

Pioneering experience on the development of accelerators from scratch: SESAME facility

Andrea Lausi



Photo © Ivan Lim



SESAME

The origins of SESAME



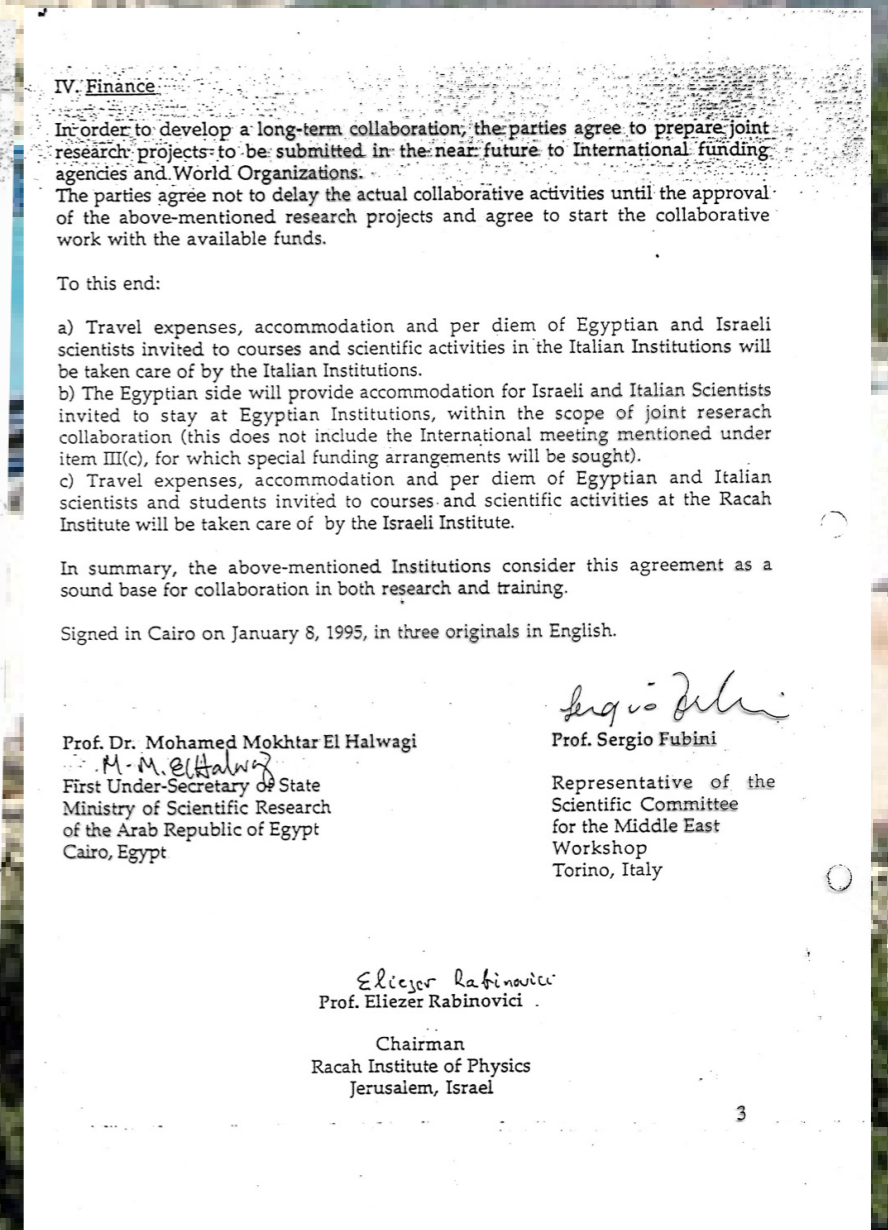
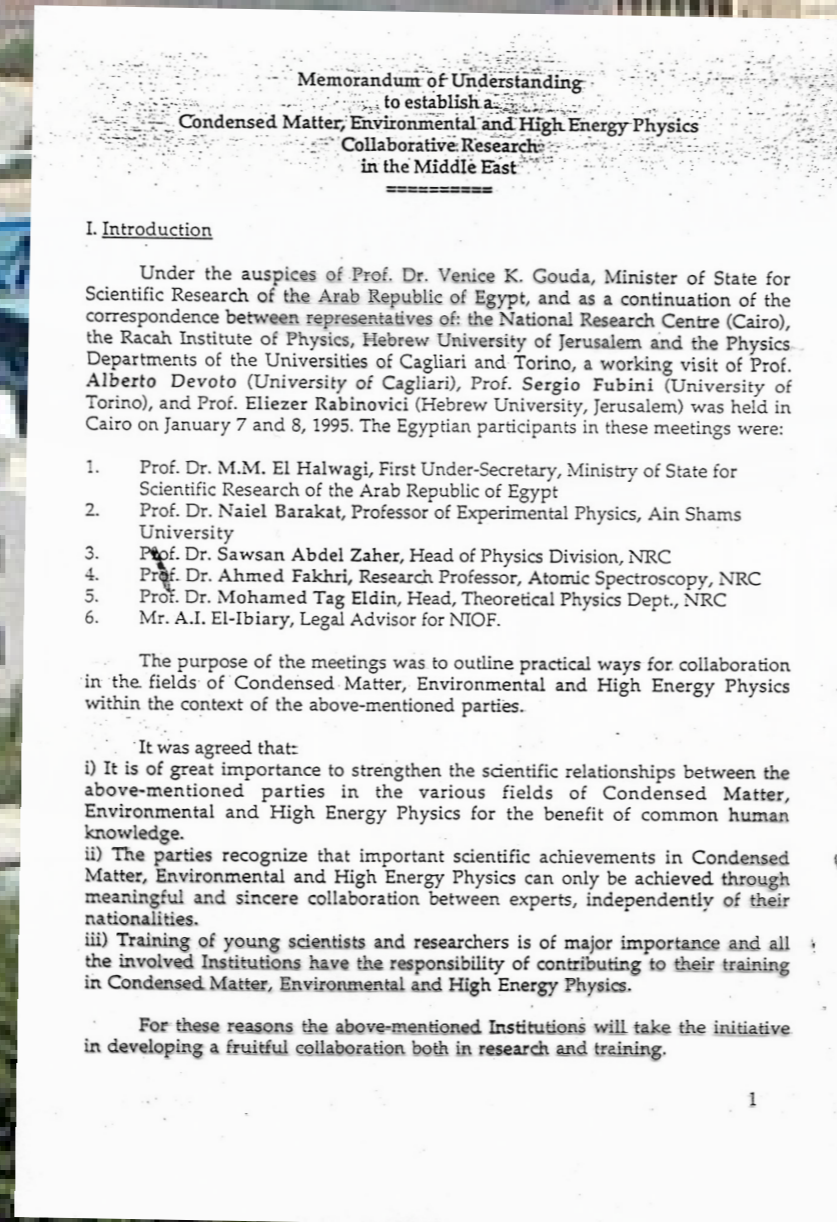
Sergio Fubini



Eliezer Rabinovici

CERN/MESC
Middle East
Scientific
Cooperation

January 1995 in
Cairo



The origins of SESAME





Sergio Fubini



Eliezer Rabinovici

CERN/MESC
Middle East
Scientific
Cooperation

November 1995 in
Dahab, Egypt

 INTERNATIONAL ATOMIC ENERGY AGENCY
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION
 INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS
I.C.T.P., P.O. BOX 586, 34100 TRIESTE, ITALY, CABLE: CENTRATOM TRIESTE

Trieste, July 20, 1995

Prof. S. Fubini
Chairman of the
Scientific Committee for the Sinai School of Physics,
Universita di Torino
Torino, Italy

cc: Prof. G. Denardo
Prof. A. Devoto
Prof. E. Rabinovici

Dear Prof. Fubini,

I'm happy to let you know that the ICTP has decided to grant a special contribution of 22,000 \$ for the organization of the "Sinai Meeting on High Energy Physics, Condensed Matter and Environmental Physics" to be held in Dahab (Egypt) from 19 to 26 November 1995.

This contribution will be given to the Organizing Committee at its address in Israel.

Yours sincerely,

Miguel A. Virasoro
ICTP Director

Action plan for a collaborative programme in physics in the Middle East.

As part of the implementation of the collaboration agreement signed in Cairo on January 8th, 1995 under the auspices of H.E. Prof. Dr. Venice K. Gouda, Minister of State for Scientific Research of the Arab Republic of Egypt;

In the spirit of the agreement to promote co-operative work in fields that have impact on peoples' lives and standards of living, facilitating the use of equipment and expertise to support and collaborate in the ongoing peace process;

As a consequence of fruitful discussions among scientists of the Middle East held during a successful meeting in Dahab, Sinai from November 19 to November 26, 1995 under the chairmanship of Professor Sergio Fubini, acting also as delegate of the Minister of University and Scientific and Technological Research of Italy, attended by 125 scientists: American, Argentinian, British, Egyptian, French, German, Israeli, Italian, Japanese, Jordanian, Moroccan, Palestinian, Spanish, and honoured by the presence of Prof. Dr. Venice K. Gouda, Minister of State for Scientific Research of the Arab Republic of Egypt, Prof. Jacob Ziv, President of the Israel Academy of Science and Humanities, Prof. Miguel A. Virasoro, Director of ICTP and Dr. Adnan Badran, Deputy Director-General of UNESCO;

It was decided:

-To create a "Steering Committee for International Collaboration in the Middle East on Basic and Applied Physics" under the auspices of UNESCO, ICTP and the Italian government.

The tasks of this committee will be:

1. To promote collaboration between scientists in Egypt, Israel, Italy and other scientists in the region; to identify research groups with common interests and to facilitate research collaboration and the exchange of scientists and students;
2. The committee will initiate, promote and support other meetings and regional Schools of Physics. The next School is planned to take place in Jerusalem and Bethlehem in May 1996, on the subject of the Physics of Detectors.
3. The establishment of a computerized data base of regional scientific and educational activities for the benefit of all students and researchers in the area, with a view to connecting the institutions and groups active in research and education.

The origins of SESAME



Sergio Fubini



Eliezer Rabinovici



Gustav Voss



Herman Winick



1997: building a light source in the Middle East using the decommissioned Berlin Synchrotron, BESSY I.



The origins of SESAME



Sergio Fubini



Eliezer Rabinovici



Herwig Schopper



Gustav Voss



Herman Winick



Isa Khubeis



The origins of SESAME



United Nations
Educational, Scientific and
Cultural Organization

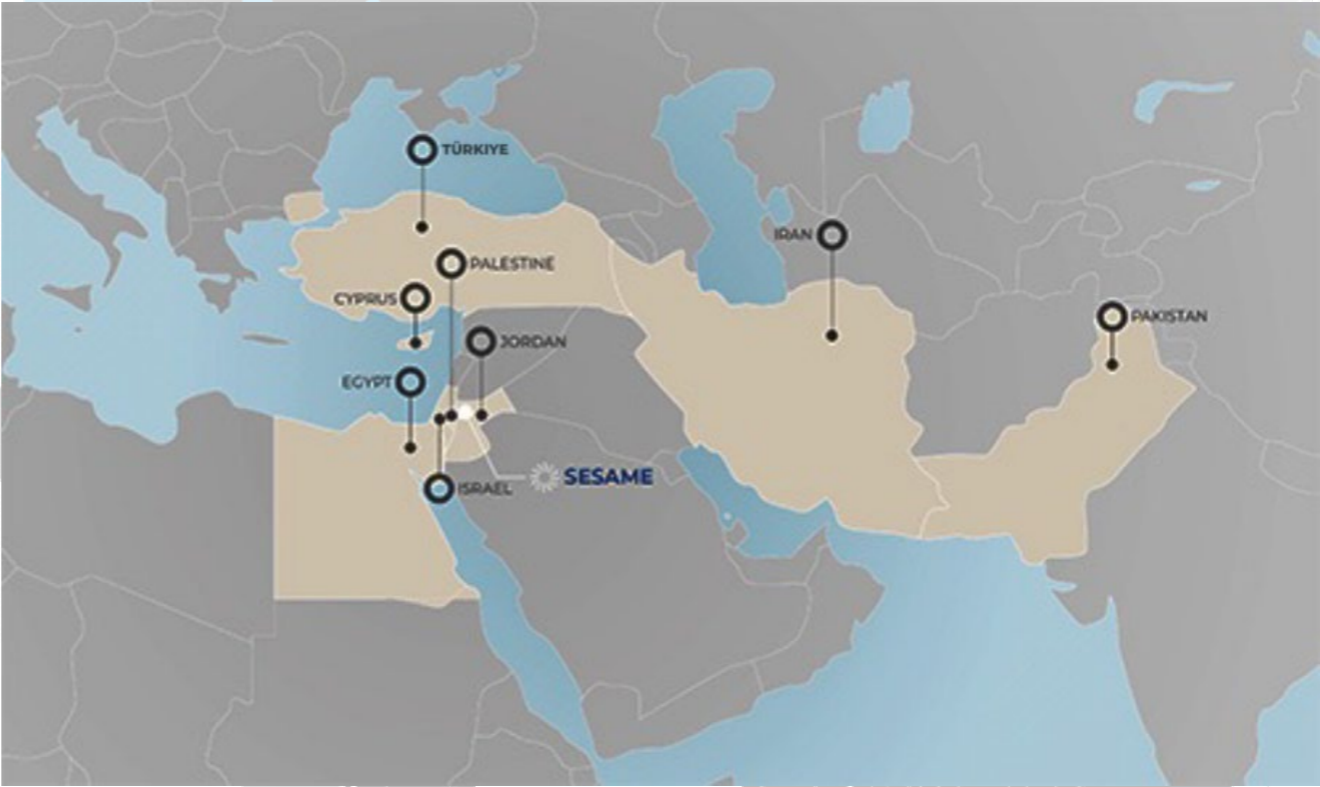
- 2022: SESAME is established under the auspices of following the formal approval given for this by the UNESCO Executive Board (164th session, May 2002).

