POLISH SYNCHROTRON RADIATION SOURCE

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Abstract: Recent decisions of Polish authorities open the door to a national high performance synchrotron radiation source in Poland. The current status of a project is presented, and basic features of the facility are discussed. In particular, the beamlines proposed for the initial operation phase are mentioned. An overview of further actions to be taken in order to prepare the Conceptual Design Report is given.

Streszczenie: Wpisanie projektu synchrotronowego źródła promieniowania na listę priorytetowych inwestycji infrastruktury badawczej w Polsce otwarło drogę do jego realizacji. Artykuł przedstawia obecny stan zaawansowania przygotowań i zasadnicze parametry określające skalę urządzenia. W szczególności określono specyfikację linii eksperymentalnych proponowanych do stworzenia w pierwszej kolejności. Wskazano również na niektóre ważniejsze kroki poprzedzające opracowanie projektu ogólnego.

There are good reasons to believe that a construction of a Polish synchrotron facility will soon start. After almost a decade of efforts to broaden the understanding of unsurpassed research possibilities which open with the availability of the synchrotron light source the decisive step has been made: the Minister for Science and Higher Education has signed a document which includes the Polish synchrotron project among priorities of the national programme to establish large research facilities in years 2007 – 2013 and assures a considerable part of financial support. The decision was confirmed *expresis verbis* by the Prime Minister of the Polish Government, Mr. Jarosław Kaczyński at the meeting with representatives of the scientific community at the Jagellonian University on November 19, 2006. The act was a positive reaction to the proposal put forward in June this year by 45 Polish scientists from 22 leading research institutions (the proposal is available at address http://www.if.uj.edu.pl/Synchro/). The document specifies the basic features of the future radiation source, which will meet the present and prospective needs of Polish and Central-East European scientific communities. The required full-energy booster-synchrotron and the storage ring of about 180 m circumference (with 10 to 12 straight sections) should operate at 2.5 to 3 GeV electron energy and enable measurements with photon energies up to 25 – 30 keV. Higher photon energies (of about 40 keV) may be achieved with appropriate insertion devices. Seven beamlines are proposed at the first construction step (Phase I) as a result of polling among the synchrotron radiation users in Poland. The photon energy ranges and general research areas are listed in the Table along with coordinators/contact persons for each specific line. The provisional (working) coding of the lines starts with a letter designating the device type used for generation of radiation, where 'M' stands for bending magnet (BM), 'W' for wiggler and 'U' for undulator insertion devices (IDs).

Table 1. Seven beamlines proposed for installation at the first stage of the experimental facility development (Phase I).

BM or ID	Photon energy range [keV]	Experimental methods	Coordinator (Affiliation)
M1	4 ÷ 30	High Resolution, High Energy X-ray Absorption and Emission Spectroscopy	K. Ławniczak-Jabłońska (Institute of Physics, Polish Academy of Sciences; Warszawa)
U1	5 ÷ 20	Powder diffraction, SAXS (Small Angle X-ray Scattering)	W. Paszkowicz (Institute of Physics, Polish Academy of Sciences; Warszawa)
W2	4 ÷ 30	Hard X-ray Absorption Microscopy and Microtomography, Microanalysis	W.M. Kwiatek (H. Niewodniczański Institute of Nuclear Physics, Polish Academy of Sciences; Kraków)
M3	0.001 ÷ 0.250	NIR – VUV Absorption, Dichroism, Fluorescence, Luminescence, PES	K. Polewski (Institute of Physics, Agricultural University of Poznań)
U3	0.02 ÷ 2	X-ray Photoelectron Spectroscopy (XPS) and Auger Electron Spectroscopy (AES)	J. Szade (Institute of Physics, University of Silesia, Katowice)
M4	$4{*}10^{-7} \div 2{*}10^{-4}$ (k: 20 - 10000 cm^{-1})	High Resolution Infrared Spectroscopy	M. Handke (Faculty of Materials Science and Ceramics, AGH University of Science and Technology; Kraków)
U4	5 ÷ 20	Protein and macromolecular crystallography (PX)	M. Jaskólski (Chemistry Department, Adam Mickiewicz University; Poznań) and K. Lewiński (Chemistry Department, Jagellonian University; Kraków)

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The drawing (Fig. 1) presents, in a concise, diagrammatic form, a general scale of the future establishment. The injector and the full energy booster synchrotron are placed inside the storage ring. Three out of 10 to 12 straight sections will be reserved for injection, radio frequency (RF) cavity and diagnostics while leaving the remaining 7-9 sections for insertion devices. The first seven lines are depicted schematically, and the unoccupied part of the ring offers an opportunity to build new beamlines.

