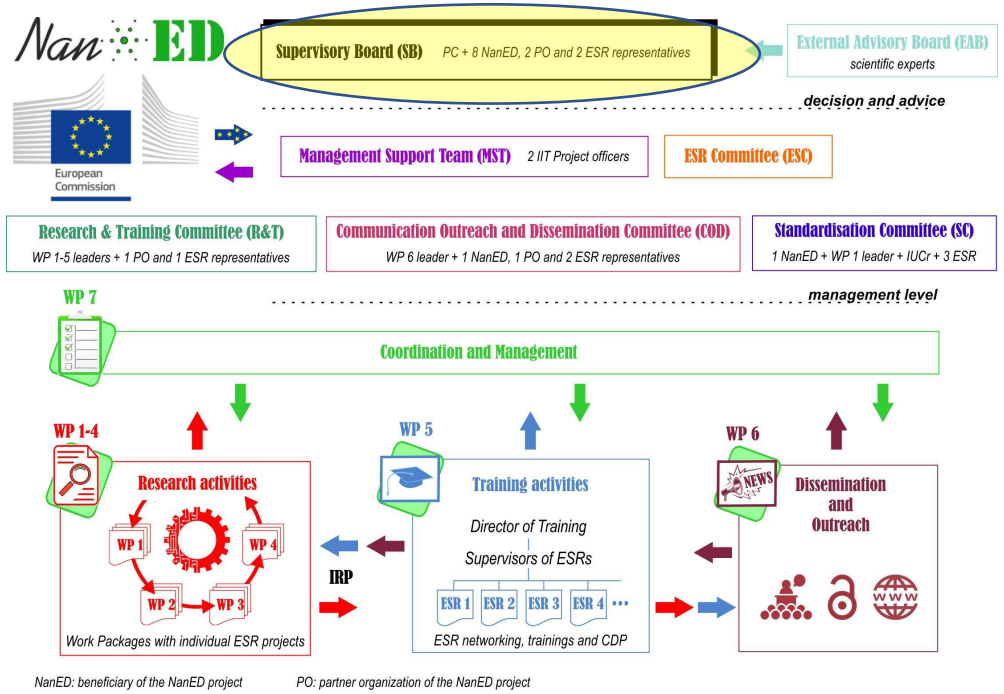


Supervisory Board (SB)

The highest organ in the project and takes all essential decisions.
The SB will be chaired by the project coordinator (PC) and is composed by:

8 Beneficiary + 2 Partners (change every 2 years, have an advisory role) + 2ESR

The SB will be responsible for the strategic decisions and high level monitoring of research and training activities, including CDPs, ESRs recruitment strategy, knowledge transfer, dissemination and outreach.



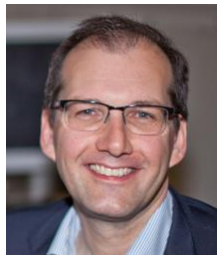
SB will meet <u>once a year</u> with an increased frequency whenever required.

EAB experts will be invited to the sessions and asked for opinion to improve the supervision capacity of SB and the quality.

External advisory board (EAB)

To reinforce the supervision scheme, a multidisciplinary EAB, composed of reputable experts in NanED's main disciplines will additionally provide guidance on scientific priorities, providing recommendations both during the definition and the monitoring of ESRs' projects and attending the yearly progress meetings.

