mechanism

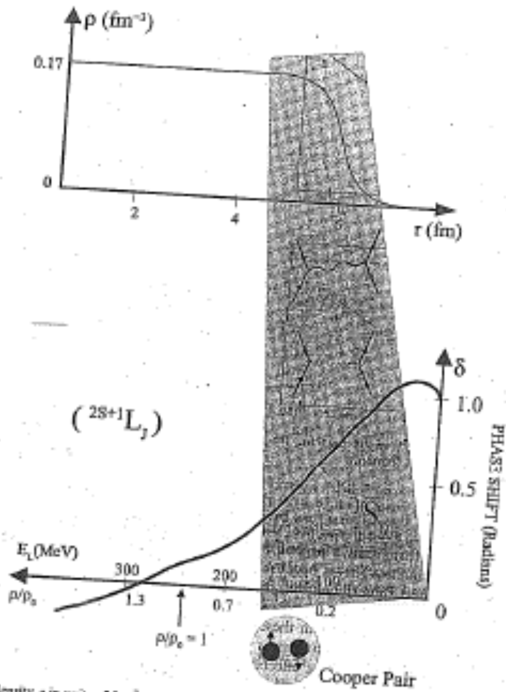

Fig. 15. (top) Nuclear density ρ in units of fm^{-3} (where $fm \equiv 10^{-13}$ cm), plotted as a function of the distance r (in units of fm) from the centre of the nucleus. Saturation density correspond to ≈ 0.17 fm^{-3}, equivalent to 2.8×10^{14} g/cm^3. Because of the short range of the nuclear force, the strong force, the nuclear density changes from 90% of saturation density to 10% within 0.65 fm, i.e. within the nuclear diffusivity. (bottom) Phase parameter associated with the elastic scattering of two nucleons moving in states of time reversal, so called $^1S_0$ phase shift, in keeping with the fact that the system is in a singlet state of spin zero. The solution of the Schrödinger equation describing the elastic scattering of a nucleon from a scattering centre (in this case another nucleon) is, at large distances from the scattering centre a superposition of the incoming wave and of the outgoing, scattering wave. The interaction of the incoming particle with the target particle changes only the amplitude of the outgoing wave. This amplitude can be written in terms of a real phase shift—or scattering phase—δ. Positive values of δ implies an attractive interaction, negative a repulsive one. For low relative velocities (kinetic energies E_L), i.e. around the nuclear surface where the density is low, the $^1S_0$ phase shift arising from the exchange of mesons (like for example pions, represented by an horizontal dotted red line) between nucleons (represented by upward pointing arrowed lines) is attractive. This mechanism provides about half of the glue to nucleons moving in time reversal states to form Cooper pairs. These pairs behaves like boson and eventually condense in a single quantal state leading to nuclear superfluidity. Cooper pair formation is further assisted by the exchange of collective surface vibrations (green wavy curve in the scattering process) between the members of the pair.