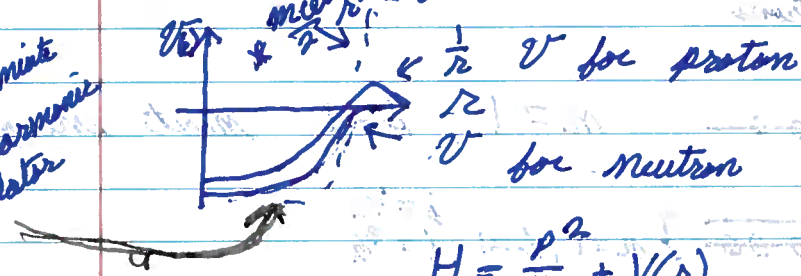


10/6/14

Nucleons potential energy for two nucleons at distance r
 $V \sim \frac{1}{r} - \alpha r$ at large distances

* approximate as harmonic oscillator



$$H = \frac{p^2}{2m} + V(r) \quad p = \frac{\hbar}{i} \frac{\partial}{\partial r}$$

$$H \Psi(r, \theta, \varphi) = E \Psi(r, \theta, \varphi)$$

$$\Psi(r, \theta, \varphi) = R(r) Y_{lm}(\theta, \varphi)$$

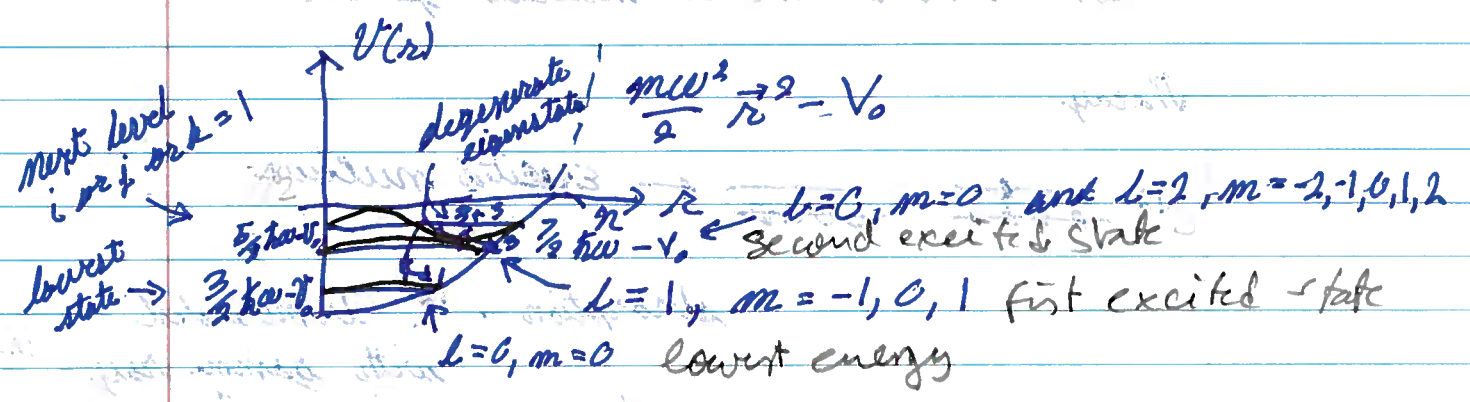
Eigenstate to $\frac{\partial^2}{\partial r^2}, l, m$

OR

$$\Psi(\vec{r}) = \Psi_i(x) \Psi_j(y) \Psi_k(z)$$

1D harmonic oscillator eigenstate

$$E_{ijk} = (i+j+k + \frac{3}{2}) \frac{1}{2} \hbar \omega - V_0$$



Atomic Physics: $n=1 \quad l=0$ lowest state
 $n=2 \quad l=0, 1$
 $n=3 \quad l=0, 1, 2$

Nuclear Physics: $n=1 \quad l=0$ lowest state
 $n=1 \quad l=1$ same energy level
 $n=1 \quad l=2$
 $n=2 \quad l=0$
 $n=2 \quad l=1$

nucleus (possible ^{Hot} nucleons in nucleus)
~~to of~~ ~~to of~~ $n=1, l=0$ lowest energy level
 protons neutrons up to 2 protons + 2 neutrons \rightarrow ${}^4\text{He}$

BUT $n=1, l=1$ next energy level
 + up to 6 p, 6 n \rightarrow 160
 $n=1, l=1$ } $i = \frac{1}{2}$ } split between
 $i = \frac{3}{2}$ } antiparallel s, l ($j = \frac{1}{2}$)
 and parallel s, l ($j = \frac{3}{2}$)
 ${}^{12}\text{C}$ another quantum numbers s, l
 $j = \text{total angular momentum} = l + s$
 \leftarrow spin
 \rightarrow angular momentum
 coupling (related to binding energies) = $l + s$

\rightarrow Magic numbers: 2, 8, 20, 28, 50, 82, 126

See Nuclear level scheme graph

lead - heaviest stable nucleus possible: 82p, 126n

Decays

${}^{12}\text{C}$  \leftarrow Excited nucleus

absorption - ${}^{12}\text{C}$ bombarded with gamma ray - ${}^{12}\text{C}^*$
 spontaneous emission - ${}^{12}\text{C}^*$ emits a gamma ray

See graph Evidence for excited states
 ${}^{232}\text{Th}$ decay by α decay to ${}^{228}\text{Ra}$ which in turn gives off γ ~~decay~~ emission

excited state \rightarrow γ emission

~~fission~~

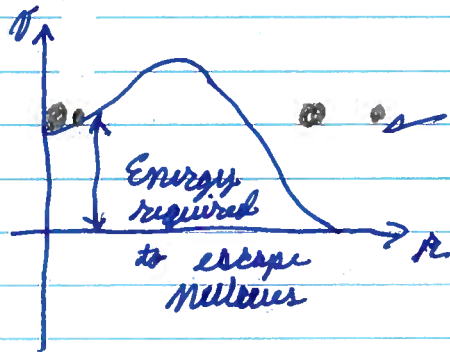
α decay

${}^4_2\text{He} = \alpha$ particle

fission

α - decay!

Tunneling



in Quantum mechanics there exists a probability particle can be found outside nucleus

τ = life time

N = number of Nucleons

$$\frac{dN}{dt} = -\frac{1}{\tau} N$$

$$N(t) = N_0 e^{-t/\tau}$$

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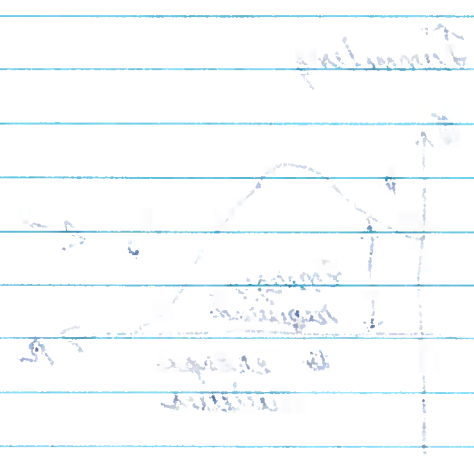
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Handwritten text, possibly a name or a specific term.

Handwritten text on the left side of the page, possibly describing a concept or process.



Handwritten text below the graph, possibly providing a definition or explanation of the graph's components.

Handwritten mathematical formulas, including $\mu = \frac{\sum fx}{N}$ and $\sigma^2 = \frac{\sum f(x-\mu)^2}{N}$.