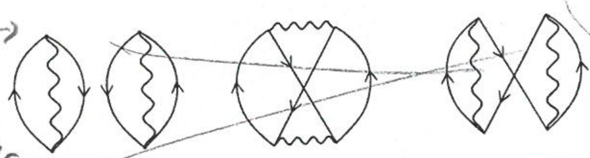
In (a) we show two of such diagrams. In (b) and (c) we display a symmetrized (boson exchange), an antisymmetrized (fermion exchange) correction to (a), while (d) contains a symultaneous boson and fermion exchange.

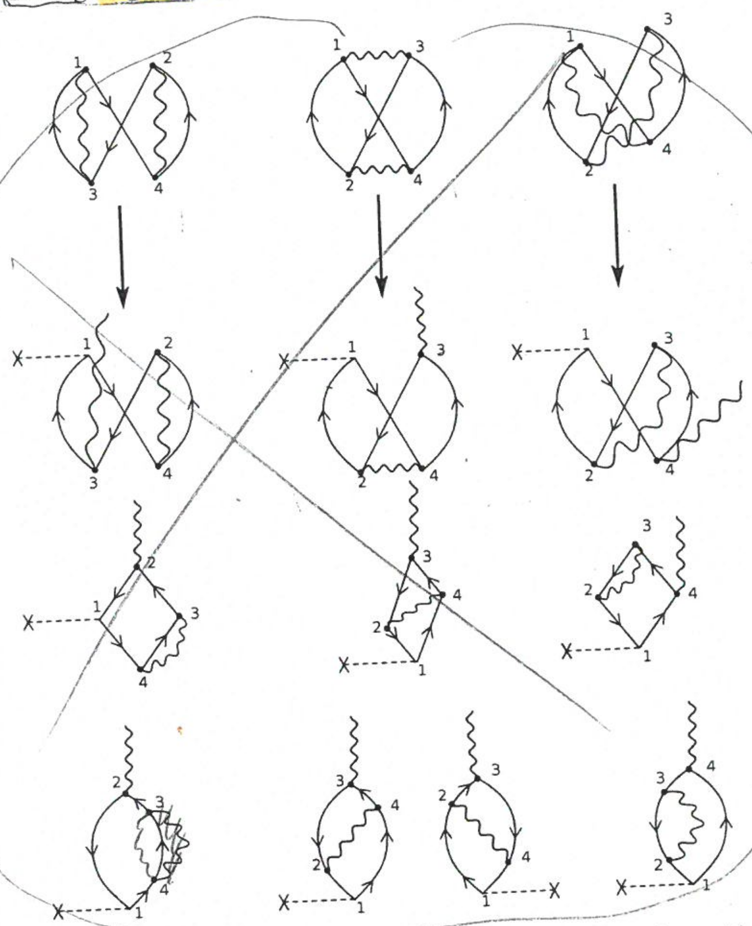
new Fig. 1.7.1



p. 55 c

Figure 1.7.1: Oyster diagrams describing the correlation of the nuclear ground state associated with the ZPF of collective particle–hole–like excitations, ~~and Pauli principle correction processes in which fermions are exchanged. This is in keeping with the fact that the collective modes are built out of the particle degrees of freedom~~. (~~see~~ e.g. Fig. 1.D.1).

