SESAME

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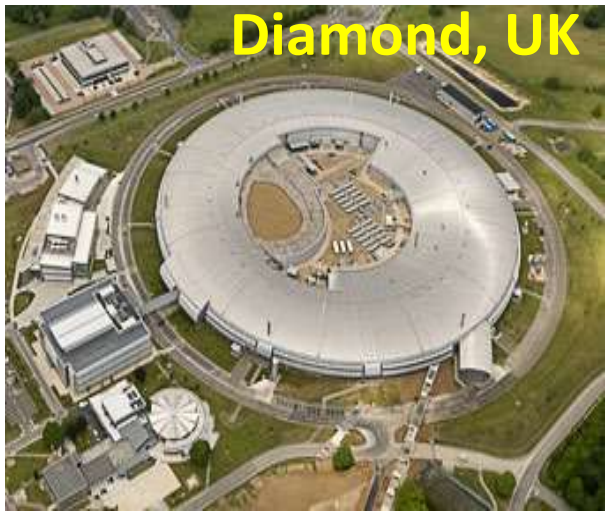
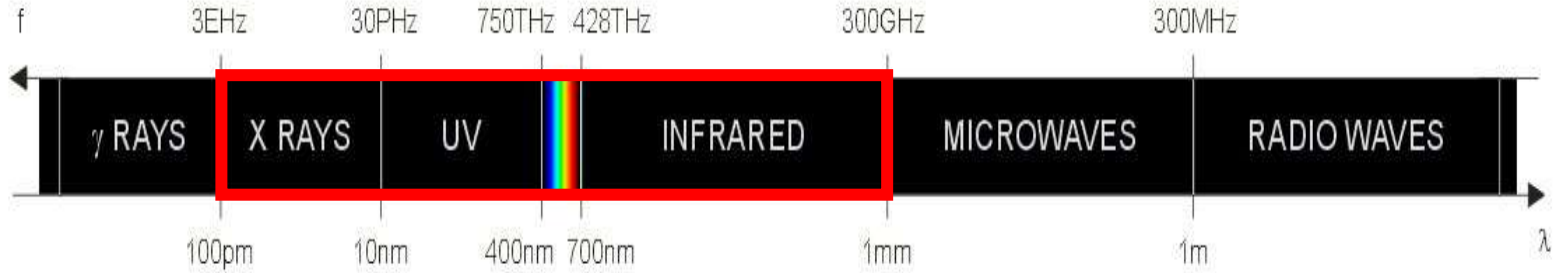
BM02-IR Beamline Principal Scientist

***on leave* from: Department of Physics, Faculty of Science, Helwan University, Cairo, Egypt**

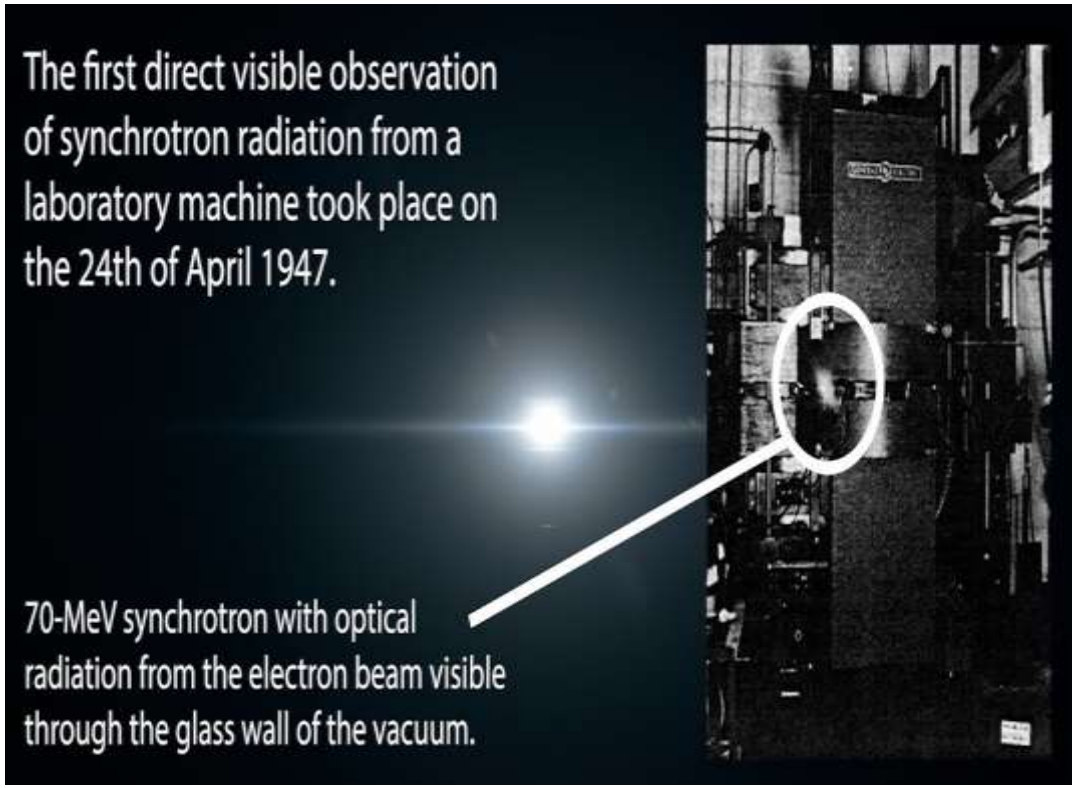
SESAME

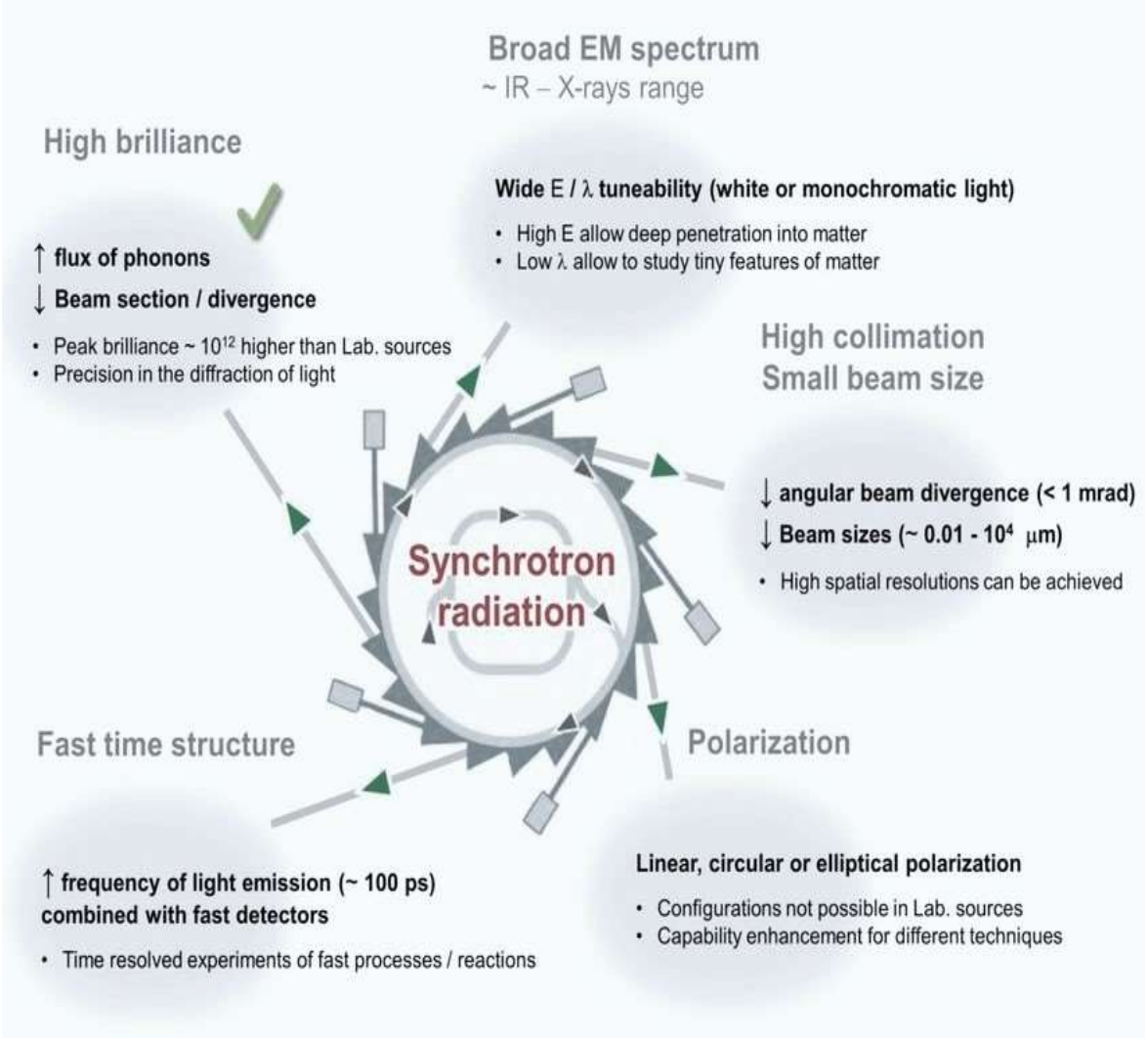
Science = common purpose + common values



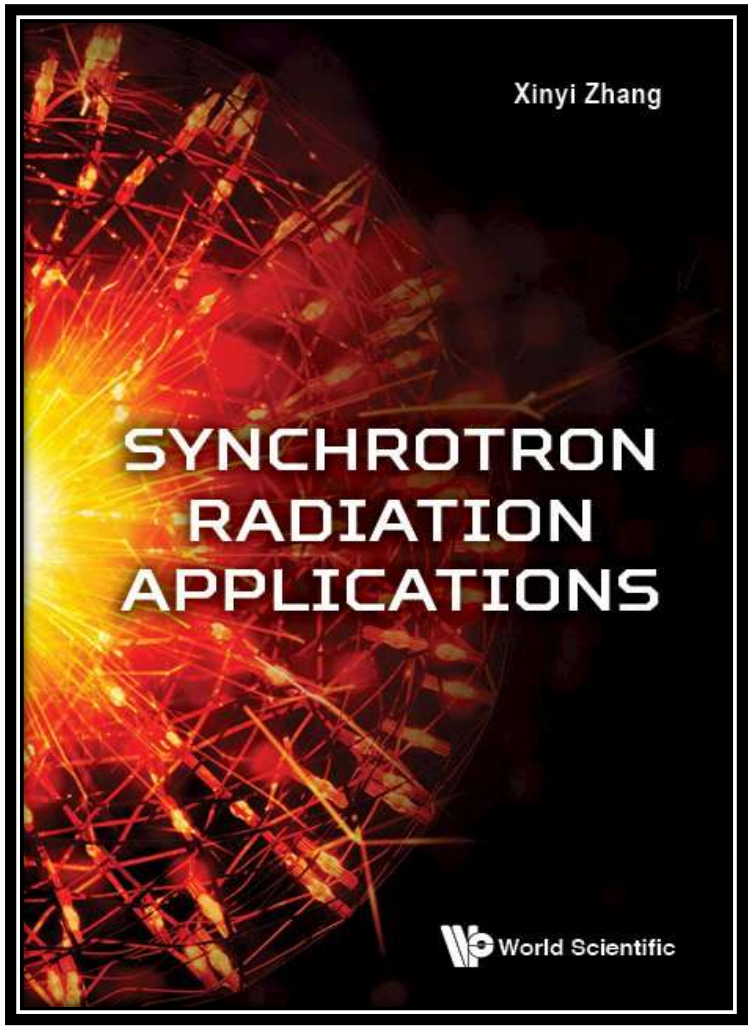


.. Electromagnetic waves emitted by charged particles that move in a curved trajectory at a speed close to the speed of light.. *Spectrum of opportunities and* (*complementarities*)..

