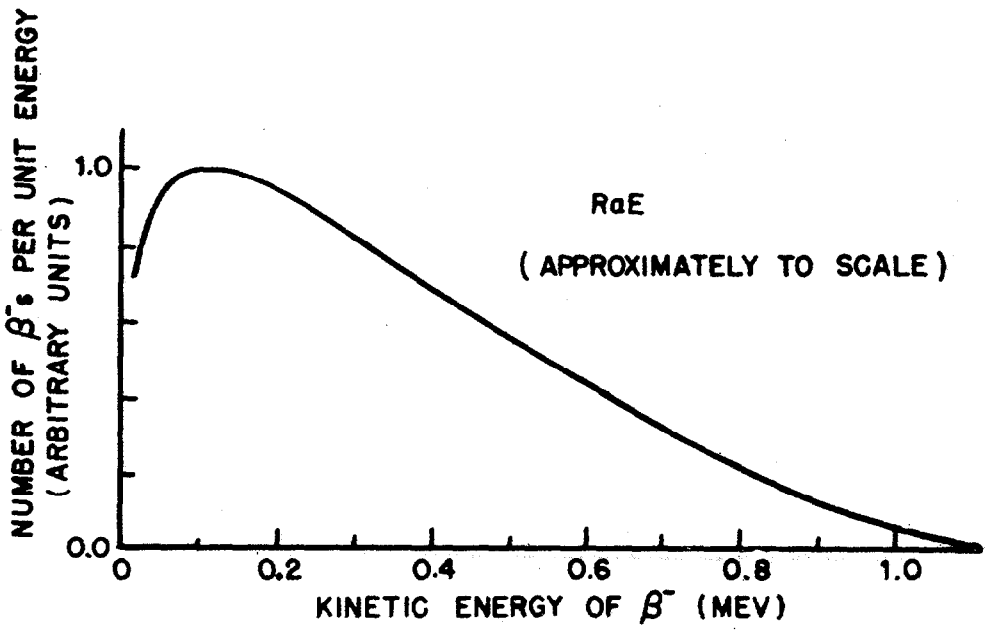

Figure 14. Typical Beta Spectrum.

0.75 Mev. Since E_o is 1.8 Mev it follows that Q must be −1.05 for consistency. This is observed experimentally, for the reaction Al^{27} (n,p) Mg^{27} is found to be endothermic with a threshold corresponding to Q = −1.05 Mev. If the observed Q were, say, −1.2 Mev this would imply that the energy given out upon beta-decay exceeds the maximum of the beta spectrum. In this case to satisfy energy conservation the neutrino mass would have to be assumed non-negligible.

Positron emission is similar in all respects. As with beta emitters the total energy of the reaction must be taken equal to the maximum energy of the emitted particle. Observed spectra and reaction energies are quantitively consistent provided a neutral particle of negligible mass (i.e., mass small compared to electronic mass) is assumed to accompany the emission of a positron.

3.2 ISOTOPIC WEIGHTS AND THE BINDING ENERGY OF NEUTRONS

In an (n,γ) reaction a neutron is captured by a nucleus and the excess energy emitted as gamma radiation. The energy balance of the reaction leads to a quantitive measure of the binding energy of the neutron to the target nucleus. A rough idea of the magnitude of this energy may be obtained by assuming that the addition of a neutron to a nucleus of mass number A increases its mass number to A + 1 and its mass by one unit. Since the neutron mass is, in round numbers, 1.009 mass units this would indicate a binding energy of about .009 mass units or 8 Mev. Actually the true atomic weight differs appreciably from the mass number A in many cases. It has, in fact, been found convenient to define the fractional deviation as the "packing fraction":

$$f(A) = (M-A)/A \qquad (3\text{-}3)$$

M = atomic weight (a function of A)
A = mass number

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