The proposed machine is expected to satisfy needs of Polish and Central-East-European users in the years to come. It is comparable with modern, versatile, medium size light sources lately completed or soon becoming operational: ALBA (Cerdanyola del Vallès/ Barcelona, Spain; circumference: 269 m; energy: 3 GeV), AUSTRALIAN SYNCHROTRON (Clayton/Melbourne, Australia; 216 m; 3 GeV), CLS (Saskatoon, Canada; 171 m; 2.9 GeV), DIAMOND (Didcot/ Oxfordshire, UK; 562 m; 3 GeV), SLS (Villigen, Switzerland; 288 m; 2.4 GeV), SOLEIL (Saint-Aubin, France; 354 m; 2.75 GeV), SPEAR3 (Stanford, USA; 234 m; 3 GeV).

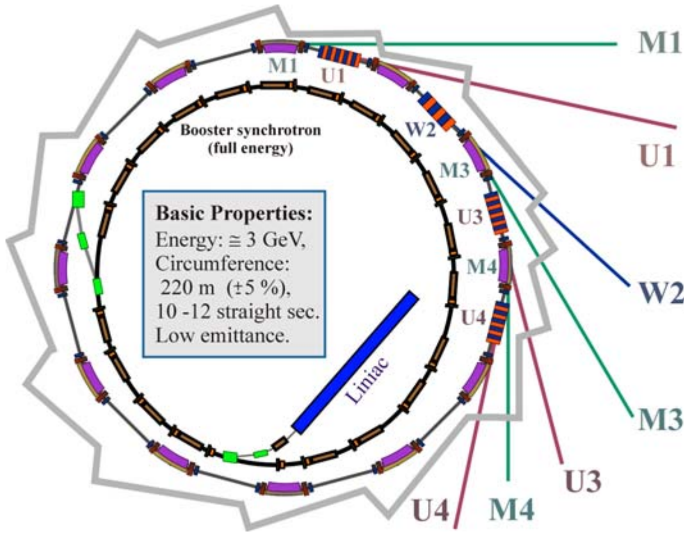

Fig. 1. Schematic presentation of the proposed facility layout to visualise a general scale of the project with first seven experimental beamlines.

The Centre for Synchrotron Radiation Co. Ltd. (CPS Sp. z o.o., located at the Jagellonian University) was established to facilitate preparatory steps for the successful construction of the synchrotron light source. The final legal form of the institution directly responsible for the construction stage of the National Centre for Synchrotron Radiation is under consideration. It seems that the form of a company limited (Ltd.) is best legally defined, financially transparent and organisationally effective. This structure of a synchrotron institution is well established in many countries with longstanding experience. Once a legal path opens (changes in regulations are being prepared), other institutions and scientific organisations may become the shareholders. However, from the users' point of view it matters little, as the National Institution is open, by definition, freely to non-profit users. Projects are subject to a usual process of reviewing. Furthermore, practically there are no technical limitations as far as the development of new beamlines is concerned in a foreseeable future – in particular with bending magnet based lines. The decisions rest upon the advisory and peering committees' reports according to the scientific and technical merit of the individual proposals for the coordinated developement of experimental facilities. All initiatives (like that of AKCENT consortium), and not necessarily coming only from scientific institutions in Poland, concerning new beamlines are welcome. However, it must be borne in mind that such (private) lines are open to all users on general principles in 30% to 50%.

Before a state of experimental readiness of the facility is achieved, a lot of work is facing us. The main objective of a further course of action is to create a Conceptual Design Report formulating the detailed technical requirements of the machine (booster synchrotron and the storage ring) as well as for the Phase I beamlines. To accomplish the task several committees and working groups will be formed to cover different parts of the project. The structure of their organisation, exact mandates and coordination is a subject of a wide consultation with experienced facility managers and project directors worldwide. Several meetings and workshops are being planned for the first half of the year 2007. In particular, the decisions concerning the specific solutions for the beamlines and end-stations characteristics will be elaborated by the individual Users' Advisory Beamline Committees (to be established soon). For the sake of future development it is expected that each beamline initiative group, lead by the coordinator, will form such a committee responsible for the structure of the given line, its parameters, and instrumentation [e.g. concerning priorities of the proposed end-station(s)]. This is an important issue to achieve a balanced design of a system with insertion devices and decide on the storage-ring-parameters optimisation.

Simultaneously, actions on several other planes should proceed. One of them, perhaps the most important one, is to educate young people in different specialities necessary to develop, build and operate the machine. The practical knowledge and expertise may be acquired only by direct access to the working facilities and a contact with experienced scientists and technicians. The EU training and educational programmes should be widely used in addition to a well organised, directed schooling in Poland.

At the present stage of the work on the Polish synchrotron light source, it remains an important task to point out in public the diverse advantages of the venture. Therefore, the informative action among researchers should lead to a considerable increase in a number of users of synchrotron radiation in this country, especially in fields beyond physics or chemistry. Possibilities which open for techniques based on synchrotron radiation are greatly advantageous with respect to the laboratory systems using individual light sources. On the other hand, it has to be stressed at this point that among positive bearings of a direct access to the national light source there are those which make usage of the most advanced and highly specialised beamlines of the world top synchrotron facilities, better justified and prepared.