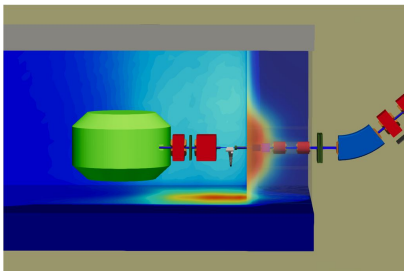
The Nuclear Metrology Research Unit (SMN) was set up in the early 1960s in conjunction with the physics engineering specialisation at the École polytechnique de Bruxelles. It is directed by Prof. Pierre-Etienne Labeau and has 4 full-time professors for a total staff of about 25. In 2024, it received €1 million in external funding for its research and teaching activities. 6 PhD theses were successfully defended in the last 3 years, while the SMN unit hosts 12 other PhD students, some in partnership with CERN and SCK-CEN.



Prof. Pierre-Etienne Labeau, Head of the "Service de Metrologie Nucleaire"

Historically associated with the beginning of the nuclear era in Belgium, research at SMN focuses on five areas: reactor physics (neutronics, reactor core calculations); development of efficient numerical algorithms for solving large systems of linear equations derived from the discretisation of mathematical physics equations; modelling and simulation of particle transport in various applications like radiotherapy, proton therapy and radiation protection; development of probabilistic methodologies and simulation algorithms for the assessment of the safety, reliability and other performance indicators of major energy systems (nuclear power plants, power systems); perception of technological risks and ethical aspects linked to new technologies, such as the geological disposal of nuclear waste or the deployment of new reactor technologies.



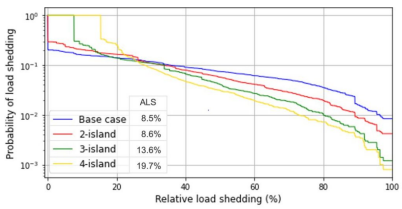
Model of a proton therapy infrastructure, its shielding, its primary proton beam in blue and the secondary neutron fluence - © Eliott Ramoisiaux, Time-dependent evaluation of machine and shielding activation for medical accelerator systems - Self-consistent numerical evaluation of concrete shielding activation for proton therapy systems, PhD thesis, SMN, ULB (2023)

The Nuclear Metrology Research Unit is collaborating with SCK-CEN on future reactor designs, like lead-cooled, fast small modular reactors (SMR). These reactors are expected to better use the nuclear fuel, and to be more flexible, safer and easier to install in industrial areas for electricity production, heat generation or hydrogen storage. In this context, the SMN provides its expertise in reactor core calculations, support studies of severe accidents and safety analyses – all challenges to be met in order to retain valuable know-how in Europe.

In the field of proton therapy, the SMN is supporting the development of more efficient accelerators and better beam control, in order to expose patients to more local doses, thereby preventing healthy tissue from being affected by the radiation. With this in mind, accurate simulations are being carried out to develop more effective treatment protocols, optimise treatment infrastructures and shielding equipment around infrastructures to protect patients and staff.

Another topical project is the study of the resilience of power systems in the event of disruptive situations (major storms, earthquakes, etc.) with a view to coping with the loss of multiple active elements, absorbing the subsequent shock and restoring network performance as quickly as possible. These calculations are complemented by studying intentional controlled islanding: in the event of a challenging weather situation, the network could be preventively split into electrically independent sub-regions, in order to limit the impact of the event and make it easier to restore the grid.

Thanks to its expertise, which is widely recognised by its academic and industrial partners, the SMN is perfectly positioned to contribute to the deployment of new types of nuclear reactors that are more efficient, more acceptable, more controllable, safer and more optimised. A good way of facilitating the energy transition with carbon-free, controllable production resources that are perfectly suited to the expected increase in the demand for electricity. On the horizon: industrial developments in response to societal needs that the students in the Nuclear Metrology Research Unit are keen to satisfy. Similarly, the medical applications of nuclear sciences are helping us to deal with disease as effectively as possible. In short: great challenges and a joyful responsibility!



Load shedding probability vs. load shedding ratio in an intentional controlled islanding approach ; Ref: Enhancing Power System Resilience With Controlled Islanding Strategies,

Léa Hayez, Farshid Faghihi, Pierre-Etienne Labeau, Pierre Henneaux, Proceedings of PMAPS 2022, Manchester (UK), June 2022

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