SESAME

Co-operative Brightness

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75 years SR

Synchrotron Radiation was named after its discovery in a General Electric synchrotron accelerator built in 1946 and announced in May 1947 by Frank Elder, Anatole Gurewitsch, Robert Langmuir, and Herb Pollock in a letter entitled "Radiation from Electrons in a Synchrotron".

Synchrotron Radiation covers a broad spectrum from microwaves to hard X-rays

Synchrotron Radiation is extremely collimated

Scientific Cultural Centers in continuous evolution

50.000 users, the largest scientific community in the world

1) Synchrotron Radiation covers a **Broad Spectrum**
from microwaves to hard X-rays:
the user can select the wavelength required for experiment

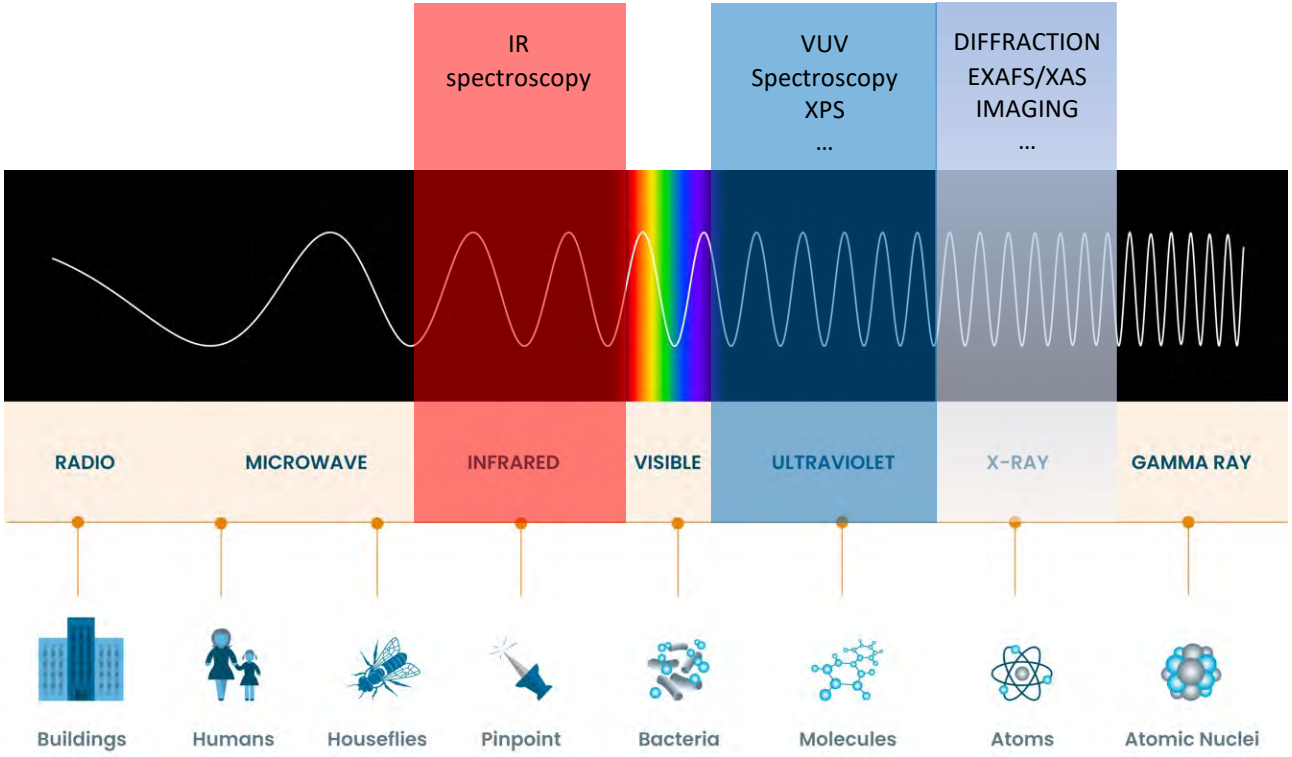
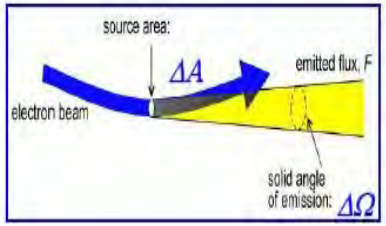
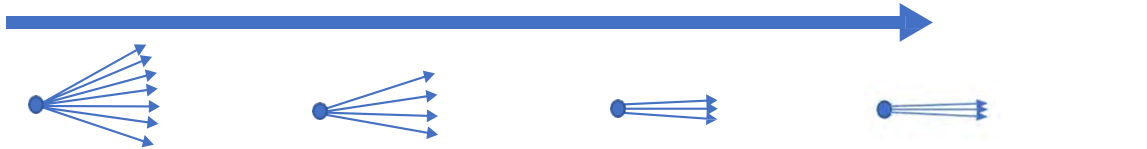


Image courtesy XFEL

2) Synchrotron Radiation is extremely **collimated**

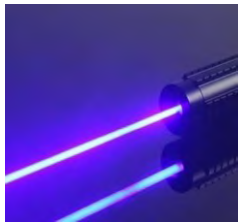


$$\text{BRILLANCE} = \frac{\text{Photon flux}}{\text{Source area x angular divergence}}$$