(A) - (A) p. 55 a

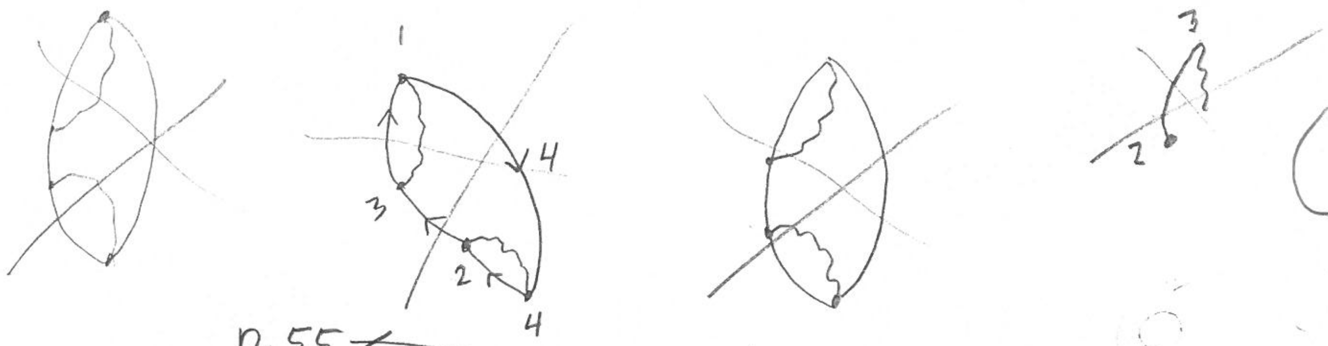


new Fig. 1.7.2 p. 55 c

Figure 1.7.2: Some of the possible outcomes resulting from acting with a an external single–particle field, ~~e.g.~~ i.e. that associated with inelastic processes (represented by a horizontal dashed line starting with a ×), on ~~the Pauli corrected ZPF oyster diagrams associated with collective (p−h) excitations of the nuclear vacuum (see Fig. 1.7.1)~~ (c) ground state the ZPF of a nucleus associated with particle-hole correlated vibrations. Within this context one returns to the question of renormalization mentioned in the text (see end of Sect. 1.1 and Sect. 1.4, see also Idini et al. (2015), Broglia et al. (2016), Barranco et al. (2017a); see also Sect. 6.5).

cross

(B) - (B) from p. 55 b



p. 55 ← Caption to Fig. 1.7.1

(A)

In all the diagrams shown only ground state correlation vertices are present. They are conneceted with the Y^{a}_{ki}-components ($\varepsilon_k > \varepsilon_F$, $\varepsilon_i \leq \varepsilon_F$) of the RPA wavefunction describing the collective mode (wavy line). While this is so for ~~one~~ any time ordering ~~[illegible]~~, i.e. the sequence ~~in~~ with which the particle-vibration coupling vertices (black dot) appear (time is assumed to ~~[illegible]~~ run as indicated to the left of (a)), in the case of the processes shown in (a) and (b), this is not the case in connection with processes (c) and (d) as can be seen from the corresponding diagrams (c') and (d') shown in the inset. Because of Pauli principle (~~fermion exchange~~) between particles (holes) present ~~(e.g. those of the first oyster diagram~~ in (a)) and those involved in the collective mode (~~those of the second oyster diagram in (a)~~), the harmonic approximation is not valid any more. This is reflected ~~in~~ by the ~~comparison~~ presence of scattering vertices diagramatically ~~reflected~~.

Caption to Fig 1.7.1 (A)

~~The last diagram describes~~

55

b

B The diagrams of the first row result by intervening the virtual process shown in Fig. 1.7.1 (c) and eventual time ordering.

Similar for those of the second row but in connection with diagram (d) of Fig. 1.7.1. The boxed processes correspond to particle self-energy (first row) and vertex correction (second row).

Reversing the sense in which the fermions (arrowed lines) circle the loop from anti clockwise to clockwise, one obtains two new graphs. The complete set of processes obtained in this way are shown in the third and last row, and constitute a sum rule conserving set of diagrams (see text) ~~as discussed in connection with Fig.~~ B

