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Development of radioactive xenon analysis system by diagnostic assessment using mass spectrometry

In order to diagnose each function of currently adopted xenon acquisition system (Gammadata, SAUNA II), two kinds of preliminary test have been carried out. First of all, the mole fraction of the air concentrated in the transport columns adopted for the SAUNA was measured by utilizing mass spectrometer. It has been verified that the terrestrial xenon was well concentrated to be 0.2% of mole fraction from the trace amount of 0.087 ppm of the atmosphere and that also the moisture as well as carbon dioxide contained in the air was removed efficiently. The SAUNA II is designed to adsorb xenon physically into the molecular sieve (5A) in the transport column at room temperature, although the adsorption efficiency of xenon is enhanced under the cooling system. For this matter, subsequently, the adsorption efficiencies at room temperature were compared with that at -196 °C, measuring the Xe concentrations in the stainless steel frit packed with 5A by mass spectrometry. We experimentally demonstrated the adsorption efficiency was improved by two times at the lower temperature.

Based on the preliminary test, we propose an innovative structure for xenon acquisition system which has a cooling bath equipped to the transport columns and a portable mass spectrometer for real-time diagnosis. Xe transferred from the transport column is highly enriched in the tiny sample reservoir to be mounted on the high-purity germanium (HPGe) well detector.

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