

CANDLE lights up re

As Armenian scientists continue their efforts to promote the project, **Vasili Tsakanov** explains the importance of the project.

In late 2001 a new non-profit foundation, CANDLE (Center for the Advancement of Natural Discoveries using Light Emission), was established in Armenia. Its aim is the construction of a 3 GeV synchrotron light facility in the Armenian capital, Yerevan. The project is well supported by the Armenian government, which has provided the office building and 20 hectares of land for the creation of the new laboratory. In a letter to the president of the CANDLE foundation, the minister of foreign affairs of the Republic of Armenia, Vardan Oskanian, said: "We believe the project is worthy of support by the private sector, the international community, the US government and, of course, the Armenian government."

Early in 2002 the new institute received a \$500 000 (~€419 000) grant from the US State Department for the design study of the facility (*CERN Courier* October 2002 p7). This was performed under a US Department of Energy contract with the director of CANDLE, Alex Abashian from Virginia Tech in the US, as principal investigator, and the work was undertaken by a team of Armenian scientists and engineers in close collaboration with colleagues from other countries. The design report was completed only six months later, in June 2002. Meanwhile, 69 user proposals from the international scientific community were submitted to a review panel established by the US State Department with the help of the National Science Foundation. The review panel, headed by Maury Tigner from Cornell University, held a special two-day meeting in Washington in August 2002 to evaluate the scientific, technical and organizational viability, as well as international aspects, of the proposed facility.

World class

The review panel reported that the CANDLE project would be a "world-class facility capable of enabling frontier work across the full range of physical, life and engineering sciences" and that it was highly likely that a reasonable user community could be developed. The report also described CANDLE as "an excellent investment from a scientific/technical point of view...providing a great opportunity to be the principal third-generation synchrotron facility, not only in Armenia but also the entire region." An important recommendation of the review panel relates to the funding of the new facility: "The committee urges the state department to consider an approach in which a construction funds commitment is contingent on the project delivering a plan for operations funding with hard commitments."

Several leading European synchrotron laboratories – ANKA, BESSY, DESY, ELETTRA and ESRF – along with the co-ordinator of the European Round Table on Synchrotron Radiation and Free-Electron Laser, Giorgio Margaritondo, have expressed their support for the creation of the new facility in Armenia. DESY has expressed



Signing the memorandum of understanding between Provence University (Jean-Marc Layet, left) and CANDLE (Vasili Tsakanov).

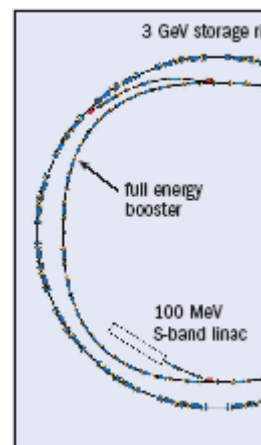


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CANDLE: a light source for Armenia

The CANDLE project is a 3 GeV synchrotron light facility that will deliver photons in the energy range 0.01–50 keV, which is suitable for investigations at the level of cells, viruses, proteins, molecules and atoms. The facility will consist of a 100 MeV energy S-Band linear injector; a full-energy, 2 Hz repetition rate, booster synchrotron; and a storage ring with a circumference of 216 m.

A critical photon energy of 8.1 keV will be achieved from 1.354 T bends and an energy of 12 keV from a 2 T wiggler magnet. In total, 12 insertion devices can be installed in the ring. For the initial stage of machine operation, six beam lines are currently foreseen to support diffraction and scattering, X-ray absorption spectroscopy, imaging, LIGA, soft X-ray spectroscopy and small-angle X-ray scattering experiments.



The diagram above shows the CANDLE facility. The table below the facility's spectral brightness...

its willingness to make an in-kind contribution to the project by providing the components of the S-Band linear accelerator for the injector system. The radiofrequency components will be transported to Armenia during 2004. The Scientific Committee of the University of Provence in Marseille has also expressed its support and interest. An official delegation from the university, headed by Jean-Marc

Research in Armenia

creation of the CANDLE facility, a third-generation light source, project both to the region and to international research.



Members of the US scientific delegation to CANDLE in February 2004. From left: Paul Neureiter (National Academies), Barry Barish (California Institute of Technology), Vasili Tsakanov (CANDLE), Samuel Harutiunyan (Yerevan State University) and John Dickson Baldeschwieler (California Institute of Technology).

be unique within an area of 2000 km radius and will involve the huge intellectual potential of the region. In turn, the initiative of the Armenian scientists provides a good case for the promotion of synchrotron light-based research worldwide.

