The Middle East synchrotron laboratory and India

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Jordan has been chosen as the site for relocating the decommissioned BESSY-I, from Germany. This will be the first synchrotron in the Middle East and will serve as a seed for an International Centre, open to scientists from the region and elsewhere. A detailed account of events leading to this and related developments is presented. Importantly, a significant role for India is envisaged in this international enterprise, urging international scientific collaboration and a leadership role for India.

A synchrotron provides an exceedingly powerful source of light generated by circulating charged-particle beams. It has become an important tool for scientific research and technological progress. Currently there are about fifty synchrotron light sources located in about twenty countries. Jordan will be the first country from the Middle East to join this elite group of countries possessing a synchrotron light source. This is due to the generous gift of the decommissioned BESSY-I, a successful synchrotron X-ray source by the German government[1]. BESSY-I, a 800 MeV machine and its successor BESSY-II, a 1900 MeV machine are located in Berlin.

After an effort of several years the Middle East synchrotron is at last becoming a reality. The project is known by the acronym 'SESAME' (Synchrotron-light for Experimental Science and Applications in the Middle East)[2]. Jordan was recently chosen as the site for hosting the relocated German synchrotron[3,4] upgraded to BESSY-Ia (ref. 5). The proposed synchrotron will be the seed for an International Centre built around the facility[6]. Such a centre has been long overdue and it will be the first one of its kind in the region. The centre will be operated and supported by eleven member countries (Armenia, Cyprus, Egypt, Greece, Iran, Israel, Jordan, Morocco, Oman, Palestine and Turkey) with support from countries, including, France, Germany, Italy, Japan, Russia, Sweden, Switzerland and USA[3]. Other countries which have expressed an interest to join this new fount of science include, Bahrain, Tunisia and Yemen[7]. SESAME will be located at the Al-Balqa' Applied University in Al-Salt and will be open to scientists from any country in the region and elsewhere. A wide range of planned research programmes include, structural molecular biology, molecular environmental science, surface and interface science, microelectromechanical devices, X-ray imaging, archaeological microanalysis, materials characterization and medical applications.

It all started with the Sinai Physics Meeting in Dahab, Egypt in November 1995 (ref. 8). This historic meeting was conceived by Sergio Fubini[9], which led directly to the formation of the Middle East Science Collaboration (MESC) in 1997. Several meetings have been since held (mostly in Europe) under the auspices of the United Nations Educational, Scientific and Cultural Organization (UNESCO), European Laboratory for Particle Physics (CERN), Abdus Salam International Centre for Theoretical Physics (Abdus Salam ICTP) to name a few. The grand project is under the valuable political umbrella of UNESCO. Its new director-general, Koichiro Matsuura has generously underwritten an amount of US $400,000 to expedite the project. Jordan's King Abdullah II has pledged US $1 million a year for five years and the member countries are expected to contribute US $50,000 per year for the three years of construction. The idea of donating the BESSY-I synchrotron came from Gustav-Adolf Voss, a former director of Deutsches Elektronen-Synchrotron (DESY), Hamburg, Germany and Hermann Winick of Stanford Linear Accelerator Center (SLAC) in California[10,11].

This is not the first time that a synchrotron is being gifted and relocated, thanks to the generous support of those in charge of the original facilities. Recently the Japanese gifted a 1000 MeV synchrotron to Thailand[12]. Siam Photon Source is Thailand's first synchrotron light facility and is intended to serve scientists throughout south-east Asia. The original synchrotron light source, called SORTEC, was located in Tsukuba Science City, near KEK, Japan's High Energy Accelerator Research Organization. A Dutch accelerator and storage ring used for nuclear physics is being moved to Dubna, to add to Russia's synchrotron capability[13].

It is disheartening to note that there has been no Indian participation in all these meetings. We as a nation are missing yet another opportunity in International Scientific Collaboration.

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As is well-known, India has had very old ties with the Arab world since ancient times. In recent decades these ties have been further strengthened by the presence of a large Indian community in the region, leading to economic collaboration. The proposed synchrotron will be a seed for an International Centre built around the facility, the first of its kind in the Arab world. I strongly feel that India can (and it should by all means) get involved with the coming of this International Centre[14]. India can play a significant role due to the strong Indian presence in the region and the old cultural ties, not to mention its scientific resources. It shall not be difficult for India to start a new era of scientific collaboration with the Arab world. India has the required expertise and the experience of building two synchrotrons at the Centre for Advanced Technology (CAT), Indore. Indus-I is a 450 MeV machine and Indus-II is a very energetic 2000 MeV machine. India can play a leadership role in such projects. The first step would of course be to participate.

Scientific cooperation across the geographical and cultural borders helps stimulate not only the advancement of ideas in the professional field, but also the building of lasting bridges and the establishment of contacts on a personal and more importantly at a national level. The costs involved for participation are not much. Some of the western nations are joining by contributing small amounts of a few thousand dollars[14]! Here it would be very relevant to note that one of the key individuals who laid the ground work for what is turning out to be the Middle East's first synchrotron light source and a major international scientific research centre is none other than the Nobel Laureate Abdus Salam.

