**Photonuclear Neutrons from Synchrotron Linac: Bridging Environmental Science and Isotope Technology at SOLARIS**

This study explores the feasibility of utilizing the electron linear accelerator (linac), currently integrated into the synchrotron infrastructure at the SOLARIS National Centre for Synchrotron Radiation, as a compact and versatile photoneutron source. The objective is to evaluate its potential for two key applications: neutron activation analysis (NAA) of environmental samples and the production of select radioisotopes for medical and industrial use. Traditionally, these applications have relied heavily on reactor-based neutron sources, which pose logistical, regulatory, and operational challenges. Accelerator-driven systems, particularly those based on electron linacs, offer a promising alternative by generating high-energy bremsstrahlung photons capable of inducing (γ,n) reactions in high-Z target materials such as tungsten or beryllium.

The proposed concept involves adding a experimental line to the existing SOLARIS linac to operate in pulsed or continuous mode to produce photonuclear reactions in a designated target assembly. Neutron yield, energy spectrum, and flux distribution are evaluated through preliminary Monte Carlo simulations and theoretical modeling. Considerations include target geometry, shielding requirements, and moderation systems tailored for maximizing thermal or epithermal neutron availability, depending on the application.

For environmental analysis, the focus is on establishing protocols for instrumental neutron activation analysis (INAA), enabling the detection of trace elements in soil, water, and atmospheric particulates. The compact footprint and controllability of the linac-based source could support rapid, decentralized testing in response to environmental monitoring needs, pollution events, or scientific studies