- Modeled on CERN, aims to foster scientific and technological excellence and build peace through collaboration.

- Promotes international cooperation and scientific collaboration in a region often noted for conflict.

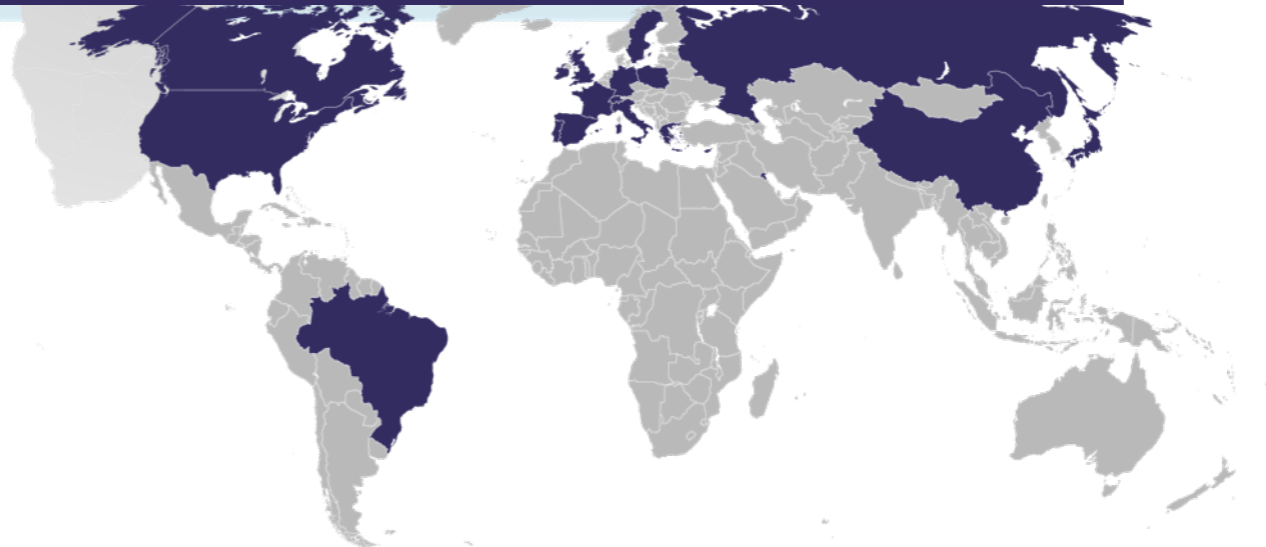


SESAME is
composed of
Members and
Observers



SESAME is
composed of
Members and
Observers

Brazil, Canada, CERN, China, the
European Union, France, Germany,
Greece, Italy, Japan, Kuwait, Portugal,
Russian Federation, Spain, Sweden,
Switzerland, the United Arab Emirates,
the United Kingdom, and the United
States of America



SESAME
received much
support from
non-members.
Examples are...



Solar Power Plant (EU)

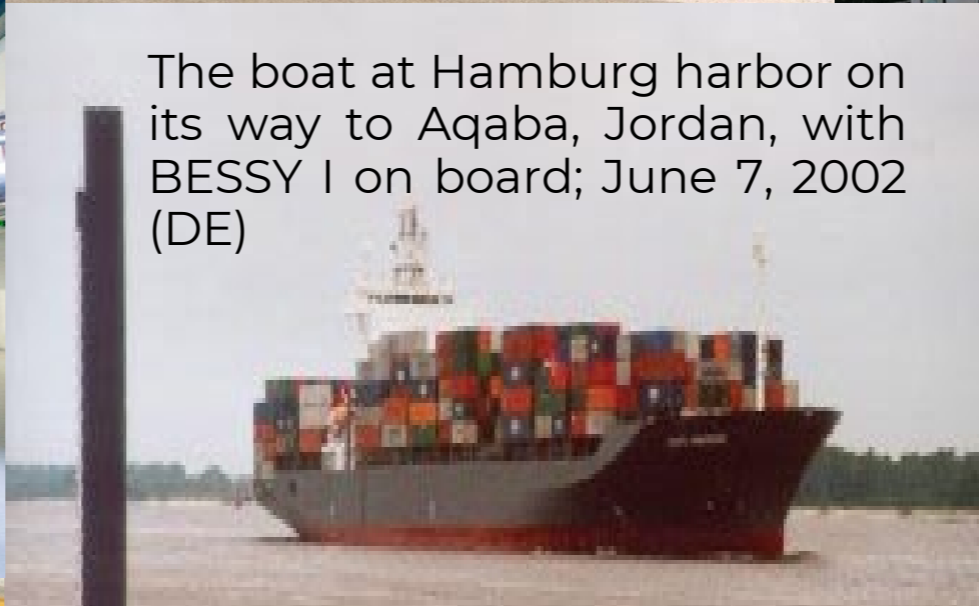


Sergio Fubini Guest House (IT)

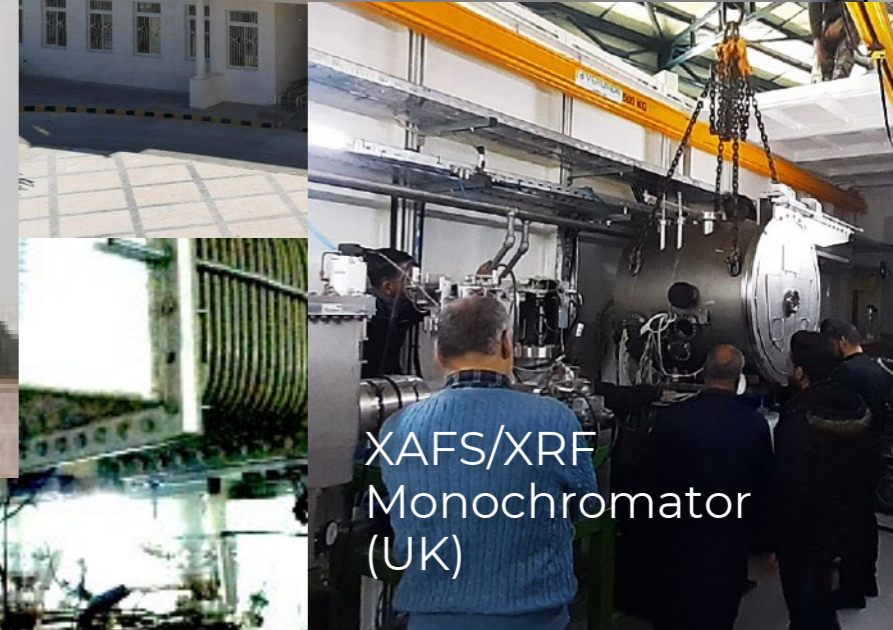


HESEB Beamline (DE)

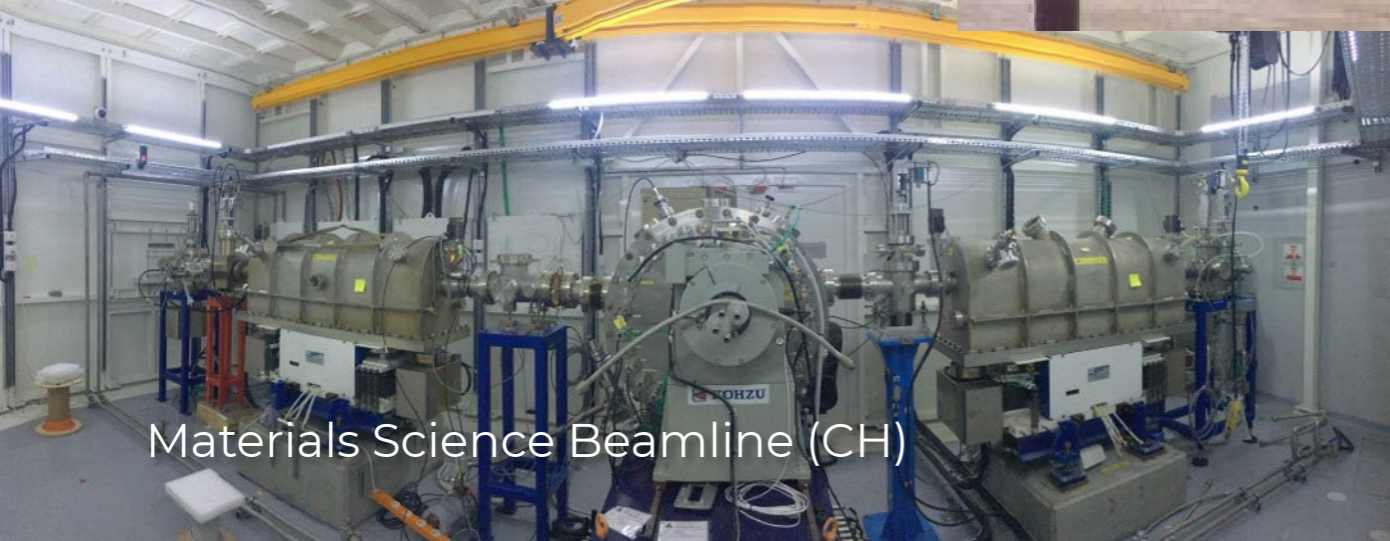
Photo © Ivan Lim



The boat at Hamburg harbor on
its way to Aqaba, Jordan, with
BESSY I on board; June 7, 2002
(DE)



XAFS/XRF
Monochromator
(UK)



Materials Science Beamline (CH)



The four RF Cavities (IT)

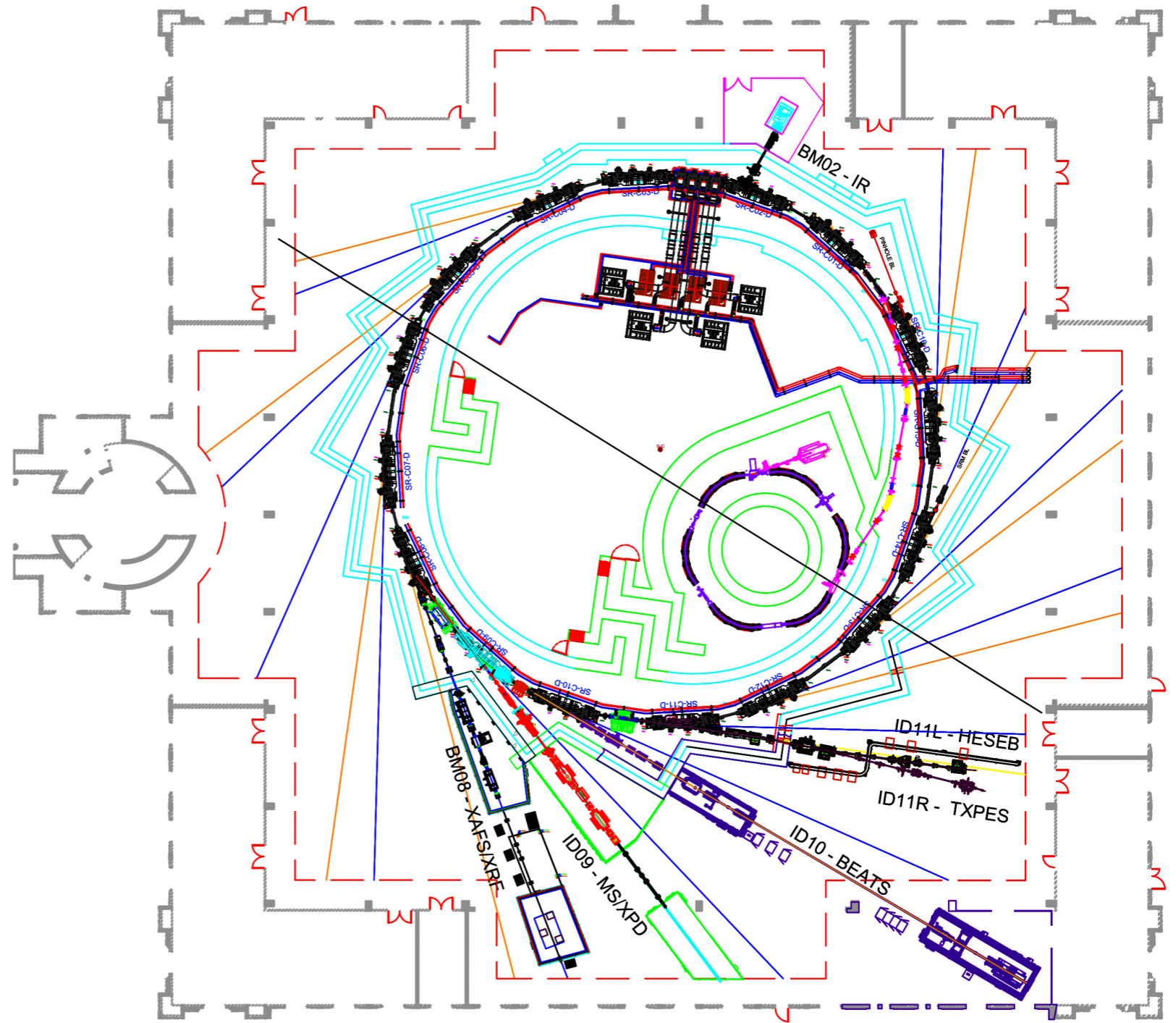
The Status of SESAME



**3rd generation light source
2.5 GeV
133 meters circumference
5 operational beamlines
70 international staff**



**Dieter
Einfeld,
SESAME
storage
ring
designer**



CESSAMag

Magnets designed at SESAME,
procured by SESAME/CERN EC FP7 project CESSAMag
QA/QC at ALBA (Spain) and at CERN

