C15

BIOMEDICAL FACILITY AT POLISH SYNCHROTRON IN CRACOW

J.B. Pelka

Institute of Physics, Polish Academy of Sciences, Al. Lotnikow 32/46, 02-668 Warsaw, Poland

e-mail: pelkay@ifpan.edu.pl

A project of biomedical facility at the Polish Synchrotron Light Source (PSLS) [1] to be built near Cracow will be presented. The design outlines of the facility take into consideration construction principles and experience at other dedicated biomedical beamlines [2, 3]. A special attention was paid to solutions accepted in design of beamlines for biology and medicine at storage rings with parameters similar to that planned at PSLS. That are the Canadian CLS (BMIT) [4], the Australian ALS (BL-10) [5] and the Catalonian ALBA [6].

The proposed facility is aimed at application of SR x-ray techniques for imaging, diagnostics and therapy in biological and medical systems, including humans and animals. Some of considered solutions are on the top edge of currently developed accelerator and x-ray optics technology, with feasibility and efficiency confirmed at the above mentioned biomedical beamlines.

The facility will take advantage of two different types of radiation sources: the bending magnet (BM) and the more advanced and powerful superconducting wiggler (SCW). The sources with the accompanying infrastructure will be constructed subsequently in two phases with BM first, and afterwards the SCW will be added. A significant part of infrastructure will be shared by both beamlines.

The BM beamline will host a wide range of imaging techniques exploiting absorption and phase contrast with diffraction enhanced imaging (DEI), phase contrast imaging (PhCI) operating in computed tomography (CT) and in planar modes, and fluorescence imaging, among others. The beamline will also serve as a place to test and validate new techniques, to develop new ideas in imaging and therapy technologies, and will relieve some of the imaging program from the SCW beamline after its construction. The dose rates available at the BM line will be, however, insufficient to most of time-resolved techniques.

The innovative SCW beamline is designed to provide tunable monochromatic beam, of width up to 25 cm, suitable for imaging and treatment of a wide variety of subjects, from mice to large domestic animals, with spatial resolution down to 10 μm and below. The SCW beamline will host a number of imaging capabilities, including K-edge subtraction, diffraction enhanced imaging, multiple image radiography, phase contrast imaging, as well as normal absorption imaging. The SCW beamline will deliver also a filtered white beam, foreseen to reach the entrance dose rates on the order of 3500 Gy/s or higher, invaluable in some imaging and therapy techniques, like microbeam radiation therapy or synchrotron stereotactic radiation therapy. Monochromatic X-ray flux of up to 10^{14} ph/s/cm^2 will be available.

The design of the monochromators and the front ends of the beamlines will cover specific demands of biomedical applications, with high stability under radiation load, precise and fast beam locking/shutting, radiation protection and fast air volume exchange. Design of all of the components, windows, slits, filters and shutters, monochromators and slits will be focused on the heavy duty stability, performance and radiation security.

Due to specificity of objects being studied at the biomedical facility, including live animals and humans, a significant additional area of 70-100 m^2 for preparation rooms, labs, rest rooms, is foreseen.

The life sciences and medical program at the facility will be extended to other beamlines of the PSLS. Especially important are here the microbeam line and protein structure line, as well as IR. Due to its exceptional intensity, high energy SCW source at the biomedical facility, part of beamtime will be allocated to studies extending beyond the strict biomedical program. One of the fields is here material science exploiting higher photon energies (defectoscopy, strain studies, high Z materials absorption and phase contrast imaging, etc.)

Upon completion, the biomedical facility with its unique synchrotron specific imaging, diagnostics and therapy capabilities will be ready to cope with unsolved, the most crucial issues in biology, medicine, agriculture, ecology, biotechnology and other areas related to life sciences. The research teams at the facility will be able to develop strong, worldwide, competitive scientific and medical programs.

References

[1] http://synchrotron.pl/.

[2] R. Meuli, Y. Hwu, J.-H. Je., G. Margaritondo, "Synchrotron radiation in radiology: radiology techniques based on synchrotron sources", *Eur. Radiol.* **14** (2004) 1550–1560.

[3] J.B. Pełka, "Promieniowanie synchrotronowe w biologii i medycynie", *Synchr. Rad. Nat. Sci*. **6** No. 1-2 (2007) 99-107, English version in preparation.

[4] *Canadian Light Source Activity Report 2001* – 2004; Editor: M. Dalzell; CLS Document No. 0.18.1.2; Canadian Light Source Inc. 2005 (http://www.lightsource.ca/).

[5] R.A. Lewis, "Medical applications of synchrotron radiation in Australia", *Nucl. Instrum. Meth. in Phys. Res. A* **548** (2005) 23–29.

[6] A. Bravin, R. Noguera, M. Sabés, J. Sobrequés, *ALBA Biomedical Beamline (ABME). A Proposal for the ALBA S.A.C.*, Barcelona 2004.