We inquire next as to the flux and energy of the neutrinos to be expected from gravitational stellar collapse (GSC).

II. Neutrino Emission from Gravitationally Collapsing Stars (Including Supernovae)

Gravitational collapse (see Fig. 1) occurs when a massive star, of mass above the so-called Chandrasekhar limit (1.2 solar masses) runs out of nuclear fuel. The internal electron degeneracy pressure is then insufficient to restrain the gravitational force, and a collapse ensues.

Current pictures of GSC[10] envision the process as occurring in two stages, involving different neutrino production mechanisms and luminosities; in addition there are numerous variations due to differing initial composition and mass. The main features are constant however, since they refer to the innermost core.

When the collapsing star reaches a density of about 2×10^{11} g cm^{-3}, electron capture by protons from the Fermi sea of degenerate electrons, which is now filled to about 25 MeV, gives rise to a burst of about 10^{52} ergs, comprising 10^{57} electron neutrinos of mean energy about 10 MeV. This "neutronization" process, in which all the nucleons are converted to neutrons, ($e^- + p \rightarrow n + \nu_e$) lasts at most a few hundredths of a second. The mean free path of the neutrinos is comparable to the stellar radius, and the emitted neutrinos undergo elastic coherent scattering from the heavy nuclei in the stellar mantle, via the neutral current interaction. This may perhaps be the long-sought mechanism whereby momentum is transferred to the