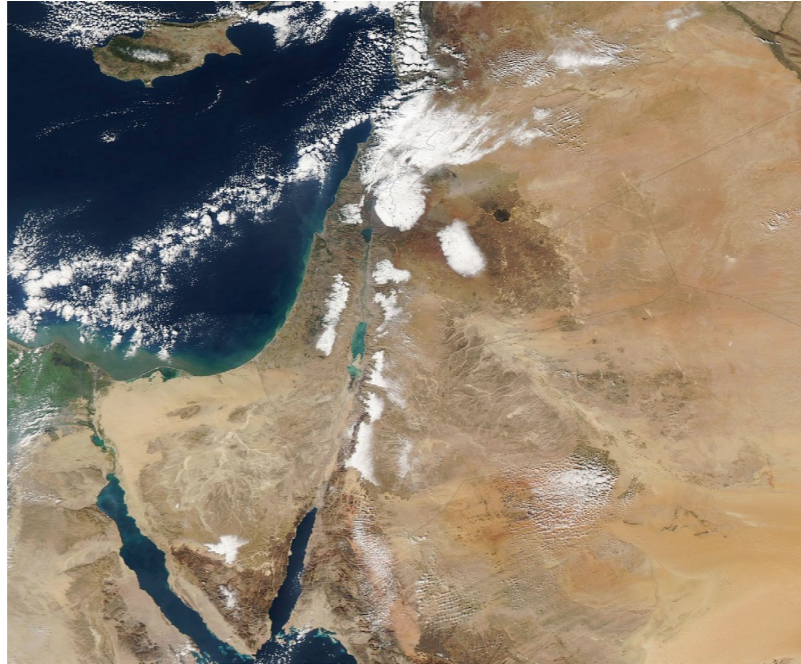
Quadrupole magnets: ELYTT (Spain), SONMEZ (Türkiye)

Sextupole magnets: CNE Technology (Cyprus), HMC3 (Pakistan), SEF (France)

Bending magnets: TESLA (United Kingdom)

Girder: Nortemecánica (Spain)

Power sources and control electronics: TDK Lambda (Israel), EEI (Italy), PSI Light Source (Switzerland)



December 14, 2013, winter storm **ALEXA**

Worst snowfall in 50 years in Amman and Jerusalem



2016: installation





SESAME Opening Ceremony, May 16, 2017

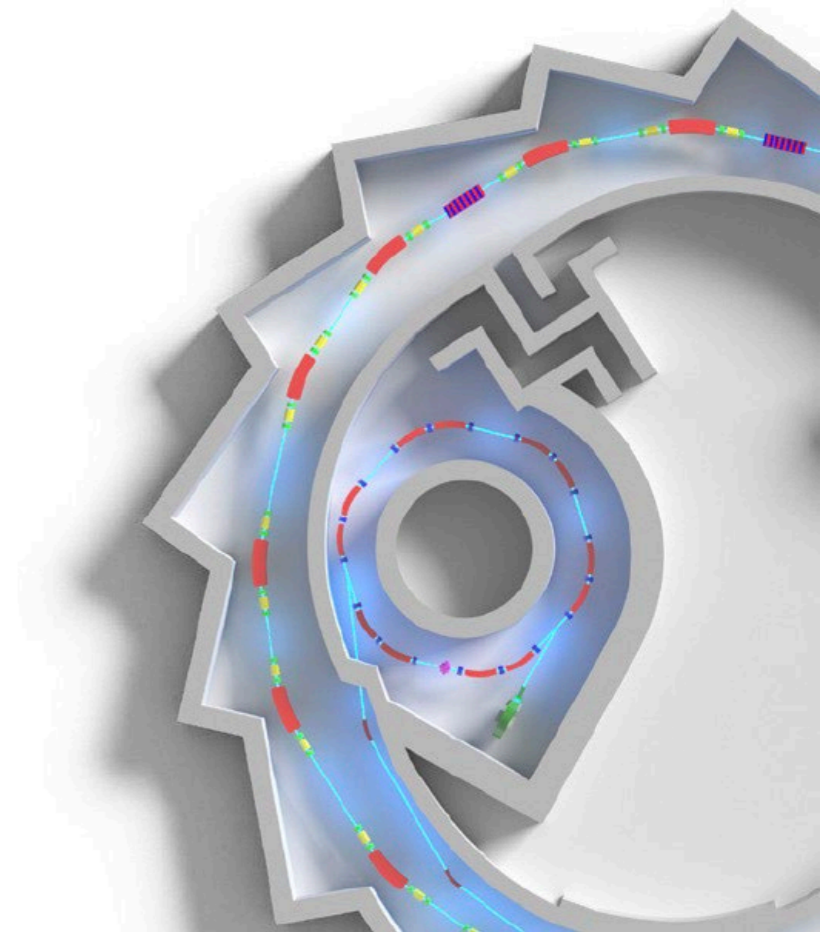
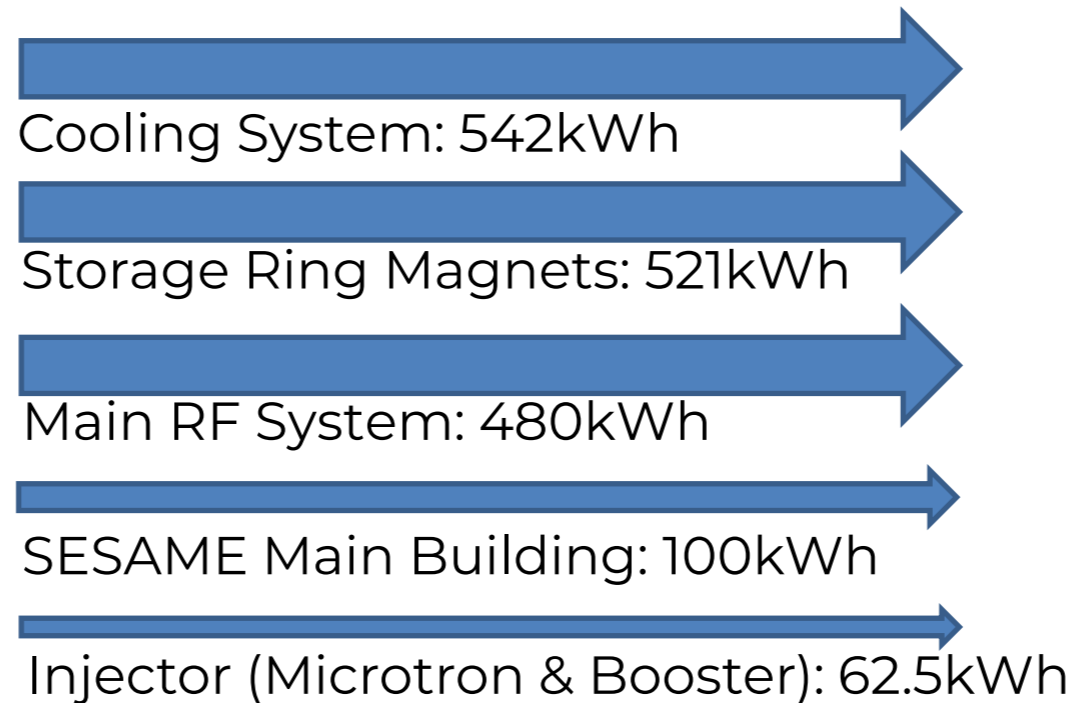
HM King Abdullah II at the opening of SESAME, flanked by Heads of the delegations of the SESAME Members and Directors of International Organisations having supported SESAME. Left of the King, HRH Princess Sumaya, head of Jordan delegation, and Fabiola Gianotti, Director General CERN; to the right, Irena Bokova, Director-General UNESCO, Carlos Moedas, EC Commissioner for Research, Science and Innovation and Rolf Heuer (present President SESAME Council). Directly behind the King, Chis Llewin-Smith, President SESAME Council with on left Khaled Toukan, Director SESAME.

6.5 MW Solar Power Plant
Financed by EU

Average Annual Production:
11.57 GWh
CO₂ Saved: -7,104 Ton

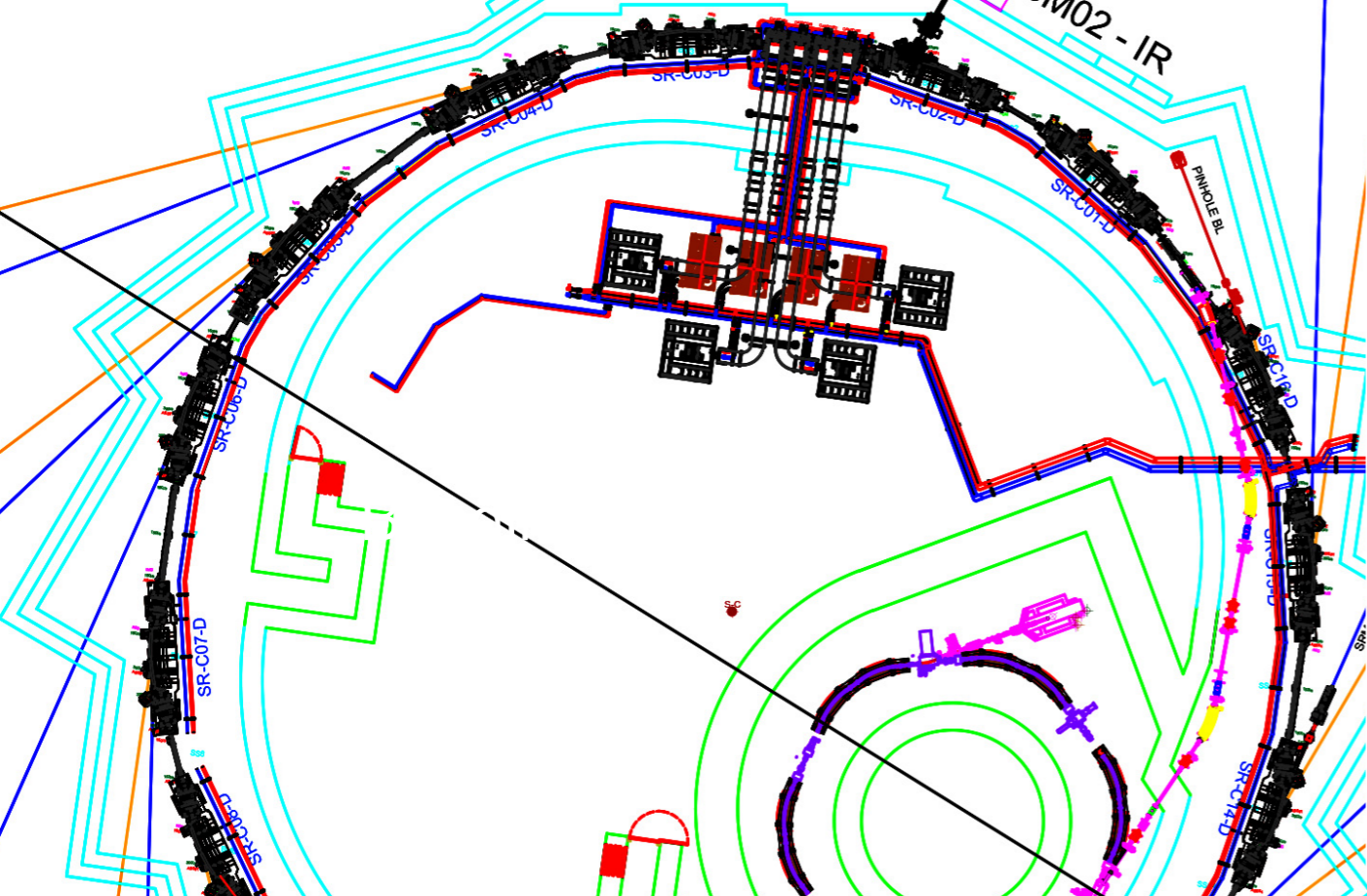
SESAME Energy Balance

MAX Peak Load: 2.1MW
Average Annual
Consumption: 9.7GWh
CO₂ Saved: - 5,955 Ton

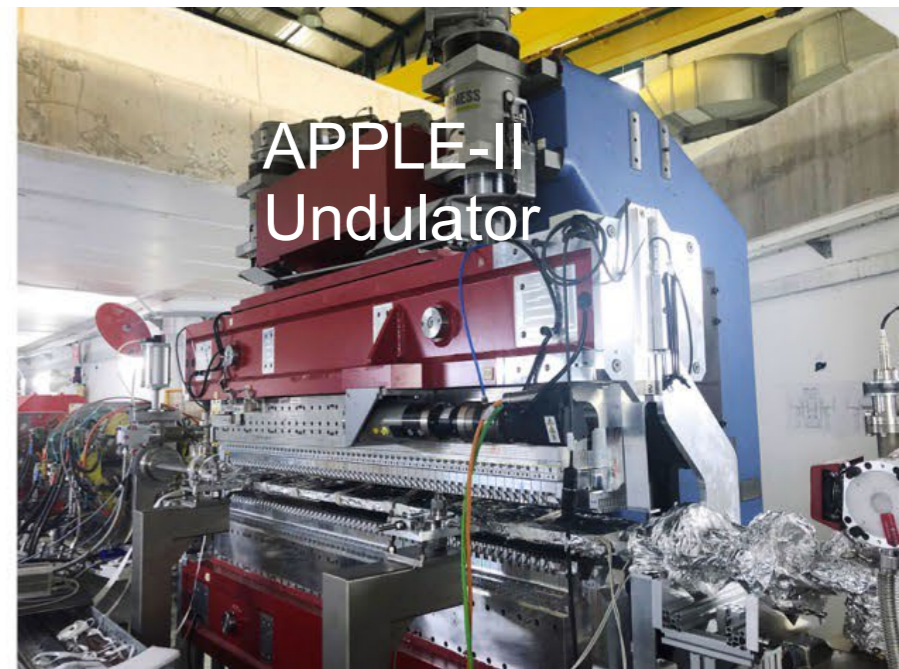
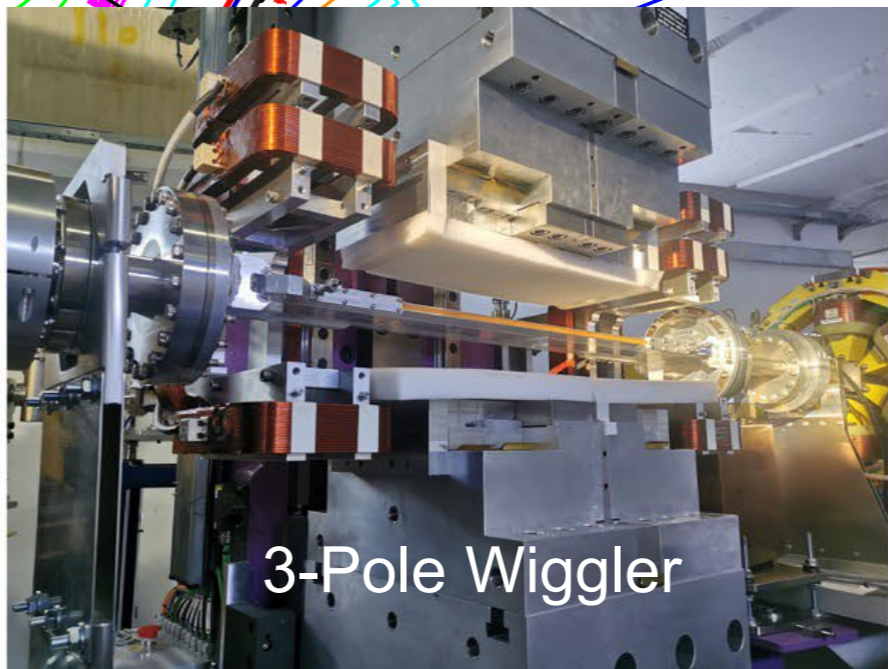


Inaugurated December 4, 2019, the Sergio Fubini Guest House was funded by the Italian Ministry of Education, Universities and Research through INFN (total of 1.75 M Euro). The Guest House includes a canteen, meeting rooms and 48 guestrooms. 2 are accessible to disabled persons.





