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THERMAL NEUTRON CAPTURE CROSS-SECTION FOR ^{111}Cd

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ABSTRACT

The ratio of the gamma transition intensities was measured at 558 keV and 617 keV gamma transition energies separating the first excited states of ^{114}Cd and ^{112}Cd. The sample contained 95.9% ^{111}Cd and 0.55% ^{113}Cd. The neutron capture cross-section was measured and found to be 2.1 b.

The thermal neutron capture cross-section for ^{111}Cd, according to the data given in Ref. [1], is 24.3 b and, according to the data given in Ref. [2], it is 8(1) b. This divergence is caused by a failure to take sufficiently accurate account of the contribution made by the isotope ^{113}Cd to the probability of the thermal neutron capture by the sample of ^{111}Cd containing ^{113}Cd as impurity.

A more accurate result may be obtained by measuring the intensity of the transitions between the first excited level of ^{112,114}Cd and its ground state using a Ge(Li) detector. The ratio of these intensities in the ^{111}Cd sample used by us is R = 0.018(2). The sample of metallic cadmium contained 95.9(3)% ^{111}Cd and 0.55% ^{113}Cd. Assuming that the population of the first excited state of ^{114}Cd (E_f = 558 keV) and ^{112}Cd (E_f = 617 keV) is the same, and

using the thermal neutron capture cross-section for ^{113}Cd from the data in Ref. [1], σ_a = 20600 b, we can determine the thermal neutron capture cross-section for ^{111}Cd. It is 2.1(2). Calculations using the statistical theory of gamma decay and various models for the density of excited states and the radiative strength functions show that the population of the first excited level of ^{114}Cd for decay of the $J^\pi = 1^+$ neutron resonance varies from 70 to 74% of decays. Similarly, for ^{112}Cd in the $J^\pi = 1^+$ resonance state it varies from 71 to 73%, and in the $J^\pi = 0^+$ resonance state from 65 to 67% of decays.

The additional systematic error in the determination of σ_a for ^{111}Cd associated, for example, with the different populations of the first excited level of ^{112}Cd and ^{114}Cd probably does not exceed 10-12%.

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