Abdus Salam had visualized and devoted much of his life towards uplifting of Science & Technology in the Third World. The International Centre for Theoretical Physics (ICTP), Trieste, Italy, was founded by Salam in 1964, under the auspices of the International Atomic Energy Agency (IAEA), with a very generous support from the Italian Government. Few years later, UNESCO also joined in extending support to the new centre. The centre attracts thousands of visitors every year, mostly from the developing countries, for whom it was created. During the period 1970–1998, Indians have been benefited by 4569 visits totalling 7560 person months[15]. In November 1997 on the occasion of Salam's first death anniversary, ICTP was renamed as 'Abdus Salam ICTP', to commemorate the memory of its founder. In his speeches and writings regarding the Middle East, Abdus Salam had visualized an International Centre which did include a synchrotron laboratory as part of a larger scheme[9,16]. In May 1983, at the Symposium on the Future Outlook of the Arabian Gulf University, held in Bahrain, Salam had presented a very detailed proposal in which he reminded his listeners that, 'I have mentioned an international laboratory in materials sciences for Bahrain, with specialization in microelectronics and modern electronic communications, including space satellite communication, to help also with the banking communications needed at Bahrain. Such a laboratory was in fact proposed for the University of Jeddah. The idea was to emphasize science transfer in addition to technology transfer and to create international laboratories in the fields of materials sciences, including surface physics and a laboratory with *a synchrotron radiation light source*. The facilities created would have been of the highest possible international order; the laboratories would have been opened to teams of international researchers, who would congregate and work at Jeddah, just as they congregate now at the great laboratories in Hamburg, Geneva or Paris (p. 53 in ref. 17).

The SESAME Training Committee at ICTP is coordinating programmes which will enable the trainees to join research groups and technical teams at several synchrotron laboratories. They will get training in research and experience to work on the current technical issues relevant to the maintenance, running and repairing of a synchrotron light source. The participating laboratories include Elettra (Trieste), Daresbury Synchrotron Radiation Source (Daresbury), EMBL-DESY (Hamburg) and LURE (Paris).

Another approach, a crucial one, to the Middle East synchrotron would be to conduct a series of 'Schools' on synchrotron radiation and related fields. Such Schools are yet to take place. India can definitely initiate such Schools and play a pivotal role. These would train the potential users and more importantly promote international collaboration among India, the Arab world and the other nations involved. I would like to further add that the accelerator and beam physics and associated technologies are not yet part of the regular university curriculum in most parts of the world! The learning of such an important interdisciplinary science is done to a very large extent individually and through the very few Schools when and where available[18]. In passing, it is to be noted that, there is yet to be an Accelerator and Beam Physics Association/Society of India. When created, such an association/society will provide the much awaited forum[18], strengthening the accelerator and beam physics community nationwide. This has been the case in various other areas of physics, for a very long time! Why should accelerator and beam physics continue to make an exception?

India, one of the very few countries, regularly holds Accelerator and Beam Physics Meetings. For several years CAT at Indore has been holding a series of Schools on the 'Physics of Beams' every year in December–January. This series of Schools is funded by the Department of Science and Technology (DST), with the aim of dissemination more widely in India, knowledge of, and interest in, beam physics. The School attracts

several speakers from the premiere accelerator laboratories around the world. The Schools are very well-structured with tutorials and a few laboratory experiments. The participants of the school are further attracted to the Summer Research Programme conducted at CAT (see the School Reports in ref. 19). For over a decade the IUC-DAEF Calcutta Centre has been holding the tri-annual National Seminars on Physics and Technology of Particle Accelerators and their Applications. This series of seminars known by the acronym 'PATPAA' provides a forum where all the accelerator physicists and technical personnel can meet and exchange their ideas and new developments[20].

India and Jordan enjoy cordial and friendly relations. They have signed several agreements in trade and economy, cultural cooperation, science and technology to name a few. Here, it would be relevant to note the April 1985 Protocol for Scientific and Technical Cooperation between the Council for Scientific and Industrial Research (CSIR), India and the Royal Scientific Society of Jordan. India can also make use of the good offices of the Asian Committee for Future Accelerators (ACFA), which actively encourages regional cooperation in accelerator science and technology. This organization was formed in 1996 and its members are China, India, Indonesia, Japan, Korea, Malaysia, Pakistan, Singapore, Taiwan, Thailand and Vietnam. The First Asian Particle Accelerator Conference (APAC-1998) was held at KEK under the auspices of the ACFA, stressing the importance of regional collaboration among Asian regions in the field of accelerator science and technology, as well as accelerator-based science.

Siam and SESAME are very unique facilities as they are built by relocating gifted synchrotrons. Several such facilities are required in the under-represented regions of the world synchrotron map. These will immensely benefit the scientific community in these regions by enhancing international cooperation and providing them the latest technological expertise.

I conclude with the appeal to the authorities to make full use of this opportunity and be a party to international science. It is not too late and we can make a new beginning.

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