SR parameter	Value
Energy	2.5 GeV
Circumference	133 m
Emittance	26 nmrad
Current	300 mA
RF frequency	500 MHz
# cavities	4
Long straits	8 (4 m)
Short streights	8 (2 m)



radio waves

microwaves

infrared

visible light

ultraviolet

soft

X-ray

hard

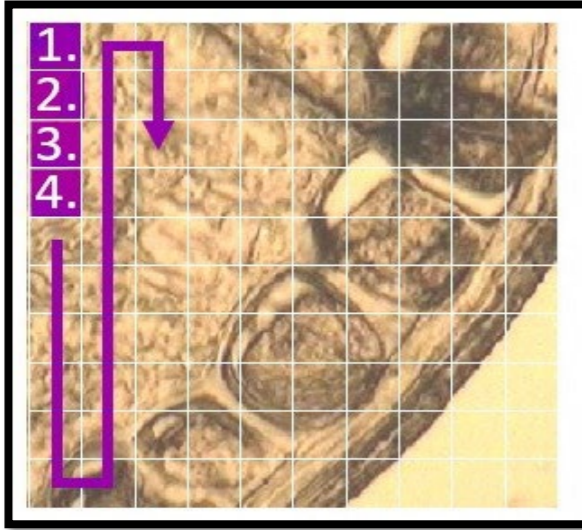


IR

Infrared Spectromicroscopy



Single Point detector

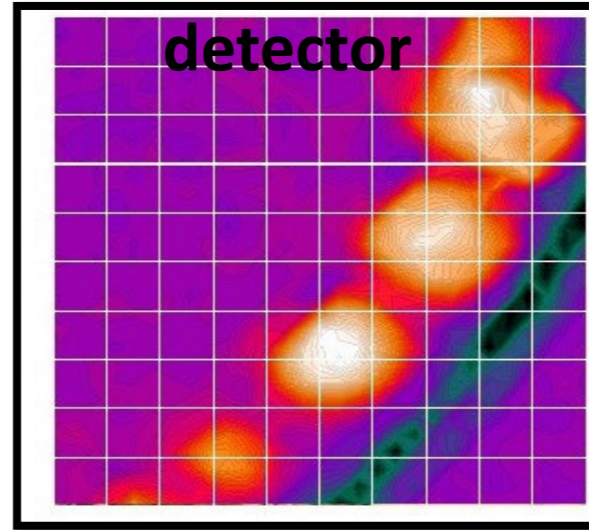


Consecutive

- Point-by-point detector,
- Long data acquisition.

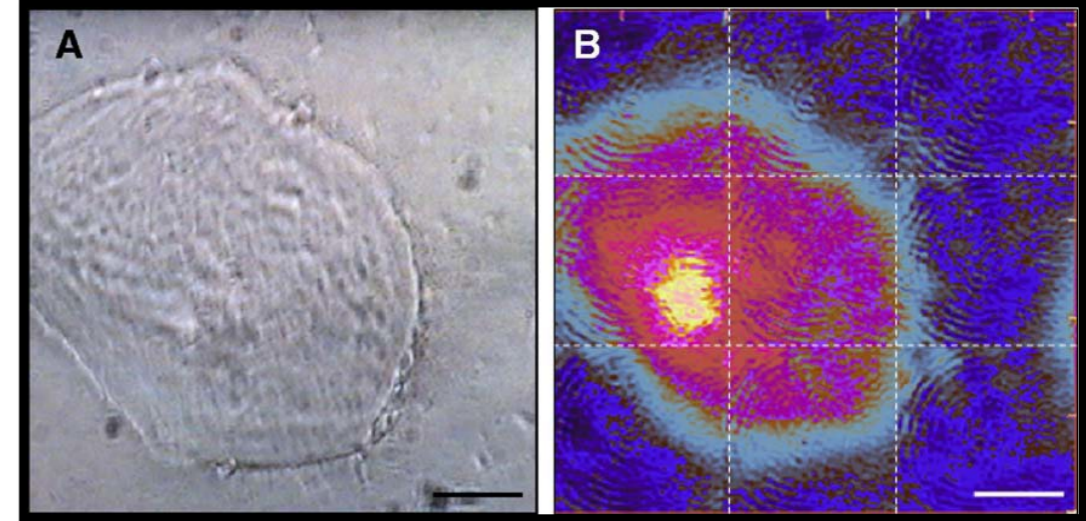
FPA

detector



All at once

- State-of-the-art detector for FTIR imaging,
- Parallel acquisition,
- An array of IR detectors arranged in a square (64 x 64 detectors),
- 4K spectra captured in a single shot, almost like a digital camera.



(A) Visible image of a human biological cell. (B) Synchrotron FPA (64x64 pixels) image of the protein (Amide I) absorbance in the cell.

L.M. Miller, P. Dumas / Biochimica et Biophysica Acta 1758 (2006)

BM02-IR: INFRARED SPECTROMICROSCOPY BEAMLIN

Journal of Pharmaceutical and Biomedical Analysis 184 (2020) 113186



Contents lists available at ScienceDirect

Journal of Pharmaceutical and Biomedical Analysis

journal homepage: www.elsevier.com/locate/jpba



Jordan: Diagnostic Tools for Pre-Eclampsia

Investigating the molecular structure of placenta and plasma in pre-eclampsia by infrared microspectroscopy

Lina A. Dahabiyeh^{a,*}, Randa S.H. Mansour^b, Shawqi S. Saleh^c, Gihan Kamel^{d,e}

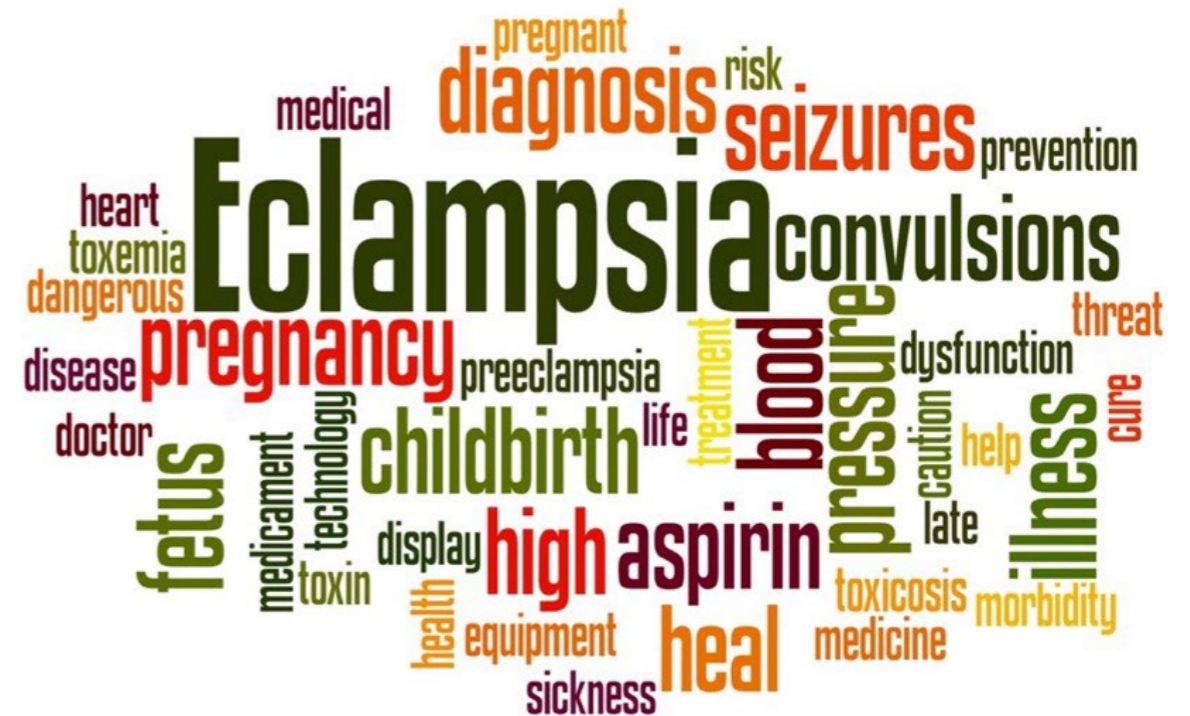
^a Department of Pharmaceutical Sciences, School of Pharmacy, The University of Jordan, Queen Rania St, Amman, 11942, Jordan

^b Faculty of Pharmacy, Philadelphia University, 19392, Amman, Jordan

^c Department of Obstetrics and Gynaecology, School of Medicine, The University of Jordan, 11942, Amman, Jordan

^d SESAME Synchrotron (Synchrotron-light for Experimental Science and Applications in the Middle East), 19252, Allan, Jordan

^e Department of Physics, Faculty of Science, Helwan University, Cairo, Egypt





radio waves

microwaves

infrared

visible light

ultraviolet

soft

X-ray

hard

XAFS/XRF

X-ray Absorption Fine Structure / X-ray Fluorescence

HZDR



Elettra Sincrotrone Trieste



SESAME

XAFS/XRF: AXPiDe (Advanced X-ray Pixel DEtector)

Energy range: 6 – 30 keV

PERIODIC CHART OF THE ELEMENTS

IA	IIA	IIIB	IVB	VB	VIB	VIIIB	VIII	IB	IIB	IIIA	IYA	VA	VIA	VIIA	INERT GASES		
1 H 1.00797														1 H 1.00797	2 He 4.0026		
3 Li 6.939	4 Be 9.0122										5 B 10.811	6 C 12.0112	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.183	
11 Na 22.9898	12 Mg 24.312										13 Al 26.9815	14 Si 28.086	15 P 30.9738	16 S 32.064	17 Cl 35.453	18 Ar 39.948	
19 K 39.102	20 Ca 40.08	21 Sc 44.956	22 Ti 47.90	23 V 50.942	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.71	29 Cu 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.909	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.905	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc (99)	44 Ru 101.07	45 Rh 102.905	46 Pd 106.4	47 Ag 107.870	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.904	54 Xe 131.30
55 Cs 132.905	56 Ba 137.34	*57 La 138.91	72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.967	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.980	84 Po (210)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	†89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 ? (271)	111 ? (272)	112 ? (277)						

: K-edge
 : L-edge

* Lanthanide Series

58 Ce 140.12	59 Pr 140.907	60 Nd 144.24	61 Pm (147)	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.924	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.97
--------------------	---------------------	--------------------	-------------------	--------------------	--------------------	--------------------	---------------------	--------------------	---------------------	--------------------	---------------------	--------------------	--------------------

† Actinide Series

90 Th 232.038	91 Pa (231)	92 U 238.03	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (249)	99 Es (254)	100 Fm (253)	101 Md (256)	102 No (256)	103 Lr (257)
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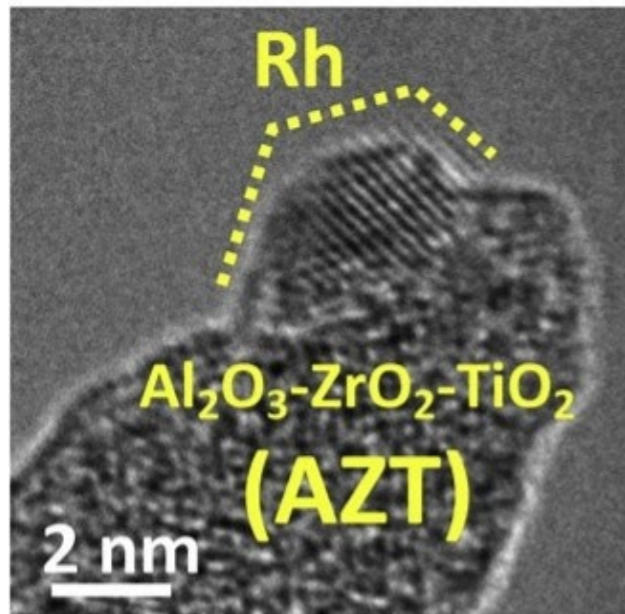


64 cells, the system can handle more than 10M counts s⁻¹ within a linearity of 75%.