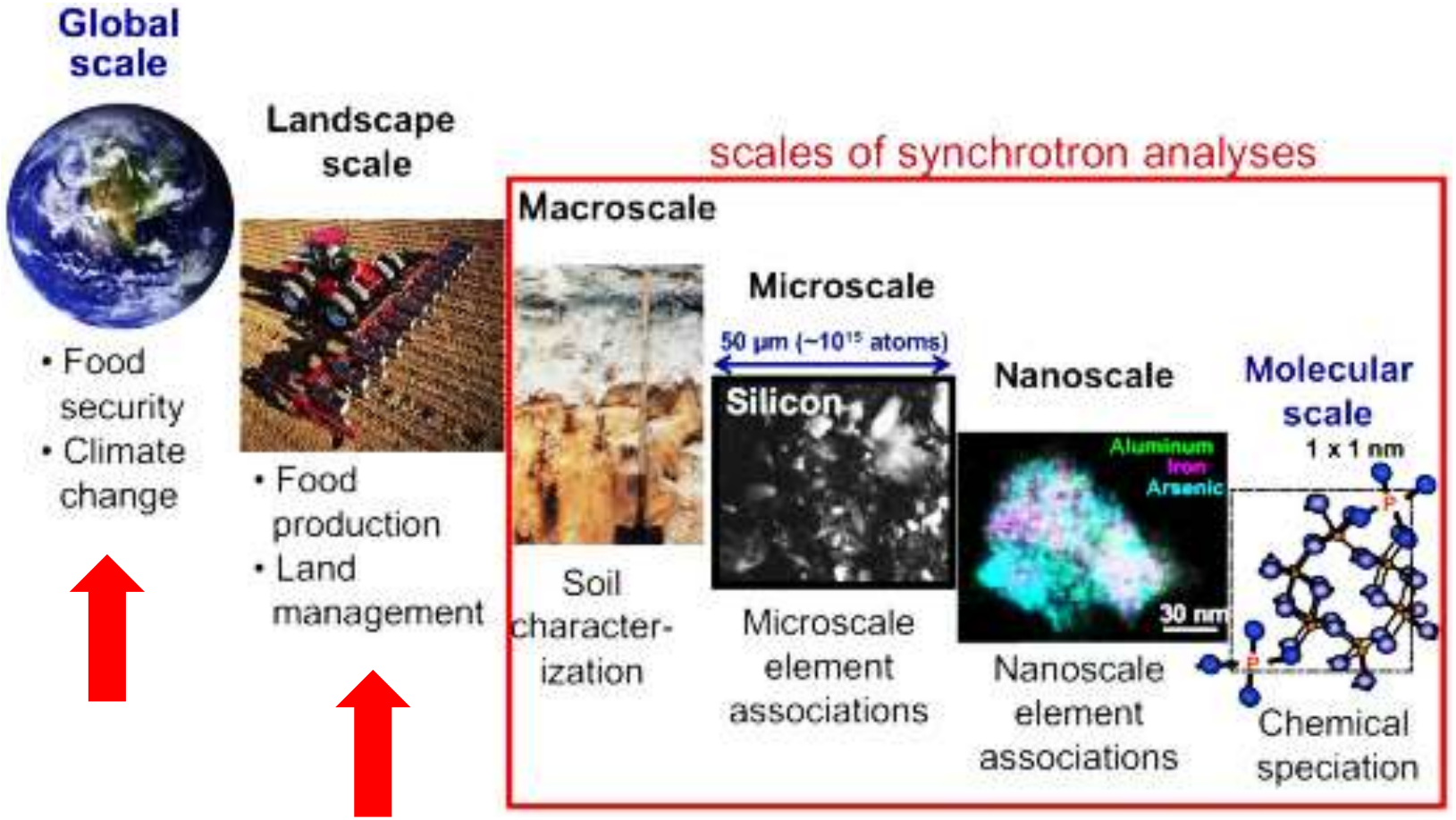




Multidimensional Analytical Techniques in Environmental Research
2020, Pages 231-265
https://doi.org/10.1016/B978-0-12-818896-5.00009-0

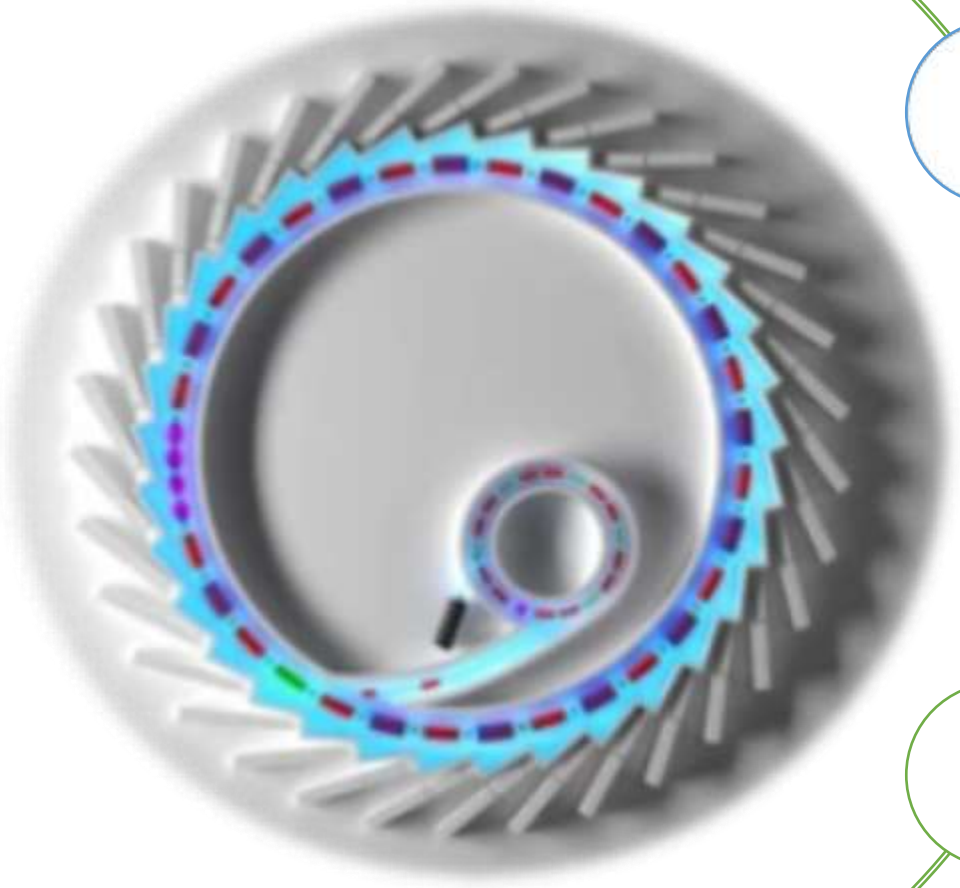


… a bright light that explores the *microscopic* world.