Caption Fig. 1.7.2

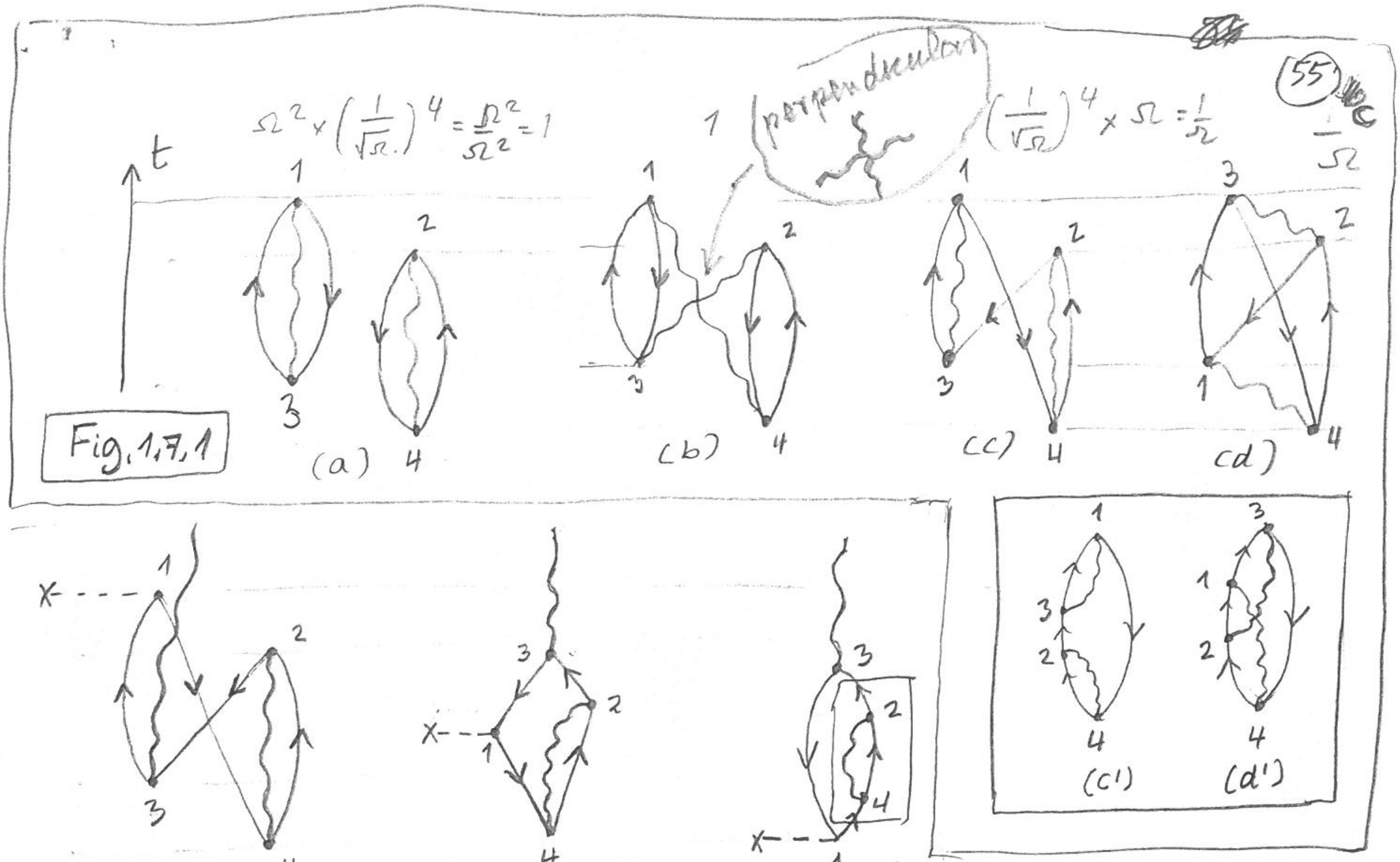


Fig. 1.7.1

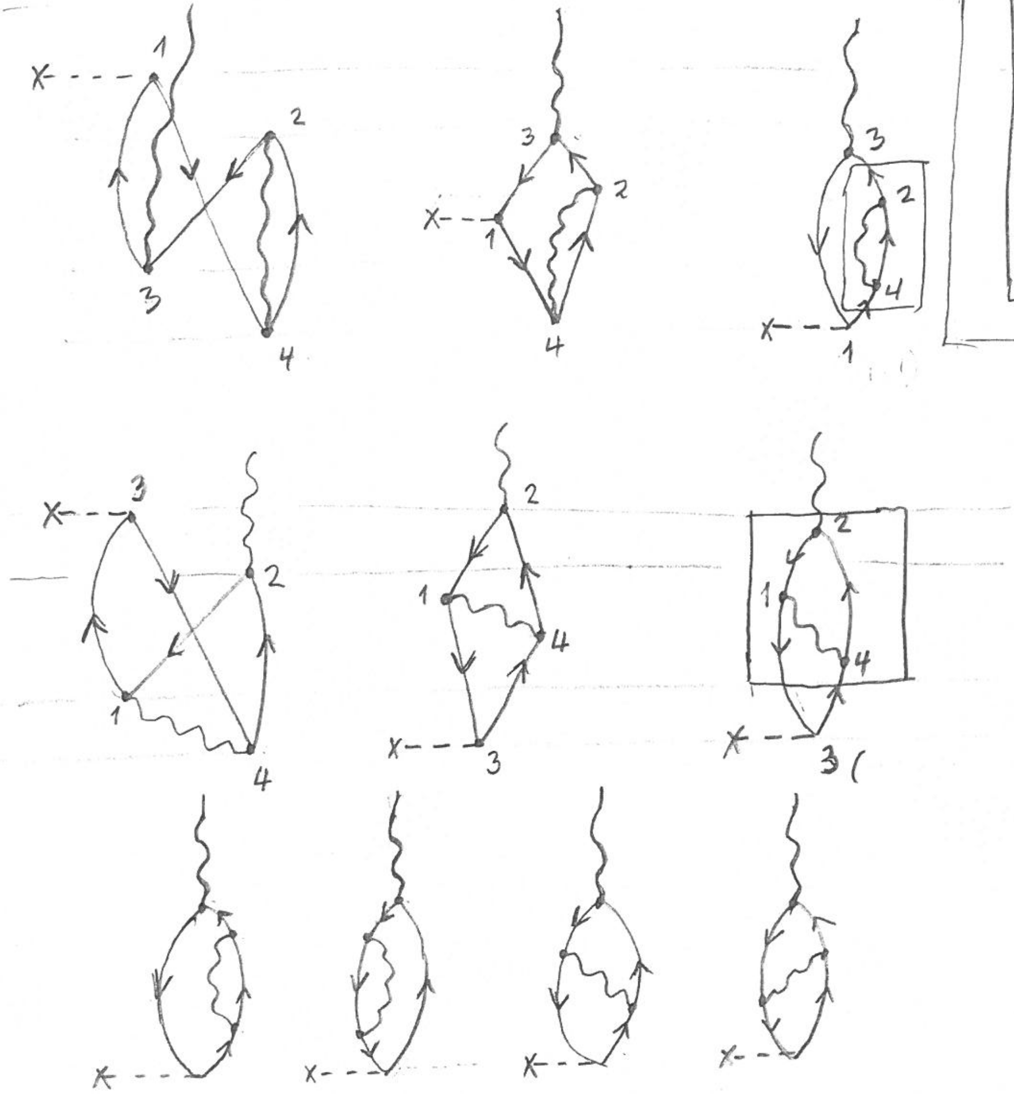


Fig. 1.7.2

$\mathcal{E} = \frac{\hbar^2 k^2}{2m}$

$\delta\mathcal{E} = 2\Delta = \frac{\hbar^2 2k\,\delta k}{2m} = \hbar v_F\,\delta k$

Interplay between

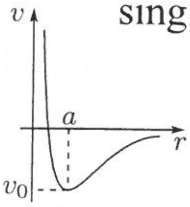
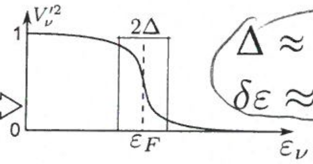
v_F/c

Classical localization and quantal ZPF

$\delta x \delta k \geq 1$ $\quad \varepsilon = \frac{\hbar^2 k^2}{2M}$ $\quad \delta k = \frac{\delta\varepsilon}{\hbar v_F}$ $\quad (v_F/c \approx 0.27)$

$\boxed{\text{structure}}$

Independent motion of

single nucleons	pairs of nucleons
	
$a \approx 0.9$ fm	$\Delta \approx 1.2$ MeV
$v_0 = -100$ MeV	$\delta\varepsilon \approx 2\Delta;\ \delta x = \xi =$
$\delta\varepsilon = \lvert v_0\rvert;\ \delta x \approx a$	
$\delta x \delta k = \frac{a\lvert v_0\rvert}{\hbar v_F} \geq 1$	$\delta x \delta k = \frac{\xi 2\Delta}{\hbar v_F} \geq 1$ =
quantality parameter	~~correlation length~~
$q = \frac{\hbar v_F}{a\lvert v_0\rvert} \approx 0.5 \lesssim 1$	$\cancel{\xi = \frac{\hbar v_F}{\pi\Delta} \approx 14\,\text{fm} \gg R}$
delocalization	long range correlation