Sven Hovmöller

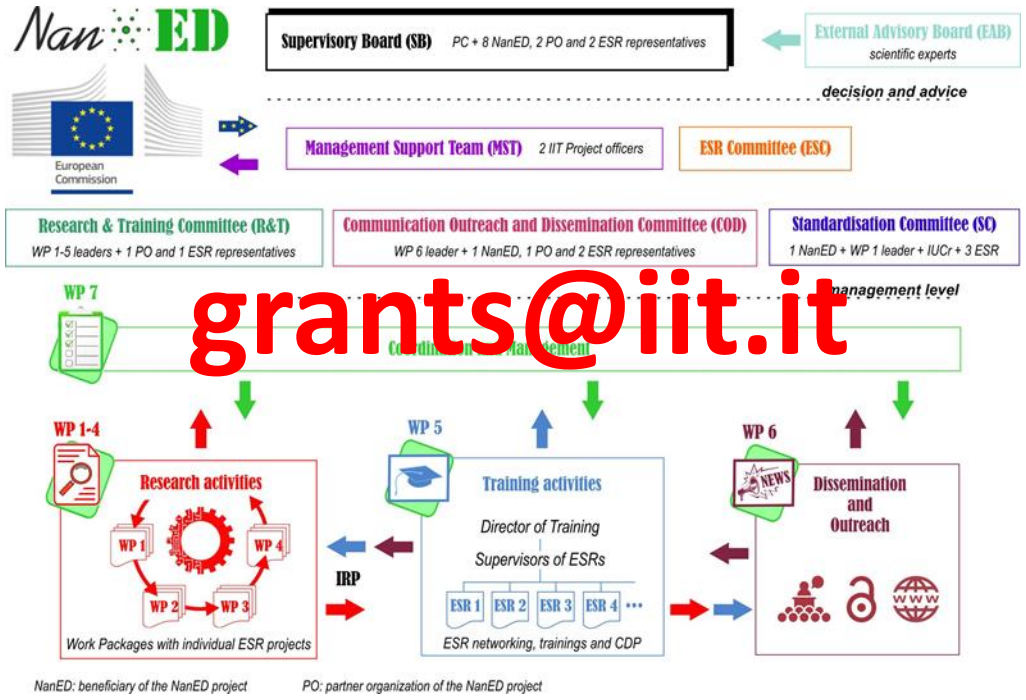


Paul Midgley

Liberato Manna

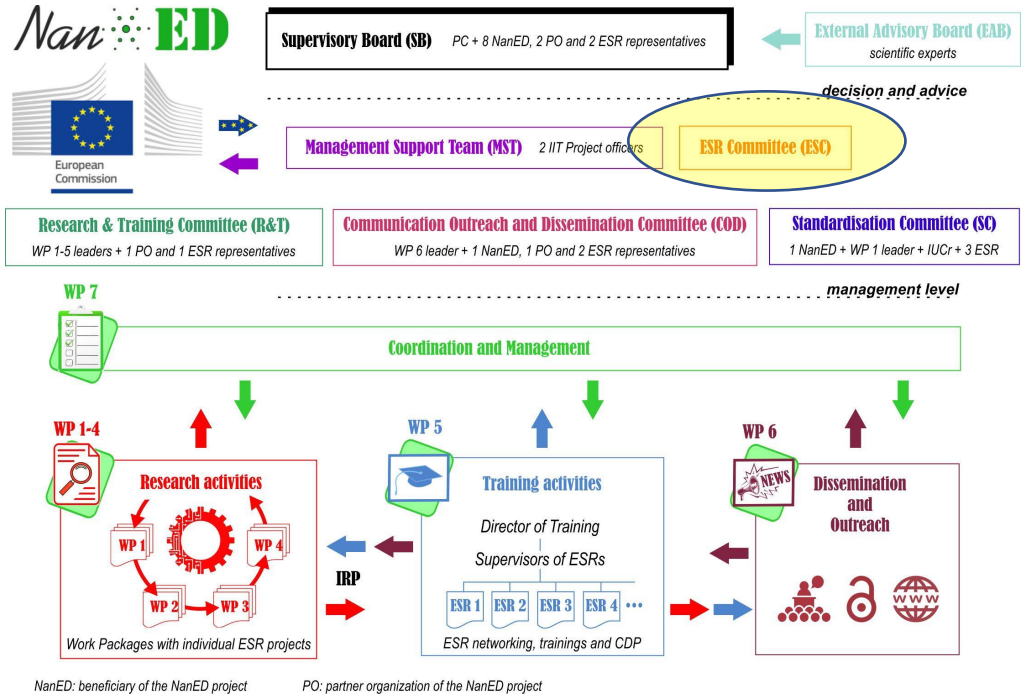
Management Support Team (MST)

Composed by two members of the IIT Projects Office, it will give support to the PC for the administrative and financial management of the project.



ESR Committee (ESC)

All ESRs will be represented in the ESC. **ESC elects the ESR representative in the other committees.** Through them it will report the integration at host institution and general progress of fellows to SB. It will also inform the SB on any issue concerning the implementation of individual research project. The ESC will also foster permanent communication among ESRs and will provide a tool to exchange experiences, clarify questions, identify common demands and potential complaints. The **ESC regularly meet (online/on-site) every 2 months** to discuss scientific issues, contributions to the research and training program and ideas concerning ESRs CDPs.