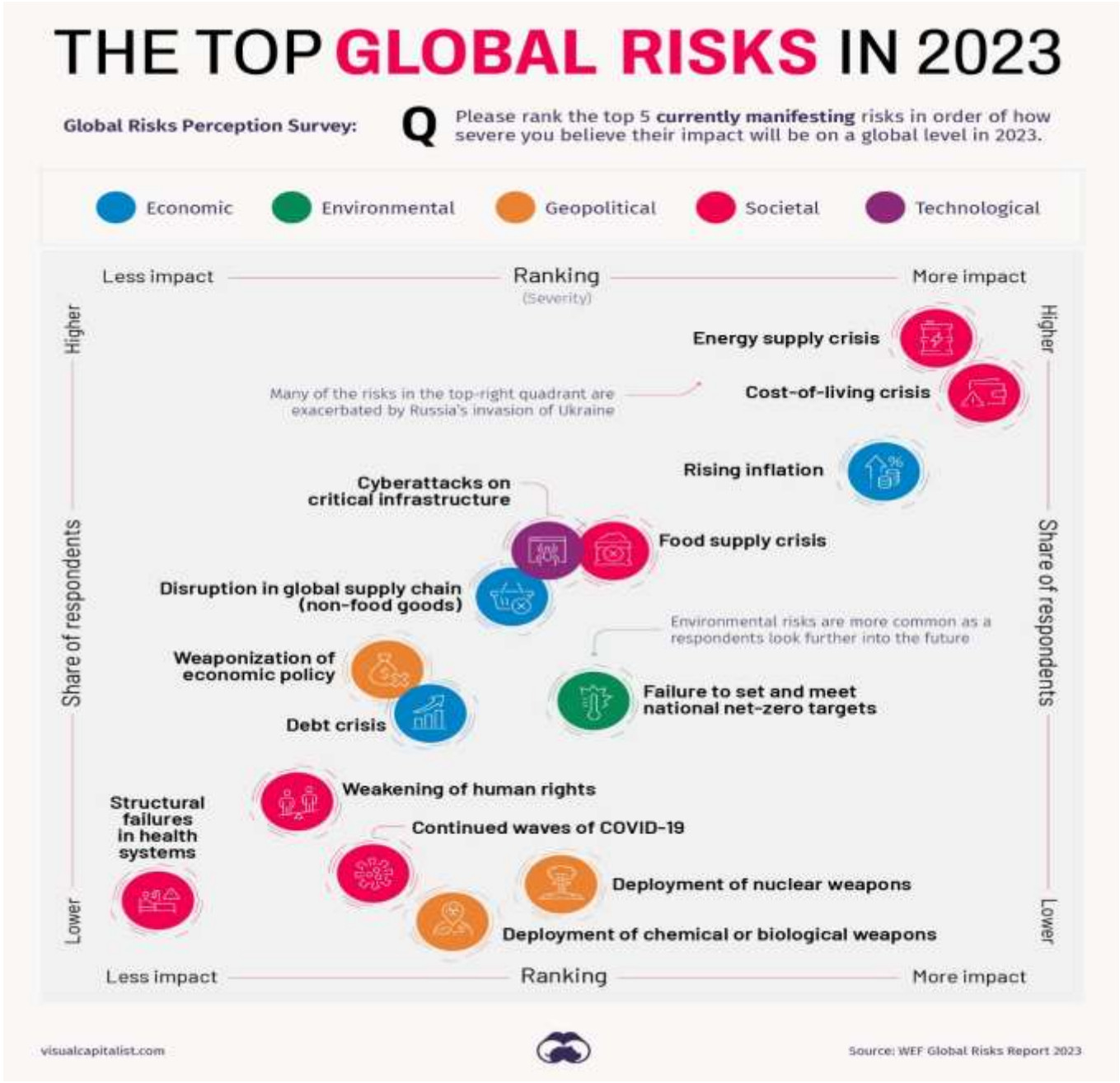


Education, capacity development and research

+ Social & Economic Impacts – "Middle East context" and beyond

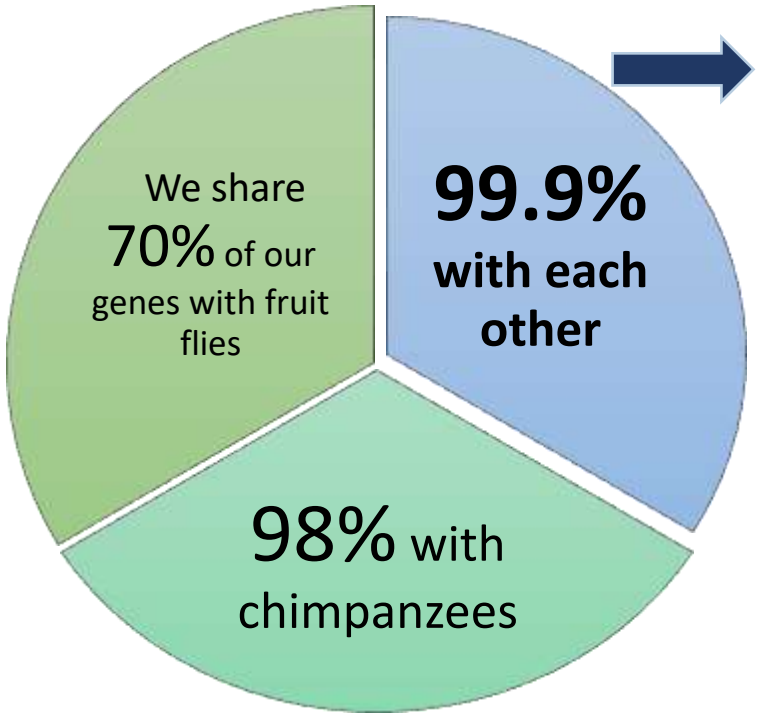


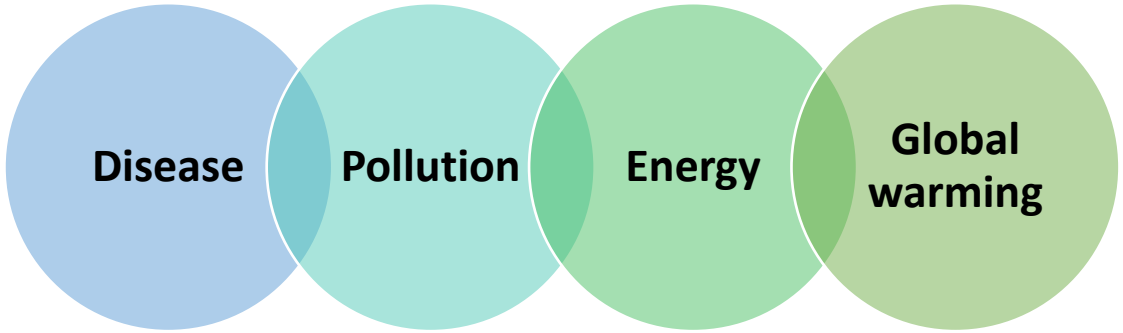
1. Global/long term impacts
2. Indirect Impacts
3. Direct local impacts
4. Collective future impacts



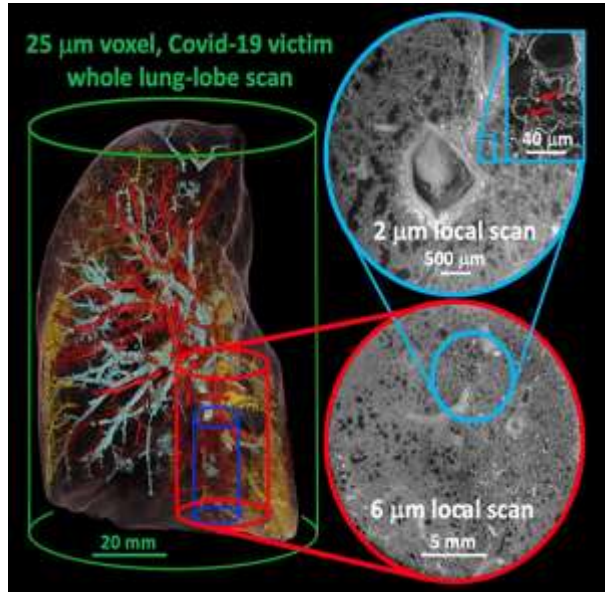
- **How to establish sustainable cutting-edge institutions and research infrastructures?,**
- **How to reverse the brain-drain dramatic concern?,**
- **how to address the local and regional alarms related to health, environment, and human heritage?,**
- **How to use science as a vehicle for industrial development and growing economy?**

Global Research Infrastructures





Basic and applied multidisciplinary science..



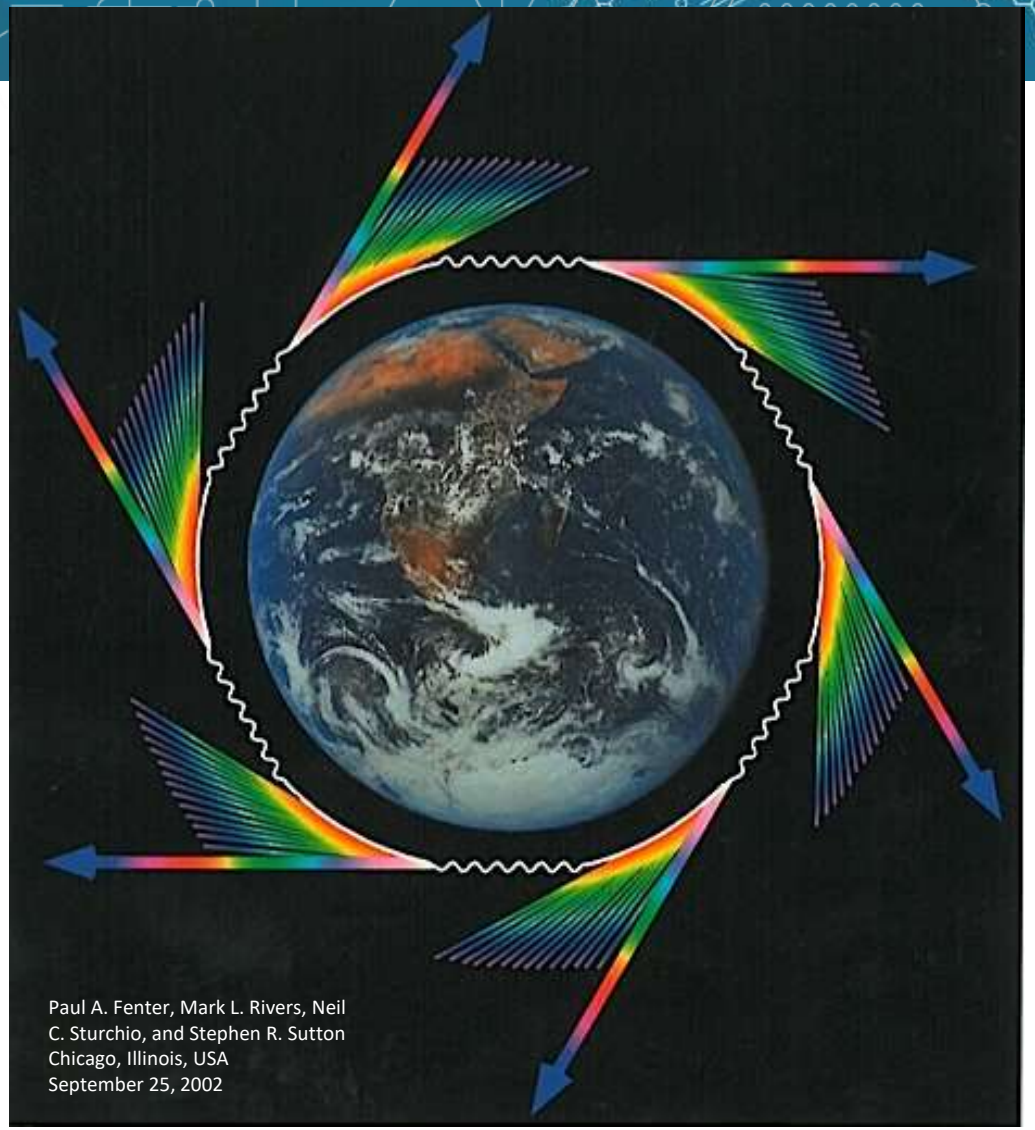
HiP-CT synchrotron technique is being used to image whole human lungs to help understand the injury caused by COVID-19. P. Tafforeau/ESRF.

Beyond individual capacity / budget

But what if what we need is more than money?

“Regionally-shared problems can best, or only, be solved through cross-border collaboration. The similarities of culture and experience, coupled with a common language and history of scientific achievement make collaboration an obvious strategy.”

Not enough..