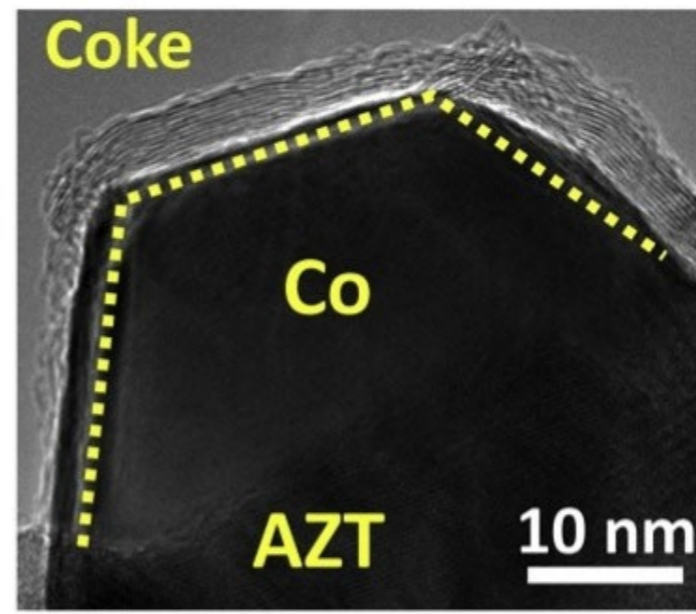


✓ **Carlomagno et al.**
 ✓ **Volume 28 | Part 6 | November 2021 | Pages 1811–1819 |**
 10.11107/S1600577521008857

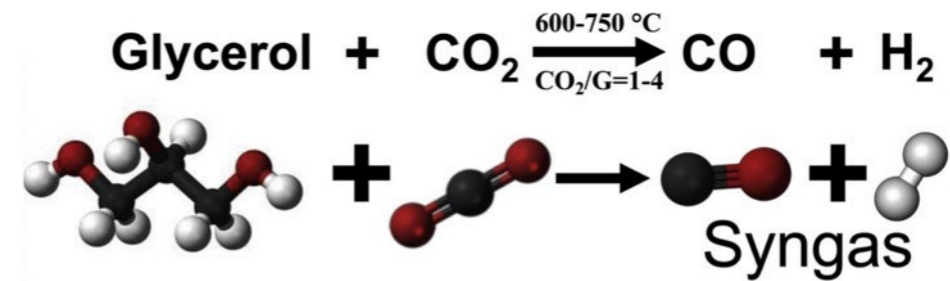
Türkiye: Syngas Production from Glycerol



Rh/AZT



Co/AZT



Applied Catalysis B: Environmental 256 (2019) 117808

Contents lists available at ScienceDirect

Applied Catalysis B: Environmental

journal homepage: www.elsevier.com/locate/apcatb



Exceptionally active and stable catalysts for CO₂ reforming of glycerol to syngas

Selin Bac^a, Zafer Say^{b,c}, Yusuf Kocak^b, Kerem E. Ercan^b, Messaoud Harfouche^d, Emrah Ozensoy^{b,e,**}, Ahmet K. Avci^{b,*}

^a Department of Chemical Engineering, Bogazici University, Bebek, 34342, Istanbul, Turkey

^b Bilkent University, Department of Chemistry, 06800, Ankara, Turkey

^c Department of Physics, Chalmers University of Technology, 412 96, Göteborg, Sweden

^d Synchrotron-Light for Experimental Science and Applications in the Middle East (SESAME), 19252, Allan, Jordan

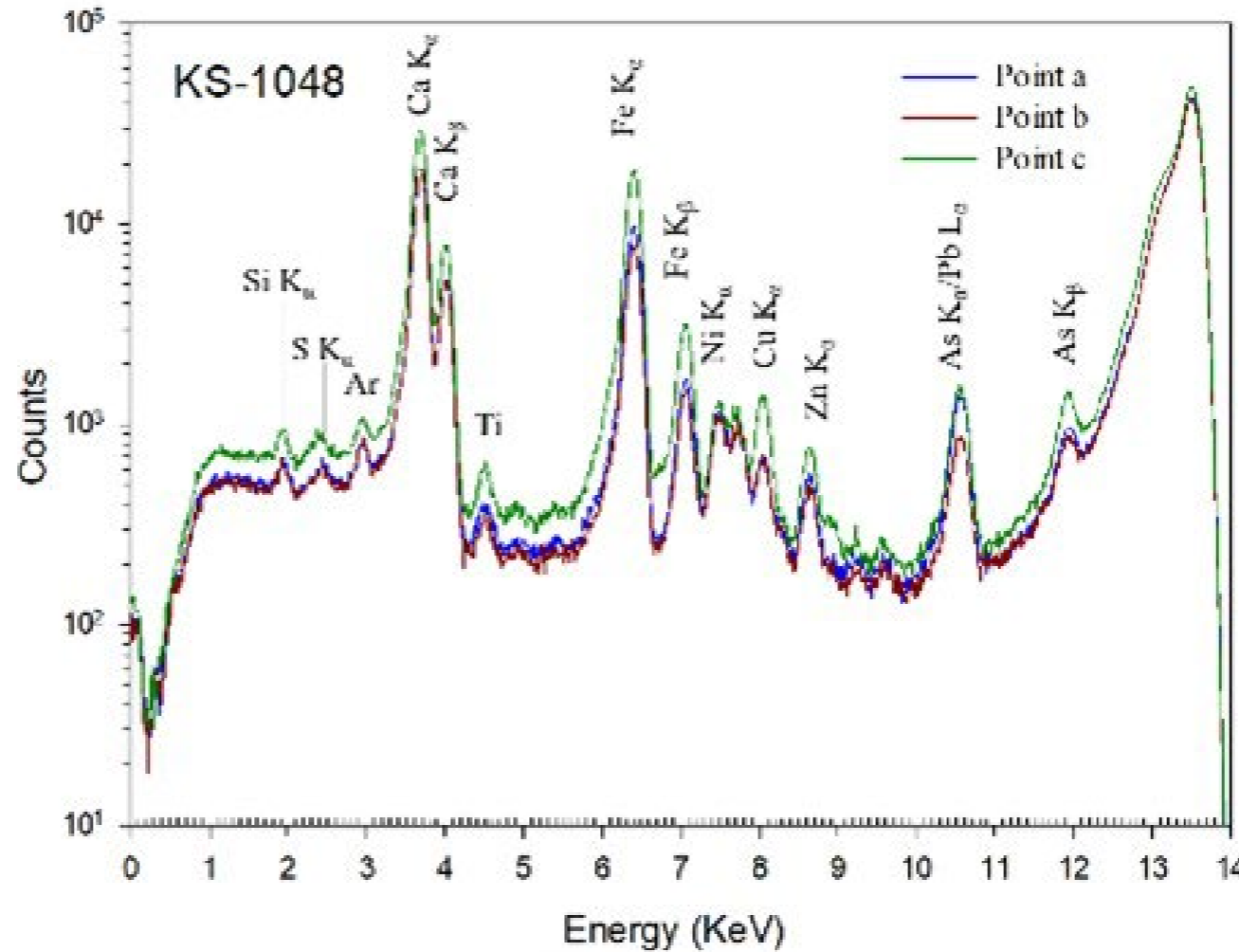
^e UNAM-National Nanotechnology Center, Bilkent University, 06800, Ankara, Turkey





SESAME

XAFS/XRF: X-ray Fluorescence Analysis



Synchrotron-based
X-ray Fluorescence
Analysis Of Byzantine
Plaster Figurines
From Jordan Museum



www.maajournal.com

Mediterranean Archaeology and Archaeometry
Vol. 23, No 1, (2023), pp. 199-208
Open Access. Online & Print.



01-17-2024 Wed 17:56:38

radio waves

microwaves

infrared

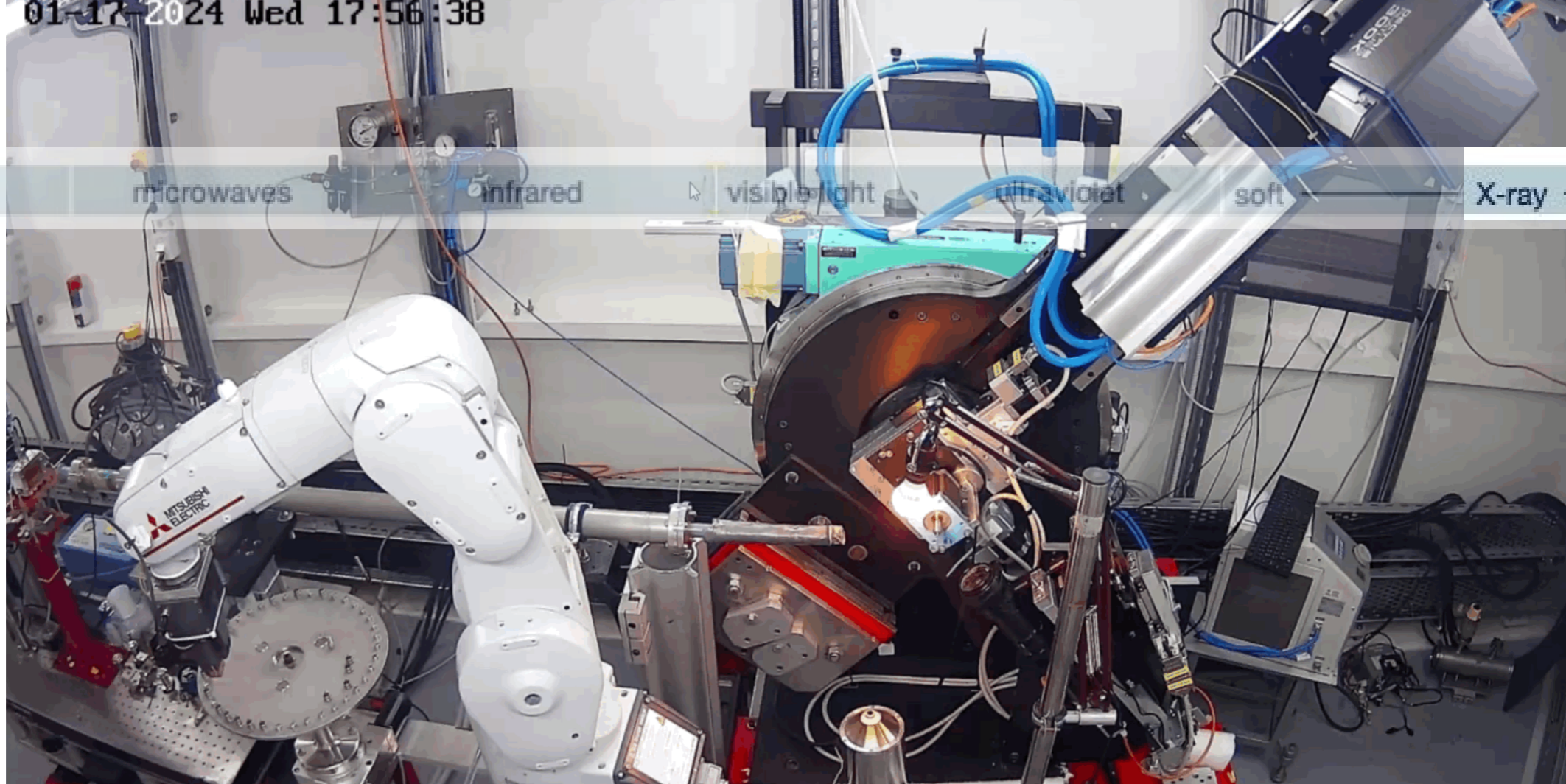
visible light

ultraviolet

soft

X-ray

hard



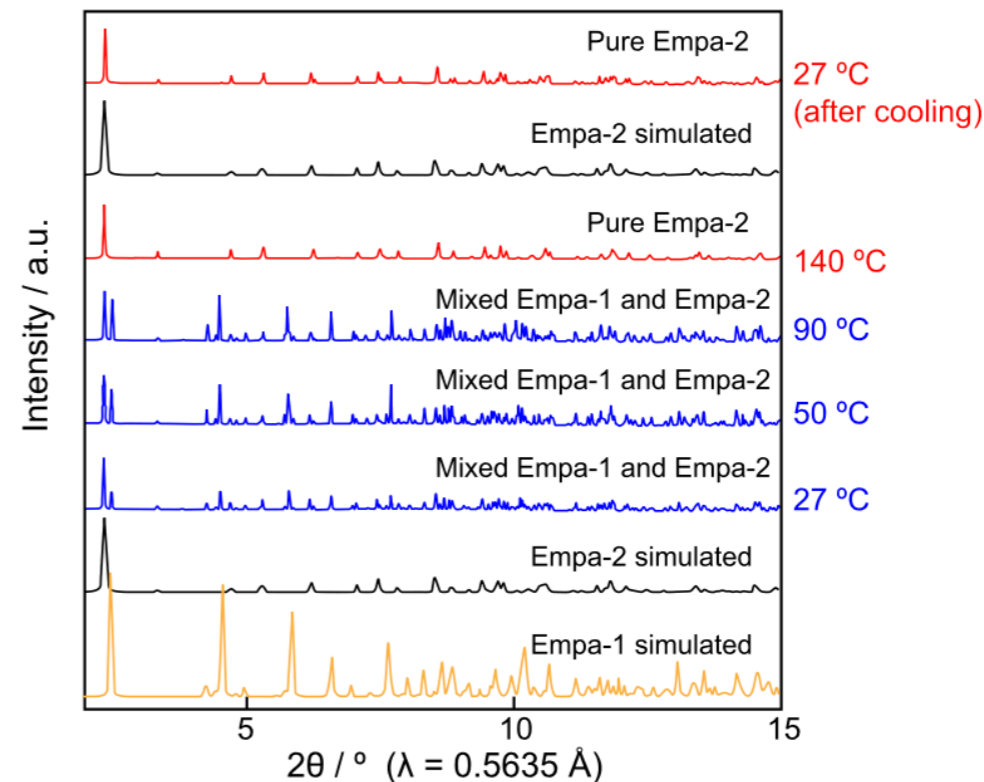
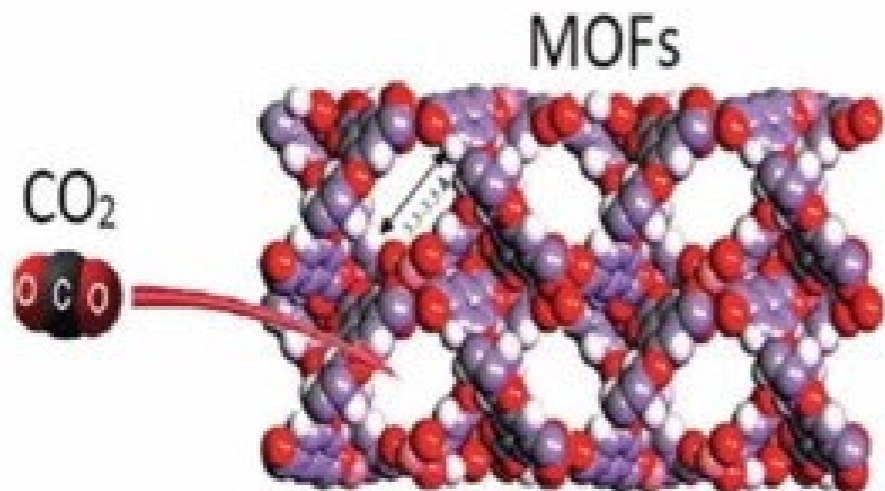
MS/XPD

