# 12-9 High Sensitivity Measurement of Iodine-129 by Accelerator Mass Spectrometry (AMS) —New Technique Has Shorter Processing Time, Higher Precision and Higher Sensitivity than Neutron Activation Analysis (NAA)—

**Fig.12-19 AMS at the Mutsu Establishment**
This AMS consists of two ion injection lines (left), a tandem accelerator (center) and two mass analyzing lines (right). The measurement of $^{129}$I uses the outer beam line. This beam line has a high-resolution magnet, a high-energy resolution electrostatic analyzer and a time of flight detector.

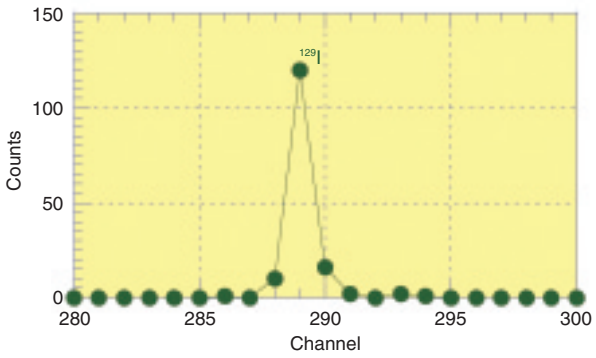


**Fig.12-20 $^{129}$I spectrum detected by time of flight detector**
There is no interfering peak around the $^{129}$I peak, showing that interfering ions were removed by the analyzing magnet and electrostatic deflector.

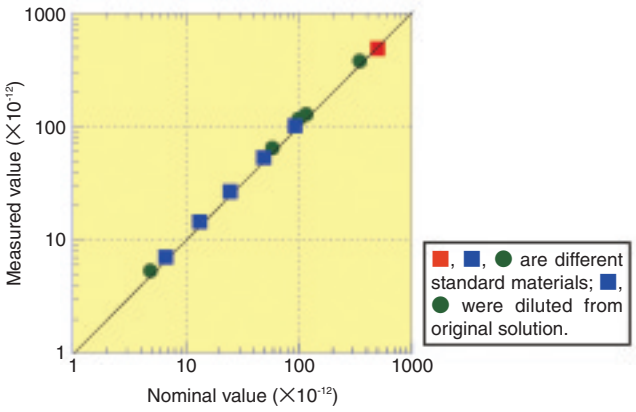


**Fig.12-21 Linearity experiment**
This experiment demonstrated that this AMS has excellent linearity with nominal value between $10^{-10}$-$10^{-12}$ iodine isotopic ratio.

Iodine-129 ($^{129}$I) is a long-lived radioactive isotope with a half-life of 15.7 million years which is released from spent nuclear fuel reprocessing plants. $^{129}$I is an important nuclide for monitoring around nuclear facilities and also useful for tracing in hydrogeologic and oceanographic research. NAA is recommended as a measurement technique for $^{129}$I in the "Analytical method of radioactive iodine-129" published by the Ministry of Education, Culture, Sports, Science and Technology of Japan. Because NAA has a high detection limit ($^{129}$I/$^{127}$I = $10^{-9}$-$10^{-10}$), it takes much time for analysis, has low precision, and would cause radiation exposure during analysis, it is not suitable for environmental samples ($^{129}$I/$^{127}$I = $10^{-10}$-$10^{-12}$) except for the monitoring around nuclear facilities. Therefore, a measurement technique for $^{129}$I with short processing time, high precision and high-sensitivity was developed using accelerator mass spectroscopy (AMS) (Fig. 12-19) set up at Mutsu establishment.

In mass analyzing for $^{129}I^{5+}$ (m/e=25.8), $^{103}Rhodium^{4+}$ (m/e=25.75) and $^{52}Chromium^{2+}$ (m/e= 26.0) interfere with analysis because the mass to charge ratio is close. We succeeded in removing the interfering ions by the improvement of the mass resolution using a high mass resolution magnet, high energy resolution electrostatic deflector and time of flight detector (Fig.12-20). Also, a stable beam from the target is obtained by mixing sufficient Niobium in the target to increase conductivity, resulting in reliable measurement.

Standard samples which had a variety of iodine isotopic ratios between $10^{-10}$ and $10^{-12}$ were measured for about 60 min and the excellent linearity of the plot of nominal and measured values (Fig.12-21) shows that this AMS has good precision. Evaluating the detection limit of this method using commercial silver iodide, it was possible to measure as low as a $10^{-14}$ iodine isotopic ratio.

This measurement technique enables not only the simplification of the monitoring around the nuclear facilities but also breakthrough use of $^{129}$I in environmental migration research.

**Reference**

Suzuki, T. et al., Performance of Iodine Beam Line for Accelerator Mass Spectrometry, 2006, JAEA-Technology 2006-018, 40p. (in Japanese).