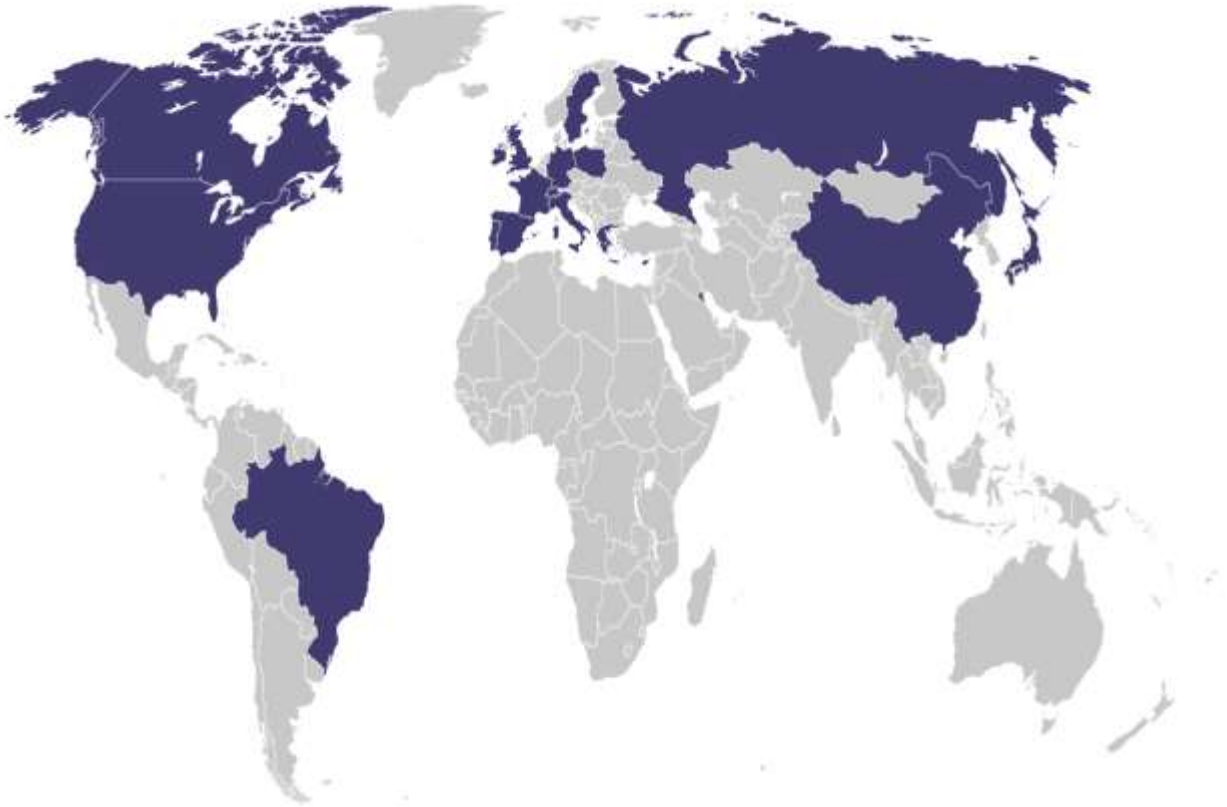
“Science Diplomacy in Arab Countries: The Need for a Paradigm Shift.”, Nart Dohjoka, Cathleen A. Campbell, Brenna Hill, AAAS Science and Diplomacy, 2017


SESAME: Synchrotron light for Experimental Science and Applications in the Middle East

Modelled on CERN

Intergovernmental Organization at the service of its Members and the whole world

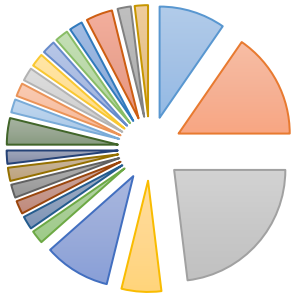
SESAME OBSERVERS



Brazil, Canada, China, the European Organization for Nuclear Research (CERN), the European Union (EU), France, Germany, Greece, Italy, Japan, Kuwait, Portugal, the Russian Federation, Spain, Sweden, Switzerland, UAE, UK and the USA. (UNESCO may serve on the SESAME Council).

SESAME and International Cooperation

Users' diversity



- Cyprus
- Türkiye
- Malta
- France
- Japan
- UAE
- Iraq
- Colombia
- Cameeron
- Jordan
- Iran
- Germany
- Colombia
- Malaysia
- UK
- South Africa
- Israel
- Egypt
- Italy
- Belgium
- Palestine
- Pakistan
- Qatar
- Mexico
- Benin

SESAME

Direct (and indirect) impacts

- World-class basic and applied research interdisciplinary science,
- Bridge to understanding and peace in the region,
- Local and regional concerns in various domains,
- Environment for collaborations and individual development,
- Training hub (Human capacity building),
- Diaspora attraction (Brain-drain reversal),
- Gender gap minimization - *as much as possible*.

SESAME

2017: Pioneering SESAME Light Source Inauguration

2018: SESAME became the first Associate of LEAPS

(League of European Accelerator-Based Photon Sources)

LEAPS League of European Accelerator-based Photon Sources

On signing the Declaration of Association to the LEAPS Consortium with Helmut Dosch, Chair of LEAPS and Chair of the DESY Board of Directors, Rolf Heuer, President of the SESAME Council.

2019: SESAME became the World's FIRST large accelerator complex fully powered by renewable energy – EU Support

The world’s first carbon neutral accelerator laboratory. This makes SESAME economically, as well as environmentally sustainable. It has signed the UN’s Climate Neutral Now pledge.

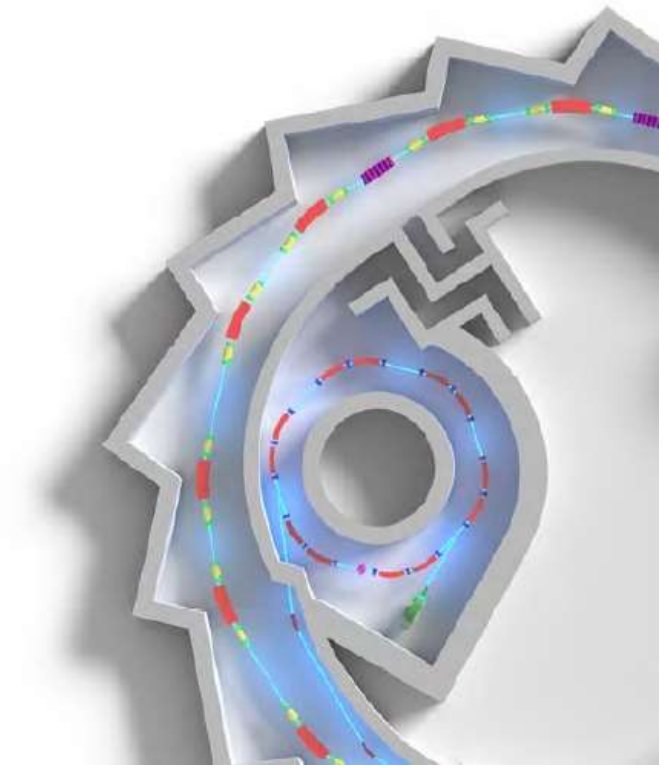
SESAME Energy Balance

6.5 MW Solar Power Plant
Financed by EU

Average Annual Production:
11.57 GWh
CO_2 Saved: -7,104 Ton

MAX Peak Load: 2.1MW
Average Annual
Consumption: 9.7GWh
CO_2 Saved: - 5,955 Ton

- Cooling System: 542kWh
- Storage Ring Magnets: 521kWh
- Main RF System: 480kWh
- SESAME Main Building: 100kWh
- Injector (Microtron & Booster): 62.5kWh



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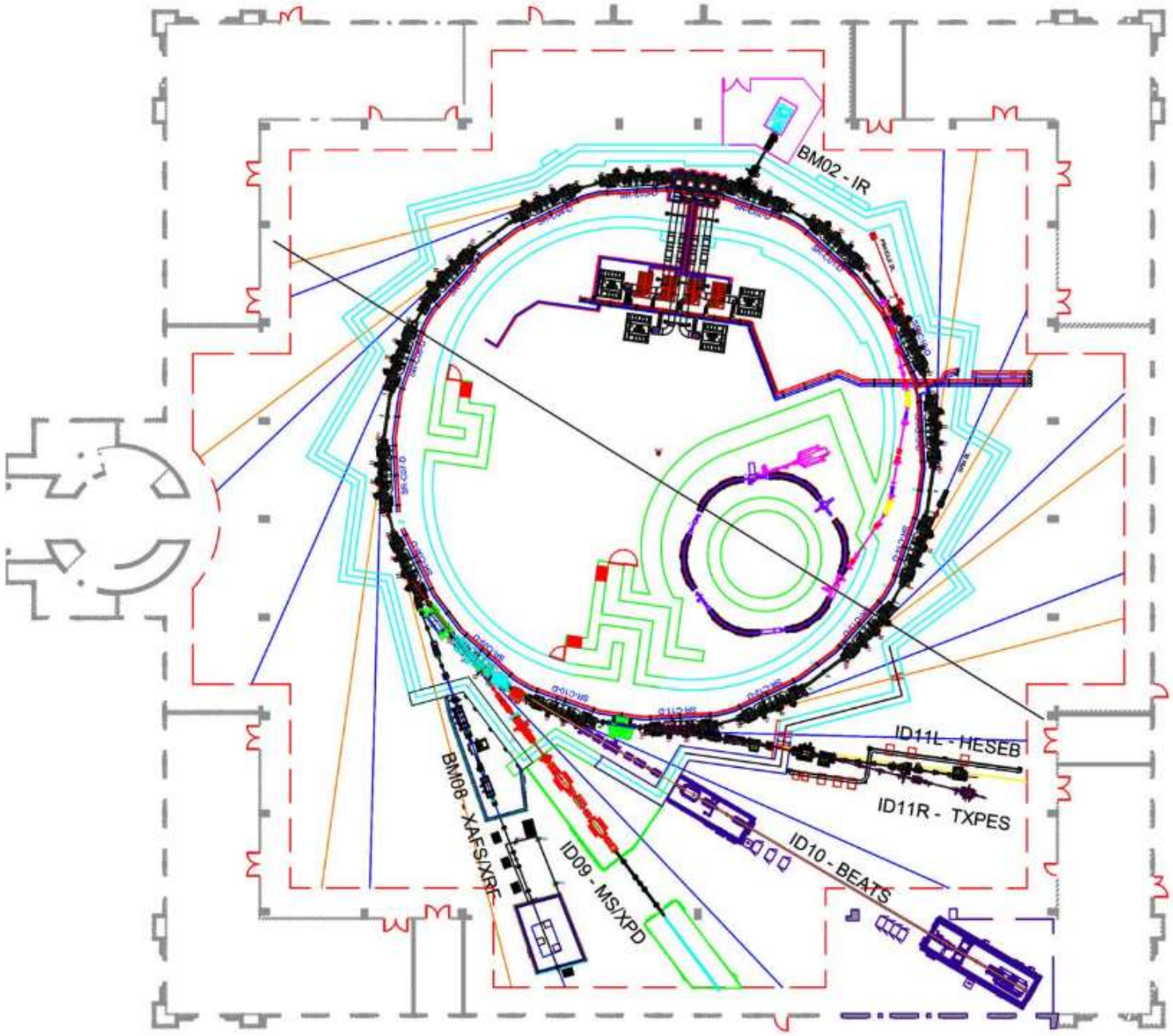
Operational:

