SEARCH FOR BARYON-NUMBER-VIOLATING NUCLEON DECAYS

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Baryon-number-violating nucleon decays were studied by searching for X and γ-rays associated with radioactive residual nuclei produced by single- and multi-nucleon decays in ^{127}I. The large volume (0.77ton) NaI(Tl) detector array in the ELEGANTS V system[1] was used for the study. New lower limits of $\tau(n) > 4.7 \times 10^{24}$yr and $\tau(p) > 3.0 \times 10^{24}$yr were obtained on the mode-independent mean-lives for the neutron and proton decays in ^{127}I, respectively. Lower limits of $\tau(nn) > 2.1 \times 10^{24}$yr, $\tau(nnn) > 1.8 \times 10^{23}$yr, and $\tau(nnnn) > 1.4 \times 10^{23}$yr were deduced for the first time on the mode-independent mean-lives for di-neutron, tri-neutron, and tetra-neutron decays in ^{127}I, respectively[2),3)].

Table 1. Lower limits (τ_{min}) on nucleon life time and multi-nucleon life time. The values, with 90%C.L., are given in units of 10^{25}yr. a; obtained by measuring residual nuclei. These limits are deduced from the limit of 1.6×10^{25}yr by multiplying the proton and neutron ratio of $\frac{24}{52}$ and $\frac{28}{52}$, respectively. b; deduced from the ν_μ flux observed by liquid scintillation detectors and flush tubes. c; deduced from the neutrino flux observed by tracking calorimeter(iron);Fréjus experiment. d; obtained by measuring high energy γ-ray from the deexcitation of neutron-hole state;KAMIOKANDE experiment.

Decay target	Mode	Method	τ_{min} ($\times10^{25}$yr)	Comment
Earth	$n \to 3\nu_\mu$	indirect	50	b
	$n \to \nu_e\nu_e\bar{\nu}_e$	indirect	3	c
	$n \to \nu_\mu\nu_\mu\bar{\nu}_\mu$	indirect	12	c
^{16}O	$n \to x$ inclusive	direct	49	d
^{130}Te	$p \to x$ inclusive	geochemical	0.74	a
	$n \to x$ inclusive	geochemical	0.86	a
^{127}I	$p \to x$ inclusive	direct	0.30	present
	$n \to x$ inclusive	direct	0.47	present
Earth	$nn \to \nu_e\bar{\nu}_e$	indirect	1.2	c
	$nn \to \nu_\mu\bar{\nu}_\mu$	indirect	0.6	c
^{127}I	$nn \to x$ inclusive	direct	0.21	present
	$nnn \to x$ inclusive	direct	0.018	present
	$nnnn \to x$ inclusive	direct	0.014	present

References

1) H. Ejiri *et al.*, Nucl. Instrum. Methods A302 (1991) 304.

2) H. Ejiri, Phys. Rev. C48 (1993) 1442.

3) R. Hazama *et al.*, Phys. Rev. C49 (1994) 2407.