PROPOSAL FOR EXPERIMENT AT RCNP

21 July 2005

TITLE:

Measurement of the half-life of ^{60}Fe for a Nearby Supernova Source.

SPOKESPERSON:

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RUNNING TIME:	Installation time without beam	1 days
	Data runs	1 days
BEAM LINE:		RING : WN course
BEAM REQUIREMENTS:	Type of particle	proton
	Beam energy	200 MeV
	Beam intensity	1 μ
BUDGET:	Experimental expenses	0.51milion yen

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SUMMARY OF THE PROPOSAL

A nearby supernova(SN) explosion in the past can be confirmed by the detection of radioisotopes on Earth that were produced and ejected by the SN. Recently,a well resolved time profile of ^{60}Fe concentration in a deep-sea ferromanganese crust are measured and found a highly significant increase about 2.8 Myr ago. The well defined time of the SN explosion makes it possible to search for plausible correlations with other events in Earth's history.

The cosmic rays (CR) flux enhancement due to an expanding supernova remnants (SNR) is estimated to be around 15% for a few 100kyr (for an interstellar medium (ISM) density of 0.5 atoms cm^{-3}). The ^{60}Fe fluence can be calculated to $(2.9\pm1.0)\times10^6$ atoms cm^{-2}. The error constitutes from the stastical error of AMS measurement, error of the half-life of ^{60}Fe (18%),the error of the ^{10}Be dating (assumed to be 10%), and the 5% error for the crust's density and its iron content, respectively. In this case, the largest error of this estimate is due to the half-life of ^{60}Fe(18%). Therefore, we propose the measurement of the half-life of ^{60}Fe accurately (less than 10% error).

The half-life of ^{60}Fe has been measured only two group. Roy and Kohman reported $T_{1/2} = 3\times10^5$, uncertain by factor of 3 in 1957. Kutschera et al. reported $T_{1/2} = (1.49\pm0.27)\times10^6$ in 1984. The specific activity of ^{60}Fe in Fe was measured through the grow-in of the 1.332 MeV gamma-ray line of the ^{60}Co daughter activity.

We propose the measurement of the half-life of ^{60}Fe by new method. After the target (^{63}Cu) is bombarded by proton beam (200 MeV), we select the iron ion by chemical method. The iron plated to the plate. The CdTe detector is used to measure the 59 keV gamma-ray from the first excitatin level of the ^{60}Co. The iron target are analysed by using of Inductively Coupled plasma Mass Spectroscopy (ICP-MS).

The aim of this proposal is established the new method and technology for measurement of half-life of ^{60}Fe and determin the half-life of ^{60}Fe accurately.