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To cite this article: M. A. G. Aranda, G. Facile, J. Gillies, N. Guimard, F. Lehner & E. P. Mitchell (on behalf of the OPEN SESAME consortium) (2019) OPEN SESAME: A Horizon2020 Project to Help the SESAME Light Source, *Synchrotron Radiation News*, 32:6, 55-56, DOI: [10.1080/08940886.2019.1680222](https://doi.org/10.1080/08940886.2019.1680222)

To link to this article: <https://doi.org/10.1080/08940886.2019.1680222>



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Published online: 26 Nov 2019.



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OPEN SESAME: A Horizon2020 Project to Help the SESAME Light Source

The challenges of conceiving, constructing, commissioning, and operating a large-scale research facility are significant. This is all the more so when the facility—the Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME) light source hosted near Amman in Jordan—is the first major international science center in the Middle East and neighboring regions. The need for an international light source in the Middle East was first recognized by eminent scientists such as the Pakistani Nobel Laureate Abdus Salam in the 1980s. In 2017, this need became a reality. SESAME's inauguration was held on May 16, 2017. Developed under the auspices of UNESCO and modelled on CERN (although it has very different scientific aims), SESAME is the result of hard work and determination on the part of governments in the Middle East and neighboring countries, but also that of governments of the observer countries of the center and scientists at large. It is also the result of goodwill and generosity on the part of international organizations and synchrotron light sources worldwide. Its aim is to foster scientific and technological excellence as well as international cooperation amongst its members, which are currently Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, Palestine, and Turkey. The first user experiments took place in July 2018 and the first paper using experimental data from SESAME was published in June 2019 [1].

Driven by Europe's open and collaborative spirit, and its wish to build durable bridges between Europe and the Middle East and neighboring regions, the European Union is a long-standing active partner and contributor to SESAME. OPEN SESAME is one of its latest chapters of collaborative work with SESAME and its members in the Middle East and neighboring regions. The three-year program of OPEN SESAME, which started in 2017, has as its objective support for SESAME and its user community during the final commissioning of the accelerator and first beamlines, and the facility's initial phase of user operation.

The OPEN SESAME project is a consortium of 11 partners in eight countries (seven in Europe and one in Jordan). It consists of seven

The SESAME light source in Jordan.

Top right: Map showing the combined global footprint of the eight SESAME members. The location of the SESAME light source is shown in yellow.



light sources (CELLS, DESY, ELETTRA, ESRF, INFN, SESAME, and SOLEIL), a high-performance computing center (The Cyprus Institute), a European structural biology network (Instruct), a national research agency (CNRS), and CERN. Two of these facilities, ESRF and CERN, have intergovernmental agreements at their basis, as does SESAME. The partners have brought to SESAME their experience and know-how in running a synchrotron and in exploiting the unique photon and X-ray beams for research.

SESAME, which started off with only a modest degree of experience in constructing, commissioning, and operating an international synchrotron facility, is progressing to a center that has the required expertise for this, and it is now a nascent operational user facility. This has been made possible thanks to the generous support it has received from the members themselves (Israel, Jordan, and Turkey), the international community (UNESCO, the IAEA, the European Union, and ICTP), national agencies (in particular, the UK Department for Business, Energy and Industrial Strategy (BEIS) through the Rutherford Fund, Italy, the US Department of Energy, and the US National Academy of Science), numerous synchrotron laboratories, professional scientific societies, and small charities. The support from the OPEN SESAME project focuses on the operation of the facility, and is being provided via a comprehensive cooperative program with European light sources and institutes, thereby allowing SESAME to move more rapidly towards fully realizing its potential.

OPEN SESAME's training and support has three pillars:

1. Training of SESAME's staff: allowing SESAME to benefit from the pool of European experience through a two-way staff mobility program between the European partners and SESAME.
2. Building regional researcher capacity: empowering researchers across the SESAME members through high-quality training and education activities.
3. Integration of SESAME into public and socio-economic landscapes: targeting stakeholders and researchers, this is designed to build awareness of SESAME as an international science center in the Middle East and neighboring regions, thereby helping to assure the center's longer-term stability and sustainability.

