Excited State β-Decays the r-Process

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β-Decays of excited-state nuclei are calculated using a single-particle model, which incorporates shell energies of individual nucleons into the mass formula. Energies of two-particle levels are calculated by assuming a Fermi gas model with shell and pairing forces. A comparison of level energies to those of the spherical shell model for nuclei of the same mass yields a determination of a configuration mixture of spherical shell model eigenstates characterized by their quantum numbers. Therefore, the order of the decay is specified. The resulting density of particle states is inserted into the gross theory of β-decay, so the ease of calculation is maintained with the decay form factors. This model is quite useful in that β-decays of individual nucleons can be deduced. In addition, decays of excited state nuclei, which are created by the promotion of nucleons to levels above the Fermi surface, can be calculated with the same method. The ultimate purpose of this calculation is to determine the effects of excited-states – specifically, β-decays – on the r-process of nucleosynthesis. Since r-process progenitor nuclei are very neutron rich, decay rates must be calculated, and current models have utilized only ground-state nuclear decay rates. The possibility of a faster progression along the r-process path, as well as the possible elimination of closed-shells in a small population of the N=82 nuclei due to excitations above the shell may create an r-process simulation in which the mass 195 nuclei are produced in greater abundance by the time the r-process freezes out. An r-process model which evolves average β-decay rates as a function of temperature is used. The environmental parameters of this model simulate those of the supernova hot-bubble region, a strong candidate for the r-process site. The final freezeout abundance distribution is compared with that of the solar system r-process abundance distribution.