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Energy Losses in e± Capture Processes at High Temperature.

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The ± electron-capture processes (*e.g.* URCA process in central part of supernovae), first studied by GAMOW and SCHOENBERG (1), are examined taking into account the electron-pair production (2) at high temperatures ($kT \geqslant mc^2$, where m is the electron mass).

The distinction of three classes of interactions, strong, electromagnetic and weak interactions, leads us to calculate the energy losses in processes of generation of ν_e, $\bar{\nu}_e$ (electron neutrinos and antineutrinos), making the assumption that in a stellar body the weak interactions are not in a state of equilibrium, and the neutrinos escape freely from the region of the star under consideration.

Starting from the formalism of pair production suggested in some earlier paper (2) and from the general line of deduction of GAMOW and SCHOENBERG, one finds easily the following formulae for energy loss in erg/cm³ in electron-capture processes:

$$W^- = \frac{2 \ln 2}{tf}\, mc^2 x_0^{-6} n_{ZA} \int\limits_{x_0[1+Q/mc^2]}^{\infty} \left[x - x_0\left(\frac{Q}{mc^2}+1\right)\right]^3 \frac{(x^2 - x_0^2)^{\frac{1}{2}} x\, \mathrm{d}x}{\exp[-\alpha + x] + 1} \tag{1}$$

and in positron capture processes

$$W^+ = \frac{2 \ln 2}{tf}\, mc^2 x_0^{-6} n_{ZA} \int\limits_{x_0}^{\infty} \left[x + x_0\left(\frac{Q}{mc^2}-1\right)\right]^3 \frac{(x^2 - x_0^2)^{\frac{1}{2}} x\, \mathrm{d}x}{\exp[\alpha + x] + 1}, \tag{2}$$

where $x_0 = mc^2/kT$; tf has the usual meaning of the comparative half-life of Fermi theory; Q is the maximum kinetic energy of the electron in Fermi theory; α is the statistical parameter of electrons and positrons (2) and n_{ZA} is the number per cm⁻³ of nuclei of charge Z and mass number A.

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(1) G. GAMOW and M. SCHOENBERG: *Phys. Rev.*, **59**, 539 (1941).
(2) G. WATAGHIN: *Phil. Mag.*, **17**, 910 (1934); *Phys. Rev.*, **66**, 149 (1944).

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