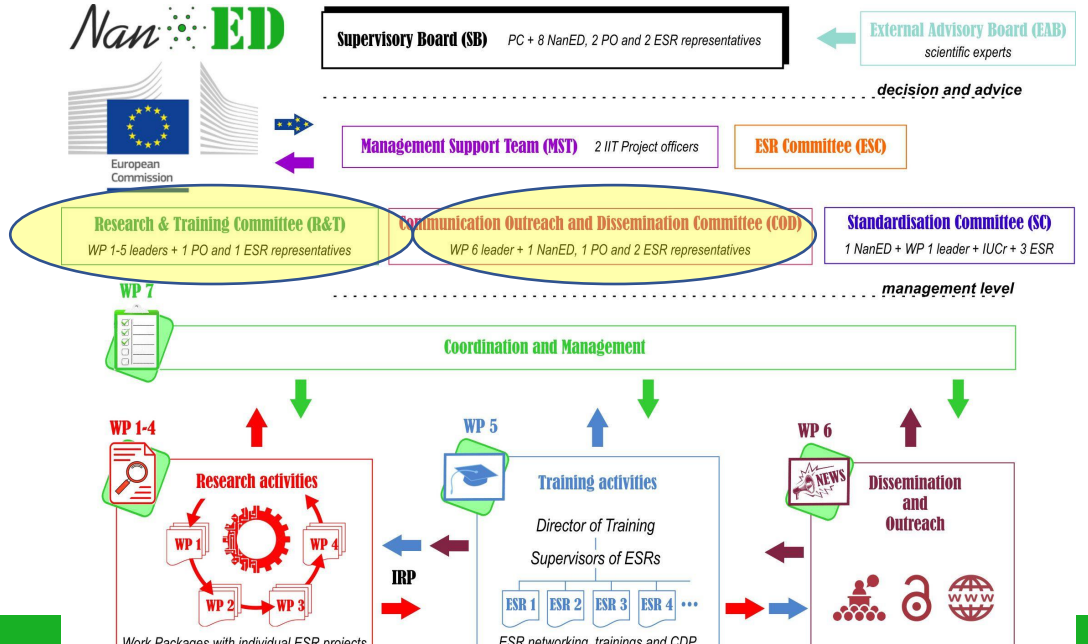


Research & Training Committee (R&T)

Chaired by **Philippe Boullay** (WP5 leader) and participated by the 4 scientific WPs leaders (WP1-4), **by one representative of the partner organizations and one ESR delegated by the ESC**. R&T will supervise the fulfilments of the task objectives related to each work package. It will coordinate, through the WPs leaders, the execution of the deliverables and milestones and be in contact with the SB to report any incident or changes.

Communication Outreach and Dissemination Committee (COD)

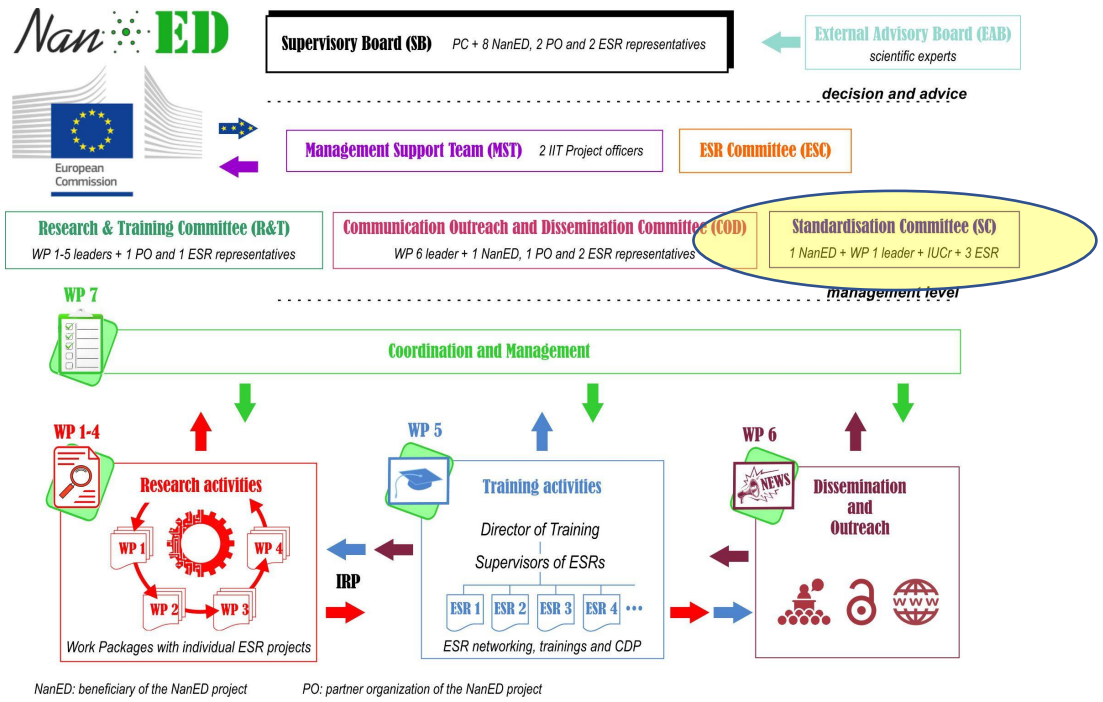
Chaired by the **Xiaodong Zou** (WP6 leader) and participated by another beneficiary, **one partner organization and 2 ESR representative**. It will be responsible of scheduling, monitoring and evaluating NanED's communication, outreach and dissemination activities. It will coordinate and monitor the dissemination communication and exploitation plan.