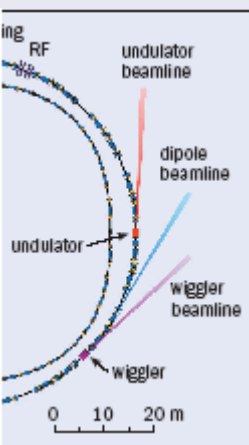
Armenia's leaders fully appreciate the value of the project for the country's long-term development and its integration into the international scientific community. "The beneficial impact will extend well beyond the boundaries of research, producing a positive picture of a country oriented towards science and technology and is capable of mastering the most sophisticated and ambitious projects," said Margaritondo in a letter to the Armenian minister of science and education. The Armenian National Academy of Science, Yerevan State University, the Georgian Academy of Science, Tbilisi University, and prominent scientists from Armenia and the surrounding region have all expressed their support for the CANDLE project. They consider the creation of the new light source as an "engine" for the promotion of scientific co-operation both in the region and globally.

Encouraging signs

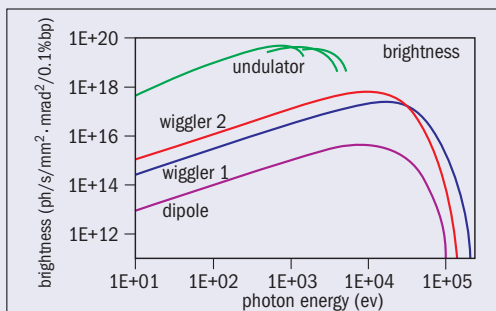
On 26 February this year the European Parliament voted for a special amendment related to scientific co-operation with the countries of South Caucasia, specifically stating that: "the commitment of the European Union to the Armenian synchrotron facility CANDLE will be an encouraging sign for this project, which primarily concerns European scientific research teams." At the same time the US State Department has renewed its consideration of the CANDLE project. Also in February, an official US delegation, including Barry Barish from the California Institute of Technology, visited the CANDLE laboratory to inspect the project and review the steps necessary for the continuation of the project.

More recently, a special session on "Synchrotron radiation research in developing countries and international scientific co-operation", organized by Herman Winick of the Stanford Synchrotron Radiation Laboratory and sponsored by the American Physical Society, took place in Montreal, Canada, on 22 March. In the session the regional impact of the Brazilian Light Source in South America, SESAME in the Middle East and SIAM in Southeast Asia were presented, together with the CANDLE project, which was described in an aptly titled talk: "Rejuvenating science in Armenia and its neighbours". Several US officials and experts attended the session, including Ray Orbach, director of the Office of Science at the Department of Energy.

Alex Abashian hopes that this latest effort will result in a green light for the CANDLE pre-construction stage during 2004, in line with the funding schedule and based on the report of the review panel. The pre-construction phase includes an extensive prototyping ►



The diagram shows the general layout of the CANDLE facility. The graph top-right depicts the brightness of CANDLE, and the table below lists its main parameters.



Energy E	3 GeV
Circumference	216 m
Current I	350 mA
Number of periods	16
Tunes Q_x/Q_y	13.22/4.26
Emittance	8.4 nm
Beam lifetime	18.6 h

Layet, visited the new laboratory in Armenia in April 2003, when a memorandum of understanding on the co-operative programme to be conducted on the future facility was signed.

The voices of the international community indicate the high regard in which the Armenian project is held, and that the user case for the facility will be robust upon its completion. The facility will

LIGHT SOURCES

programme; test stands for radiofrequency, vacuum and magnet systems; site development; the establishment of machine and user advisory committees; and a number of international workshops on the facility and opportunities for users.

The vision behind the CANDLE project has been aptly summarized by the president of the foundation, Jirair Hovnanian, head of a New Jersey-based family-run building company: "It is our vision and desire that CANDLE will be an international facility that will provide opportunities for scientists in the region and beyond to have access to a user-friendly, world-class, third-generation light source. A natural by-product of CANDLE is the renewal of the scientific standards in Armenia to their past world-class level, and the provision of employment for Armenian, as well as neighbouring, scientists, both young and mature, thus reversing the brain drain from the region." Some of these aims are already bearing fruit: as early as May 2003 the ArmElectroMash company in Armenia had successfully completed the first prototype dipole magnet for the CANDLE booster synchrotron. This positive experience has made local fabrication of the magnets and vacuum chamber for the new facility a reality, providing benefits to Armenian industry, even at the construction stage. The CANDLE leadership believes that the continuation of the project will provide a good base for the commitments by other funding sources, and will strengthen international co-operation in setting up and using the new facility.



The first prototype dipole magnet for the CANDLE booster ring.

Further reading

A Abashian *et al.* 2002 CANDLE Design Report, ASLS-CANDLE R-001-02; see also www.candle.am/~TDA/.

V Tsakanov *et al.* 2002 Status of 3 GeV Intermediate Energy Light Source Project in Republic of Armenia, EPAC 2002.

Vasili Tsakanov, technical director of the CANDLE project.