Powder Diffraction



SESAME

MS/XPD: phase transitions

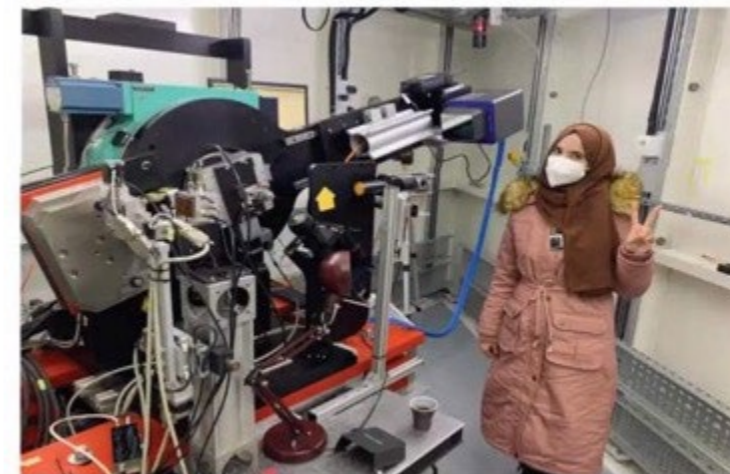


ACS
MATERIALS LETTERS

www.acsmaterialsletters.org

Robust Barium Phosphonate Metal–Organic Frameworks Synthesized under Aqueous Conditions

Khalifah A. Salmeia,^{*} Simone Dolabella,[‡] Dambarudhar Parida,[‡] Terry J. Frankcombe, Akef T. Afaneh, Kyle E. Cordova, Bassem Al-Maythaly, Shanyu Zhao, Romain Civioc, Ali Marashdeh, Bernhard Spingler, Ruggero Frison, and Antonia Neels^{*}





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microwaves

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X-ray

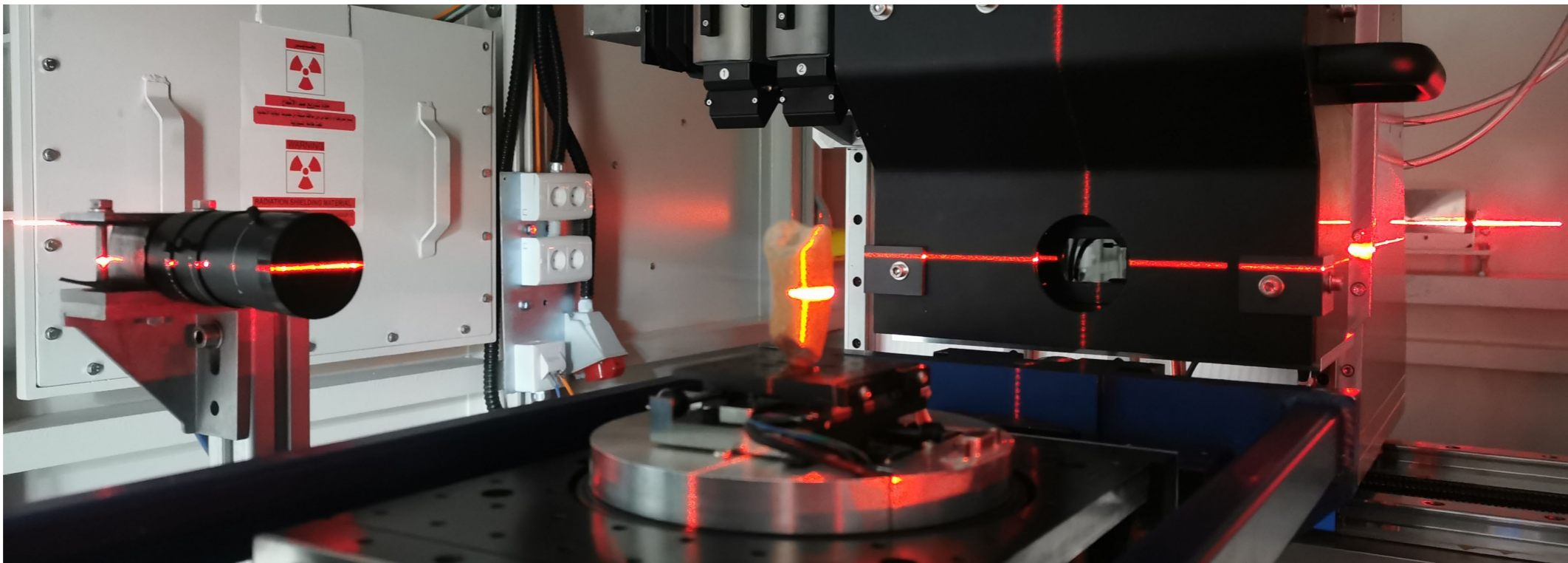
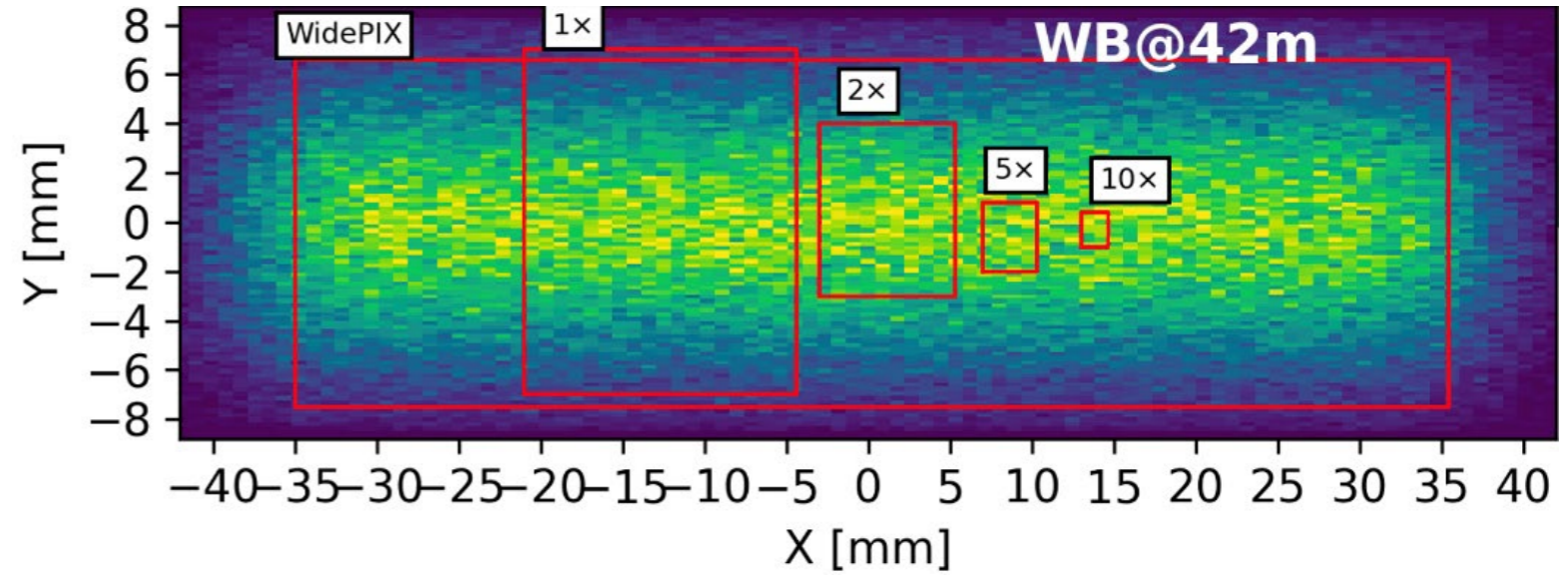
hard

BEATS

X-ray Microtomography



Magnif.	Field of view	Pixel size
0.5x	33.2 × 28.0 mm ²	13.0 μm
1x	16.6 × 14.0 mm ²	6.5 μm
2x	8.3 × 7.0 mm ²	3.25 μm
5x	3.4 × 2.8 mm ²	1.3 μm
10x	1.7 × 1.4 mm ²	0.65 μm





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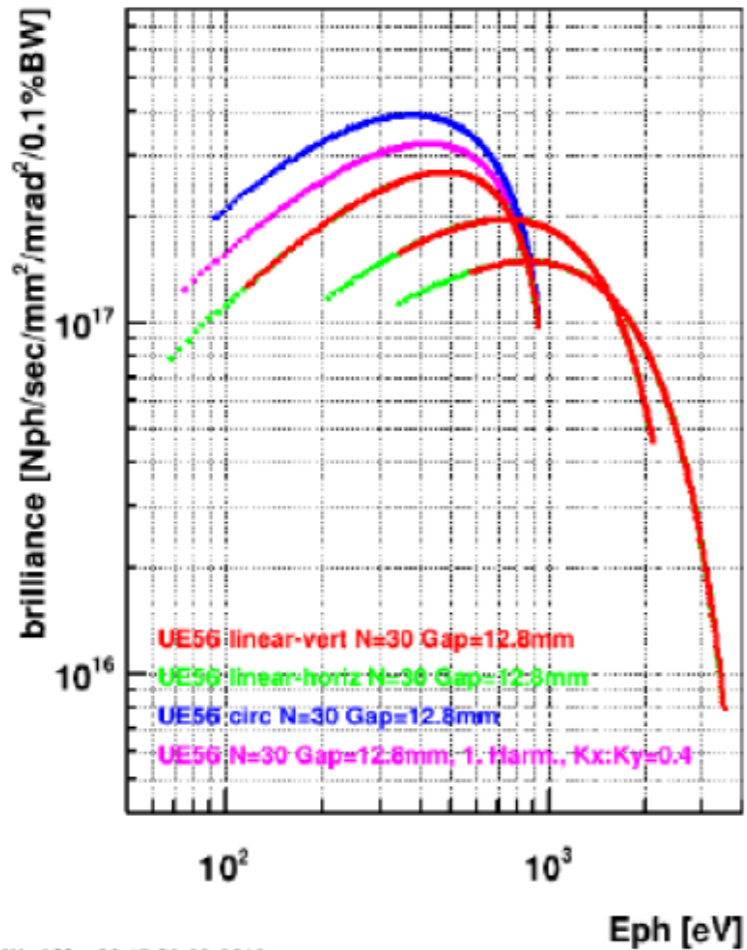
Photo © Ivan Lim

HESEB

Soft X-ray Absorption Spectroscopy



Brilliance, 2.5 GeV, 400 mA



Wed Mar 28 15:39:03 2016



Design led by W. Eberhardt / M. Genisel

Absorption, CMXD and fluorescence yield studies

Manipulator arm with sample transfer heating/cooling (FZ Jülich)

Assembly for focussing capillary (TU-Berlin) has been designed and built

2D-mapping of surfaces with 20 mm spatial resolution UHV---up to pressures of 1 atmosphere (He)



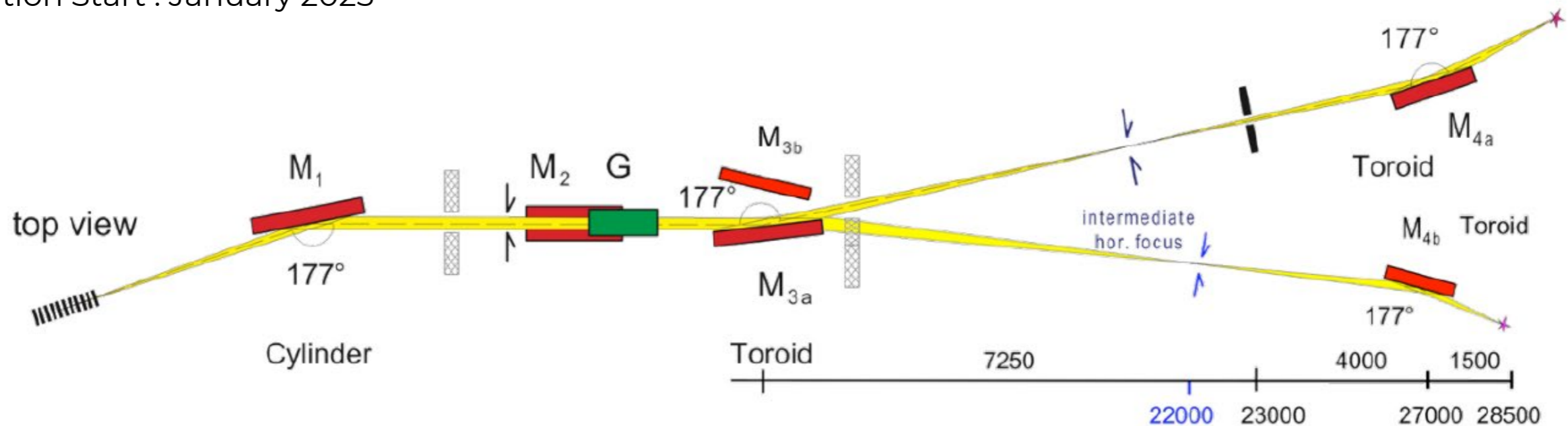
ID11 right – TXPES



The Turkish soft X-ray PhotoElectron Spectroscopy beamline (TXPES) is a project for the design and construction of a Soft X-ray Photoelectron Spectroscopy beamline at SESAME as a complementary beamline to HESEB