HALOGEN LAMP


TORCH

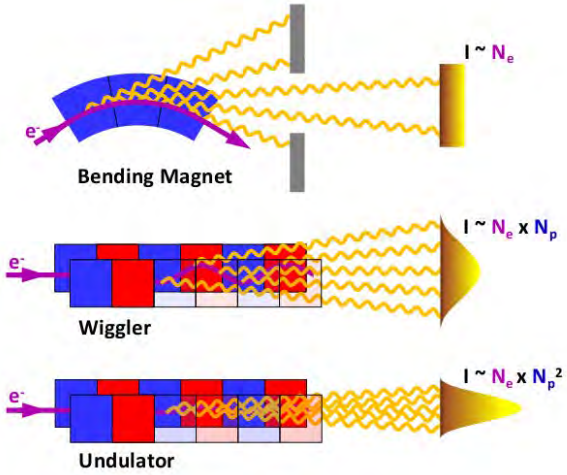

LASER

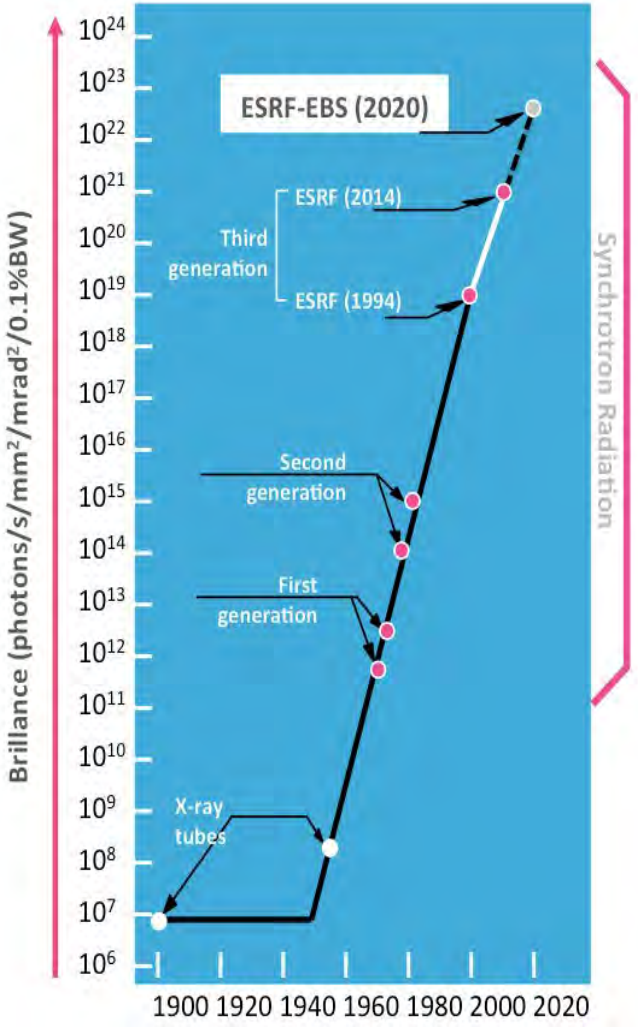

SYNCROTRON RADIATION

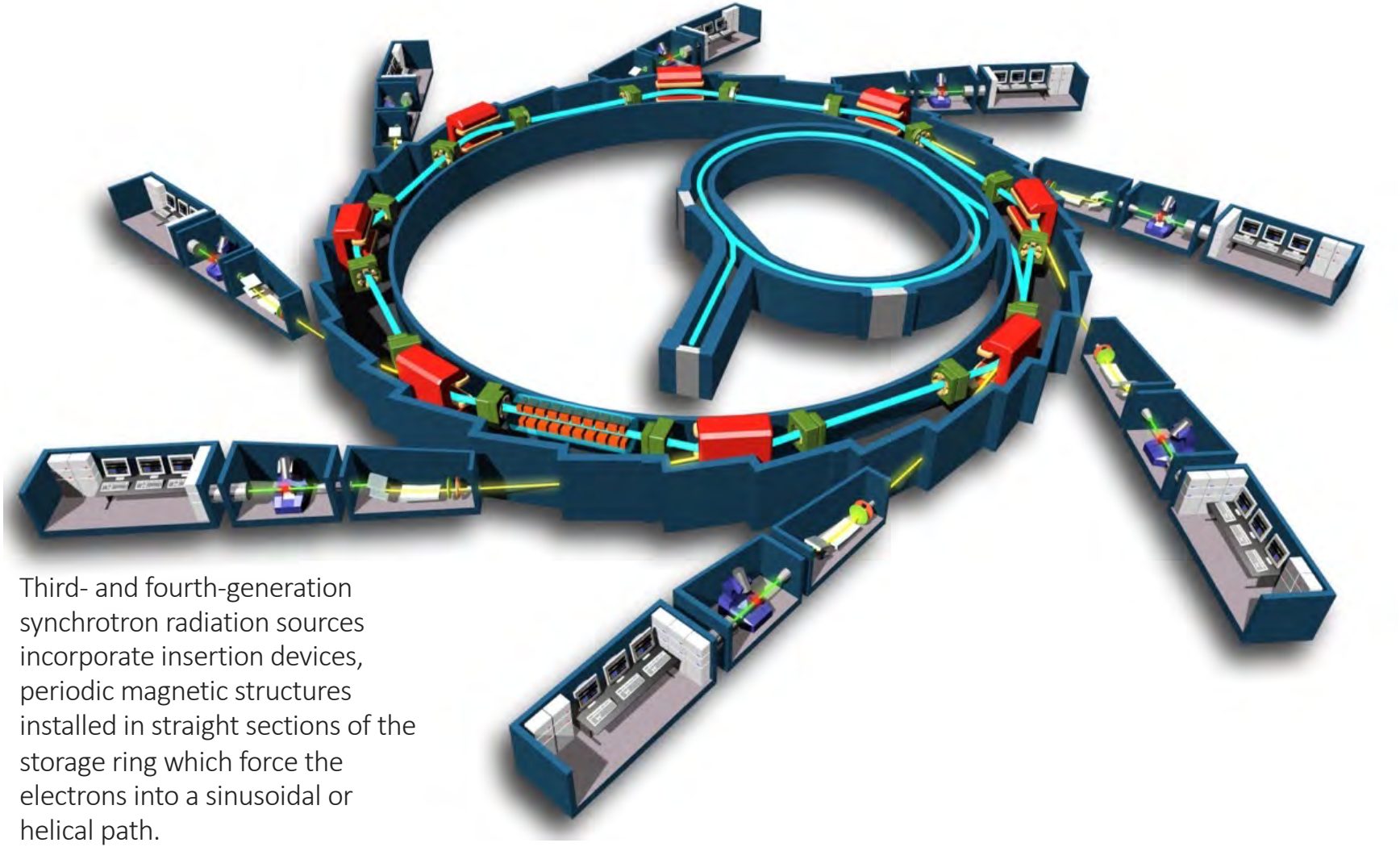
Collimation: Conventional Sources vs Syncrotron Ligth

Courtesy M. Cestelli Guidi

Synchrotron Radiation can be **taylored** to the experiment needs







Third- and fourth-generation synchrotron radiation sources incorporate insertion devices, periodic magnetic structures installed in straight sections of the storage ring which force the electrons into a sinusoidal or helical path.

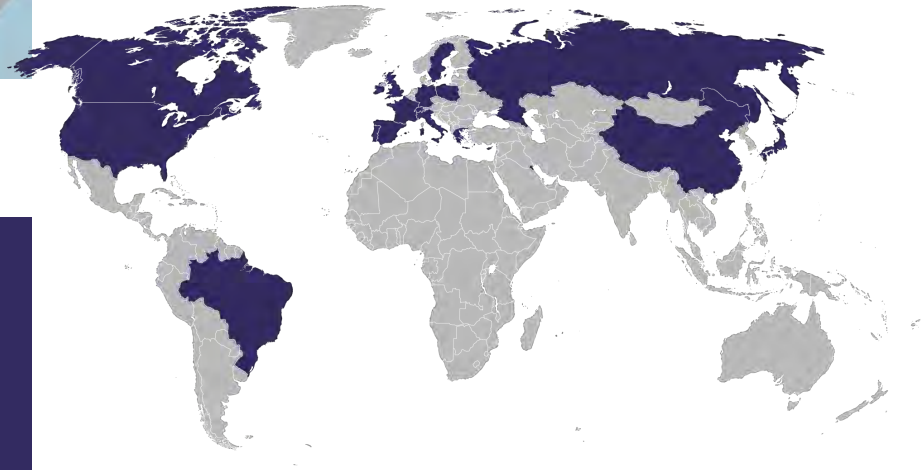
SESAME is located in Allan, NW of Amman, the capital of Jordan

United Nations
Educational, Scientific and
Cultural Organization

- SESAME is a cooperative venture by scientists and governments of the region set up on the model of CERN (European Organization for Nuclear Research) although it has very different scientific aims.

- It was developed under the auspices of UNESCO (United Nations Educational, Scientific and Cultural Organization) following the formal approval given for this by the Organization's Executive Board (164th session, May 2002).

Members: Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, Palestine, and Turkey.

