T-E_γ Charts of Short-Lived Nuclides Formed by Neutron Activation

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Whenever γ-active radionuclides formed by nuclear-reactor exposure are dealt with, it is useful to identify the nuclides by using a chart in which the half-life, T, is plotted against the γ-ray energy, E_γ. For the half-life range from 36 sec. to 10^4 hr., T-E_γ charts have been made by Westermark and Sjöstrand.[1] Recently, however, nuclides with shorter half-lives have become familiar in rapid radioactivation analysis. Therefore, a T-E_γ chart for shorter half-lives is needed. Since neutrons in nuclear reactors exhibit an extremely broad energy range, from zero to at least 15 MeV.,[2] various types of neutron reactions are likely to occur simultaneously. The charts presented here include the nuclides formed by these reactions.

The data have been taken from the table of the "Short-Lived Nuclides"[3]. The reactions considered are: (n, γ), (n, n'), (γ, γ'), (n, p), (n, α), $(n, 2n)$, (γ, n), $(n, n'\alpha)$, (n, pn), (n, t), $(n, {}^3\mathrm{He})$ and $(n, 2p)$. The charts show nuclides formed from naturally-occurring elements; they do not include the following:

(a) Nuclides formed by secondary nuclear reactions, e. g., $^{28}\mathrm{Al}(t, p)^{28}\mathrm{Mg}$ with lithium present.

(b) Nuclides formed by multiple neutron capture.

(c) Fission products.

Annihilation radiations are included in the charts unless they are very weak. X-rays are omitted. Whenever possible, the most intense γ-ray has been especially labeled in the charts.

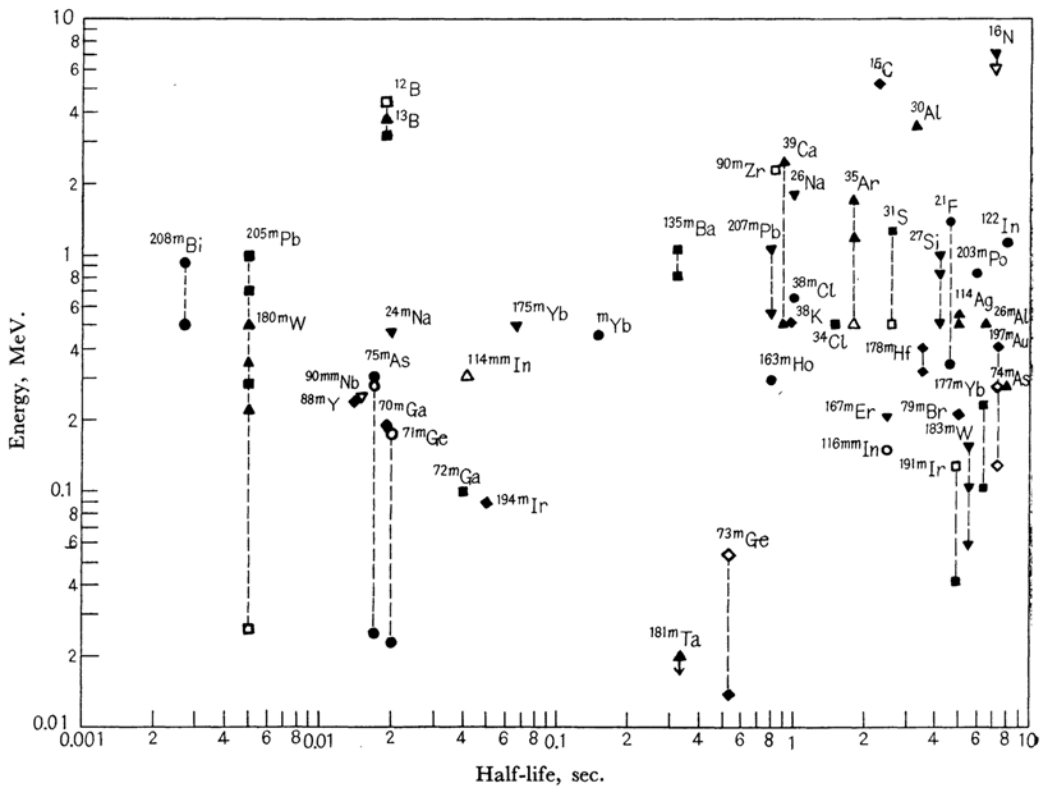

Fig. 1. T-E_γ chart No. I covering half-lives of 0.001—10 sec. The most intense γ-rays are labeled with open circles, open triangles, etc. If several γ-rays are emitted from the same nuclide, dots connect the corresponding points. Arrow in the charts shows that the true value should appear on the direction but only a limit is known.