BM08- XAFS/XRF Beamline

BM02-IR Beamline

ID09- MS/XPD Beamline

3rd Generation light source

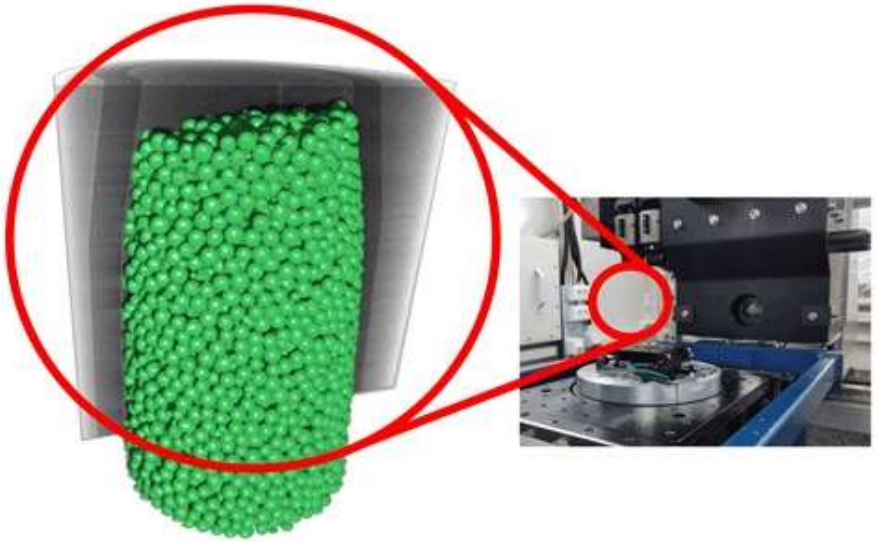


Recently added

BEATS – BEAmline for Tomoghraphy at SESAME

HESEB – Helmholtz-SESAME Beamline

TXPES – Turkish X-ray PhotoEmission Spectroscopy Beamline



© SESAME 2023: Phase contrast reconstruction generated by combining 1000 projections of 12 ms exposure time each (left) of a vial of glass speres 300 µm in diameter positioned in front of the detector on the sample stage (right) for the first test of the BEATS beamline at SESAME.

© SESAME 2022: Commemorative plaque and the HESEB beamline

SESAME

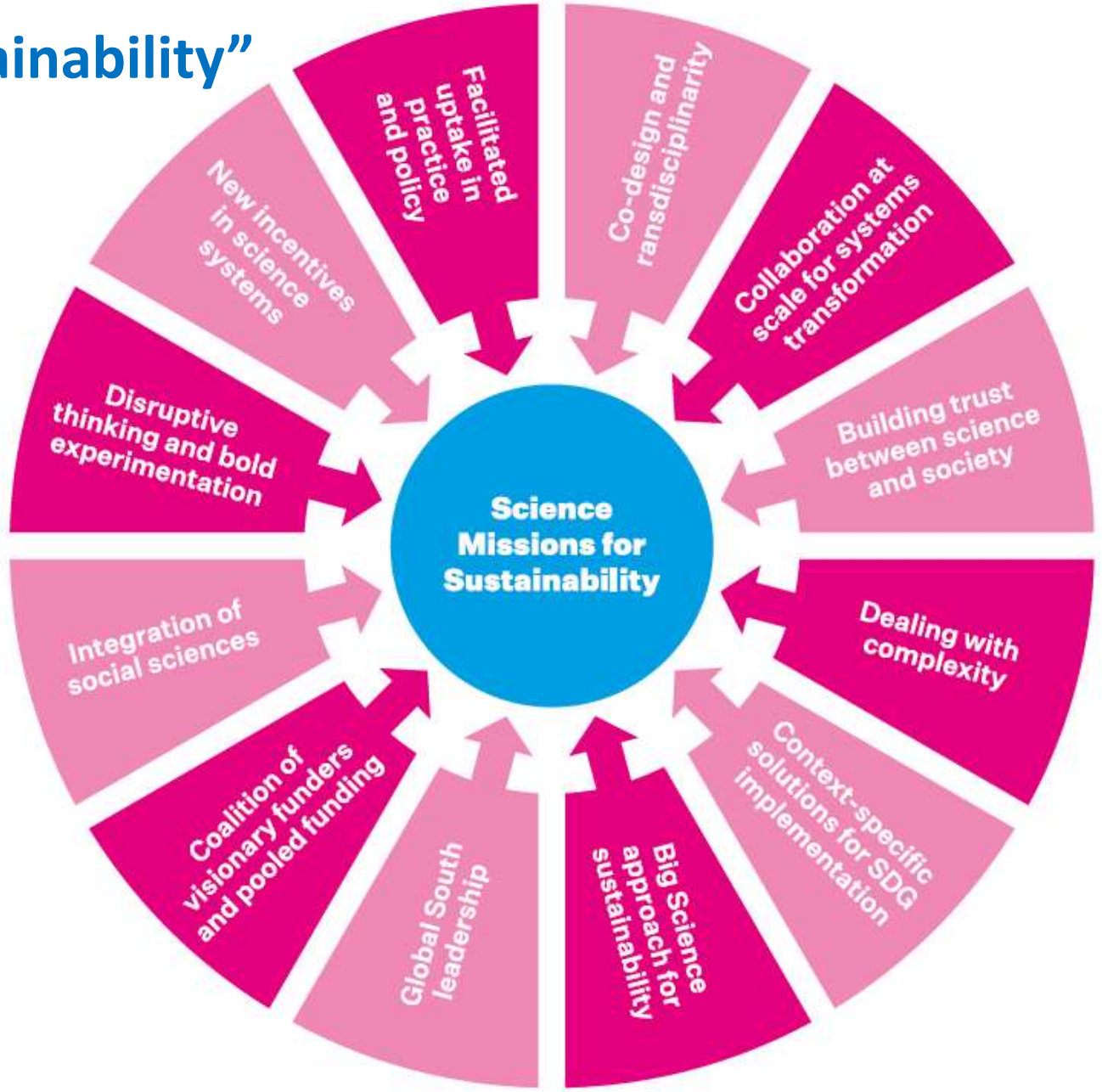
SUSTAINABLE DEVELOPMENT GOALS

"ISC: Science Missions for Sustainability"

Collective projection of science missions in realizing the UN Sustainable Development Goals.

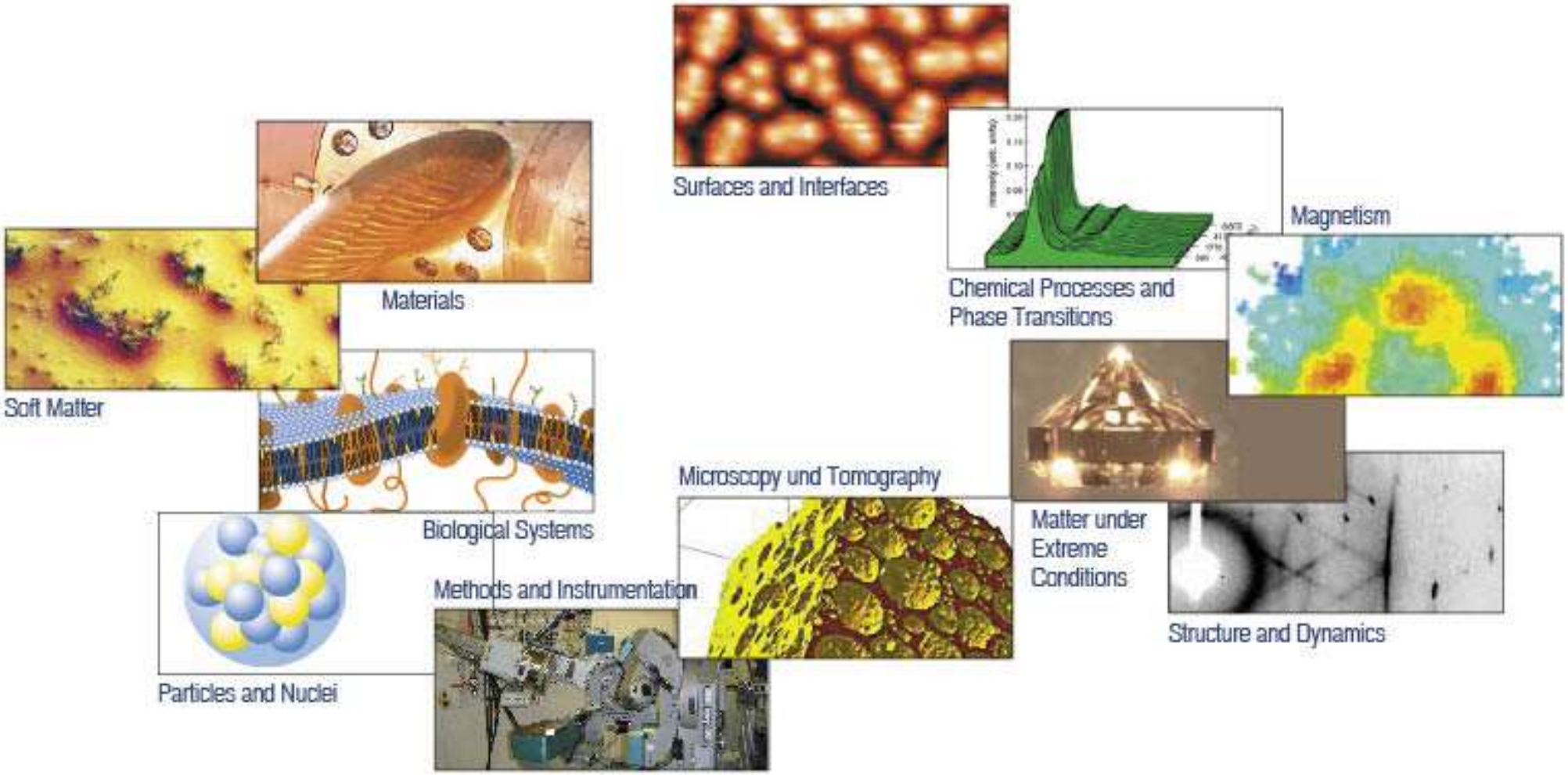
Encouraging science funders to step out of "*business-as-usual*" approaches beyond traditional science models.

:: Innovative strategies and collaborative actions on all levels. For instance, scaling up the investment in science to strongly support transdisciplinary and inclusive mission.



