

By Prof. Nick REYNAERT

Head of Medical Physics Department HUB, Director, Medical Radiophysics Lab ULB

The Institute Jules Bordet (IJB), which is affiliated with the Brussels University Hospital (HUB) and specializes in the field of oncology, employs a multidisciplinary approach encompassing various healthcare domains pertinent to cancer treatment. The primary mission of this institution is the delivery of effective treatments within a patient-centered framework. This mission is realized through a tripartite structure that encompasses clinical care, research, and educational initiatives.

Much like the overarching structure of IJB, the Medical Physics Department at HUB adopts a tripartite framework, constituting a multidisciplinary unit. This unit comprises Medical Physicists accredited by the Federal Agency of Nuclear Control (FANC), engineers specializing in equipment maintenance and quality assurance, data scientists, a dosimetry team, and a dedicated research division functioning as a university laboratory. The department operates as a hub for fostering research innovation, applying cutting-edge technology, and promoting interdisciplinary collaborations with the ultimate goal of augmenting healthcare outcomes through technology-driven and data-centric methodologies.



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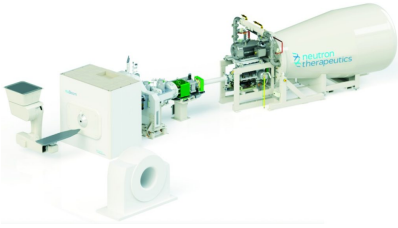
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Integration of Imaging and Radiotherapy Techniques

The department maintains intrinsic connections with the Departments of Radiation Therapy, Nuclear Medicine, and Radiology. Through concerted collaborative efforts, the department is committed to facilitating the seamless integration of emerging technologies (as detailed below) into the clinical workflow, thereby enhancing the precision of diagnostic procedures and the efficacy of therapeutic interventions. Our research endeavors also concentrate on the amalgamation of multimodal imaging and dosimetry within the framework of precision radiotherapy, encompassing MRI-Linac and Nuclear Medicine Theranostics (notably 68-Gallium/177-Lutetium PRRT and PSMA).

Application of Data Science in Healthcare

The establishment of a specialized Data Science unit within the department represents a significant milestone. This unit is responsible for amalgamating diverse datasets sourced from the hospital's infrastructure. Employing machine learning algorithms, the unit concentrates on developing predictive models based on biomarkers and multi-omics data, thereby pioneering advancements in personalized medicine. Additionally, the data science unit harnesses AI and deep learning techniques to automate labor-intensive tasks within the domains of Radiation Therapy, Nuclear Medicine, and Radiology. In this context, our team is actively engaged in refining data collection methods through the concept of data farming, as well as improving image segmentation (covering CT, MRI, and PET images), predicting absorbed doses, generating pseudo-CT images from MRI data, and modeling TCP/NTCP.



Boron Neutron Capture Therapy (BNCT), the largest project in the HUB's «Medical Physics Department» - © IJB - HUB BNCT

Innovative Approaches in 3D Printing and Biocompatible Printing

The department extends 3D printing services across various departments, encompassing the production of bolus materials for radiotherapy, phantoms for quality control in nuclear medicine and radiology, and simulations of surgical interventions. Furthermore, the department is venturing into the domain of biocompatible printing in collaboration with the Laboratory of Clinical Cell Therapy. This exploration aims to unlock the potential for advancements in tissue engineering and regenerative medicine.

Advancements in Therapeutic Techniques

The department is actively involved in the evaluation and integration of cutting-edge therapeutic modalities. Current focal areas include the development of image quantification and dosimetry techniques in Nuclear Medicine Theranostics, enabling patient-specific definition of therapeutic windows for these treatments. Initiatives like the introduction of Flash therapy, an innovative radiation therapy technique, and the utilization of MRI-Linac for daily adaptive radiotherapy with continuous MRI imaging during irradiation are actively pursued. Ongoing research in Boron Neutron Capture Therapy (BNCT) is also underway, with plans to establish a dedicated BNCT system in a new facility. Also, our team plays a pivotal role in the preclinical research, for the medical physics aspects, associated with these cutting-edge therapeutic methods.

Specific radiotherapy techniques: MRI Linac and mobetron for Flash therapy - © IJB - HUB

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Industry-Academia Collaboration

Collaborative projects with industry leaders such as Elekta, Siemens, GE Healthcare, and IBA serve as bridges between academia and industry. The department, in this capacity, acts as a crucible for knowledge transfer, catalyzing advancements in medical technology.

Fostering Academic Excellence

Aligned with its commitment to scholastic rigor, the department hosts a contingent of PhD candidates and post-doctoral researchers engaged in projects funded by the Jules Bordet Association, Télévie, FNRS, and Biowin. These early-career scholars are integral to the department's ongoing research endeavors. In summary, the Medical Physics Department at the HUB extends beyond its traditional disciplinary boundaries, serving as a vanguard in healthcare innovation and collaborative research. Its activities are geared towards optimizing patient care through technological and data-driven solutions, making significant contributions to the healthcare landscape.

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