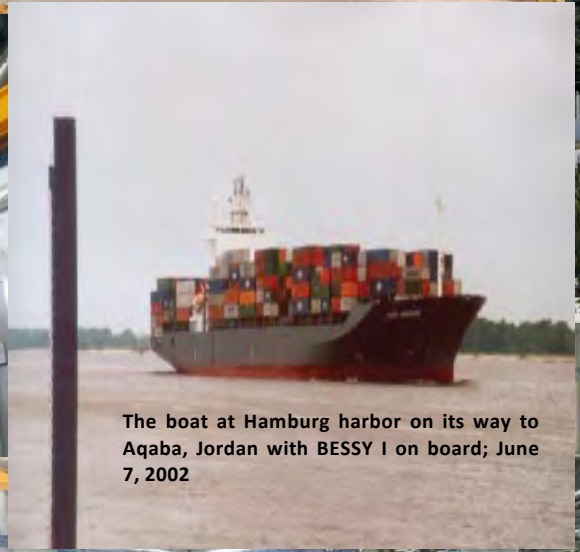


Observers: Brazil, Canada, CERN, China, the European Union, France, Germany, Greece, Italy, Japan, Kuwait, Portugal, Russian Federation, Spain, Sweden, Switzerland, the United Kingdom, United Arab Emirates, and the United States of America.

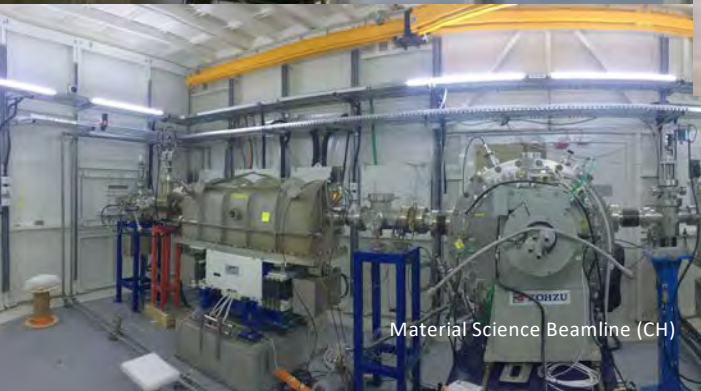
SESAME received much support from non-members.
Examples are…


Solar Power Plant (EU)


Sergio Fubini Guest-House (I)


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


XAFS/XRF Monochromator (UK)

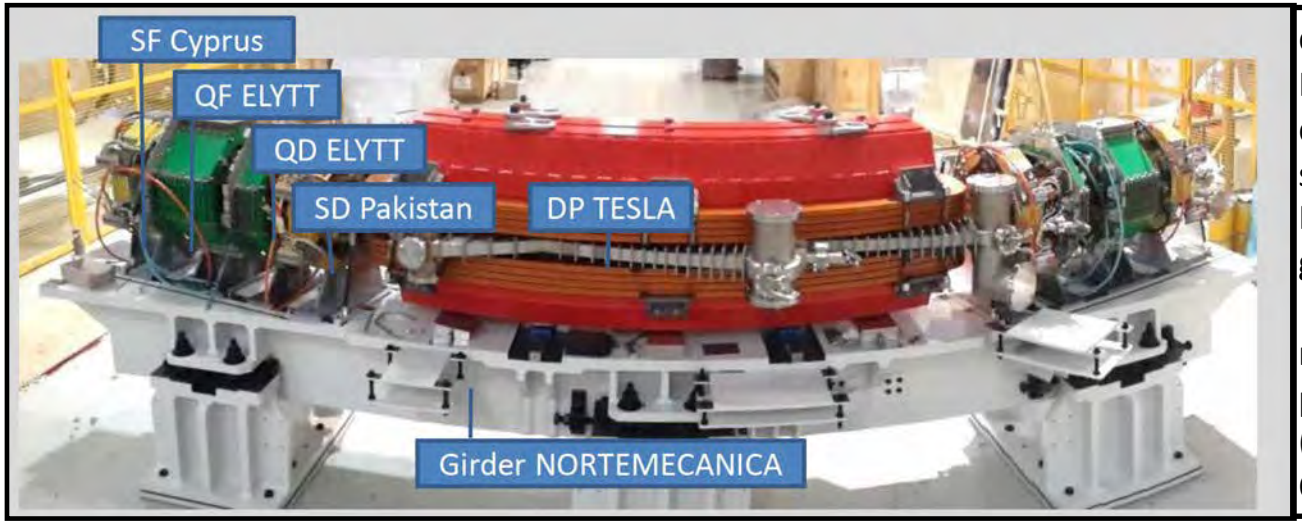


Material Science Beamline (CH)


The 4 RF Cavities (I)

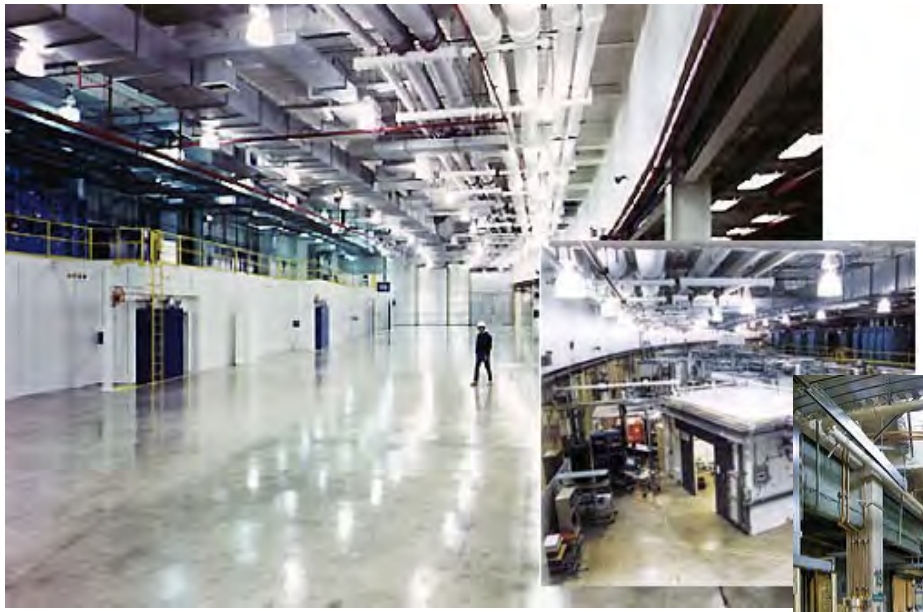
SESAME Opening Ceremony, May 16, 2017 His Majesty King Abdullah II following the opening of SESAME, flanked by Heads of the delegations of the SESAME Members and Directors of International Organisations that have supported SESAME. To the King's left, HRH Princess Sumaya of Jordan, who headed the Jordanian delegation, and Fabiola Gianotti, Director General of CERN; to the right, Irena Bokova, Director-General of UNESCO, Carlos Moedas, European Commissioner for Research, Science and Innovation, and Rolf Heuer, President of SESAME Council