- Project Budget: ₺27 M
- Project Coordinator: Turkish Energy, Nuclear and Mineral Research Agency (TENMAK)

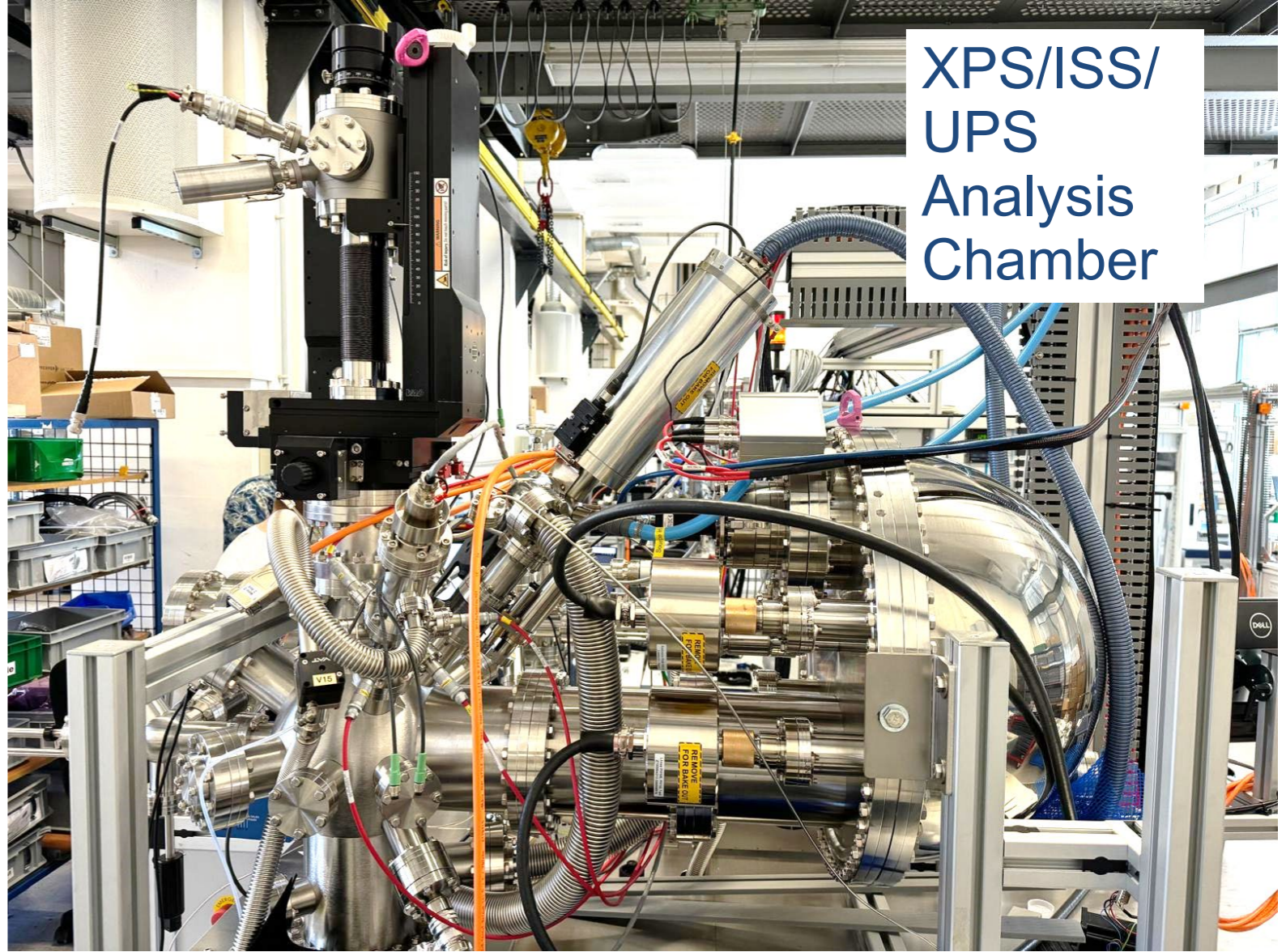
Installation Start : January 2025



XPS/ISS/
UPS
Analyzer

Prep
Chamber

High
Pressure
Cell



XPS/ISS/
UPS
Analysis
Chamber

TXPES



Archaeological and Heritage Sciences	
Mariangela CESTELLI GUIDI (coordinator)	INFN, Italy
Francois FAUTH	ALBA Synchrotron, Spain
Caroline JACKSON	University of Sheffield, UK
Costanza MILIANI	CNR, Italy

Life Sciences	
Michel HOUGH	Diamond Light Source, UK
Christophe SANDT	Synchrotron SOLEIL, France
Zehra SAYERS	Sabancı University, Türkiye
Lisa VACCARI (coordinator)	Elettra Sincrotrone Trieste, Italy

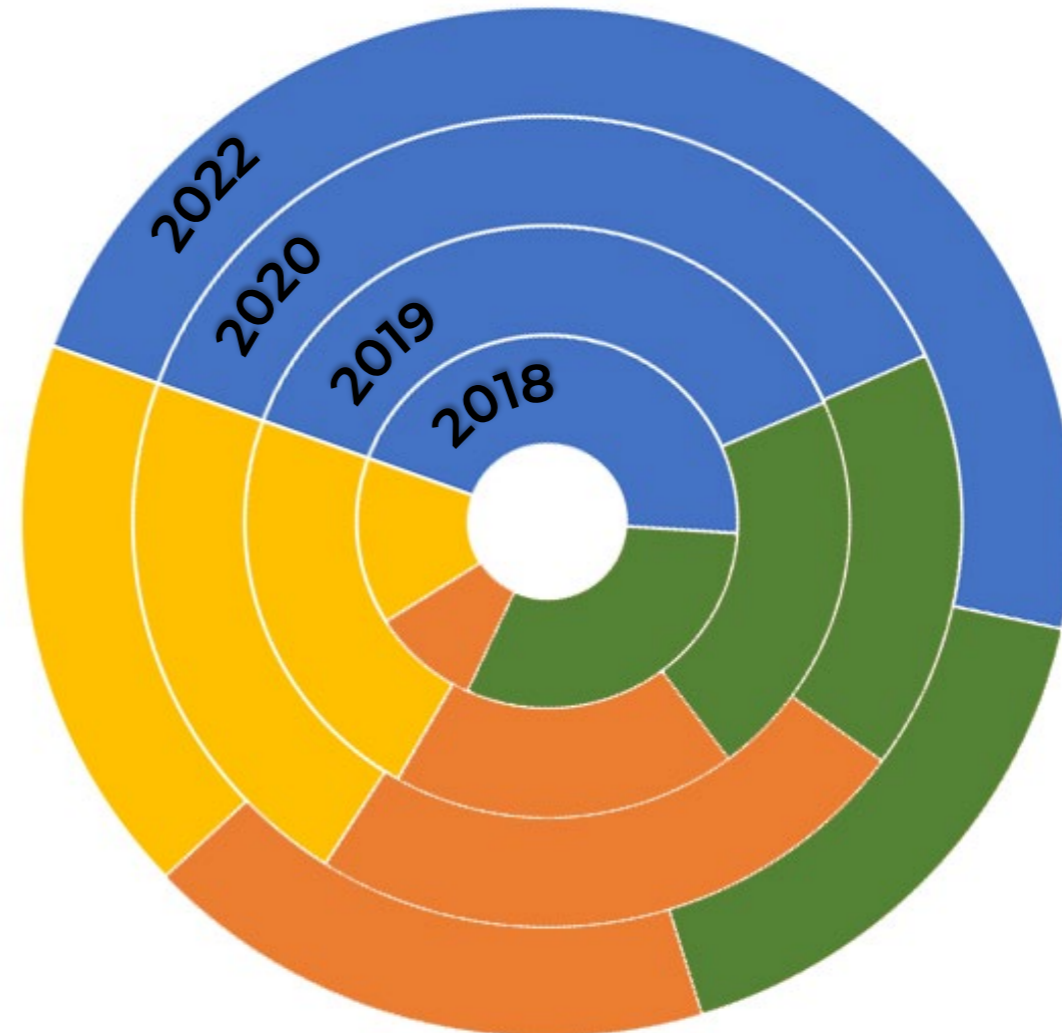
Chemical Sciences	
Sofia DIAZ-MORENO (coordinator)	Diamond Light Source, UK
Thomas ELLIS	University of Saskatchewan, Canada
Antonella GLISENTI	Univerty of Padova, Italy
Sarp KAYA	Koç University, Türkiye

Materials and Physical Sciences	
Muhammad Javed AKHTAR	PINSTECH, Pakistan
Andrew FITCH (coordinator)	ESRF, France
Bruce RAVEL	NIST and NSLS II, USA
Brian ROSEN	Tel Aviv University, Israel