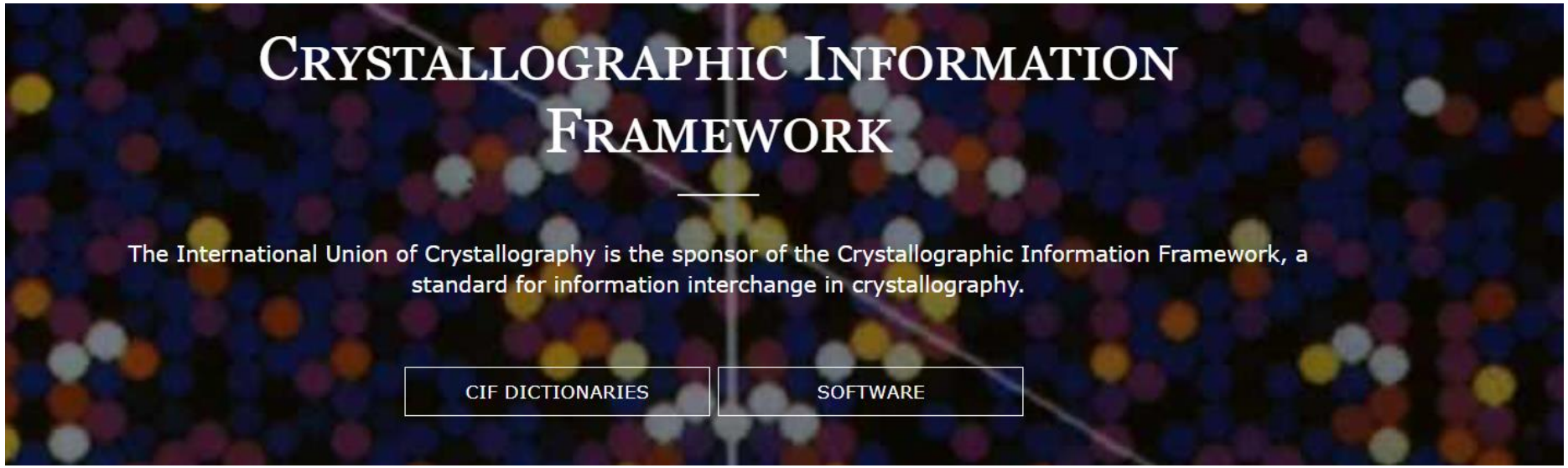
Standardization Committee (SC)

Chaired by one of the beneficiaries (elected during the first SB meeting) and participated by the WP1 leader, by the IUCr scientist in charge and by the **3 ESRs** that will do a secondment at IUCr. It will be the organ responsible for gathering all the information from the beneficiaries necessary for inserting into the cif file format all the specifications for crystal structures solved and refined with 3D ED.

I will schedule a meeting soon!!!!!



Standardization Committee (SC)



The acronym CIF is used both for the **Crystallographic Information File**, the data exchange standard file format of Hall, Allen & Brown (1991) (see Documentation), and for the Crystallographic Information Framework, a broader system of exchange protocols based on data dictionaries and relational rules expressible in different machine-readable manifestations, including, but not restricted to, Crystallographic Information File and XML.

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_cell_angle_gamma	106.679(16)
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_diffrn_source	'120 kV electron microscope'
_diffrn_source_type	'LaB6 gun'
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_diffrn_detector	'single-electron detector MEDIPIX'
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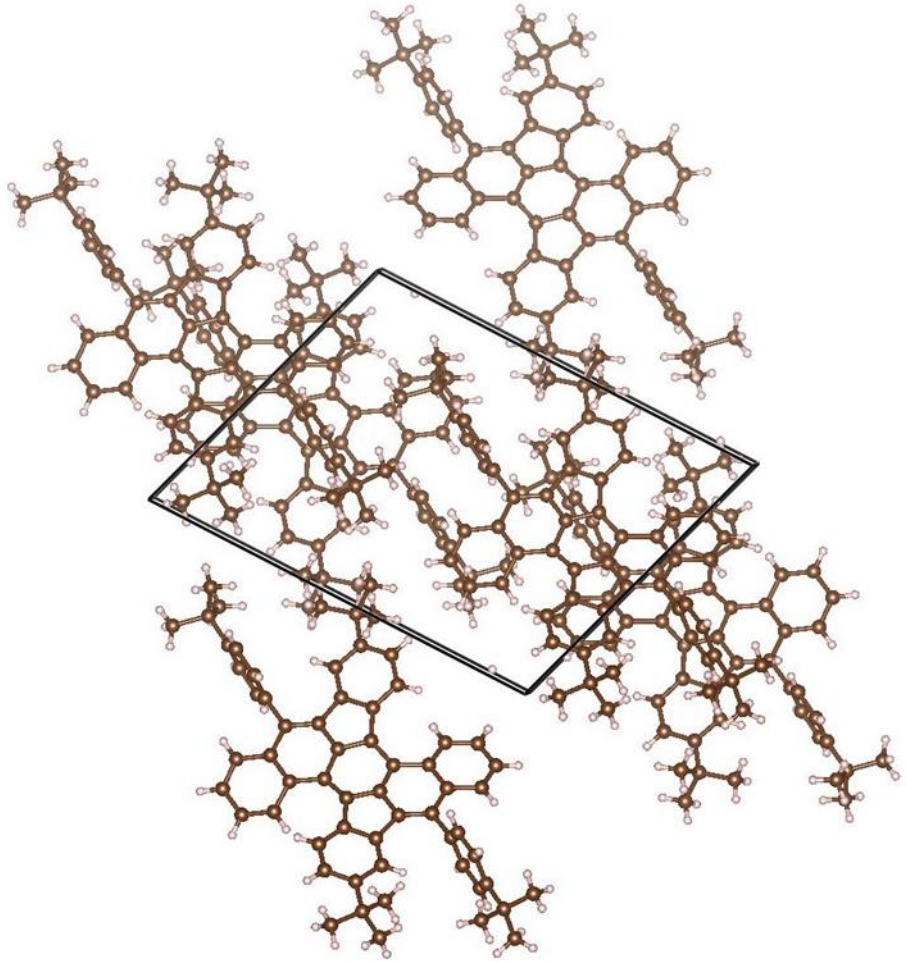