To build a storage ring is a shared effort

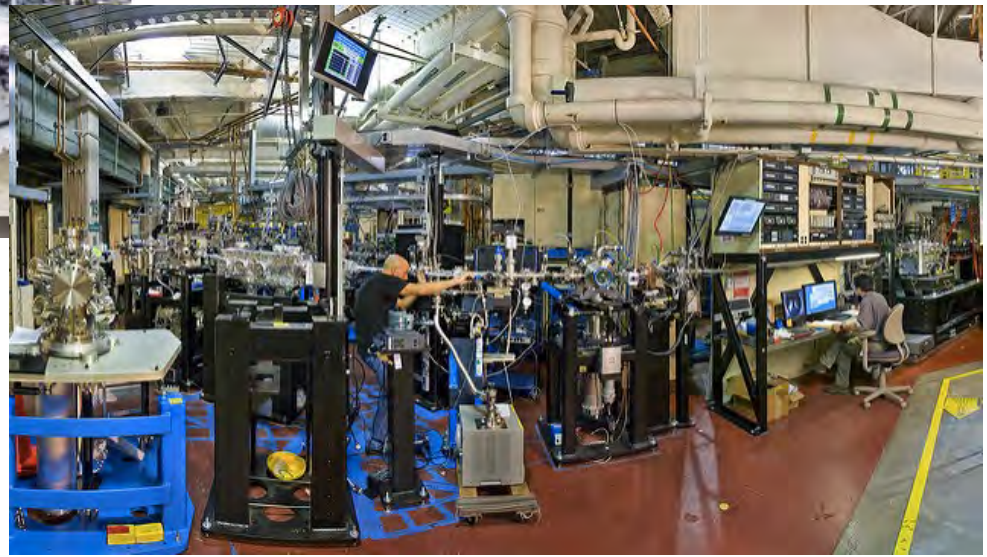


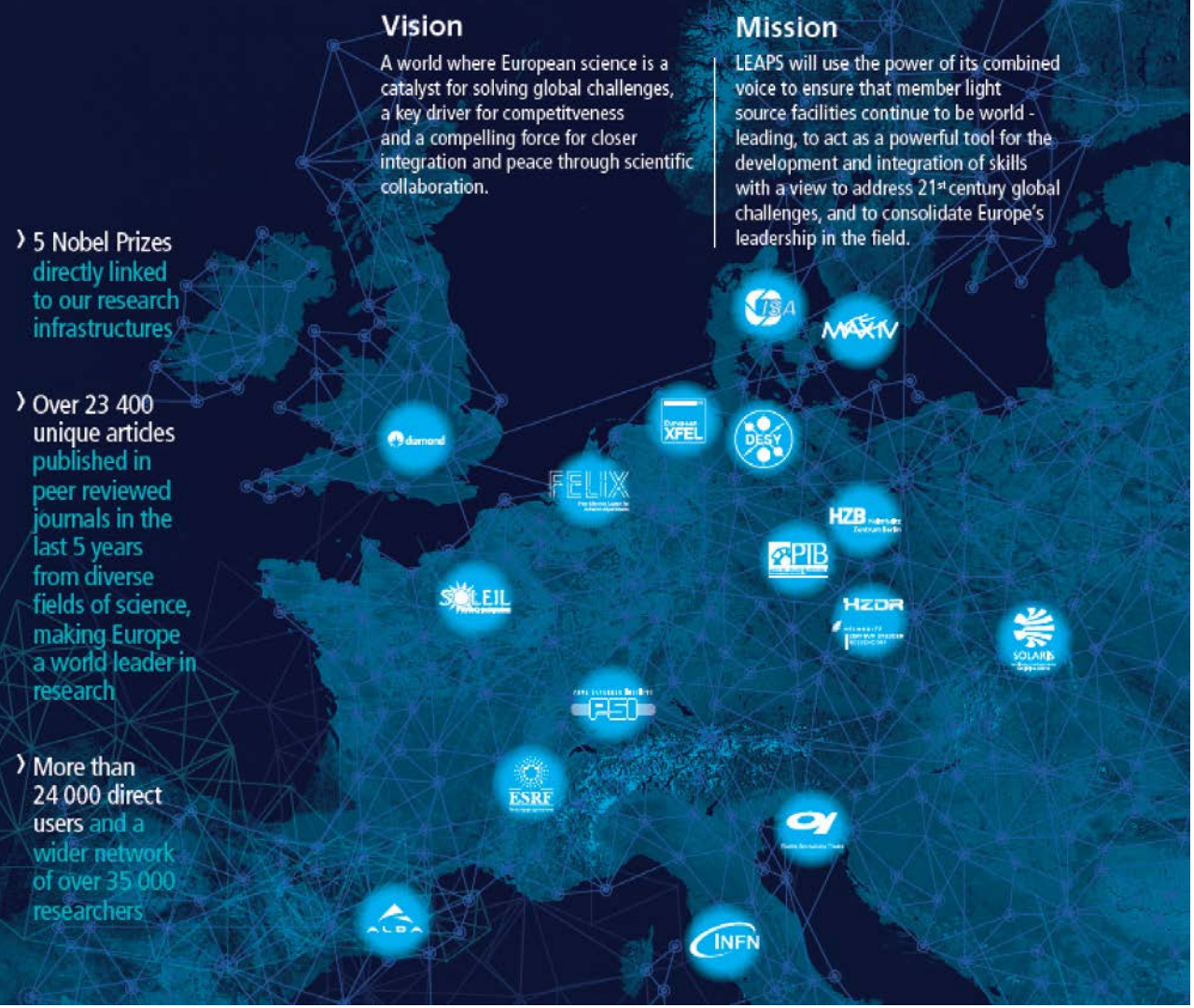
dipole magnets: TESLA, United Kingdom
quadrupole magnets: ELYTT: Spain
sextupole magnets: Cyprus and Pakistan
girders: NORTEMECANICA, Spain

magnets designed at SESAME, procured by SESAME/CERN office (CESAMAG)
QA/QC at ALBA (Spain) and at CERN



Synchrotron Light Facilities are
cultural science centers
in continuous evolution



