Hindsight

Let us make use of the experimental (empirical),

$$\varepsilon_{s1/2} = 0.2 \text{ MeV},$$
$$\varepsilon_{p1/2} = 0.5 \text{ MeV},$$
$$V_1 = 25 \text{ MeV},$$

and theoretical

$$R_0(^{11}Li) = 1.2(11)^{1/3} \text{ fm} = 2.7 \text{ fm}$$
$$\xi = 20 \text{ fm}$$
$$R_{eff}(^{11}Li) = 4.83 \text{ MeV}$$
$$G = \frac{25}{A} \text{ MeV} \approx 2.3 \text{ MeV} \quad (A=11)$$
$$K_1^0 = -\frac{5V_1}{A R_{eff}^2(^{11}Li)} \approx -0.49 \text{ MeV fm}^{-2}$$
$$K_1 = -\frac{5V_1}{A(\xi/2)^2}\left(\frac{2}{11}\right) = -0.022 \text{ MeV fm}^{-2}$$

inputs.

One can then calculate the ratio

$$r = \frac{2}{(2j+1)}\left(\frac{R_0}{R_{eff}}\right)^3 \approx 0.042,$$

where used was made of $(2j+1) \approx (2k_F R_0 + 1) \approx 8.34$. Thus, the screened bare pairing interaction is,

$$(G)_{scr} = rG = 0.042 \times \frac{25}{A} \text{ MeV} = \frac{1 \text{ MeV}}{A} \approx 0.1 \text{ MeV}.$$

Similarly

$$K_1 = s K_1^0$$

where the screening factor is

$$s = \frac{R_{eff}^2}{(\xi/2)^2}\left(\frac{2}{11}\right) \approx 0.042.$$

Thus, the screened symmetry potential is,

$$(V_1)_{scr} = s\,V_1 = 0.042 \times 25\,\mathrm{MeV} = 1\,\mathrm{MeV}.$$

The fact ~~that~~ r and s coincide within numerical approximations is in keeping with the fact that both quantities are closely related to the overlap

$$O = \left(\frac{R_0}{R_{eff}}\right)^3 = \left(\frac{2.7\,\mathrm{fm}}{4.83\,\mathrm{fm}}\right)^3 = 0.17,$$

quantity which has a double hit effect concerning the mechanism which is at the basis of of much of the nuclear structure of exotic nuclei at threshold: 1) it makes subcritical the screened bare NN-pairing interaction $(G)_{scr} = rG < G_c$ ($(G)_{scr} = 1\,\mathrm{MeV}/A$); 2) it screens the symmetry potential drastically, reducing the price one has to pay to separate protons from delocalized neutrons, thus allowing a consistent chunk ($\approx 8\%$) of the TRK sum rule to essentially becoming degenerate with the ground state ($(V_1)_{scr} = 1\,\mathrm{MeV}$), thus allowing for the first nuclear example of a Van der Waals Cooper pair and thus a novel mechanism to break dynamically gauge invariance.

Dipole-dipole fluctuating fields (H3)
associated with the exchange of
the pigmy resonance between the
halo neutrons of ^{11}Li, As a result,
a new, composite mode of nuclear
excitation join the ranks of the
previously known: halo pair addition
mode carrying on top of it, a low-lying
collective pigmy resonance. This
symbiotic mode can be studied through
two-particle transfer reactions, eventually in coincidence with γ-decay.
In particular, making use of the
reactions,