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 _atom_site_U_iso_or_equiv
 _atom_site_adp_type
 _atom_site_occupancy
 _atom_site_site_symmetry_order
 _atom_site_calc_flag
 _atom_site_refinement_flags_posn
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 _atom_site_disorder_assembly
 _atom_site_disorder_group
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C5_1 C 0.
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C6_1 C 0.2485(18) 0.6419(12) 0.9899(8) 0.025(7) Uiso 1 1 d D U . . .
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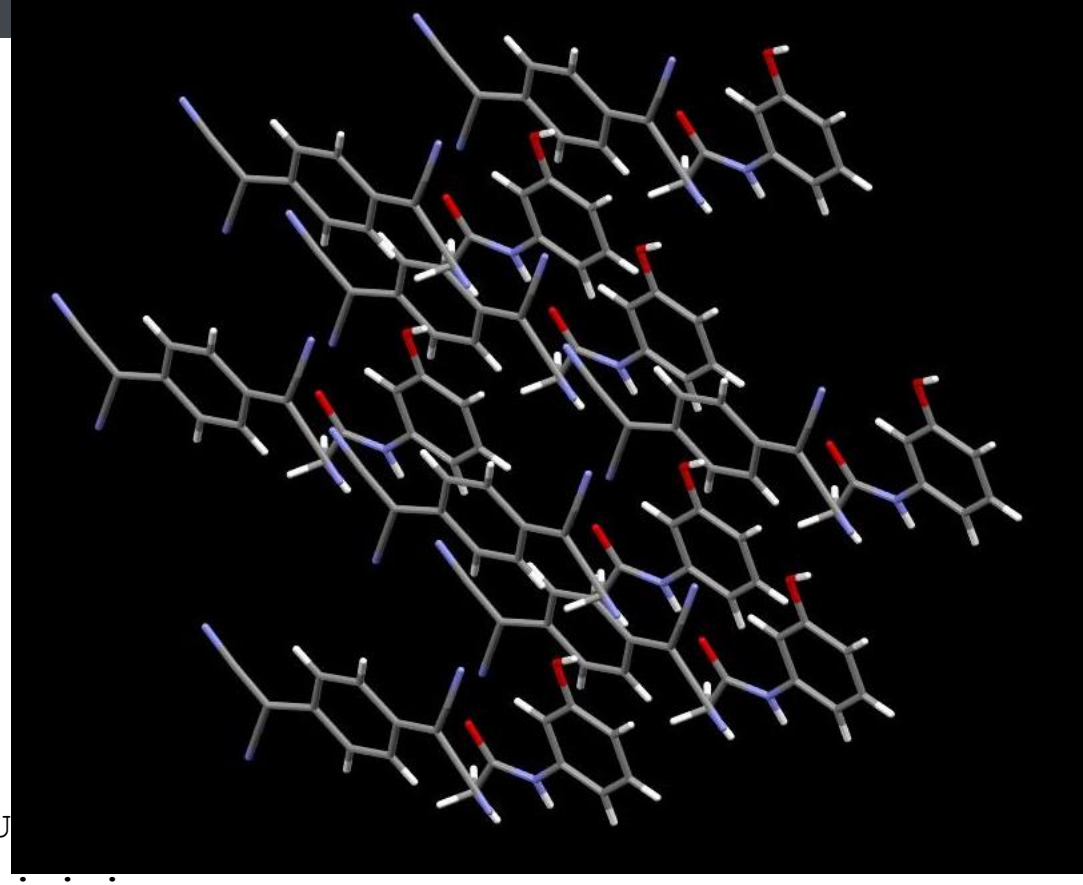


3ESR will participate to this commitee but all will contribute!!!!

NanED GANTT

2021	1	2	3	4	5	6	7	8	9	10	2022	11	12	13
	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec		Jan	Feb	Mar
IIT		D6.1 - D7.1 - D7.2							JIM	D5.2			D8.1 - MS1	
CNRS										D5.1				
FZU						D6.2								
JGU														
SU													D6.3	D7.3
UA														
UBA														
ULM														
Event									JIM					

