



*Synchrotron-light for Experimental Science
and
Applications in the Middle East*

**Flyer on Privileges, Benefits and Obligations of Members of
SESAME**

I. Background

1. What is a Synchrotron-Light Source?

Synchrotron-light – or synchrotron-radiation – sources produce very intense pulses of light/X-rays, with wave lengths and intensities that allow detailed studies of objects ranging in size from human cells, through viruses down to atoms, with a precision that is not possible by other means. Synchrotron-light sources therefore enable a very wide range of important applied sciences, from biology and medical sciences (imaging and therapy) through pharmaceuticals, physics, chemistry and materials science to archaeology, and can be used to improve manufacturing techniques, provide forensic evidence, and address environmental issues.

The heart of a synchrotron-light source is a ring of magnets (133m in circumference in the case of SESAME) in which electrons are stored after being accelerated to high energy. They are therefore relatively expensive devices which are frequently built by international collaborations. Working in collaboration has the important benefit that it disseminates the highest scientific and technical standards through the participating countries, which helps foster the development of a wide range of basic and applied science and industrial activities.

Synchrotron-light sources are generally ‘user facilities’. Scientists from universities and research institutes typically visit synchrotron laboratories for a week or two, two or three times a year, to carry out experiments, frequently in collaboration with scientists from other centres/countries, and then return home to analyze the data they have obtained. These scientists bring back scientific expertise and knowledge, which they share with their colleagues and students.

A detailed description of the status and aims of SESAME, and future plans, may be found in the SESAME Strategic Plan 2010-2014. A copy of the Plan may be obtained from the Administrative Director of SESAME by addressing a request to the following e-mail address: sonia@sesame.org.jo.

2. Rationale for a Synchrotron–Light Source in the Middle East

Synchrotron light is nowadays considered an essential way of promoting many modern technologies and fostering interdisciplinary activities and this has resulted in about 60 synchrotron-light sources being set up in the world (including in Brazil, India and Thailand). No such facility exists in the Middle East, although a need for this had been recognised by eminent scientists such as the Nobel laureate Professor Abdus Salam more than 25 years ago. This need promoted the CERN-based Middle East Scientific Cooperation (MESC) group to take concrete action in the late nineties to establish the SESAME light source.

SESAME will foster the development of a very wide range of science and technology, and motivate leading scientists and technologists to stay in the region, or to return if they have moved elsewhere.

3. The SESAME Centre

SESAME is an intergovernmental scientific centre established under the auspices of UNESCO along the model of CERN (European Organization for Nuclear Research). It is ‘owned’ by its Members which have full control over its development, exploitation and financial matters. It is located in Amman some 35km north-west of Amman in Jordan in a building specially constructed for it by the Jordanian Authorities, which was officially opened in November 2008. The host state has additional obligations, such as providing diplomatic privileges, tax exemptions, necessary facilities to allow the Centre to function properly, etc.

The current Members of SESAME are Bahrain, Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, Palestinian Authority and Turkey. Observers are: France, Germany, Greece, Italy, Japan, Kuwait, Portugal, Russian Federation, Sweden, U.K. and U.S.A. Switzerland is expected to shortly also become an Observer and Iraq and China have expressed interest in the Centre.

4. The SESAME Machine

SESAME will be a competitive “third generation” light-source. The energy of the electrons will be 2.5 GeV and the circumference of the storage ring will be 133m.

SESAME will be exploited in experiments at up to 25 beamlines, which will focus the synchrotron light on samples of materials. Three beamlines will be available

from day-one of operation of the light-source, and four more will be added soon after.

SESAME will incorporate equipment that (having become surplus to requirements) has been generously donated by a number of the world's synchrotron-light sources, including in particular components from the German BESSY I machine, which will be upgraded to provide the booster that will inject electrons into a new 2.5 GeV storage ring, and five beamlines from the Daresbury Laboratory in the U.K. The 'microtron', also from BESSY I, which will provide the initial acceleration and inject electrons into the booster, has been installed in the SESAME building, and produced the first electron beam on 14 July 2009.

The investments made so far in SESAME (including capital funding provided by Jordan and the European Union, and manpower and operational costs covered by the Members' contributions), plus the value of the donated equipment that will be in use on day-one of operation and the land put at the disposal of SESAME by Jordan, amount to some \$50M. The additional work that is needed to complete SESAME and bring it to operation in 2014 with three 'day-one' beamlines is described in the Strategic Plan 2010-14. The capital funding will be provided by voluntary contributions from the Members (very significant funds have already been pledged) and external sources.

5. Returns for investment in SESAME

Because SESAME groups the efforts of a number of countries, it offers an extraordinarily cost-effective way of obtaining excellent wide-ranging research opportunities.

SESAME should be considered as a long-term investment that will provide full benefits after the start up of the facility (planned in 2014). However, at this stage it is already producing very significant benefits, mainly through the extensive training programme, which is described below.

Investment in SESAME, which because it exploits high-class donated equipment is relatively modest compared to the sums invested in similar facilities in other countries, will contribute to promoting research and technologies in its Members, and, in the long run, will have far-reaching beneficial effects on the development of national capacities. Participation in SESAME will also contribute to improving the standards of teaching and research at national universities and make industries more competitive. In addition, it will strengthen international cooperation between Members.

II. Privileges of Members and Benefits for Them

1. Governance

Through the Council, which is the governing body of SESAME, Members participate in decisions on:

- the Centre's policy in scientific, technical and administrative matters;
- the Centre's financial regulations and staff rules;
- the establishment of staff posts at the Centre;
- the installation, operation and upgrading of the Centre's facilities,
- the scientific programme of the Centre;
- the training programme of the Centre;
- the election of the President of Council, and appointment of the Directors of the laboratory and chairpersons and members of the advisory committees;
- all financial issues, including adoption of the yearly budget, review and approval of expenditures, etc.