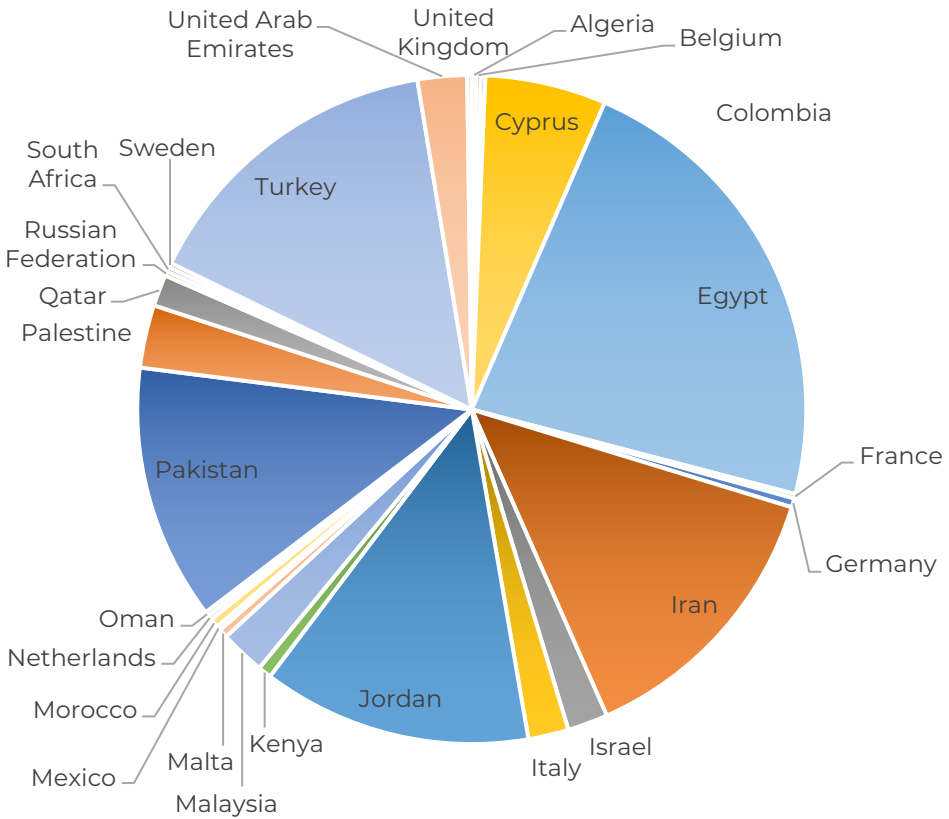


LARGE SCALE FACILITIES

Major "Photon Factories" in Europe

Third generation synchrotrons

Free-electron Lasers



461 proposals from 27 countries

2018

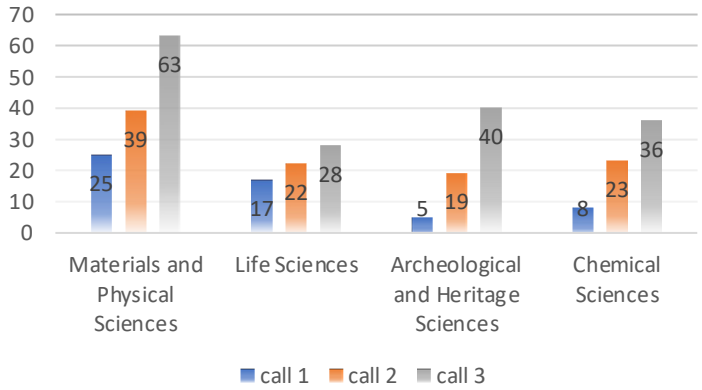
BM02
IR

2018

BM08
XAFS/XRF

2020

ID09
MS



BM02 - Infrared Beamline, IR

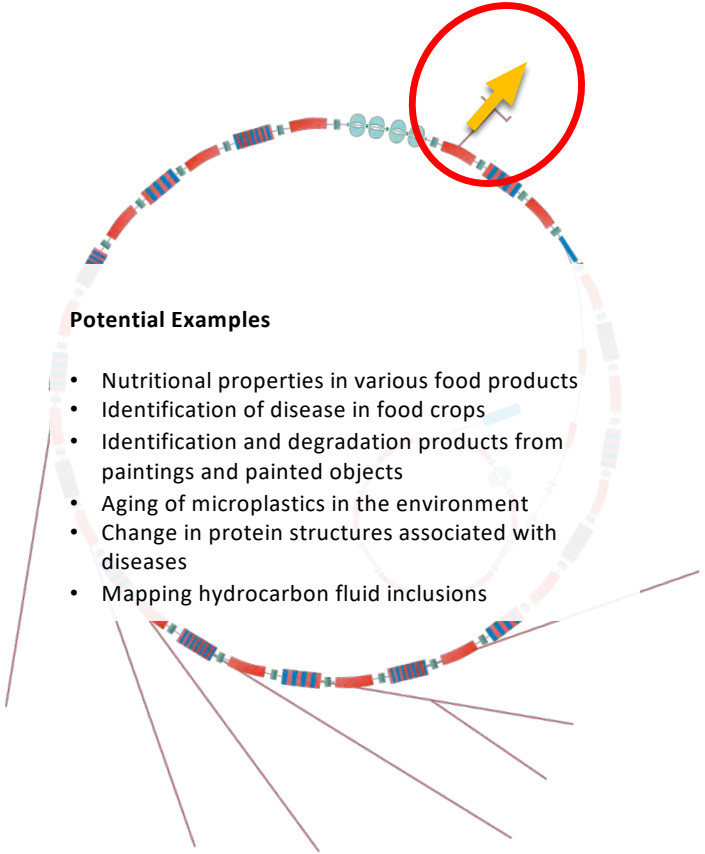
Gihan Kamel Ahmed Refaat

Operational since November 2018
infrared spectroscopy and microscopy

Source – Bending magnet

Experimental station – Thermo Scientific© 8700 FTIR Spectrometer equipped with internal DLaTGS detectors. The spectrometer is coupled with a Thermo Scientific© Nicolet Continuum IR-microscope equipped with 15x and 32x for transmission/reflection, ATR, and grazing incidence angle IR objectives.

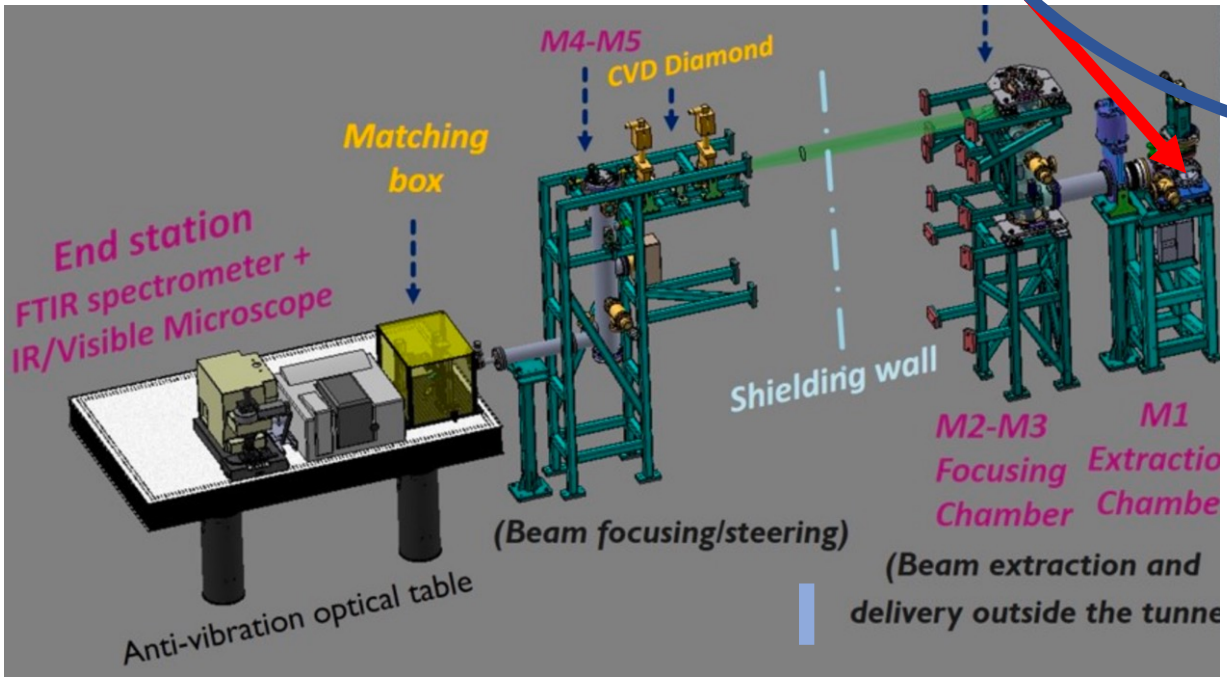
Sample Type – Fiber, Liquid, Powder, Solid.