The project has Deliverables and Milestones and Events

NanED GANTT

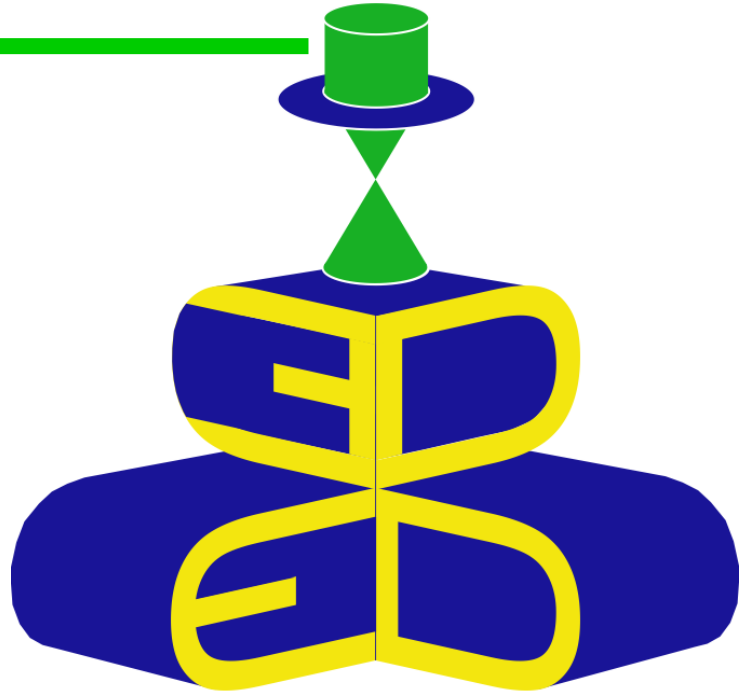
2021	1	2	3	4	5	6	7	8	9	10	2022	11	12	13
	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec		Jan	Feb	Mar
IIT		D6.1 - D7.1 - D7.2							JIM	D5.2			D8.1 - MS1	
CNRS										D5.1				
FZU						D6.2								
JGU														
SU													D6.3	D7.3
UA														
UBA														
ULM														
Event									JIM					

D7.1	2	IIT	Consortium Agreement		Done
D7.2	2	IIT	Supervisory board of the network		
D6.1	2	IIT	Web site + logo		Done
D6.2	6	FZU	Data managment plan I		
D5.1	10	CNRS	CDP for each ESR		To be postponed
D5.2	10	IIT	Joint initial Meeting Report		

NanED LOGO

Green
the electron colour

3D ED
symbol



The colours of
the EU flag

NanED

NanED GANTT

2021	1	2	3	4	5	6	7	8	9	10	2022	11	12	13
	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec		Jan	Feb	Mar
IIT		D6.1 - D7.1 - D7.2							JIM	D5.2			D8.1 - MS1	
CNRS										D5.1				
FZU						D6.2								
JGU														
SU													D6.3	D7.3
UA														
UBA														
ULM														
Event									JIM					

D7.1	2	IIT	Consortium Agreement
D7.2	2	IIT	Supervisory board of the network

D6.1	2	IIT	Web site + logo
D6.2	6	FZU	Data managment plan I

D5.1	10	CNRS	CDP for each ESR
D5.2	10	IIT	Joint initial Meeting Report

D6.3	12	SU	dissemination comm. Exploit. Plan
D7.3	13	IIT	Progress report
D8.1	12	IIT	Ethics requirements
MS1	12	IIT	Recruitment completed

NanED GANTT

2022	11	12	13	14	15	16	17	18	19	20	21	22	2023	23	24
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec		Jan	Feb
IIT		D8.1 - MS1			MS2			D1.1		D1.2					D1.4
CNRS															
FZU					WS1	D5.3									D3.1 - D6.4
JGU												WS2		D5.4	
SU		D6.3	D7.3												D1.3 - D2.1 MS3
UA															
UBA															
ULM															
Event					WS1							WS2			

D6.3	12	SU	dissemination comm. Exploit. Plan
D7.3	13	IIT	Progress report
D8.1	12	IIT	Ethics requirements
MS1	12	IIT	Recruitment completed

MS2	15	IIT	Mid term meeting
D5.3	16	FZU	Report on WS1
D1.1	18	IIT	Round Robin
D1.2	20	IIT	Protocols 3D ED on beam sensitive

D1.1 Round Robin of 3D ED on a test sample among all labs (M18)

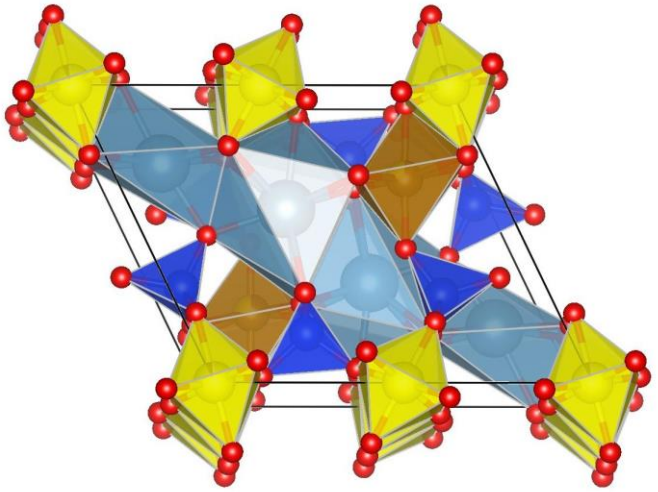
It was a specific request of the project officer to have a scientific deliverable at the early stage

It is made for the ESR to practice with 3D ED

We need to decide the test sample and to make it available to the consortium

It can be an ideal case for a joint publication of the consortium and the first time the same sample will be analyzed by different labs, different TEMS different data collection types, different detectors.