$\Delta \approx 1{,}2$ MeV
$\delta\mathcal{E} \approx 2\Delta$
$\delta x = \xi \approx \frac{\hbar v_F}{2\Delta}$

$q_\xi = \frac{\hbar^2}{2m\xi^2}\frac{1}{2\Delta} \approx 0.02$

$\frac{\hbar^2}{ma^2}\frac{1}{\lvert v_0\rvert}$

emergent property: generalized rigidy in

3D-space	gauge space

¿how does a short range force lead to

single-nucleon mean free paths	pairing correlations over distances

larger than nuclear dimension?

$2R \approx 20/k_F$

quantal

fluctuations	phase correlations

no hecho

$\boxed{\text{reactions}}$

single particle transfer, e.g. *(p,d)*	Cooper pair transfer, e.g. *(p,t)*
$\cancel{2R/a \approx 15}$	$\cancel{\xi/a \approx 30}$
absolute cross section reflects the full nucleon probability amplitude distribution, and does not depend of the specific choice of v_{np}	Successive and simultaneous transfer amplitude contributions to the absolute cross section carry in a equal efficient manner information concerning pair correlations

leave space

leave space

Figure 2.4.2: Classical localization and zero point fluctuations, associated with independent–particle (normal density) and independent–pair motion (abnormal density).