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Development of RANS-III for Outdoor Measurement

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We have been developing the RIKEN Accelerator-driven compact Neutron Systems (RANS) since 2011. Two accelerator-based neutron systems and an RI-based neutron salt meter are already being used for daily neutron scattering measurement experiments. RANS-I consists of 7 MeV proton LINAC (425MHz RFQ+DTL coupled) and a beryllium target with a room temperature polyethylene moderator and a helium-cooled mesitylene moderator. For the RANS-II (200MHz RFQ), the proton energy was lowered to 2.5 MeV to reduce the weight of the accelerator and the shielding. At the same time, we have developed a method to make measurements with a smaller number of neutrons produced. RANS-II is currently used as a stationary compact neutron source.
Based on the measurement technique, accelerator technology, and shielding parameters obtained from RANS-II, we are now developing RANS-III equipped with a 500 MHz RFQ accelerator and preparing it for field measurements on a trailer. RANS-III is currently being developed to irradiate neutrons downward and to detect the bridge deterioration through moisture and salt density measurements with neutron scattering visualization and PGAA from the surface level.
In 2024, the equipment was installed on a 40 foot size custom-built trailer, and operational testing of the equipment is currently underway. The floor of the trailer is reinforced with 22 mm thick steel plates and seven steel gates are installed to ensure rigidity. Protons accelerated horizontally toward the rear of the vehicle are deflected vertically by electromagnets and irradiated to a lithium target installed in the center of the elevating shielding under the floor through an approximately 80 cm square through-hole in the floor. The lithium target is 40 mm in diameter, and the irradiated proton beam diameter is designed to be about the same size to distribute the heat load on the target surface. In 2025, with the trailer stored in the newly constructed building, we will conduct neutron generation tests, environmental radiation level measurements, and actual sample measurements.

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Instrumentation and Hardware

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