D1.1 **Round Robin of 3D ED on a test sample among all labs (M18)**

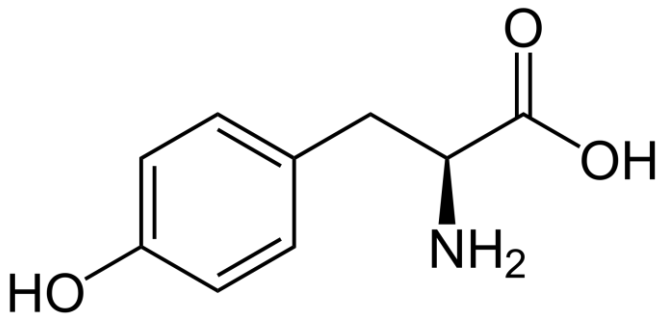


Epidote: $Ca_2Al_2(Fe^{3+};Al)(SiO_4)(Si_2O_7)O(OH)$

Monoclinic $P2_1/m$

a=8.9 b=5.6 c=10.2 beta=115°

21 atoms in the asymmetric unit + 1 H



L-Tyrosine: $C_9H_{11}NO_3$

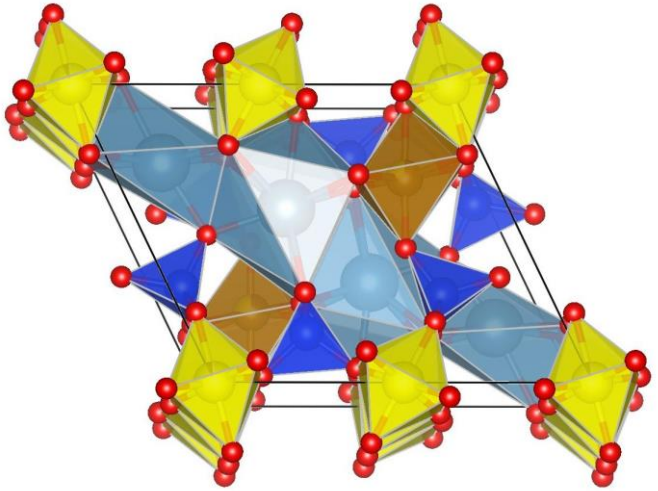
Orthorhombic $P2_12_12_1$

a=6.9 b=21.2 c=5.8

13 atoms in the asymmetric unit without H

D1.1

Round Robin of 3D ED on a test sample among all labs (M18)

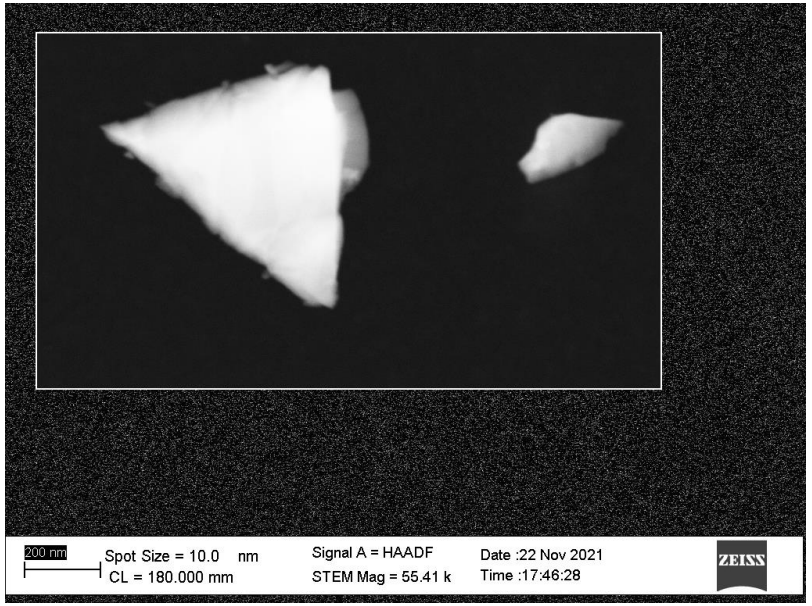


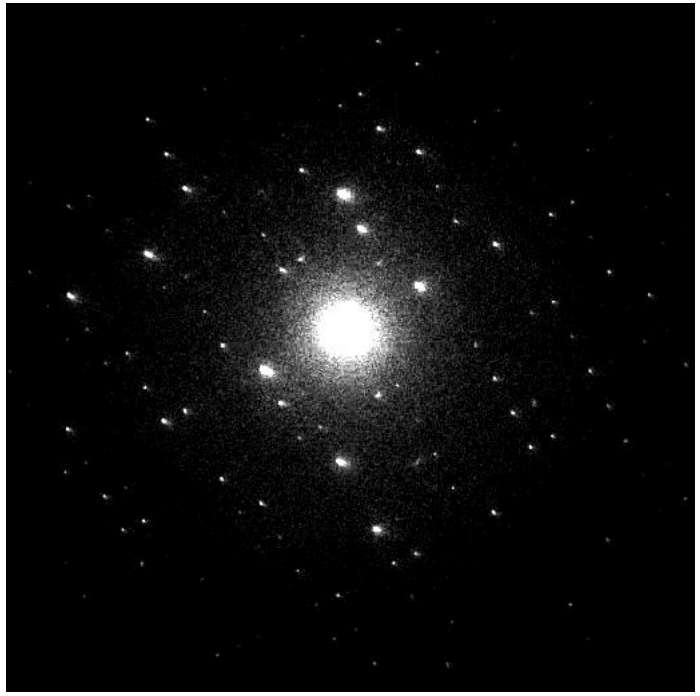
Epidote: $Ca_2Al_2(Fe^{3+};Al)(SiO_4)(Si_2O_7)O(OH)$

