10.4 Shell Model

Magic numbers

If \( Z \) or \( 2N \) is \( 2, 8, 20, 28, 50, 82, 126 \)

nuclei are stronger bound

Nucleons are fermions and a nuclear ground state can be thought of as single particle states that are filled up consecutively according to their energy

\[ \phi_0, \phi_1, \phi_2, \phi_3, \phi_4, \ldots \]

\[ \varepsilon_0, \varepsilon_1, \varepsilon_2, \varepsilon_3, \varepsilon_4, \ldots \]

Degeneracy

\[ \varepsilon_1, \varepsilon_2, \varepsilon_3, \varepsilon_4, \ldots \]

Of course the ground state wave function \( \psi_0 \) has to be completely antisymmetric.

10.5 Harmonic oscillator shell model

Let us see how this works for the \( \hbar \). This is a reasonable model for the nuclear potential.