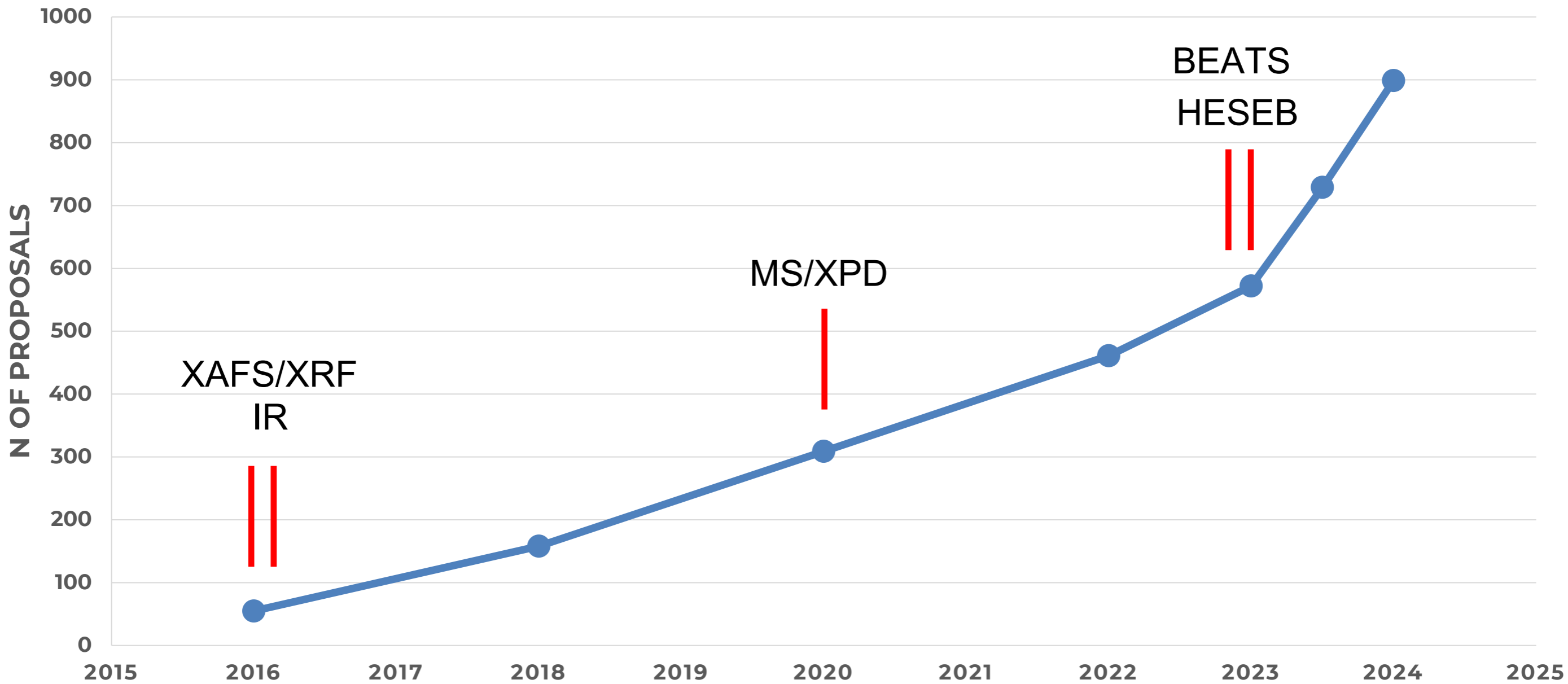
SESAME PRC

Proposal Review Committee

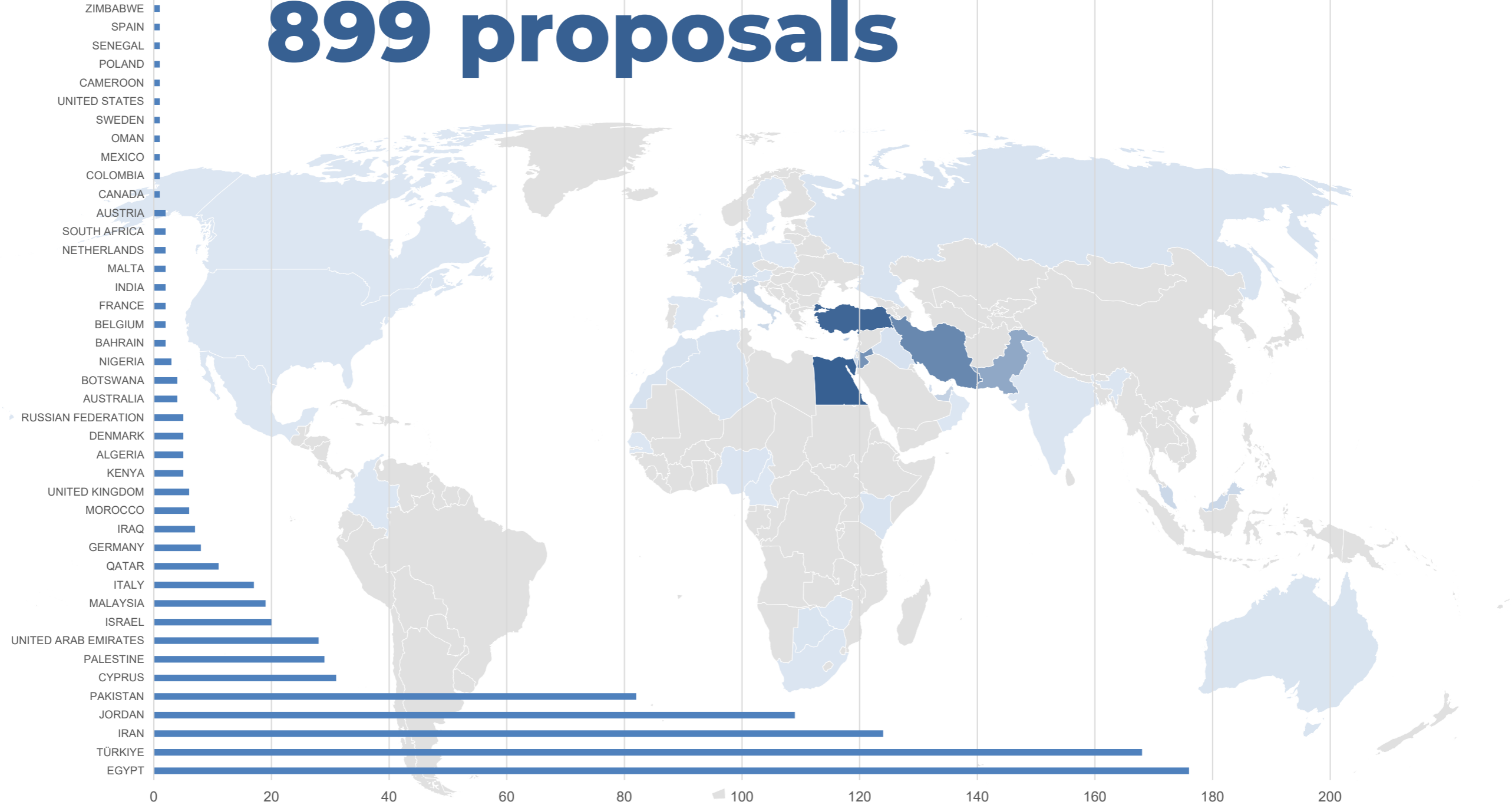
Samar HASNAIN (Chair) University of Liverpool, UK



Call 8 is open, deadline November 15, 2024 – beamtime April-September 2025



899 proposals

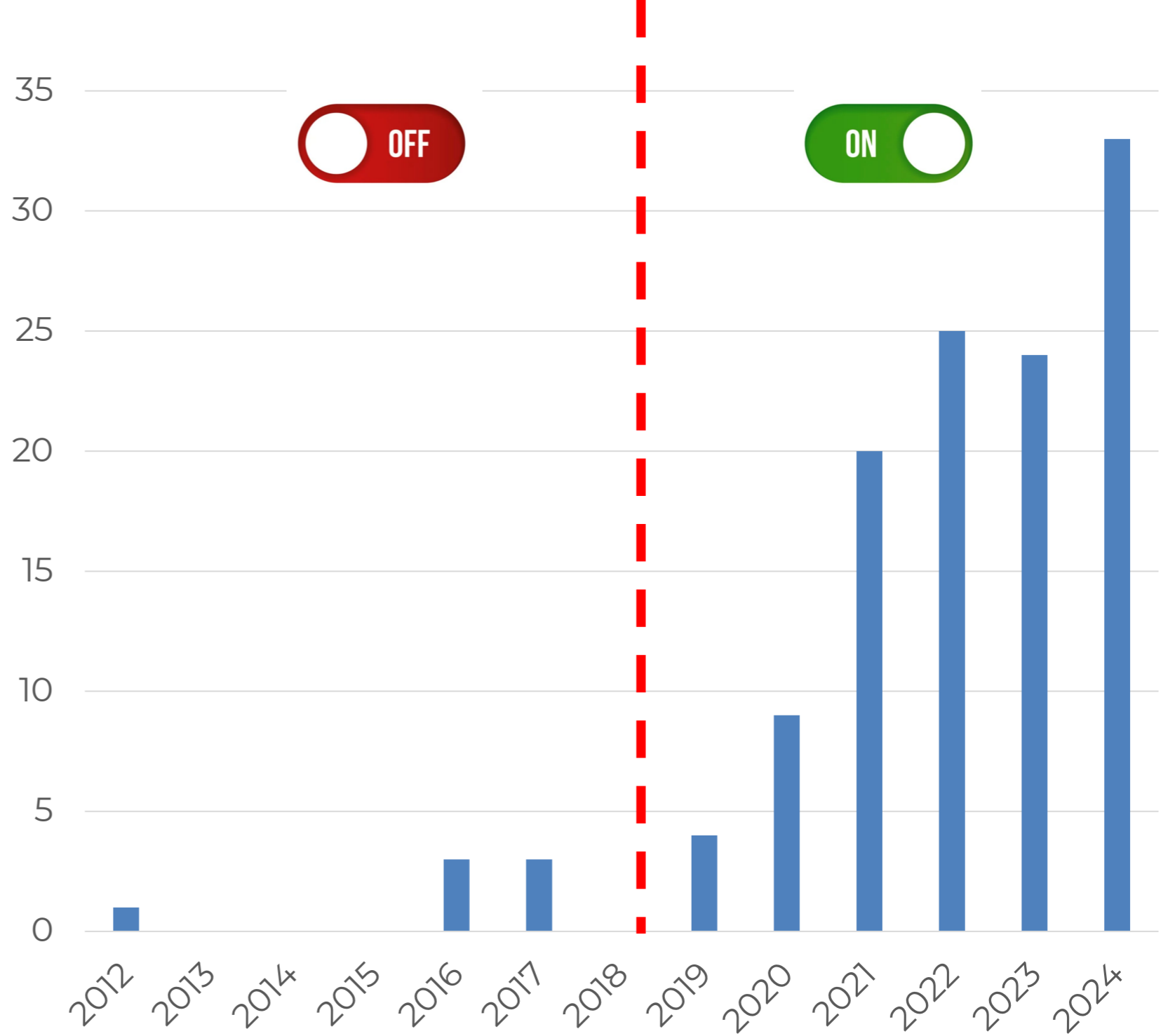


Publications

122

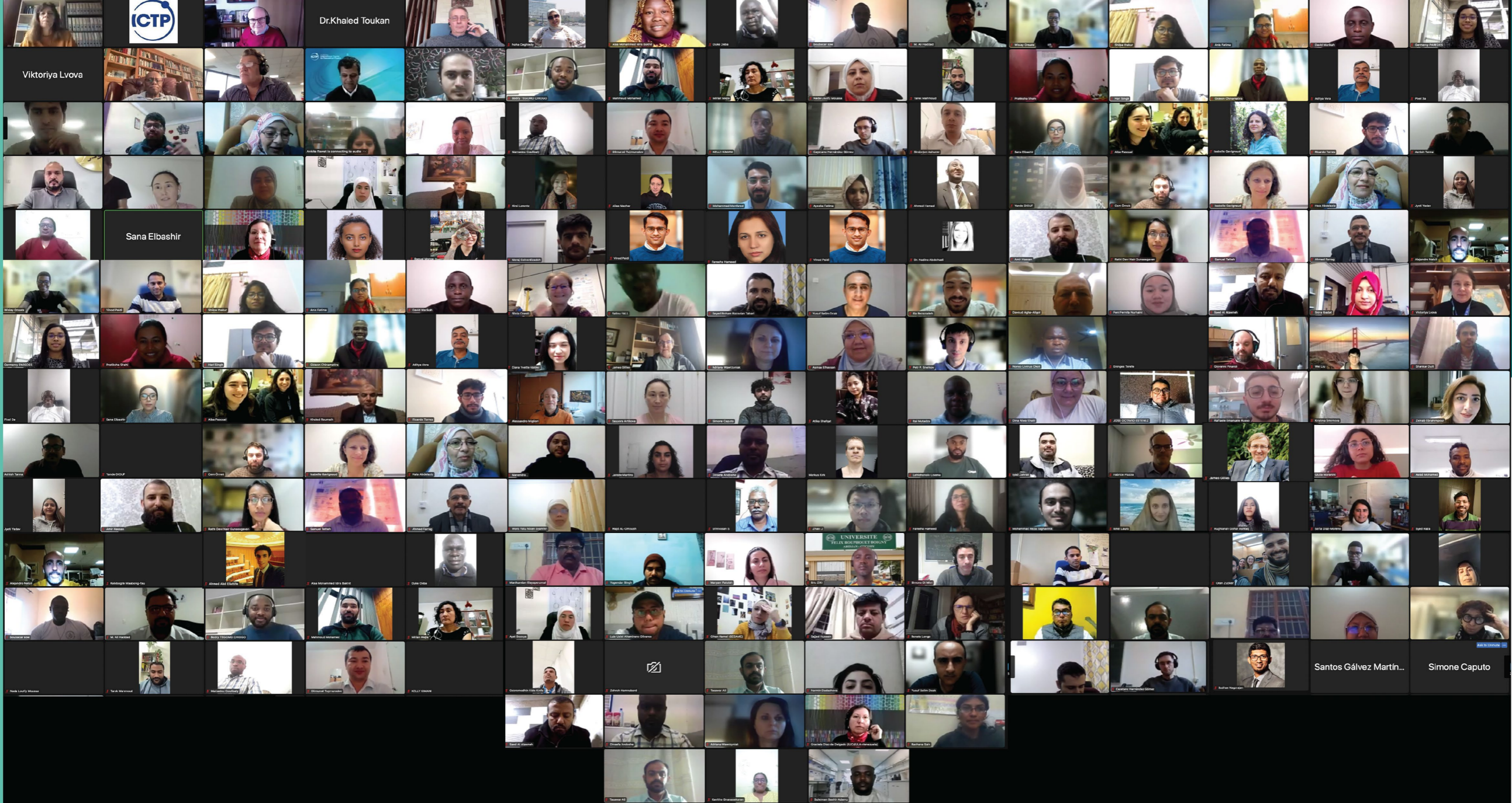
peer-review publications until
September 2024

- Average scientific impact factor > 5
- 19% of publications have IF > 7



Training at SESAME





15 - 26 January 2024





INFN - SESAME International
School on Efficient Scientific
Computing

May 27, 2023 to June 2, 2023
on SESAME premises

The school is organized as a small class of at most 30 students and focuses on trends in hardware architectures and parallel programming, with more in-depth lessons on modern C++, effective memory usage, floating-point computation and programming in a heterogeneous environment combining multi-threading, GPUs and clusters.

<https://indico.sesame.org.jo/event/3/>



SUNSTONE

SESAME'S UPGRADING NETWORK FOR SCIENTIFIC USER TRAINING AND OUTREACH INTO THE NEXT ERA

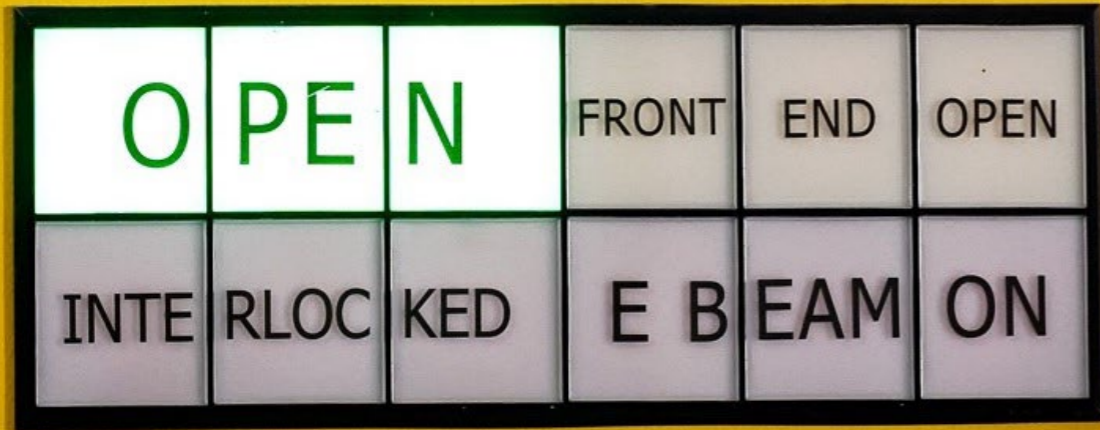
Special call: "Strengthening the international dimension of ESFRI and/or ERIC research infrastructures - consolidating the SESAME facility"

- **Coordinator: ESRF**
- **Budget: 1.5M€, of which 1.0M€ to SESAME (staff, other costs, overheads) + funds from State Secretariat for Education, Research and Innovation (PSI)**
- **Project duration: 42 months**
- **Beneficiaries (as named in the EC call): ALBA, CYI, DESY, ELETTRA, ESRF, INFN, SESAME and SOLEIL; and PSI as Associate**
- **Start 01 June 2024**

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Outlook

SESAME is open and produces world-class science

SESAME is an internationally well-connected facility

Challenges: securing remaining capital, attracting new members, managing financial disparities.

Travel restrictions and political tensions present ongoing issues.

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