$$^{9}Li(t,p)^{11}Li(f),$$

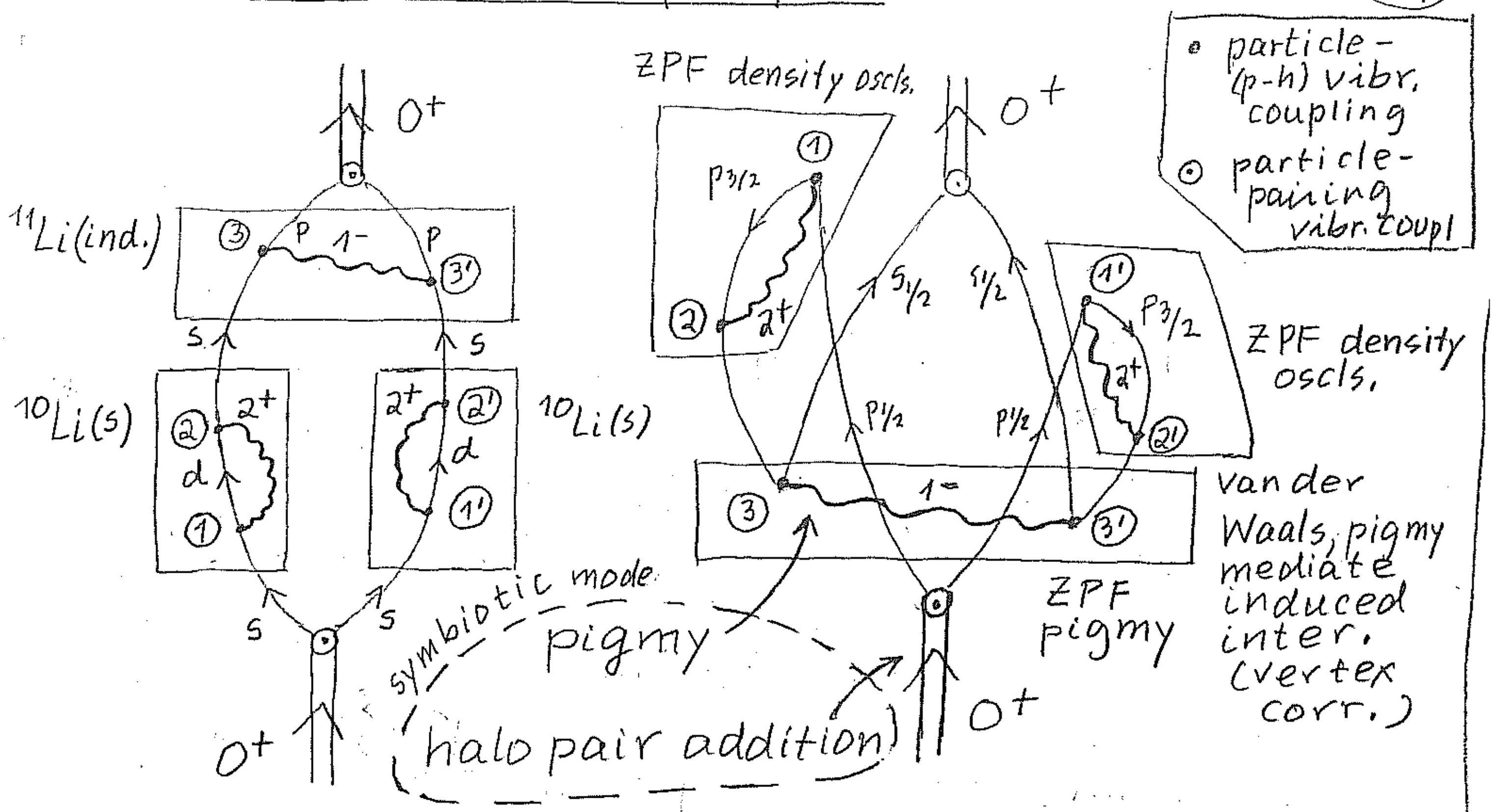
$|f\rangle$; ground state ($L=0$), pigmy ($L=1$),

and

$$^{10}Be(t,p)^{12}Be(f),$$

$|f\rangle$: first excited 0^+ state ($E_x = 2.24$ MeV) ($L=0$);
pigmy on top of it ($L=1$,
arguably within ≈ 1 MeV).

Nuclear van der Waals Cooper pair



Atomic van der Waals (dispersive, retarded contribution, like gravitation acts between all atoms and molecules, also non-polar)

$$\Delta E = -\frac{6 \times e^2 \times a_0^5}{R^6} = -\frac{6 \times e^2}{(R/a_0)^6}\,\frac{1}{a_0},$$

Possible nuclear parallel

$e^2 \to \Lambda R_0(^{11}\text{Li}) \doteq 0.6\,\text{MeV} \times 2.7\,\text{fm}$; $a_0 \to d = 4\,\text{fm}$; $R \to R_{eff}(^{11}\text{Li}) = 4.83$ fm

$$\Delta E = -\frac{6 \times \Lambda \times R_0}{(R_{eff}(^{11}\text{Li})/d)^6}\,\frac{1}{d} = -\frac{6 \times 0.6\,\text{MeV} \times 2.7\,\text{fm}}{(4.83/4)^6}\,\frac{1}{4\,\text{fm}}$$

$$= -\frac{9.72\,\text{MeV}}{12.40} \approx -0.8\,\text{MeV} \to \text{Mind}$$

$$E_{corr} = |2E_{s_{1/2}} - G' + \Delta E| = |0.4\,\text{MeV} - 0.1\,\text{MeV} - 0.8\,\text{MeV}|$$

$$\approx 0.5\,\text{MeV} \qquad ((S_{2n})_{exp} \approx 0.380)$$