Vibrations

(ph) | (pp), (hh)

correlated excitations (E_{corr})
with transfer quantum number

α=0 | $\alpha = \pm 2$

waves on

the nuclear | the Fermi

surface

correlation length
infinite medium ($|E_{corr}| = \frac{\hbar^2 k^2}{2m}$)

$$\lambda\!\!\!^{-} = \frac{1}{k} \approx \frac{\langle k \rangle_F}{2m} \frac{1}{|E_{corr}|} = \frac{\hbar v_F}{\pi |E_{corr}|} = \xi$$

typical values (finite nuclei), E_{corr}=-2.0 MeV (-0.4 MeV, ^{11}Li), $v_F/c \approx 0.3$ (0.14, ^{11}Li)

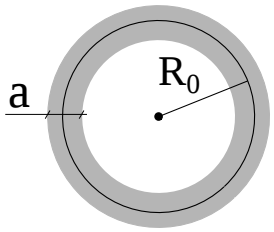
ξ = 10 fm (16 fm, ^{11}Li)

genralized quantality parameter

$$q_\xi = \frac{\hbar^2}{2m(\xi)^2} \frac{1}{|E_{corr}|} \approx 0.1 \quad (0.1, {}^{11}\text{Li})$$

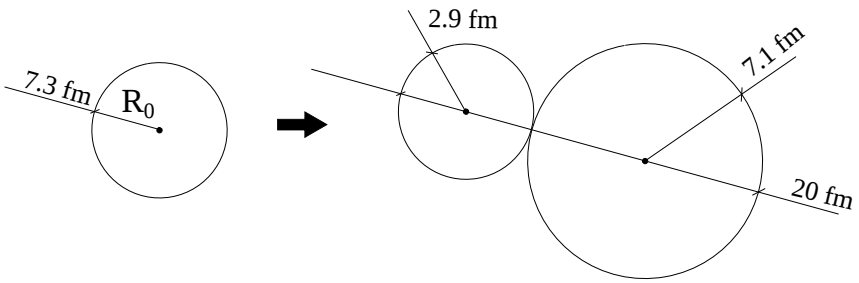
strongly correlated (cluster like $q_\xi \ll 1$), weakly bound ($|E_{corr}|/\epsilon_F \lesssim 0.06$)
very extended ($\xi/d \gtrsim 5$, $d = \left(\frac{4\pi R^3}{3A}\right)^{1/3}$) objects

subject to a strong external field



example

$^{223}\text{Ra} \rightarrow {}^{14}\text{C} + {}^{209}\text{Pb}$ ($\lambda = PfT$)



$$P = \begin{cases} 10^{-76} & (\Delta = 0) \\ 10^{-10} & \Delta_{exp} \end{cases}$$

$$\langle r^2 \rangle^{1/2}_{Cooper} = \xi = \frac{\hbar v_F}{\pi \Delta} \quad (\approx 24\ \text{fm}; \Delta = 0.8\ \text{MeV})$$