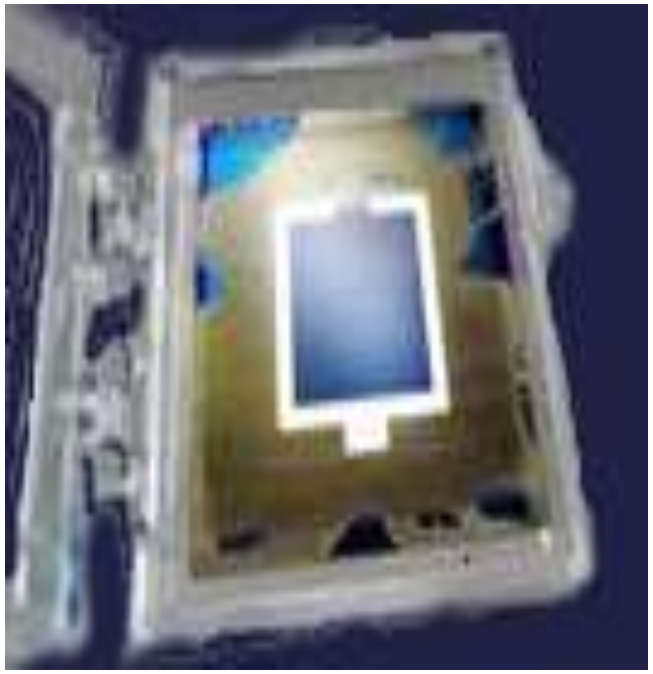
[5] Call for applications: A Global Call for Science Missions for Sustainability, International Science Council, 2024. https://council.science/mission-science/

SNI-Portal: Research with Synchrotron Radiation, Neutrons and Ion Beams at Large Facilities



Synchrotron research for climate protection and energy transition

Photovoltaics

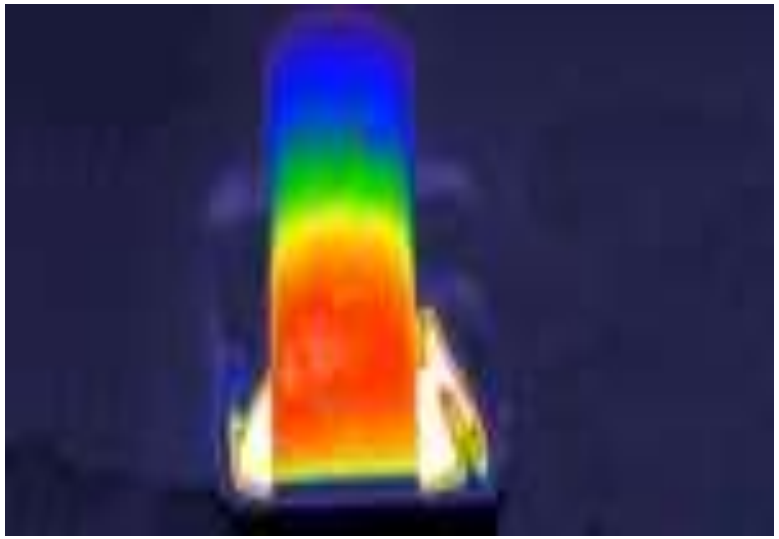


© Silvia Mariotti/HZB

Solar cells made of semiconductor materials are the basis of electricity generation from solar energy. Mostly silicon is used for this, but there are alternatives and supplementary possibilities. **Perovskite solar cells**, whose functioning is being researched at the Helmholtz-Zentrum Berlin (HZB) with synchrotron radiation, are particularly promising. They have the advantage that they can be produced cheaply and utilise different wavelengths than silicon. In so-called tandem solar cells, which combine both semiconductors, a higher efficiency can therefore be achieved than in conventional modules. Synchrotron radiation is used to research the properties of perovskite solar cells, for example the temperature-structure relationship, the process of crystallisation or the stabilising effect of fluorine additives in lead-free perovskite solar cells. But the silicon layer in the tandem solar cell can also be made even more effective through targeted nanotexturing.

Synchrotron research for climate protection and energy transition

Batteries



© Shearing et al./ Nature Communications

The use of renewable energy also includes its storage. There are different concepts depending on the application. **Batteries** have high efficiencies and can be used in mobile applications, which is why intensive research is being carried out on the entire value chain - from the functional mechanism and new materials to durability, safety and sustainability. Synchrotron radiation, for example, can be used to distinguish the role of individual elements in order to find customised solutions. Researchers all over Germany are investigating batteries and their materials with synchrotron radiation. University research and application go hand in hand.

Synchrotron research for climate protection and energy transition

Catalysis

© Dr. Ziliang Chen/HZB

Great expectations are being placed in the industrial use of green hydrogen, for example in steel production or in aviation. "Green" is the term used to describe hydrogen that has been produced in a CO_2-neutral way - either with green electricity or, in future, directly through photolysis in "artificial leaves". In this process, tailor-made **catalysts** are to make it possible to split water with the help of sunlight. Research with synchrotron radiation not only helps to find particularly suitable catalyst materials, but also to develop especially efficient structures or combinations of materials and to understand processes and investigate them during operation. Molecular films, such as those made possible by the European XFEL, can also contribute to this.

Synchrotron research for climate protection and energy transition

Hydrogen Storage

© Andreas Stierle/DESY

There are also various approaches to **storing hydrogen**. Besides the usual compressed gas storage, hydrogen can also be chemically bound in methanol or liquid organic hydrogen carriers (LOHC) or stored in solids, especially in metal hydrides and adsorptively in nanostructured materials. Their structure and functioning are studied at synchrotrons, e.g. the adsorption and release to graphene-supported Pd nanoclusters or the storage in a hydride composite system.

Synchrotron research for climate protection and energy transition

Climate Change

Research with synchrotron radiation also contributes to the **understanding of our environment**, e.g. how climate-relevant aerosols behave in the atmosphere, what basic properties water or gas hydrates have, which substances react with each other in the soil, which soils or rock formations can absorb CO_2 or what part the subduction of rocks has in the global carbon cycle.

SESAME

PNAS

RESEARCH ARTICLE | CHEMISTRY

OPEN ACCESS

Harvesting of aerial humidity with natural hygroscopic salt excretions

Marieh B. Al-Handawi[a], Patrick Commins[a], Robert E. Dinnebier[b], Mahmoud Abdellatief[c], Liang Li[a,d,1], and Panče Naumov[a,e,f,g,1]

These salts have the ability to collect water from the air even at humidity levels as low as 50-55%.

it offers proof that the plant is capable of absorbing water via its leaves

water collection or cloud-seeding technologies

nature communications

Article | Open access | Published: 19 August 2022

Environmentally adaptive MOF-based device enables continuous self-optimizing atmospheric water harvesting

Husam A. Almassad, Rada I. Abaza, Lama Siwwan, Bassem Al-Maythalony & Kyle E. Cordova ✉

Nature Communications **13**, Article number: 4873 (2022) | Cite this article

SESAME

JAAS

ROYAL SOCIETY OF CHEMISTRY

PAPER

View Article Online
View Journal | View Issue

Cite this: *J. Anal. At. Spectrom.*, 2021, 36, 981

Synchrotron X-ray fluorescence and X-ray absorption near edge structure of low concentration arsenic in ambient air particulates†

Abdallah A. Shaltout, *[a] Messaoud Harfouche,[b] Fahmy A. S. Hassan[cd] and Diane Eichert[e]

SESAME

Energy Technology
Generation, Conversion, Storage, Distribution

Research Article

Magnetic Properties and Environmental Temperature Effects on Battery Performance of $Na_{0.67}Mn_{0.5}Fe_{0.5}O_2$

Serdar Altin, Ali Bayri, Emine Altin, Erdinc Oz, Sedat Yasar, Sebahat Altundağ, Messaoud Harfouche, Sevda Avci

First published: 31 March 2021 | https://doi.org/10.1002/ente.202001130 | Citations: 6

An investigation of the improvement in energy storage performance of $Na_{2/3}Mn_{1/2}Fe_{1/2}O_2$ by systematic Al-substitution

Published: 27 July 2020

Volume 31, pages 14784–14794, (2020) Cite this article

S. Altin, S. Altundağ, E. Altin, M. Harfouche & A. Bayri

Green Plastics: Direct Production from Grocery Wastes to Bioplastics and Structural Characterization by Using Synchrotron FTIR

Onur Aras[1, *], Gihan Kamel[2,3] and Murat Kazanci[4,5, *]

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[2]SESAME Synchrotron (Synchrotron-light for Experimental Science and Applications in the Middle East), 19252 Allan, Jordan; Electronic address: gihan.kamel@sesame.org.jo.

[3]Department of Physics, Faculty of Science, Helwan University, Cairo, Egypt.

[4]Istanbul Medeniyet University, School of Engineering and Natural Sciences, Department of Biomedical Engineering, Istanbul, Turkey; Electronic address: muratkazanci.tr@gmail.com; https://www.imunanolab.com