Training of SESAME's staff

The training of SESAME's staff is a central objective of the OPEN SESAME work, given that a modern light source needs to draw upon skills across a huge range of scientific, technical, and administrative areas, all of which are being addressed by the project's staff training and mobility action. Initially, the project set out to organize 65 staff exchanges through this mobility program—either by SESAME staff visiting a European partner or European experts visiting SESAME—however, as the project draws to a close, there will have been almost 110 exchanges arranged, thus helping SESAME's staff contingent to grow in their

confidence and abilities to operate a light source with a user program to an even greater degree than first thought possible through the three-year project. Training has covered areas such as safety, accelerator technology and commissioning, electrical and power supply, vacuum, beamline commissioning, software and “big data,” as well as user office, communications, and outreach. At every stage of the activity, OPEN SESAME was able to react efficiently and rapidly to SESAME’s training needs as they arose, drawing on the wide pool of expertise across the project partners.

Capacity building

Four thematic schools focused on the use of synchrotron radiation in strategic fields of interest for SESAME have been held, each training some 20 researchers, selected from a typical oversubscription rate of three to five times. The topics were: Cultural Heritage, Biological and Biomedical Applications, Environmental Sciences, and Structural Biology. A key researcher target is young researchers, addressed through two actions. First, a two-week training on site at SESAME with a tailored edition of the renowned HERCULES School, providing an in-depth perspective of synchrotron light applications. Second, short-term fellowships for Master’s and Ph.D. students of SESAME members at the European OPEN SESAME partners. Two open calls for applications have given 18 students the opportunity to travel to Europe for training. Industry is not ignored, and a workshop at SESAME on synchrotron light applications for industry attracted 20 participants. The online Training Warehouse (opensesame-warehouse.org) will hold all of the training materials generated by OPEN SESAME, including the lectures given at all of the schools and other OPEN SESAME activities, for distribution. It is worth highlighting that this site will be maintained by The Cyprus Institute well beyond the end of the project, thereby creating a durable impact.

Integration of SESAME into public and socio-economic landscapes

OPEN SESAME has helped SESAME develop its capacity to integrate into the socio-economic landscape through a range of activities. A two-part workshop covered many administrative and support activities necessary to run a successful intergovernmental research organization. A roadshow was developed to increase awareness of SESAME among the po-

The participants and tutors of the Life Science and Infra-Red Micro-Spectroscopy Training School, hosted at SESAME light source in April 2018.



SESAME 2018 COPYRIGHT

tential user community in each of its members. Training has been provided in areas of protocol (for the official opening), website design and management, audio-visual production, and communications. Media study trips have been organized for groups of international journalists, resulting in positive media coverage for the laboratory. Finally, communications support has been provided in the form of the production of communications materials, such as brochures, audio-visual material, and participation at major public-facing conferences such as the AAAS annual meeting and the EuroScience Open Forum (ESOF).

Although OPEN SESAME is soon to finish, EU support continues with the “BEAmline for Tomography at SESAME” (BEATS, beats.esrf.fr) project. The objective of this four-year 6 M€ project, which started in January 2019, is to design, procure, construct, and commission a beamline for hard X-ray full-field tomography at the SESAME synchrotron in Jordan. BEATS will foster collaboration among the project partners in all aspects of the technical work to ensure that a comprehensive transfer of knowledge to SESAME staff is achieved.

In a further beamline project, Germany’s Helmholtz Association is supporting the construction of the Helmholtz-SESAME Beamline soft X-ray beamline at SESAME (HESEB). The beamline will have multiple end stations, the first of which will be for soft X-ray fluorescence spectroscopy, focusing on environment and cultural heritage studies. Further stations for ambient pressure photoelectron spectroscopy, as well as angle-resolved photoelectron spectroscopy, will be installed at a later stage.

After three years of work, OPEN SESAME will conclude on December 31, 2019. The project has supported over 200 SESAME staff and researchers from the Middle East and neighboring regions in mobility and training—more than 20,000 hours in total will have been provided. But perhaps OPEN SESAME’s enduring legacy will be in the researchers from

the Middle East and neighboring regions and Europe, who have worked together, crossing international and cultural divides, and have been inspired by SESAME itself, to help ensure that the SESAME light source gets off to a flying start in its user operations. ■

Funding

The OPEN SESAME project has received funding from the EU’s Horizon 2020 Framework Programme for research and innovation under grant agreement number 730943.

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