

Assuming the arrowed lines to be electrons (positrons) and the wavy line a photon, graphs (I) (c) and (d) of Fig. 3 describe the ^{mechanism at the basis of the} first direct observation of the effect of ^{QED} vacuum fluctuations through what is known as the Lamb shift ^{(Fig. 3(e))} (Fig. 3(a)), namely the splitting of 1058 MHz (4.38 meV) between the $2s_{1/2}$ and $2p_{1/2}$ levels of the H atom, levels which are degenerate in Dirac's theory.

Assuming the arrowed lines to be neutrons (neutron holes), and the wavy line the low-lying quadrupole vibration of ^{10}Be , the same graphs account for the effect of nuclear vacuum (ground) state fluctuations through what is known as parity inversion in ^{11}Be (see Fig 3(c) ^{modified for ^{11}Be}), namely the inversion of the sequence of the $1p_{1/2}$ and $2s_{1/2}$ shell model (Mayer-Jensen) states which, in the case of ^{11}Be amounts to a Lamb shift effect of the order of $\approx 3.5 \text{ MeV}$, i.e. $\approx 10\%$ of the Fermi energy.

ZPF plus Pauli: clothed fermions, retarded interactions.

Fig. d

Assume arrowed lines pointing upwards (downwards) are fermionic particles (antiparticles), while wavy lines are bosonic quanta.

(I): (a) one fermion in presence of a spontaneous excitation of the vacuum; (b) Pauli principle, the crossing of fermionic lines implying a minus sign; (c) crossing which can apparently be avoided, but which is still in force, in helping with the fact that the fermion-boson coupling vertex associated with the incoming (i) particle takes place at a later time (t_i) *— italics* than that associated with the outgoing (o) particle (t_o); (d) obtained through time ordering, i.e. now $t_i < t_o$. These processes are known as polarization (PO), while those for which $t_i > t_o$ are known as correlation (CO) processes.

induced pairing interaction in the case in which the wavy is interpreted as a nuclear vibration.

(II): (a) a bare fermion in presence of a dressed one; (b) Pauli principle; (c) leads to boson exchange between the fermions (interaction, e.g. Coulomb in the case of charge particles, the wavy line being a photon).

(III) Same as (II) but in the case in which both fermions are clothed. Only *some of the* contributions in which the intermediate fermion of the virtual processes are exchanged have been drawn. In particular process (c) is associated with van der Waals interaction, if one interprets the wavy line as a photon (see Holstein (1989)). Also nuclear analogue in the case in which the wavy line is interpreted as a GDR (e.g. $^{12}\text{Li}(gs) \rightarrow ^{12}\text{Be}$).

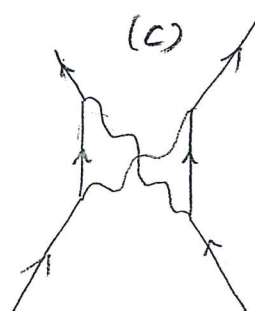
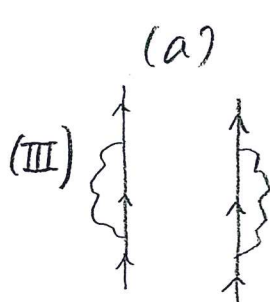
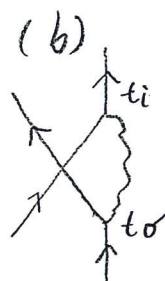
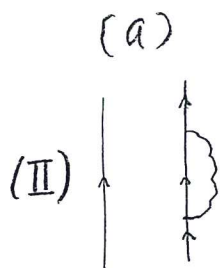
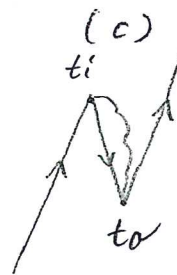
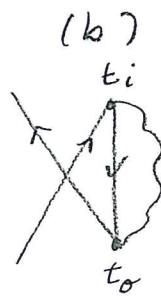
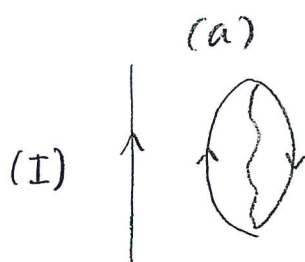


Fig. α