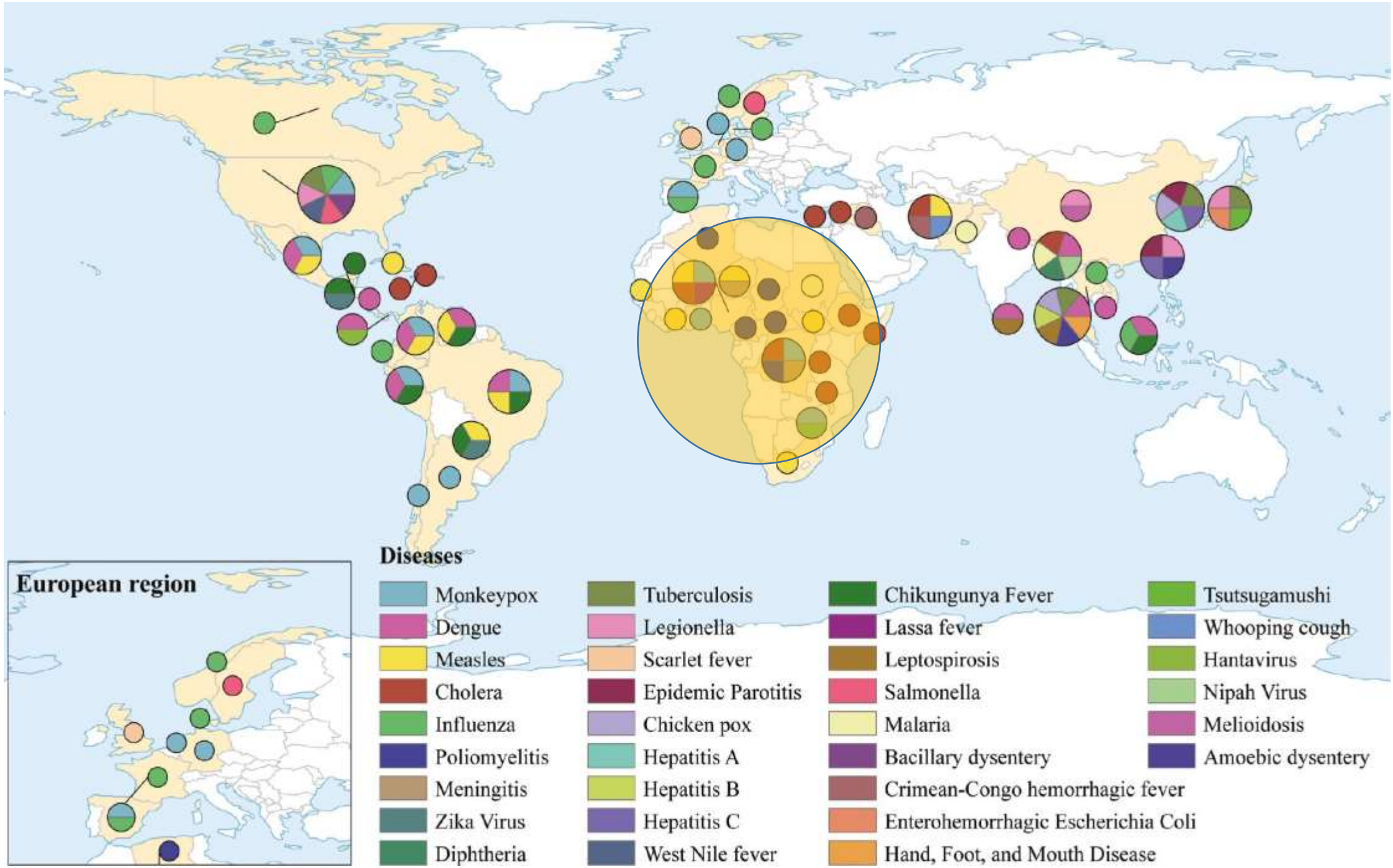
[5]Istanbul Medeniyet University, Science and Advanced Technologies Research Center (BILTAM), 34700, Istanbul, Turkey.

Over 60 worldwide, None in Africa – so far-

Towards an AfLS

Challenges..

SESAME


European region
Diseases
Monkeypox
Dengue
Measles
Cholera
Influenza
Poliomyelitis
Meningitis
Zika Virus
Diphtheria
Tuberculosis
Legionella
Scarlet fever
Epidemic Parotitis
Chicken pox
Hepatitis A
Hepatitis B
Hepatitis C
West Nile fever
Chikungunya Fever
Lassa fever
Leptospirosis
Salmonella
Malaria
Bacillary dysentery
Crimean-Congo hemorrhagic fever
Enterohemorrhagic Escherichia Coli
Hand, Foot, and Mouth Disease
Tsutsugamushi
Whooping cough
Hantavirus
Nipah Virus
Melioidosis
Amoebic dysentery

The African light source is expected to be a prominent mega-science techno-industrial and fundamental research facility, as well as an innovation hub in Africa. It would promote local and regional research platforms, as well as massive advanced human capacity development and employment in Africa.

SESAME

The AfLS will promote advanced capacity building, innovation, industrial linkages, industrial research, competitive industry, big data, 4IR technologies, and localisation of manufacturing skills. This will drive growth and new sustainable jobs.

The AfLS will promote world-leading research in agriculture. The literature has many examples of AdLS focus on food security by plant, soil and food scientists. This is based on the capacity of the AdLS for 5D imaging in terms of sensitivity to chemical and biological characterisation, 3D spatial form, and also time sequences, including in response to various stimuli.

The AfLS will be the premier instrument to tackle the disease burden of Africa. The drug discovery for the medical interventions for HIV/AIDS was driven by high resolution atomic level viral structures obtained mostly at AdLSs, allowing drug targets to be identified. A similar process is underway for the SARS-Cov-2 and other viruses.

The AfLS will promote the public understanding of science, attract new young minds, especially girls. It will be a repository and a dissemination hub for all levels of educational material. It will be a premier site for advanced human capacity building. The research outputs will be visually palatable and easily understood.

The AfLS will abound with modern role models for both women and men in science. Most AdLSs concentrate on increasing diversity, based on gender, ethnicity, geographical representation, amongst others.

The AfLS will be a premier facility for environmental research. The infrared beamlines will allow molecular imaging at unprecedented bio-sensitivity. Advanced spectroscopy, such as XAFS and XANES, are techniques that allow the study of chemistries and materials in the field at unprecedented sensitivity, complete with imaging.

Renewable energy studies will be well represented, including new photovoltaic materials, novel batteries, novel catalysts for fuel cells, and detailed chemical studies of the reactions involved, both those that are to be promoted and those that represent adverse pathways that need remediation.

The site for the AfLS will require a large space that soon will become populated with a mega-scale science and industry park. This is due to the technology transfer and innovation associated with AdLSs.

Ultimately, there will be a high demand for Industrial users to perform proprietary commercial research, where IP protection, rather than publications, will be the output. This will have a premium charge. There also will be industry-relevant research, which will be published as usual in open academic collaborations. In all cases, there will be innovation, leading to new industrial capacity.

The ethos of AdLSs is diversity, tolerance, and the global nature of science and science diplomacy. True education reduces endemic prejudice and promotes the culture of Ubuntu

The research on the environment, clean water and sanitation, renewable energies, will promote and enable sustainable lifestyles and development.

As above, the research on the environment, clean water and sanitation, renewable energies, promotes and enables sustainable lifestyles and development.

The multidisciplinary capacity of research at AdLSs includes research into the understanding of climate, including the interaction between bio-systems and the fluids around them, trace element chemistries as they affect precipitation, and other physical, chemical and biological processes. All scientific aspects can be addressed at unprecedented levels of accuracy in these studies.

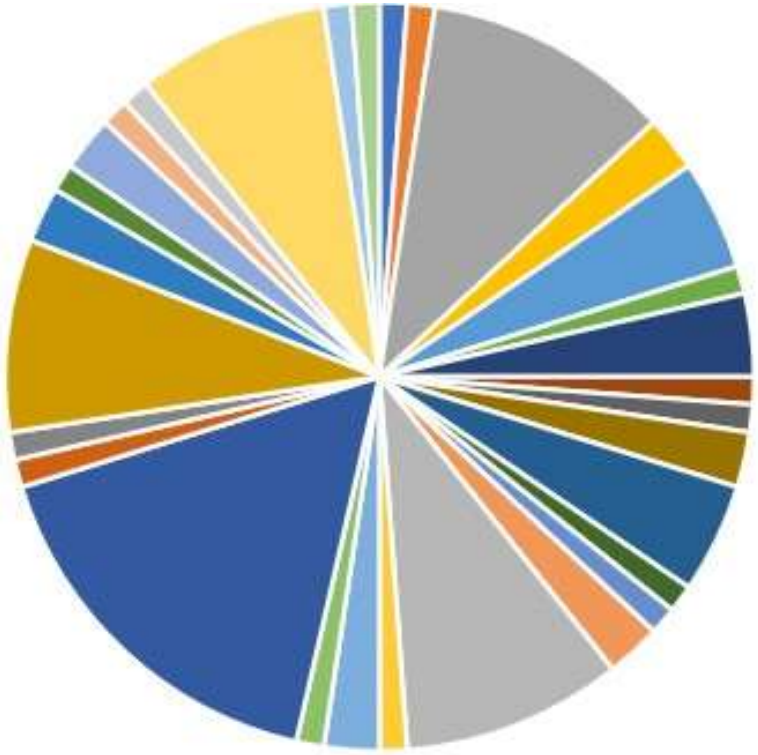
Once again, the multidisciplinary capacity of research at AdLSs will include research into other physical, chemical and biological processes relevant to water based life.

Once again, the multidisciplinary capacity of research at AdLS light sources will includes research into other physical, chemical and biological processes relevant to land- based life.

AdLSs are usually globally used and globally relevant infrastructures. The ethos of AdLSs is diversity, tolerance, and the global nature of science, science diplomacy.

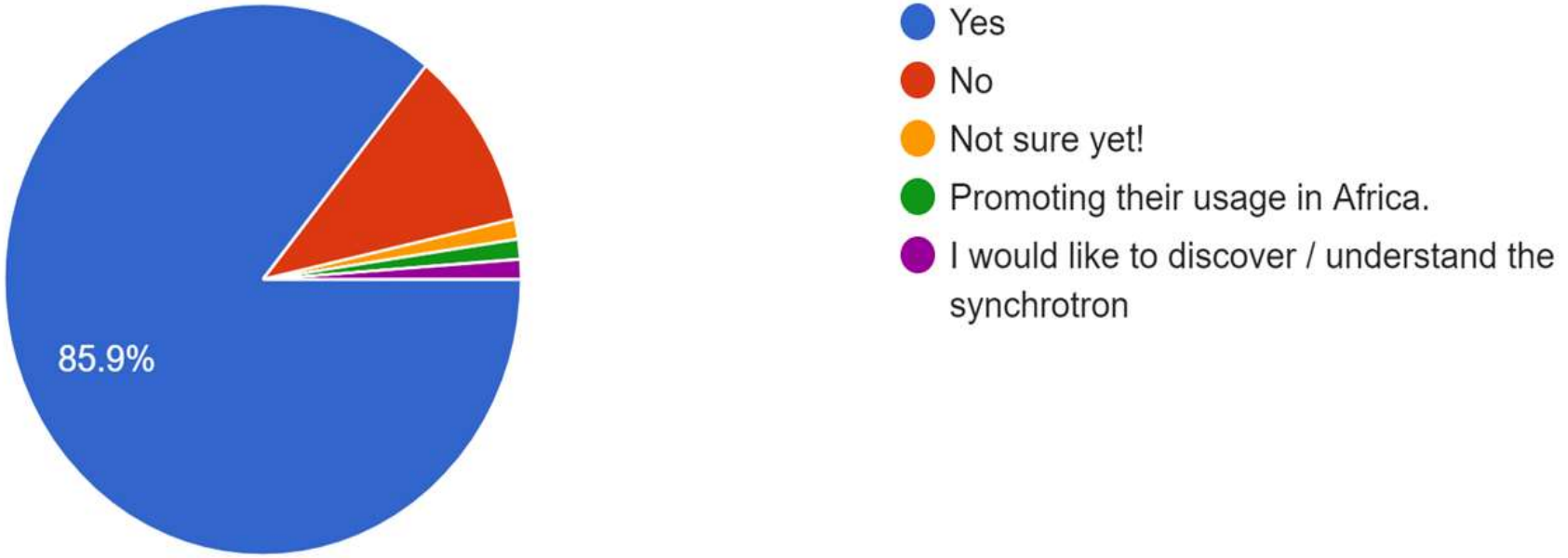
Major large-scale globally relevant infrastructures for research and innovation are unavoidably catalysts that spark networks, collaborations and partnerships that enable such concentration of equipment at such scale and innovation. The partnerships occur at government level and are evident at all other levels, most especially the user levels.