2. Scientific and Technical Activities

Scientists from Members of SESAME will have full access, free-of-charge, to all facilities in the laboratory, including existing beamlines and instruments.

Through international cooperation enabled by SESAME, scientists and technicians from Members of the Centre will be brought to world-level standards and they will become equal partners in the world scientific community.

It has been agreed, and is indeed one of the main aims of SESAME, that countries which are more advanced will help others to catch up in modern research and technology. It will be recalled that some of the SESAME Members have relatively advanced experience in using a synchrotron radiation facility whereas others still have to build up a scientific community to benefit fully from the possibilities it offers.

National universities of Members will also stand to benefit in many ways. Most experiments will be carried out in international collaborations by scientists from universities in Members of SESAME and beyond. This will enable universities to compare their standards with those of internationally-renowned universities which, in turn, will contribute to raise the level of their competence. Universities will also benefit from many spin-offs. For example, with the help of SESAME the infrastructure of internet connections will be developed since cooperation in SESAME will require an intensive exchange of electronic messages and scientific data produced by the SESAME beamlines. Already, cooperation with the Cyprus Institute in the framework of the EU-funded LinkSCEEM project is helping to

define the computing needs of SESAME and improve the internet connectivity between the Centre's various Members. Other institutes in the university will benefit from these spin-offs and other general developments.

3. Training

While a number of the scientific and technical benefits referred to in point 2 above will only become fully available once the machine starts operating (planned in 2014), at this stage already Members can profit from SESAME's extensive training programme which is considered one of the Centre's key elements. To date, US\$2.84M has been invested in training (almost all provided by outside supporters), and some 300 potential SESAME users have already benefited from the programme, whose value is set to rise to around US\$900K per annum. It has two main elements:

- (a) Workshops, users' meetings and schools. The users' meetings provide a forum for formulating SESAME's scientific strategy, and are fostering the formation of international collaborations which will carry out experiments at SESAME. So far, eight users' meetings have been held and more are being organized (for details see www.sesame.org.jo). The workshops focus on specific topics, while the schools provide basic training in carrying out experiments at synchrotrons. Support for these activities, which is currently at a level of over US\$100k per annum, is provided *inter alia* by the Japan Society for the Promotion of Science (JSPS), UNESCO, the Abdus Salam International Centre for Theoretical Physics (ICTP), and the American, British, German and European physical societies.
- (b) Individual training, through visits to leading laboratories around the world. Numerous fellowships have been established which support extended visits by young scientists and engineers from the SESAME Members. These fellowships, whose total value is approaching US\$800K per annum, are being financed by sponsors such as the International Atomic Energy Agency (IAEA), which is providing more than US\$1M for SESAME's training programme, the Deutsches Elektronen-Synchrotron (DESY) in Germany, the Portuguese Foundation for Science and Technology, the National Synchrotron Radiation Research Centre (NSRRC) in Taiwan, the Spanish synchrotron laboratory ALBA, and the Brazilian Synchrotron Light Laboratory (LNLS), to cite but a few.

It should be pointed out that the engineers who received training in European laboratories on how to install and later operate a synchrotron radiation source in the early years of the SESAME project received this tuition thanks to the SESAME training programme and the generosity of their European hosts. A number of these engineers are now staff members of SESAME. A similar mechanism has been established for scientists to learn how to install and operate beamlines, and how to carry out tests using synchrotron radiation techniques.

How much a Member benefits from SESAME's training programme depends on how active a Member is in proposing candidates. This training is not only useful for the exploitation of SESAME, but also has benefits for the Member's universities, and even industry.

4. Staff and Contracts for Equipment/Services

Although no definite quotas are foreseen, applicants from Members are given priority when international staff are hired at SESAME.

A number of components have to be purchased for the construction of the SESAME storage ring. Here again, preference is given to national companies from Members. Such contracts are not only interesting from a financial point of view, but in many cases are important tools for technology transfer.

Already, Members are starting to derive benefit from both these things. This benefit will increase as the construction of the facility progresses, to reach a climax when it is in full operation.

III. Obligations of Members

1. Intellectual and Other Obligations

Members are to ensure that they are represented on the Council of SESAME by persons having the required experience and authority. Each Member may have up to two delegates on Council. Ideally, one should be a scientist and the second a person entrusted with decision-making powers. They may be accompanied to Council meetings by up to two advisers.

The delegates to Council should make known the decisions of Council to their respective national authorities. They should be pro-active in responding to the Council's calls for representation on its advisory committees, candidates for training and vacant SESAME staff posts, bids for components that are to be purchased for the SESAME machine, etc. They should bring SESAME's activities to the attention of their national scientific institutions and universities so that their country may benefit to the full from the opportunities offered by SESAME.

The Members that are scientifically more advanced should help the other Members to catch up in modern research and technology.

2. Financial Obligations

The operational costs of SESAME (staff costs and materials for operating the machine and running the Centre) are to be covered by the Members of the Centre

In 2010, the yearly budget of SESAME stands at US\$1.7M. It is expected to increase to US\$5.7-8.5M in 2014 when SESAME is fully operational. It is hoped that eventually the number of Members will increase to more than a dozen with the consequence that the contribution of any single Member will be rather modest.

The total yearly budget is distributed among the various Members based on a system inspired from the principles of the UN scales. The total yearly budget and its distribution among the various Members are presented to Council every year and require unanimous approval by Council.

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