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XRADMED - BIOMEDICAL FACILITY FOR DIAGNOSTICS AND THERAPY AT POLISH SYNCHROTRON IN CRACOW: A CONCEPTUAL DESIGN

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XRADMED is a biomedical facility, proposed for the Polish Synchrotron Light Source (PSLS) to be built in Cracow. The design outlines of the facility refer to solutions accepted in other biomedical beamlines. Special attention has been paid to the machines characterized by parameters similar to that planned at PSLS, like the Canadian CLS (BMIT) [1], the Australian ALS (BL-10) [2] and the Catalonian ALBA [3]. XRADMED 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 the proposed solution are on the top edge of currently developed accelerator and x-ray optics technology. Their feasibility and efficiency has been confirmed at the above mentioned biomedical beamlines.

XRADMED will be equipped in two different types of radiation sources, that will be constructed in two phases. First the bending magnet (BM) will be built, and afterwards the more advanced and powerful superconducting wiggler (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, absorption spectroscopy imaging and fluorescence imaging, among others. The beamline will serve as a place to test and validate new ideas, to develop new 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, or to avoid blur due to natural body movements (like respiratory or heart action) during a single-shot irradiation of live animals or humans.

The innovative SCW beamline is designed to provide tunable monochromatic beam, of width up to 25 cm, that allows 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 (KES), diffraction enhanced imaging (DEI), multiple image radiography (MIR), phase contrast imaging (PCI) as well as normal absorption imaging in both projection and CT modes of operation. In addition, the beamline will deliver a filtered white beam, foreseen to reach the entrance dose rates up to 3500 Gy/s, invaluable in some imaging and therapy techniques, like microbeam radiation therapy (MRT) or synchrotron stereotactic radiation therapy (SSRT). Monochromatic x-ray flux of up to 10^{14} ph/s/cm^2 will be available.

Upon completion, the XRADMED will constitute a world class facility with unique synchrotron specific imaging, diagnostics and therapy capabilities. It 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 XRADMED will be able to develop strong experimental programs, competitive to that at other biomedical synchrotron facilities over the world.

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