Monoclinic $P2_1/m$

a=8.9 b=5.6 c=10.2 beta=115°

21 atoms in the asymmetric unit + 1 H





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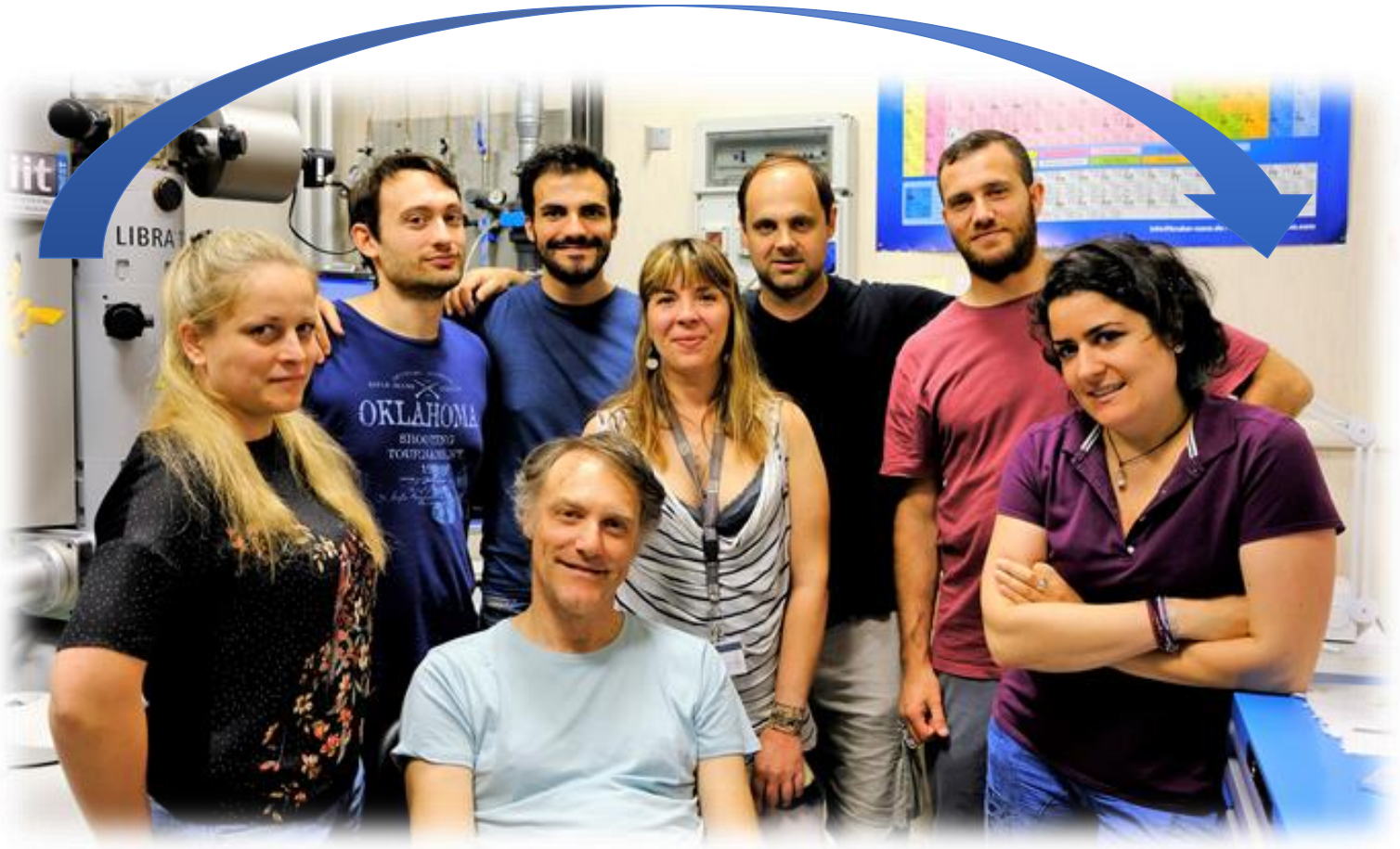

Giovanna Molinari (Unipi)

Following the arrow: Iryna Andrusenko, Francesco Papi, Andrea Griesi, Valentina Cappello, Enrico Mugnaioli, Fabrizio Campanale, Arianna Lanza

Not in the picture Elena Husanu, Andrea Sala, Danilo Marchetti Daniele Sonaglioni

Thank you