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1) T. Westermark and B. Sjöstrand, *Intern. J. Appl. Radiation and Isotopes*, **9**, 63 (1960).
2) D. J. Hughes, *Nucleonics*, **11**, No. 1, 30 (1953).
3) M. Okada, ibid., **22**, No. 8, 110 (1964).

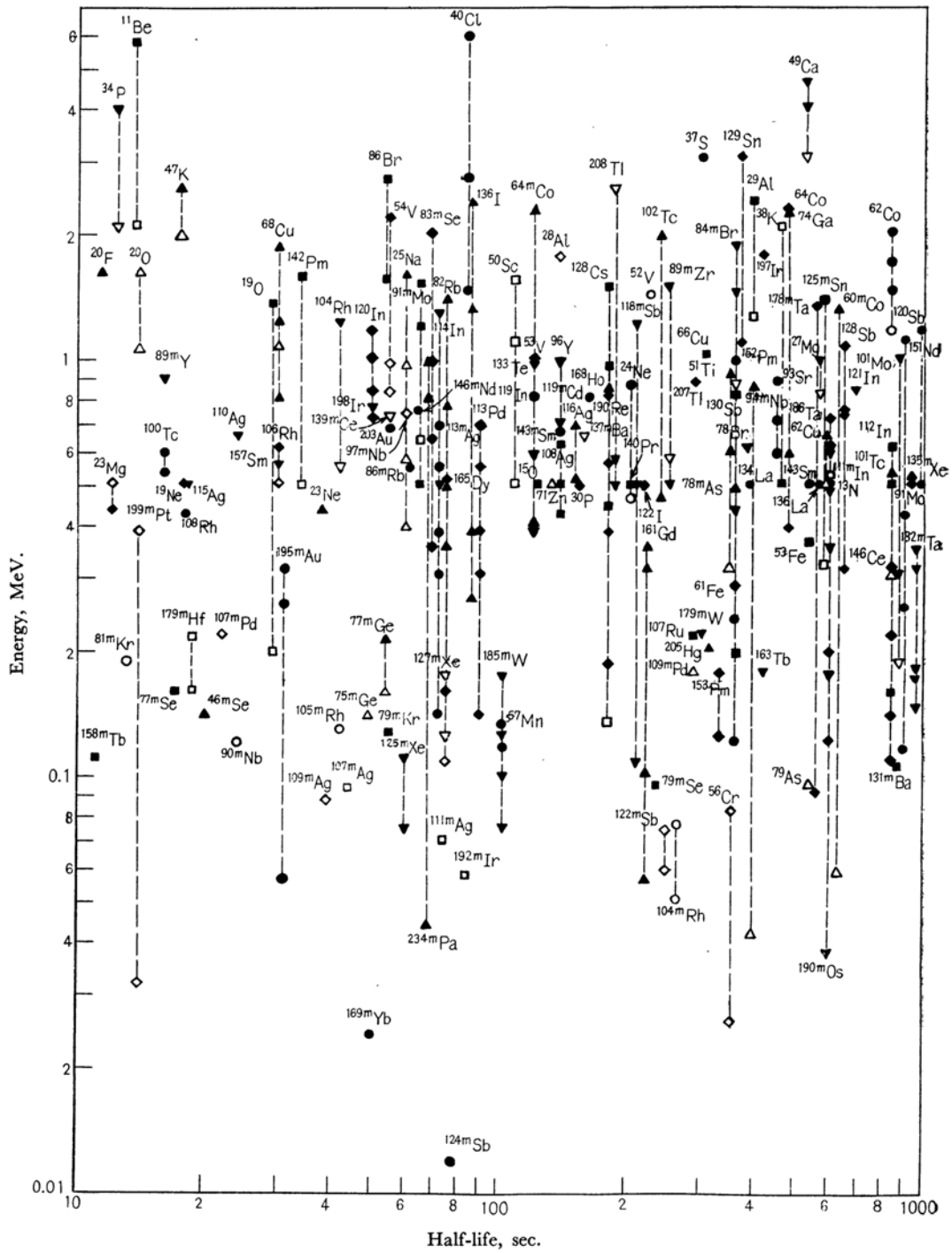

Fig. 2. T-E_γ chart No. II covering 10—1000 sec. For notes on use, see Fig. 1.