Community



- Algerian
- American & Togolese
- Cameron
- Egyptian
- Ethiopian
- French
- German
- Germany & UK
- Ghanaian
- Indian
- Italian
- Ivorian
- Japanese
- Jordanain
- Kenyan
- Malaysian
- Moroccan
- Mozambican
- Nigerian
- Pakistani
- Peruvian
- South African
- Senegalese
- South African, French & Algerian
- Tunisian
- Ugandan
- UK, Canada
- USA
- USA and Nigeria
- Zambian

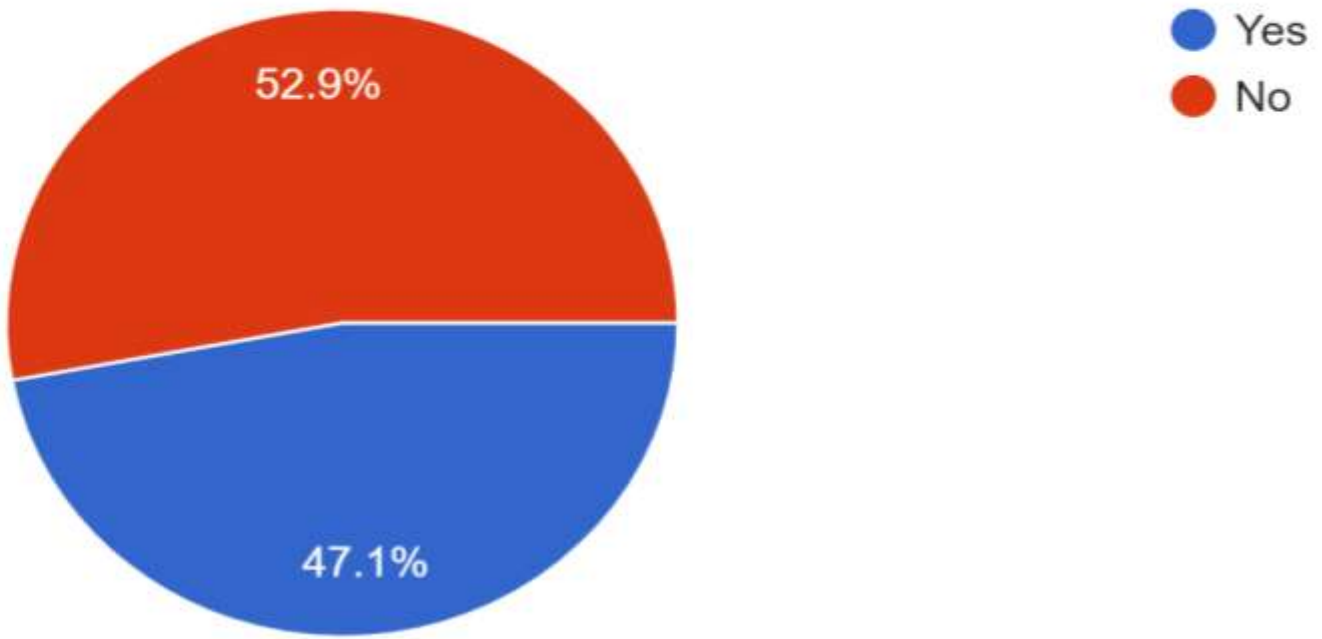
Do you have current/future synchrotron-related interest(s)?



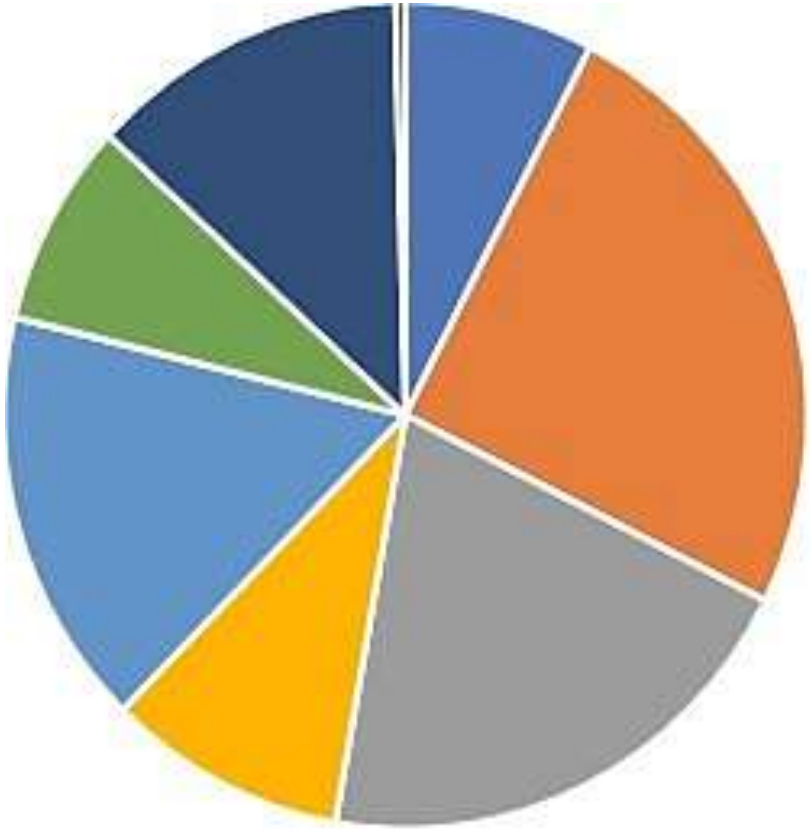
Interest

Do you have a previous experience in light sources facilities?

Diasporas



Challenges



- Bureaucracy in the facility of destination
- Lack of funding schemes (travel and mobility, project expenses, etc.)
- Lack of basic and/or preliminary research equipment in your own country
- Lack of mentoring
- Lack of training opportunities to develop professional skills
- Scientific merit-related needs
- Bureaucracy in your own country
- Lack of dedicated manpower

The African Light Source Foundation

"The first African Light Source: lighting the future of Africa"

Memoranda of Understanding

Advanced Light Source Facilities

- Synchrotron-Light for Experimental Science and Applications in the Middle East (SESAME)

International Institutions / Organisations

- Lightsources for Africa, the Americas, Asia and Middle East and the Pacific (LAAAMP)

Letters of Support

African Institutions / Organisations

- African Crystallography Association Steering Committee (AfCA-SC), Africa
- Ghana Academy of Arts and Sciences, Ghana
- African Seismological Commission (AfSC), Africa
- International Union of Geodesy and Geophysics (IUGG), Africa
- Network of African Science Academies (NASAC), Africa
- South African Institute of Physics (SAIP), South Africa
- Ministry of Environment, Science, Technology & Innovation (MESTI), Ghana
- Federation of African Medical Physics Organizations, FAMPO, Africa
- Mbarara University of Science and Technology, Faculty of Science, Uganda
- African Physical Society (AfPS)
- BioStruct Africa, Africa
- African Materials Research Society (AMRS), Africa

Advanced Light Source Facilities

- Diamond Light Source, UK
- Centre for Advanced Microstructures and Devices (CAMD) Louisiana State University, USA
- European XFEL,Europe
- Paul Scherrer Institute (PSI), Switzerland
- Elettra Sincrotrone Trieste, Italy
- European Organization for Nuclear Research (CERN)
- The European Synchrotron Radiation Facility (ESRF)
- MAX IV laboratory, Sweden
- Synchrotron SOLEIL, France
- National Synchrotron Light Source II (NSLS II), USA
- Australian Synchrotron (ANSTO), Australia
- Singapore Synchrotron Light Source NUS
- National Synchrotron Radiation Research Center (NSRRC),Taiwan

International Institutions / Organisations

- International Center for Theoretical Physics (ICTP)
- International Union of Pure and Applied Chemistry (IUPAC)
- International Union of Pure an Applied Physics, (IUPAP)
- International Union of Crystallography (IUCr)

External National Institutions / Organisations

- The Cockroft Institute of Accelerator Science and Technology, UK)
- US Particle Accelerator School (USPAS), USA
- National Society of Black Physicists (NSBP), USA

AfLS Website https://www.africanlightsource.org

Roadmap…?

Bottom Up

1. Human Capacity: scientists, engineers, technicians
2. African scientists access existing LSs
3. African relationships with existing LSs.
4. Involvement of industry
5. Community for the African light source Users
6. Conferences, Workshops, Outreach, Media

Top Down

1. Strategic approach to African Governments and (Pan) African orgs.
2. Conceptual Design Report (CDR)

3. Inter-African co-operation on Regional feeder infrastructure
4. African multinational beamlines at existing LSs
5. Regional / Pan African membership of existing LSs

6. Technical Design Report (TDR)

AFRICAN LIGHT SOURCE FOUNDATION

TRUST DEED
Letter of Authority
issued by the
Masters Office of the South African High Court
1 June 2018

The Africa Light Source Foundation
Towards a Lightsource for the African Continent

Countries Expressing Commitment

Ghana
2019, the President Akufo-Addo of Ghana
pledged to champion the project in the African Union.
2020, the science minister, Dr. Kwabena Frimpong-Boateng, reaffirmed Ghana's support for the African light source

Benin
2019, X-TechLab, as a government priority project, expresses itself as part of the Roadmap to the AfLS.

SA
2021, SA Dept Science and Innovation and the NRF invite a proposal towards the AfLS as a "Flagship Project"

2021, Nigeria
Office of the Science Ministry

2021, Cote d'Ivoire
Office of the Science Ministry

2021, AUC-HRST
Developing Process and Actions

Some Existing Regional Facilities

- X-TechLab - Benin
- Materials analysis, spectroscopy for many disciplines. Energy, health, environment, agriculture, materials

- Sir Aaron Klug Centre - SA
- Structural biology resource widely used in SADEC region

- African Laser Centre
- Pan-African NEPAD flagship initiative

- ICTP-EAIFR - Rwanda
- Condensed matter, Geology, Particle Physics, Cosmology, Astroparticle physics

- Partner with LAAAMP, IUCr – OpenLABS, START, Othe
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SESAME

"Science alone cannot solve the many political, security, and economic problems that we are facing today. However, science diplomacy still has an important role to play in addressing the health, environmental, energy, water, and food challenges that contribute to regional instability."

"Science Diplomacy in Arab Countries: The Need for a Paradigm Shift.", Nart Dohjoka, Cathleen A. Campbell, Brenna Hill, AAAS Science and Diplomacy, 2017

Thank you!

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