Potential Examples

- Nutritional properties in various food products
- Identification of disease in food crops
- Identification and degradation products from paintings and painted objects
- Aging of microplastics in the environment
- Change in protein structures associated with diseases
- Mapping hydrocarbon fluid inclusions

IR beamline layout



Stage 2 and experimental setup

Stage 1

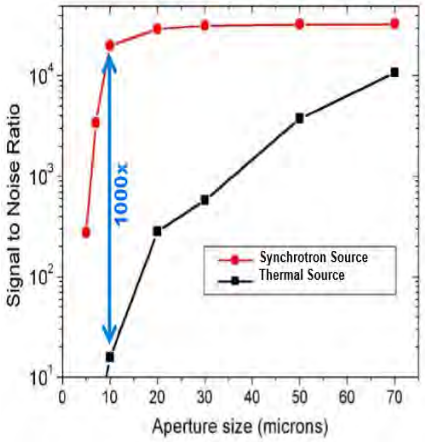
September 2017:
IR Optical elements up to the shielding wall installed

First IR beam observed in April 2018

2022: New Microscope and Spectrometer installed in the Experimental Hutch as part of INFN-CHNet.

SR Advantages over thermal sources

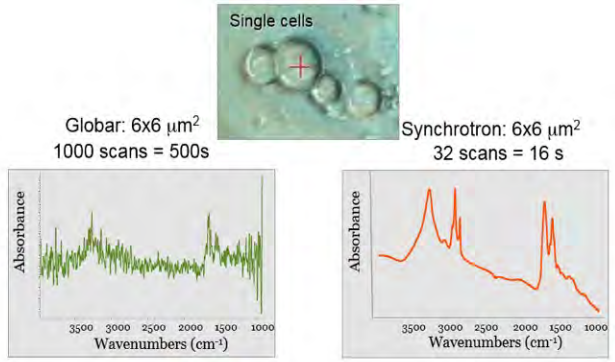
Synchrotron IR is 1000x *brighter* than a conventional blackbody source



Advantages

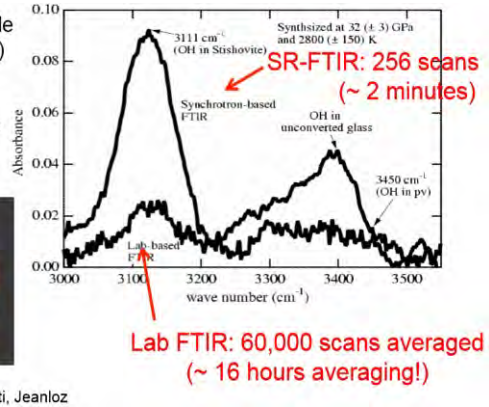
- Diffraction-limited spot sizes for microscopy (2-10 μm)
- Superior collimation for high spectral resolution
- Smaller samples
- Better signal to noise ratios
- Faster data acquisition

Holman et al., Spectroscopy - An International Journal 17(2-3), 139-159 (2003).



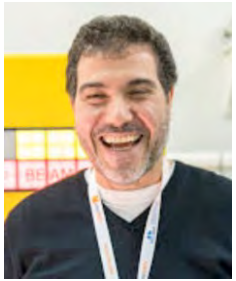
From Paul Dumas, SOLEIL

Mineral sample (ocean basalt) in diamond anvil cell at high pressure (32 GPa)



Panero, Benedetti, Jeanloz

BM08 – XAFS/XRF



Messaoud Harfouche

Ahmed Refaat

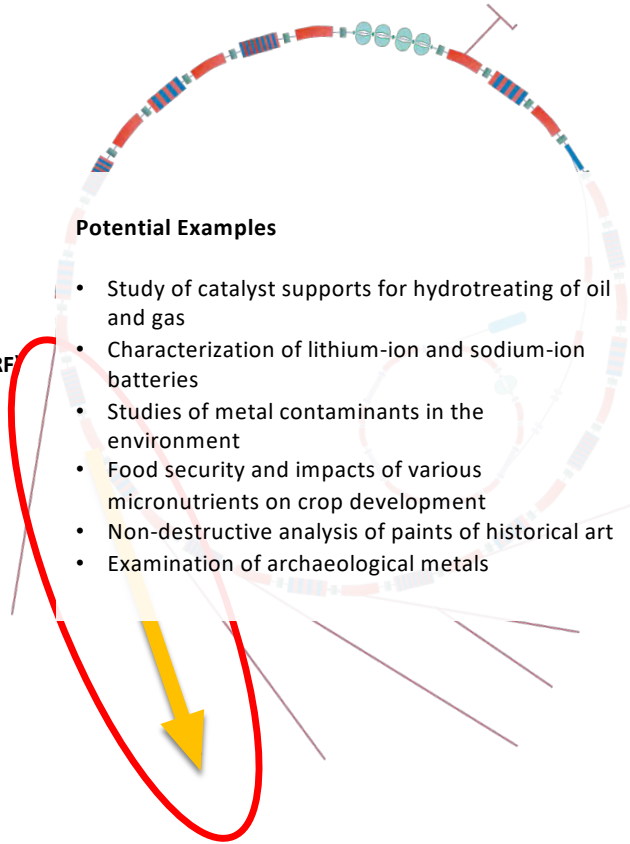
Operational since July 2018

X-ray Absorption Fine Structure/X-ray Fluorescence (XAFS/XRF)

Source – Bending magnet

Experimental station – optical table with 6 axis of freedom and used as support for different detectors as well as for the sample manipulator and other sample.
Detectors comprise Ion Chambers and X-Ray Fluorescence detectors (KETEK single element silicon drift detector and INFN 64 element silicon drift detector)

Sample Type – Crystal, Amorphous, Powder, Gel, Liquid, Gas



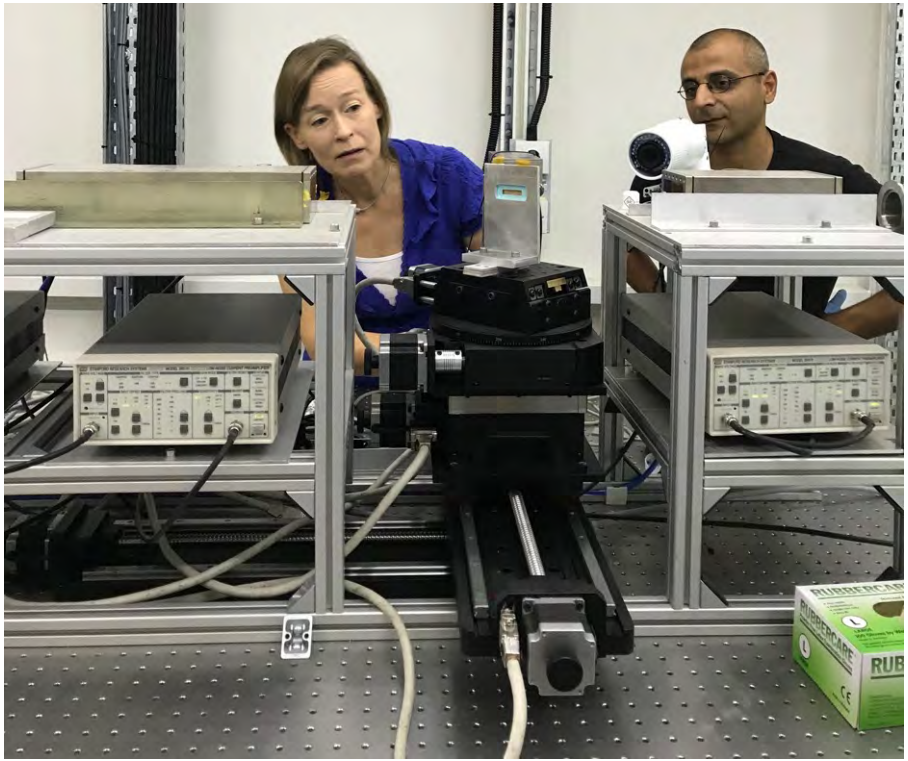
Potential Examples

- Study of catalyst supports for hydrotreating of oil and gas
- Characterization of lithium-ion and sodium-ion batteries
- Studies of metal contaminants in the environment
- Food security and impacts of various micronutrients on crop development
- Non-destructive analysis of paints of historical art
- Examination of archaeological metals

