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<TITLE >Beta Decay Half-Lives and Delayed Particle Emission from TOFI Measurements

BETA DECAY HALF-LIVES AND DELAYED PARTICLE EMISSION FROM TOFI MEASUREMENTS

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Half-lives, delayed-neutron emission probabilities, and average neutron energies have been measured for very neutron-rich nuclides from ^{8}Li to ^{45}Cl.

We have used the Time-of-Flight Isochronous (TOFI) spectrometer at the LAMPF accelerator to systematically measure the half-life ($t_{1/2}$), delayed neutron emission probability (P_n), and average energy of delayed neutron spectra for a large number of neutron-rich isotopes for all Z values between Li and Cl. The TOFI spectrometer identifies the Z, A, and Q of each recoiling ion produced by fragmentation reactions from 800-MeV proton bombardment of a ^{232}Th target. These ions are stopped in a thin Si detector surrounded by a 2-mm-thick plastic scintillator plus a thick Si detector, which together are used to measure beta particles. The vacuum pipe containing these detectors is surrounded by a polyethylene-moderated neutron counter. Ions are detected during the LAMPF beam pulse. Beta-decay products are detected during the 7-ms period between beam pulses (87.6% duty factor).

Half-lives are determined by a delayed coincidence technique based on time-interval histograms using the arrival time of a specific ion as the start time and the arrival time of subsequent betas or neutrons as the stop time. The neutron yield relative to the number of ions of a specific type provides a measurement of the P_n. Beta-neutron coincidence counting gives an alternative measurement of P_n. An energy dependent neutron counting efficiency is used based on a calibration curve of efficiency vs. the ratio of counts in the outer ring of neutron counter tubes to counts in the inner ring (ring ratio). Nuclides with well-known P_n values are used to construct the calibration curve. Similarly, average energies of delayed-neutron spectra are determined using a calibration curve of energy vs. ring ratio for nuclides with well-known energy spectra.

Preliminary results with this technique for about 30 nuclides were published previously.[1] Measurements are now available for about 60 nuclides based on data collected over several years. Half-lives have been measured for 55 nuclides and include the first half-life measurements for ^{25}F, ^{26}F, ^{28}Ne, ^{35}Mg, ^{33}Al, ^{36}Al, ^{37}Si, ^{41}S, and ^{44}Cl. We report P_n values for 40 nuclides including previously unmeasured P_n values for ^{14}B, ^{17}C, ^{18}N, ^{35}Mg, ^{32}Al, ^{33}Al, ^{36}Si, ^{37}Si, ^{38}P and ^{45}Cl. Average neutron energies are reported for 14 nuclides ranging from ^{11}Li to ^{30}Na.

The average neutron energies for ^{17}N and ^{29}Na measured here are in excellent agreement with average energies derived from spectra measured with ^{3}He spectrometers. However, the average energies measured here for ^{14}Be, ^{17}C, ^{18}C, and ^{18}N are much lower than average energies deduced from neutron spectra measured by a time-of-flight technique at Michigan State University.[2] This can readily be explained as being due to the high threshold at about 700 keV for the time-of-flight spectrometer. In particular, our average neutron energy of 0.60±0.06 MeV for ^{14}Be is below the threshold of the MSU detector and suggests that most of the delayed neutrons are emitted from a state at about 1.6 MeV in ^{14}B.

The P_n values measured here are generally in agreement with previously measured values except for the nuclides listed in Table 1.

Table 1. Nuclides with discrepant P_n values.

Nuclide	P_n from TOFI (%)	P_n from Lit. (%)
^{31}Mg	6.2 ± 2.0	1.7 ± 0.3 [3]
^{34}Al	12.5 ± 2.5	54. ±12. [4]
^{35}Al	26. ± 4.	87. +37 -25 [4]
^{36}Si	12.4 ± 4.6	<10. [4]
^{38}P	12. ± 5.	<10. [4]

References:

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1) P. L. Reeder et al., Phys. Rev. C 44, 1435 (1991).
2) M. D. Belbot, et al., Phys. Rev. C 51, 2372 (1995).
3) M. Langevin et al., Nucl. Phys. A414, 151 (1984).
4) A. C. Mueller et al., Z. Phys. A 330, 63 (1988).