XAFS/XRF Safety Hutches being installed in April 2016

XAFS/XRF First monochromatic beam on November 22, 2017

XAFS/XRF first users in July 2018



Kirsi Lorentz and Iosif Hafez from The Cyprus Institute positioning the detector and mounting a sample for study in the experimental hutch of the XAFS/XRF beamline during their measurement run at SESAME in July 2018

First Scientific Paper Published in June, 2019 in a High Impact Factor Journal (11.6)

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 CO_2 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[a,*]

[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

ID09 – Powder diffraction Beamline (Materials Science), MS

Mahmoud Abdellatief

Operational since December 2020
Powder diffraction

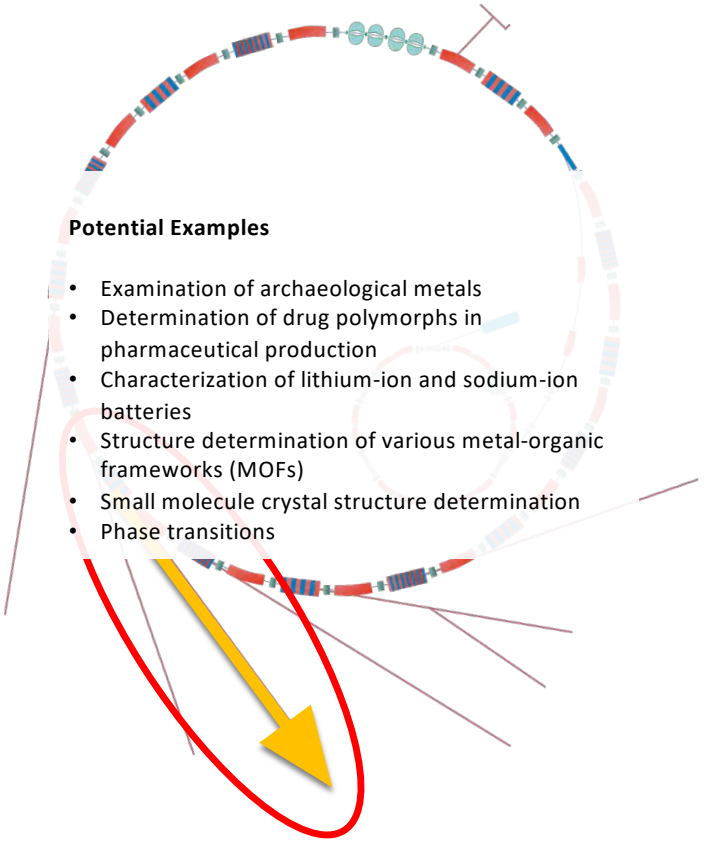
Source – Multipole wiggler

Experimental station – 2-circle diffractometer, with motorised translation stage to align the capillary to the spinner.

Sample environment – Hot Blower (RT to 1300 K) and Cryo Stream (100 K to RT)

Detector – Dectris Pilatus 300K

Sample Type –Powder in Capillary. (Flat sample geometry will be available in 2022)



Potential Examples

- Examination of archaeological metals
- Determination of drug polymorphs in pharmaceutical production
- Characterization of lithium-ion and sodium-ion batteries
- Structure determination of various metal-organic frameworks (MOFs)
- Small molecule crystal structure determination
- Phase transitions

ID09 – Powder diffraction Beamline (Materials Science), MS

January 2019 - Wiggler source before installation and commissioning

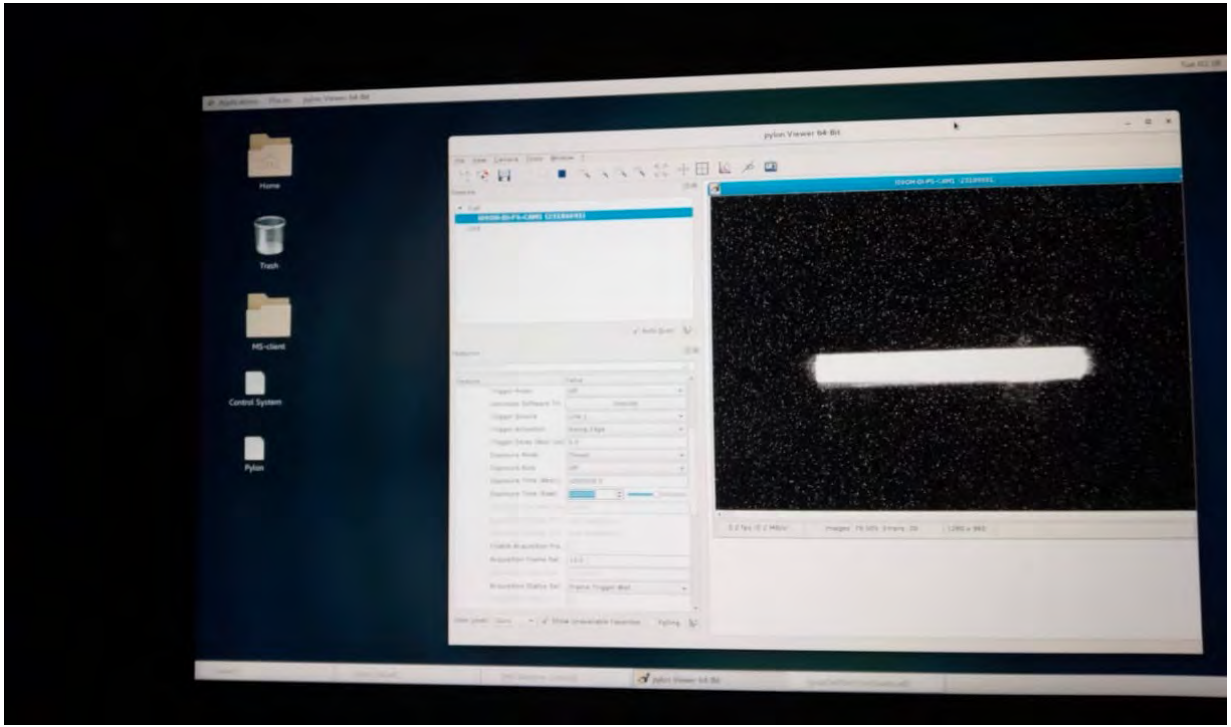
ID09 – Powder diffraction Beamline (Materials Science), MS

Wiggler final motion control tests before operation

ID09 – Powder diffraction Beamline (Materials Science), MS

November 24, 2019: all MS components installed and under vacuum

ID09 – Powder diffraction Beamline (Materials Science), MS



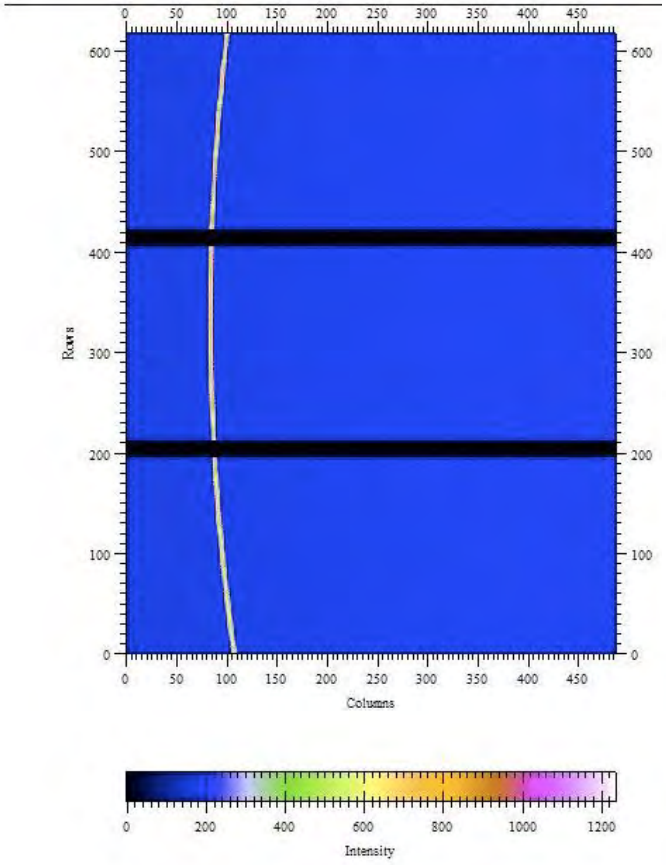
December 1, 2019: Start of commissioning
December 3, 2019: First monochromatic beam at Experiment

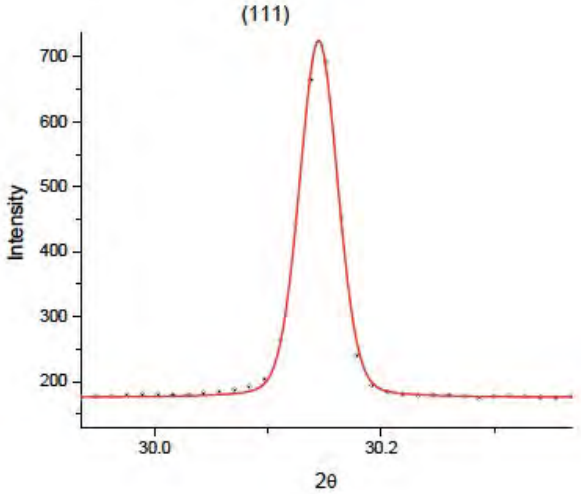
ID09 – Powder diffraction Beamline (Materials Science), MS

In 2019, Diamond donated a Kappa diffractometer to SESAME for its MS (Materials Science) beamline. After modification from Kappa to two-circle geometry the diffractometer was installed in the beamline utilising a support table from the 2008 Daresbury loan.

January 2020: beginning installation of the Experimental Station

ID09 – Powder diffraction Beamline (Materials Science), MS

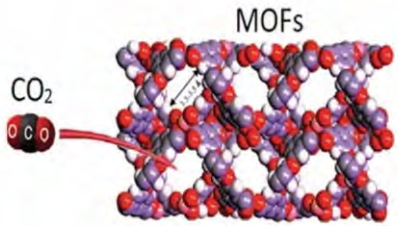




22 Oct. 2020:
First diffraction pattern measured
Silicon standard @ 8 keV

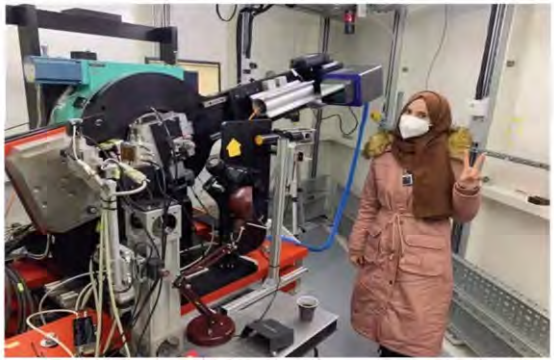
ID09 – Powder diffraction Beamline (Materials Science), MS

MOFs materials have attractive structures due to the presence of well-defined nanosized pore channels that lead to intrinsically high internal surface areas, which allow for the physical adsorption of a wide range of guest molecules



(Climate change control)

XRD is used to investigate and understand the correlation between MOFs crystal structures and their gas storage and sorption properties (mainly CO2 is of interest). The experiments should provide the needed knowledge required to tune these materials for better sorption efficiency.



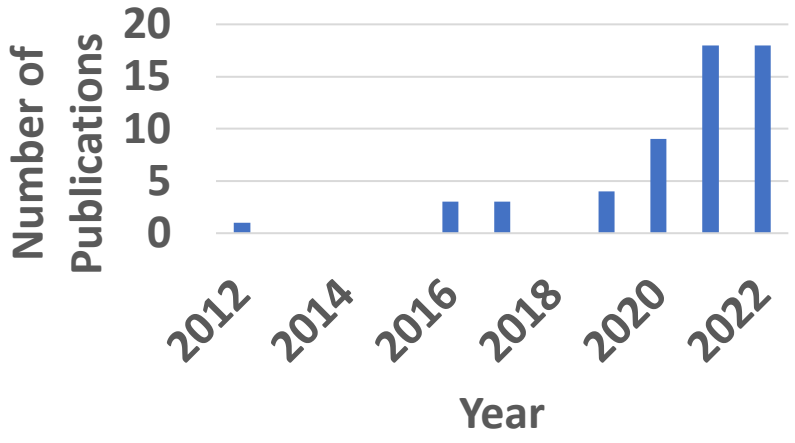
December 17, 2020 first user group, Crystallographic Analysis of Porous Metal Oxide Frameworks (MOFs) for C02 sorption applications.






IR beamline
2018-19





Number of Publications
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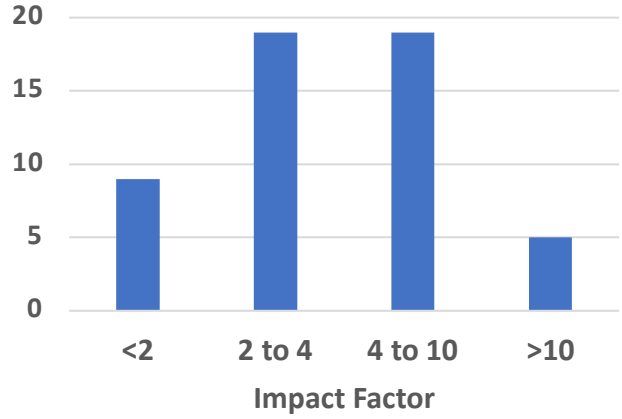
15
10
5
0
2012
2014
2016
2018
2020
2022
Year

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Impact Factor

ID10 - BEATS
BEAmline for Tomoghraphy at SESAME (2022)

ALBA · The Cyprus Institute · DESY. · Elettra Sincrotrone Trieste · ESRF · INFN LNF · PSI · SOLARIS National Synchrotron Radiation Centre

ID11 left – HESEB
Helmholtz-SESAME Beamline (2022)
Inaugurated on June 12, 2022

DESY. · JÜLICH Forschungszentrum · HZB Helmholtz Zentrum Berlin · HZDR · KIT

ID11 right – TXPES
Türkiye X-ray PhotoEmission Spectroscopy Beamline (2023)

TENMAK · TARLA · KOÇ UNIVERSITY

SEE YOU AT SESAME